Title : Distributed Generation and Power Quality

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Combustion (gas) turbines:

- Combustion turbines commonly used in cogeneration applications interconnected to the distribution system generally range in size from 1 to 10 MW.
- The turbines commonly turn at speeds of 8000 to 12,000 rpm and are geared down to the speed required by the synchronous alternator (typically 1800 or 3600 rpm for 60-Hz systems).
- Natural gas is a common fuel, although various liquid fuels may also be used.
- New combustion turbine technology—the micro turbine—has been responsible for some of the renewed interest in DG. One of the major
- Advantages of this technology is that installations are clean and compact.

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- The only moving part in a micro turbine is a one-piece turbine with a permanent-magnet rotor. The assembly spins at speeds typically ranging from 10,000 to 100,000 rpm. The alternator output is rectified to direct current immediately and fed into an inverter that interfaces with the ac electric power system. Thus, the characteristic of the micro turbine that is of interest to power quality engineers is the response of the inverter to system disturbances.
- This technology is best suited for combined heat and power applications in small- to medium-sized commercial and industrial facilities.

Fuel cells:

- A fuel cell is basically a battery powered by an electrochemical process based on the conversion of hydrogen. It produces dc voltage, and an inverter is required for interfacing to the ac power system

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- This technology also occupies a relatively small footprint, is very quiet, and has virtually no harmful emissions during operation. Fuel cells are efficient electricity generators and may be employed in combined heat and power applications to achieve among the very best possible energy-conversion efficiencies.
- The drawback to fuel cells at present is cost. Fuel cell technologies are on the order of 10 times more expensive than reciprocating gensets.

Wind turbines:

- Wind generation capacity has been increasing rapidly and has become cost competitive with other means of generation in some regions. A common implementation is to group a number of wind turbines ranging in size from 700 to 1200 kW each into a “wind farm” having a total maximum capacity range of 200 to 500 MW.

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- Power quality issue associated with wind generation is voltage regulation. Wind generation tends to be located in sparsely populated areas where the electrical system is weak relative to the generation capacity. This results in voltage variations that are difficult to manage. Thus, it is sometimes impossible to serve loads from the same feeder that serves a wind farm.

There are three main classes of generator technologies used for the electrical system interface for wind turbines:

1. Conventional squirrel-cage induction machines or wound-rotor induction machines. These frequently are supplemented by switched capacitors to compensate for reactive power needs.

2. Doubly fed wound-rotor induction machines that employ power converters to control the rotor current to provide reactive power control.

3. Non–power frequency generation that requires an inverter interface.

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Photovoltaic systems:

The recent power shortages in some states and the passage of net metering legislation has spurred the installation of rooftop photovoltaic solar systems.

Photovoltaic solar systems generate dc power while the sun is shining on them and are interfaced to the utility system through inverters. Some systems do not have the capability to operate stand-alone—the inverters operate only in the utility-interactive mode and require the presence of the grid.

Assignment Questions

1. Explain the methods of DG Technologies.

- Hard copy submission date - 31/3/2020.
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