

## Solution Tut 1

1) What does the term “Distributed Generation” (DG) refer to? List generation units that can be categorized as DG.

**Answer:**

Distributed Generation (DG) is the generation distributed within in a Distribution Network. Also known as “Embedded Generation”, “Disperse Generation” or “Decentralized Generation”

DG includes:

- Generators powered from renewable energy sources in a distribution network.
- Combined heat and power (CHP) systems, also known as co-generation (co-gen)
- Standby generators operating grid connected, particularly when centralized generation is inadequate or expensive

2) List the motivations towards the use of Distributed Generation.

**Answer:**

- Environmental Concerns – Greenhouse Gas Emissions from Fossil Fuels
- Diversification of energy sources
- Technological advancement of renewable sources
- New Government Policy – Secure, Low Carbon, Competitively Priced

3) Explain the difference between “conventional distribution system” and “distribution system with Distributed generation” in terms of power flow in a distribution network.

**Answer:**

- Conventional distribution system

The flow of both active power ( $P$ ) is always from the higher to the lower voltage levels

- Distribution system with distributed generation

The power flows may be in either direction

4) In a distribution system the voltage control should always ensure the voltage magnitude remain within a set band between an “undervoltage limit” and an “overvoltage limit”.

Why in a distribution system with Distributed generation “overvoltage limit” becomes a concern?

**Answer:**

- ① In a distribution system with generations, the active power flow may become reversal which is towards the upstream distribution transformer.
- ② Considering the resistive LV distribution lines, voltage rise becomes possible when the load is light.

5) Explain why, in a distribution network with new DG instalment, new investment sometimes might have to be made on protection system.

**Answer:**

Distribution protections are designed before DG are connected.

If DG contribute or change the fault current distribution during fault, it may cause mal-functions of the entire protective system. To avoid this, protections have to be checked and somethings reconfigured; hence the new investment.

6) What is “the fault level” in power system analysis? How it will be affected by the connection of DG to

distribution network?

**Answer:**

At any given point of the network “the fault level” is the maximum fault current that would occur.

DGs may increase the fault level within a distribution network.

Directly integrated rotating machine will contribute to the fault level; the fault current contributed by a DGs interfaced by power electronics converters is normally limited, depending on its control strategy.

7) What is the major concern for thyristor based DG in terms of power quality?

**Answer:**

Harmonics of low orders.

8) How DG may affect the maintenance operation of a distribution network?

**Answer:**

- ✓ Due to the presence of DGs, power network can be energized from a number of unknown points.
- ✓ For the purpose of planned maintenance, more difficult to ensure the safety in a de-energized network; more risk in safety hazards.
- ✓ Therefore the flexibility for work on a network with DG connected to it becomes more restricted.
- ✓ Implications for policies of isolation and earthing for safety consequently becomes more complicated.