II THE ADVANTAGES OF ELECTRICITY

The reasons why electricity is universally employed as a medium of energy transfer and use are that: (1) It can be efficiently transported from generators to the point of use in the consumer's premises through a simple-to-install network of wires. (2) It can be converted at high efficiency into heat, mechanical, and chemical energy. It powers electronic devices. It provides light. (3) It is instantly controllable at the point of use—it takes only a flick of a switch to turn an electrical device on or off.

III GENERATING STATIONS

Traditionally electrical energy has been produced in power stations using fossil or nuclear fuels.

In a typical coal-fired power station the coal is ground to fine powder in a mill, mixed with pre-heated air and blown into a furnace, where it burns like a gas. The furnace, or boiler, is the largest structure in a power station, as its walls are lined with several kilometres of water pipes which are designed to extract as much heat as possible from the burning fuel. The hot gases boil the water in the pipes and convert it into high-pressure, high-temperature steam. Afterwards, the low-temperature gases are forced through dust extractors to collect as much of the ash as possible. In modern stations they pass through specialized equipment to extract the environmentally harmful sulphur products of combustion. Finally, the flue gases are forced up a tall chimney stack and discharged into the atmosphere.

The steam generated by the boiler is supplied to a turbine, in which its heat energy is converted into mechanical energy by making a shaft rotate. It is here that the inefficiency of heat engines takes its

toll. The low-temperature, low-pressure steam at the output of the turbine has to be condensed into water and pumped back into the boiler to close the cycle. Large quantities of cooling water are needed for this task—perhaps 230,000 cubic metres (50.6 million gallons) per hour for a 2,000 MW station (1 MW equals 1 megawatt). If the power station is built on a river estuary, the river can supply the water; otherwise, the cooling water has to be recycled. Cooling towers enable this to be done by getting rid of the waste heat into the atmosphere. Only relatively small amounts of make-up water are required to replace the water lost through evaporation.

Stations fired with oil or gas operate in essentially the same way as a coal-fired station. In a nuclear power station, however, heat is generated in the core of the reactor through the breakdown of a fissionable material such as uranium. The heat is carried away by a coolant liquid or gas, which is then used to raise steam in the manner already described. There are a large number of reactor designs, using different coolants and reactor structures. The rate of reaction is controlled by a set of rods made of a material that absorbs neutrons. These rods can quickly be lowered into the core to shut the reactor down in emergencies. A “biological shield”, consisting of concrete several metres thick, surrounds the reactor to protect operators from the core, which is intensely radioactive. (*See* Nuclear Energy.)