

## **Distribution Substations**

The voltages that are required for bulk electricity transmission are too high for most consumer applications. Lower voltage levels are required for electricity to flow safely through smaller cables and distribution lines. At transmission interconnection intervals such as substations, some of the electrical energy is tapped off the transmission lines. These substations step the voltage down to lower voltage levels with large power transformers.

Substations are interconnected and dispersed among high-voltage transmission lines and distribution lines. They vary in size depending on the system they are servicing. Most substations are constructed in an area where the vegetation has been removed, and the lot is filled with gravel and is fenced and gated for safety and security.

Substations are interconnected to the transmission system and distribution system by two methods:

- High-voltage transmission circuits carrying 138 kV or 230 kV directly step-down voltage to distribution connections carrying 13 kV.
- High-voltage transmission, circuit-supplying switching stations step down voltages to a subtransmission voltage level commonly in the range of 26 to 34 kV. The subtransmission circuit's voltage level can easily be routed along public streets on wood poles or through underground cables to industrial, commercial, and utility substations. These subtransmission-supplied substations provide system monitoring and control for distribution circuits in the 4 and 13 kV range.

## **Commercial and Industrial Connections**

Some customers need higher voltage levels than what is typically provided from a residential distribution circuit but do not need voltages that are high enough to warrant a direct connection to the transmission system. These high-use customers are serviced by special distribution connections at voltages ranging from 7.2 kV to 14.4 kV through a service drop line that comes from a transformer on or near a distribution pole to the customer's end-use structure.

## **Residential Connections**

Residential customers require electricity that is distributed at a reduced voltage, typically 120/240 volts (single phase). This reduced voltage is usually achieved through a pole-mounted or pad-mounted transformer. Electrical power is delivered to residential customers through what is referred to as a service drop line, which leads from the distribution pole transformer to the customer's structure via overhead distribution lines. The service line can also be buried, as is the case with underground distribution lines. Residential connections and key components will be discussed in more detail later in this unit.