III ALTERNATING CURRENT

Electricity is generated, transmitted, and used in the form of three-phase alternating current (AC). The current strength of AC electricity oscillates sinusoidally at 50 Hz (1 Hz, or hertz, is 1 cycle per second) in most countries but at 60 Hz in the United States. Generators provide three such varying voltage outputs, delayed by one third of a cycle with respect to each other. The reason for this complexity is that generators, transmission lines, and motors can be designed to operate most efficiently when working with this three-phase AC. Additionally, and most importantly, transformers work only with AC. Householders are supplied from one of the phases of the three-phase system. Its voltage is nominally 230 V to ground.

IV FREQUENCY STABILITY

The frequency of the mains supply is maintained at 50 Hz with great precision. The frequency is a sensitive indicator of the balance between input and output power in the network. A drop in frequency indicates that the demand is greater than the supply. This indicates to the generating stations that they should connect more generating units to the system to supply the increasing demand. A rise in frequency indicates that the demand is dropping and generating units are shut down to preserve the balance. This “commitment” of units on and off the system is one of the important functions of the generating companies. Because of the delays involved in commitment, the companies attempt to predict the demand variations through load-forecasting.

V VOLTAGE STABILITY

One important task of the supply system is to provide consumers with electricity at constant voltage. All industrial and household electric appliances are designed to operate at a constant voltage. For example, a light bulb is designed to consume, say, 100 W (watts) at 240 V. If the voltage is increased, by even a small margin, the coiled filament will overheat and melt. Conversely, if the voltage drops below the nominal value the lamp will not provide its intended light output. Electricity companies have a variety of means of maintaining the voltage supplied to consumers within statutory limits.

VI RELIABILITY OF SUPPLY

Reliability is ensured through a complex protection system built into the transmission network. A typical malfunction of a network is the collapse of a pylon, owing to the weight of snow combined with the forces exerted by very high winds. The physical contact of the transmission lines, a “short circuit”, causes large currents to flow in the system, which, unless checked, would damage other equipment, such as transformers and generators.

The protection system has numerous detectors dispersed throughout the system. It trips faulty components by means of switches, known as circuit-breakers, which are located at strategic points throughout the network.

Circuit-breakers are often used to protect household circuits, too, but the cheapest and most reliable protection device is the fuse, which “blows” (burns out) if the current passing through the fuse to an appliance exceeds the fuse rating, thus protecting the wiring network.