DC Power Transmission Systems
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Lecture - 02
Introduction

So, before going to the topic of DC Transmission; first of all let us talk about transmission and why do we need transmission? So, what is the need for having a transmission network? So, if you are familiar with at least a structure of power systems; I presume all of you or all of you have done a first course at the undergraduate level in power systems; maybe even one course in power electronics, these things will definitely help you. So, I presume that I mean I mean though I have not strictly stated what are the prerequisites for this course it will help you if you have done at least one course on power systems at an undergraduate level.

Is there anyone who has not done a power system course at an undergraduate level right? So, you are familiar with the structure of power systems. So, if you are familiar; you might have noticed that there is a specific structure of power systems. If you look at the generating sites the generating stations are concentrated; they are located at some concentrated locations. On the other hand, consumption is distributed over a large (Refer Time: 01:24). So, there is a consumption or what we call in the power system terminology as load is actually distributed over a very large geographical area.

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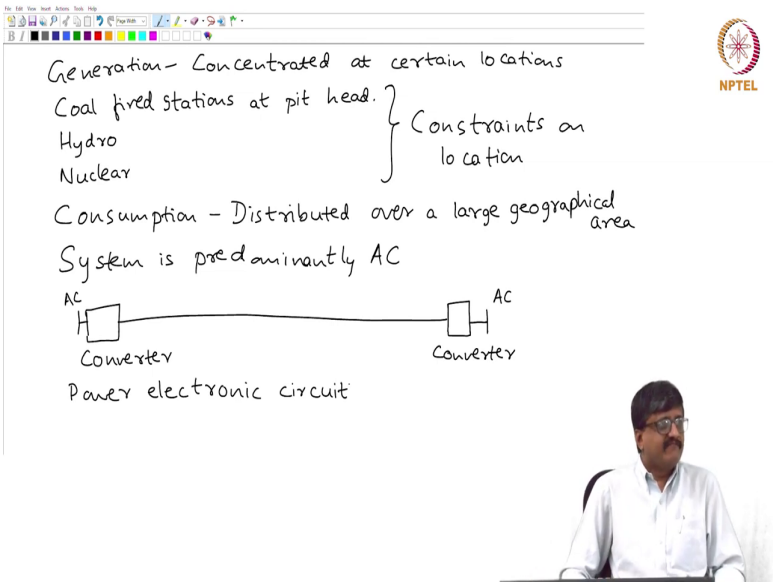

So, one point to note about the power system structure is that generation is actually concentrated at certain locations, why is it so?

Student: Because of the availability of the source.

Yeah because of the availability of the source; for example if you look at the coal fired stations. Coal fired stations are actually located at pit head only that is at the coal mine. The reason is there are two ways of doing this; I mean either you can generate power using coal at the coal mine itself and transmit electrical power or.

Student: Transport.

Transport coal to the load center and generate power at the load center both; both ways are ok, but one of them may be more economical and more convenient. So, it so happens that actually transmitting electrical power is more convenient and economical; that is why we actually generate power at the coal mine and transmit electrical energy. And there are some sources where it is inevitable they do not have a choice. So, we have to generate wherever its available; example is?

Student: Hydro.

Hydro; sorry?

Student: Hydrogen.

Yeah; right now I am just concentrating on the major sources which are so called conventional sources of energy. So, if you look at hydro; hydro is a very major source in many countries even in India, many countries it is a major source of all; it constitutes a very large percentage of the total power generation. So, if you look at hydro; you have to generate wherever it is available.

So, hydro energy is in the form of potential energy of water; say water it at a certain height is actually carrying energy. So, you allow the water to actually fall down due to gravity and the potential energy is converted to kinetic energy which in turn is converted to rotation and hence finally, electrical energy.

So, there is no choice for the location as far as hydro is concerned; you how to locate the hydro station only at the place where it is available ok. And there are some more examples; if you take nuclear, the issue here is you want to locate it at a place which is far away from populated areas. So, there are some constraints on the location of generating stations. So, these three have some constraints; there are constraints on location.

Of course, there are other players for example, solar and wind; even these sources do have constraints they; they can be located only where the source is available mainly where the energies are available ok. So, as far as generation is concerned; there are constraints and there is also a need to have very large power plants or very large generating stations. If you look at the size of the generators that we have in the generating stream; they are huge ok.

Now, the reason is when you have a large generating station consisting of large generators; you will have efficiency. So larger the machine, higher is the efficiency. So, that is why we have very large I mean generators in the generating stations and when it comes to the consumption it is actually distributed; consumption is distributed over a large geographical area. So, there is actually a need for transmission system; so we need a transmission system.

So, if you look at history what started as a DC power system; see the earliest day power systems where DC power systems but that did not last for even a few years. So, there were many limitations of the DC system that were apparent. So, due to which one had to go from DC to AC. So, very quickly at the end of 19th century itself; we have we had AC systems. So, our systems are predominantly AC. So, we still have AC systems, but for certain locations or for certain transmission links the preference is DC.

So, we will see I mean what makes us to choose DC over AC; I mean that is something we leave it for some time in a later in the course. So, there are some locations where we need DC in a predominantly AC system ok. So, the system is predominantly AC. So, if the system is predominantly AC and certain selected transmission lines are DC; then we need some additional equipment.

See, suppose I have a bus all of your familiar with a bus since I said you should have studied a course on power systems; you are familiar with a bus ok. Suppose, I have an AC bus is an AC bus; I have another bus here AC bus. So, the short lines actually are the symbols used in a single line diagram for a; in a power system. Now, if I want to transmit power from this bus to this bus and the distance is of the order of say a few hundred kilometers.

Now, I want DC transmission; then what I need to do is I need an equipment which actually converts AC to DC, then do the transmission. Again, I need one more equipment here which converts DC to AC and what is this equipment? I have shown the equipment as a box; this equipment has a name, what is the name of this equipment?

Student: (Refer Time: 08:14).

Yeah, there is a general name for this converter; so both are converters. So, the name given to this equipment is converter. So, what is a converter? So, the converter that we are familiar with is a power electronic circuit; it is a power electronic circuit. Now, somebody mentioned that one of them is a convertor, another one is an inverter; now what does that mean?

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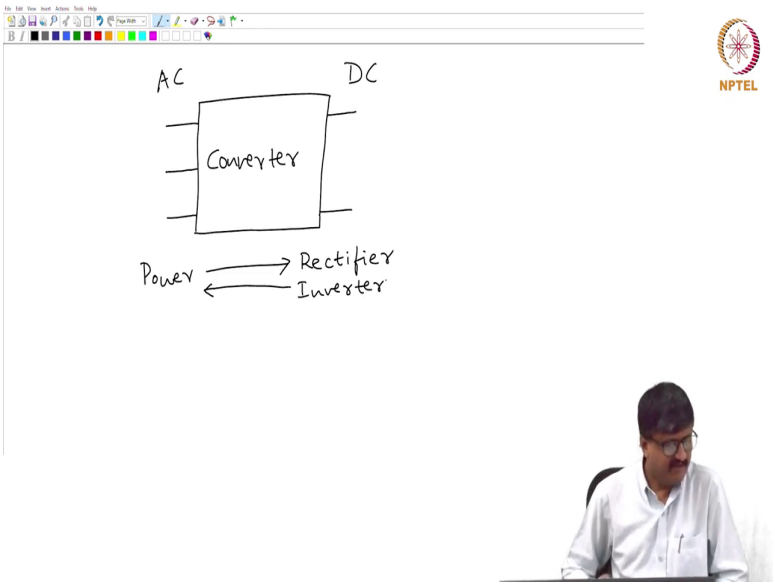

Suppose, I take a converter which I said is a power electronic circuit ok. Now, this power electronic circuit are converter has distinguishable AC and DC sides.

So, there is an AC side and there is a DC side. So, if I show 2 wires positive and negative on the DC side and I take an AC system which is 3 phase. So, I show 3 wires on the AC side. So, on the DC side I have 2 wires, on the AC side I have 3 wires. Now, when the operation is in steady state ok; so if I if I have a steady state operation and the power is flowing from the AC side to the DC side. So, if the direction of power is from AC side to DC side; then we say the converter is operating as rectifier.

On the other hand, in steady state the average power is flowing from DC side to AC side; then we say that the converter is operating as an inverter. So, the point to notice there are distinguishable AC and DC sides in a converter and depending on the direction of the average power; see I am not talking about the instantaneous power. See the instantaneous power can be in both ways sometimes, but the average power if it is always from DC to AC; we say its inverter, if it is from AC to DC; we say it is rectifier.

So, I am not going into the power electronics circuit right away, but I want to spend a few minutes on how this particular converter developed ok.