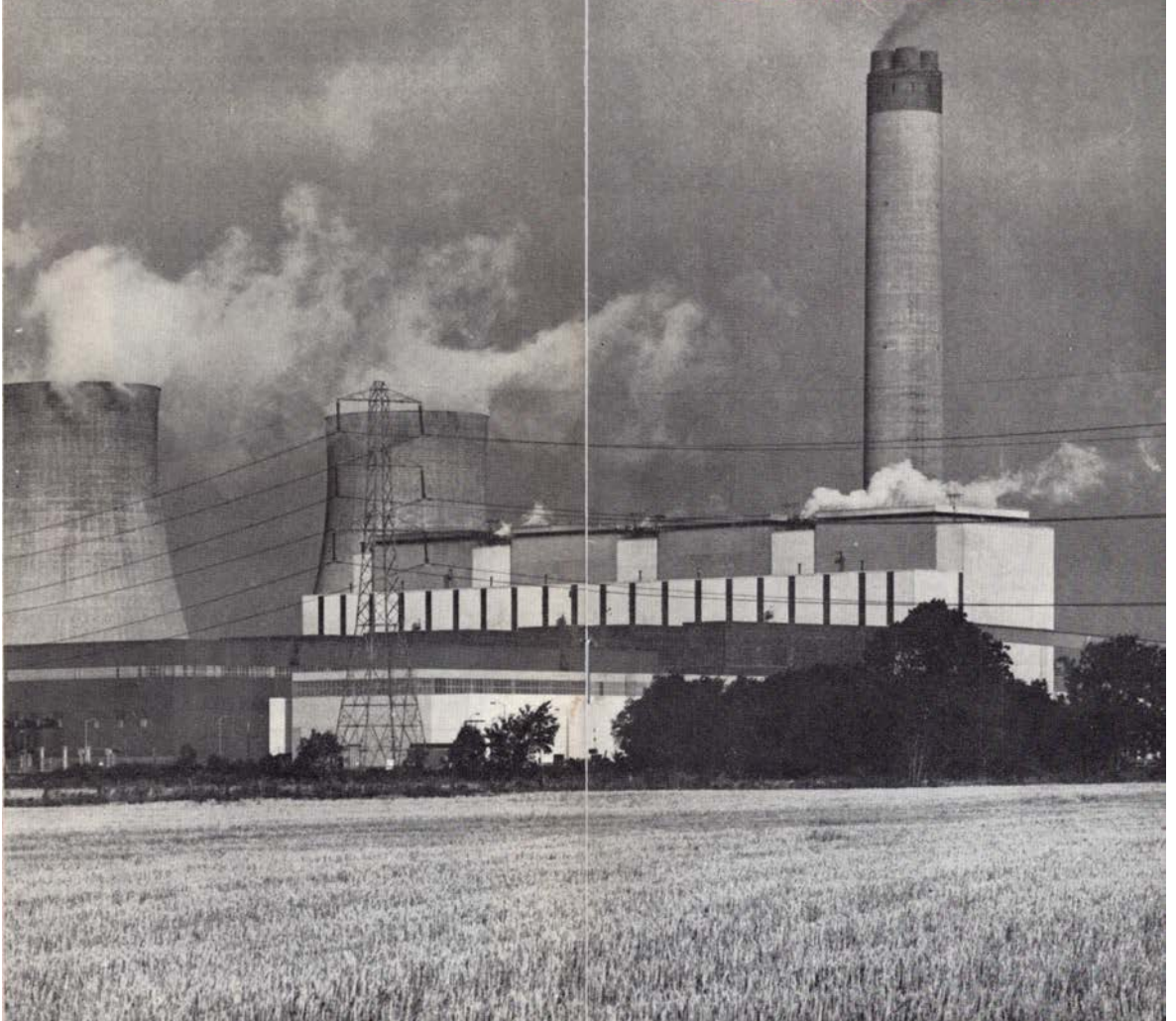


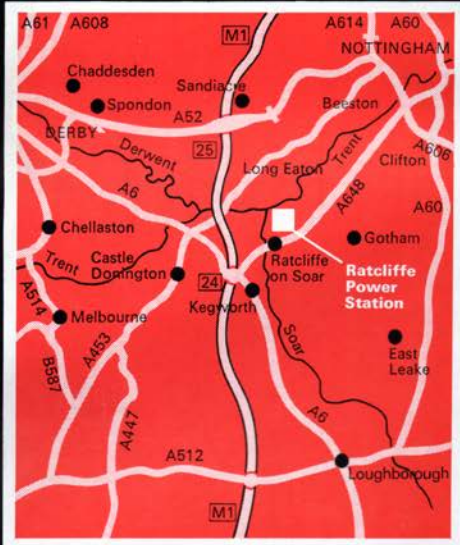


**Central Electricity  
Generating Board  
Midlands region**

# **Ratcliffe** **ON SOAR** **power** **station**



# How to get there



Ratcliffe power station is near the village of Ratcliffe-on-Soar, about eight miles south-west of Nottingham and 1½ miles north-east of M1 junction 24.

From the NORTH and SOUTH, leave the M1 at junction 24 following the A648 signposted Nottingham South. The power station is on the left, its buildings and eight cooling towers clearly visible during daylight and pinpointed at night by site lights and red aircraft warning beacons on the main chimney.

From the WEST heading for Nottingham along the A453, take a right turn for Kegworth and the East Midlands Airport at Castle Donington to join the A6 leading to motorway junction 24.

From Nottingham and the EAST, take the A648, signposted Motorway South, from West Bridgford. The power station will be on your right.

There is no regular public transport to the site.

# Ratcliffe power station

Ratcliffe, one of three 2,000 megawatt power stations in the Midlands, was built at a cost of £80 million and commissioned during 1968-70. It quickly established itself as one of the most efficient in the country.

It was the first to send out more than 12,000 million kilowatt hours of electricity in a year. Its thermal efficiency (a measure of the effective use made of all the coal burned) has made it one of the best coal fired stations operated by the CEBG.

Electricity is generated by four 500 megawatt units producing enough power to

supply industrial and domestic demand in three cities the size of Nottingham. To make the station independent of outside supplies for starting up, it has four 17½ megawatt gas turbine generators. These can also be used to supply power to the national grid to meet peak demands.

The station site lies near the River Trent and the River Soar, the former supplying cooling water. Coal supplies come by rail from the Nottinghamshire coalfields.

Some of the non-operational land on the site is used by local schoolchildren as a nature trail and field study centre.



# Station details

**Location**  
South-west Nottinghamshire at the confluence of the River Trent and River Soar.

**Site area**  
155 hectares (384 acres).

**Turbines**  
Manufactured by C. A. Parsons & Co. Ltd.  
Number of units: 4.  
High pressure cylinder steam: 159 bar at 566°C (2,300lb./sq.in. at 566°C).  
Intermediate pressure cylinder steam: 39 bar at 566°C (565lb./sq.in. at 566°C).  
Condenser vacuum: 972 M.bar (28.7 in. mercury).

**Generators**  
Manufactured by C. A. Parsons & Co. Ltd.  
Maximum continuous rating: 500 megawatts at 22,000 volts.  
Phase current: Three phases, 15,437 amp. each.  
Efficiency: 98.5%.  
Stator cooling: demineralised water.  
Rotor cooling: hydrogen.

**Boiler**  
Manufactured by Babcock & Wilcox Ltd.  
Maximum continuous rating: 435 Kg/sec. (3,450,000 lb./hr.)  
Efficiency: 90.76%.  
Steam at superheater outlet: 165 bar (2,400 lb./sq.in. at 568°C).  
Steam at reheater outlet: 41 bar (592 lb./sq.in. at 568°C).  
Feed water temperature: 254°C.  
Firing: front face, 48 burners.  
Dimensions: 30 metres long, 9 metres wide, 45 metres high (97ft. by 30ft. by 150ft.).

**Circulating water system**  
Number of cooling towers: 8.  
Cooling tower capacity: 8,000 litres/sec. each (105,000 gallons/min. each).  
Cooling tower dimensions: Height: 114 metres (375ft.). Diameter: base 93 metres (305ft.), top 52 metres (169ft.).  
Wall thickness: 560mm tapering to 180mm (22in. tapering to 7in.).  
Total evaporation in eight towers: 60 million litres/day (13 million gallons/day).  
Water temperature fall in tower: 10°C.  
Condenser water flow: 15,000 litres/sec. (200,000 gallons/min.).  
Water temperature rise in condenser: 10°C.  
Make-up water from Trent: 200 million litres/day (45 million gallons/day).  
Water returned to Trent: 140 million litres/day (32 million gallons/day).

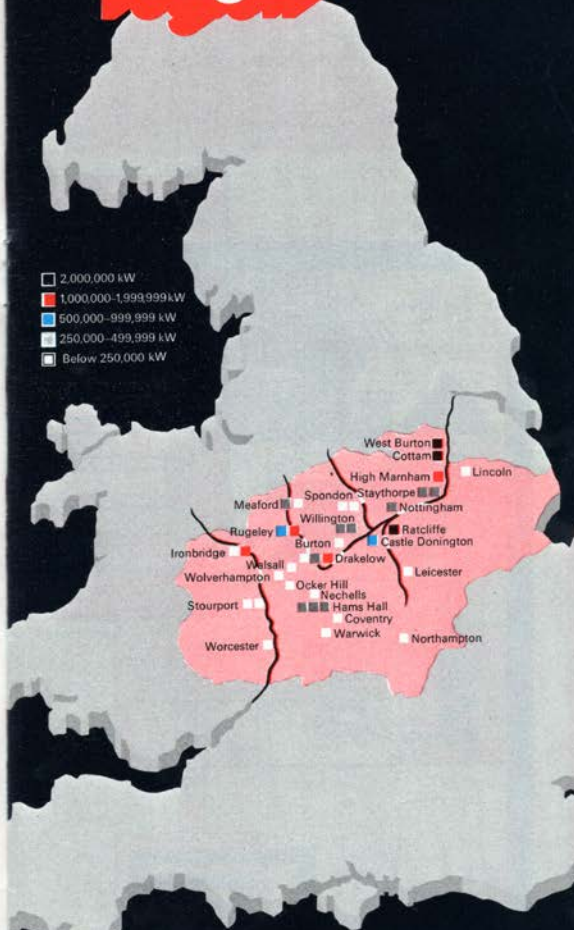
**Coal plant**  
Manufactured by Fletcher Sutcliffe Wild Ltd.  
Train capacity: 1,000 tonnes; 32 tonnes a wagon (1,000 tons, 32 tons a wagon).  
Coal used in 24 hours: 20,300 tonnes (20,000 tons).  
Coal stock capacity: 1 million tonnes (1 million tons).  
Suppliers: Pyehill, Babbington, Cotgrave, Eastwood and New Hucknall collieries.

**Main chimney**  
Height: 200 metres (654ft.).  
Base diameter: 23 metres (75ft.).  
Number of flues: 4.  
Speed of gas at exit: 80 kilometres/hr. at 120°C (50 mph).

**Gas turbine generators**  
Manufactured by Rolls Royce Ltd.  
Type: Olympus.  
Number: 4.  
Output: 17½ megawatts each.

**Power of main motors**  
Induced draught fan: 1,700 KW (2,290 hp).  
Forced draught fan: 1,200 KW (1,600 hp).  
Circulating water pump: 4,250 KW (5,700 hp).  
Feed pump: 7,100 KW (9,500 hp).  
Total staff: 540.

# Midlands region



Two important natural resources of central England — coal and river water — have given the Midlands Region a special role in fulfilling the Central Electricity Generating Board's statutory duty of supplying electricity throughout England and Wales.

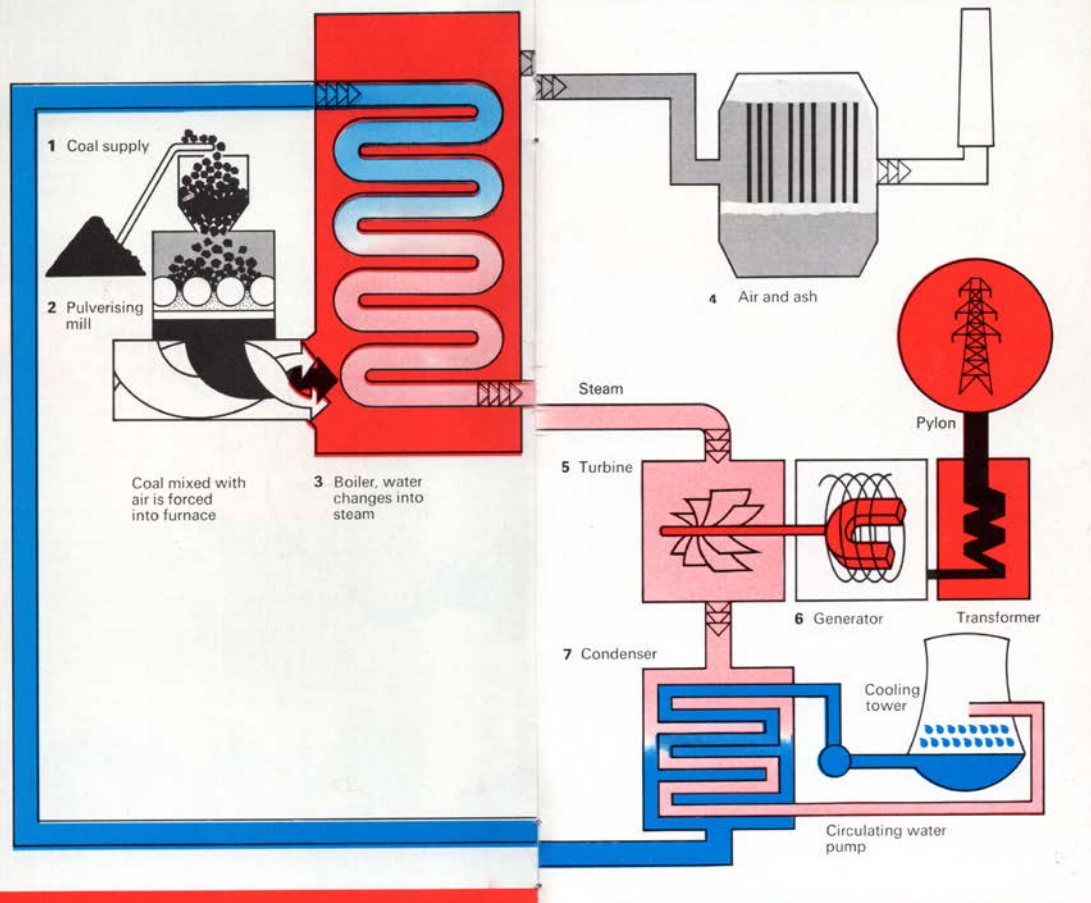
With 35 power stations the Region can provide more than a quarter of the CEBG's total output, largely from the big modern stations along the Trent.

The Region acts as manufacturer and wholesaler of electricity through the Grid system, selling to the 'retailers' — the MEB and EMEB — who are responsible for distribution and sales to individual customers.

Power generation is big business with annual turn-over equal to one of the top ten companies in British industry. The CEBG has more than £1,000 million (at historic values) invested in the Midlands Region alone. Midlands power stations burn over £1 million worth of fuel a day.

The job of the CEBG is to provide power economically and on demand — literally at the flick of a switch. This is how it's done.

# How electricity is made



**1 Coal supply:** Power stations take regular deliveries of coal from collieries throughout the year to ensure adequate reserves to meet winter demand.

**2 Pulverising mill:** Coal is ground up as fine as face powder to ensure fast and complete combustion. Some older stations still feed their boilers with lumps of coal on a steel conveyor belt.

**3 The coal dust is mixed with air and blown into the boilers which at a big station can consume 20,000 tonnes a day. Here it burns like a gas turning the water in the pipes lining the boiler walls to high pressure, high temperature steam. Oil, gas or nuclear energy could also provide the heat to make this steam.**

**4 Precipitator:** This removes more than 99 per cent of the ash from the exhaust gases

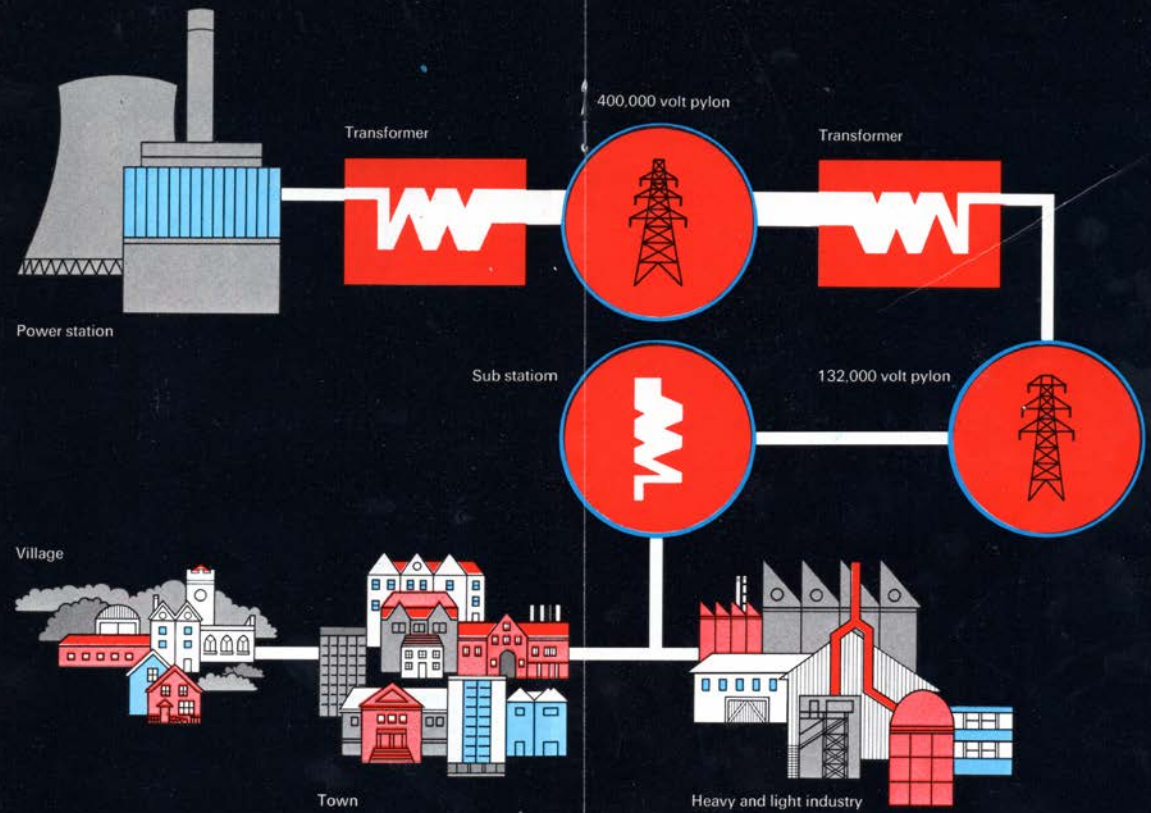
before they are sent high into the atmosphere through the tall chimney stack.

**5 Turbine:** The steam drives the turbine round as it strikes the blades, rather like an enclosed windmill.

**6 Generator:** When a magnet is rotated in a coil of wire, an electric current is produced. This, on a large and sophisticated scale, is what the generator does.

**7 Condensers:** Once the steam has done its job in the turbine it has to be converted back into water and returned to the boiler. This is done in condensers where cold water in a completely separate circuit passes over the steam pipes turning the steam into water. The temperature of this cooling water is lowered in the cooling towers, enabling the water to be used over and over again with only 'top up' supplies needed from river sources.

# How electricity is distributed



In the early days of the electricity supply industry, power stations were very much a local affair. Cities and large towns were the first to get them and power lines usually spread no further than a few miles from the generators.

Then as demand increased, power stations often had difficulty maintaining supplies during maintenance periods or after a breakdown. The most economical answer was to link with other stations which had power to spare. This, round about 1930, was the start of the national grid

— a network of power lines into which every station feeds and from which every user can draw.

Voltage is a measure of electrical pressure — the higher the pressure the more can pass along a wire in a given time. When the grid was first established, 132,000 volts was set as the ideal level but as demand increased so did the need for more lines — or an increase in the voltage. From amenity as well as cost considerations, the latter was chosen with a supergrid system at 275,000 and 400,000 volts.

One 400,000 volt line can carry three times the power of a 275,000 volt line and replaces 18 of the old 132,000 volt lines.

Electricity is generated at up to 22,000 volts but this is stepped up, using a transformer to 400,000 volts for distribution via the supergrid. When it is near its destination the electricity passes through another transformer at a marshalling point called a substation for more localised distribution. This is where your local electricity board (MEB or EMEB in the

Midlands) takes over.

As the power gets nearer to its destinations, the voltage is reduced in several stages before reaching individual users at 240 volts. Larger users have their own substations taking the supply at 33,000 or 11,000 volts.

The net work of power lines — and underground cables, particularly in built-up areas — is designed so that as far as possible, a fault in one section will not affect another as there is always an alternative route for the electricity to take.

# Protecting the environment

The electricity supply industry has a long and continuing record of being at the forefront of environmental concern among major industrial undertakings.

**Fuel:** Coal is the main lifeblood of Midlands stations and this is brought in largely by rail from the local coalfields, each of the large stations providing work for 10,000 miners. A system of self-unloading wagons in special trains operates a non-stop service to the coal mines.



**Nature trails:** Power station sites often include areas of non-operational land which are used to plant woodland screens to preserve visual amenity. Midlands Region pioneered the use of this land as nature trails, field study centres and nature reserves.



**Chimney stacks:** A modern power station burns coal much more efficiently than a factory furnace or domestic open fire and this is a direct contribution to a better environment. Exhaust gases are dispersed high into the atmosphere where they can cause no harm. Monitoring devices at ground level keep a close watch on the level of sulphur dioxide and dust.

**Ash:** The pulverised fuel ash extracted by the precipitators is a valuable by-product of generation. It is sold to make building blocks and lightweight aggregates and it is used as a filling material. A major reclamation scheme on disused clay pits near



**Cooling water:** A large power station requires vast quantities of cooling water. To avoid excessive increases in river temperature when there are several stations along a river, cooling towers are needed so that only a small percentage of water is used. Continuous monitoring of river temperature ensures no danger to fish and plant life.



**Power lines:** The cost of laying a 400,000 volt underground cable is about 16 times the cost of an overhead line. This is why most high voltage transmission is by overhead line. Careful routing of lines is essential, together with screening and landscaping of substations.



Peterborough is restoring to agricultural use land that has been derelict since the beginning of the century. For the Peterborough scheme, special sealed rail wagons are used to transport the ash to a pumping terminal for dispersal to individual pits.

The efficiency of modern power stations ensures that pollution is kept to a minimum as the energy from coal and other fuels is converted to electricity. The end product which reaches homes, factories and offices is a perfectly clean fuel, needing no combustion air, flues or storage space.



# Demand and fuel for the future

Careful planning is needed to ensure that power is available anywhere, at any time and at the lowest possible cost. At Grid Control Centres like those in Birmingham and Nottingham, daily generating programmes are based on forecasts for demand which take account of many variables.

Sudden increases in demand can come, for instance, on Monday mornings when factories and offices re-open after the weekend; when families switch on electric kettles at the end of a popular television programme; when cooks go on for Sunday lunch; or late at night when off-peak heating systems are switched on automatically.

Electricity cannot be stored so power stations must be ready to meet demand as it arises — the most efficient

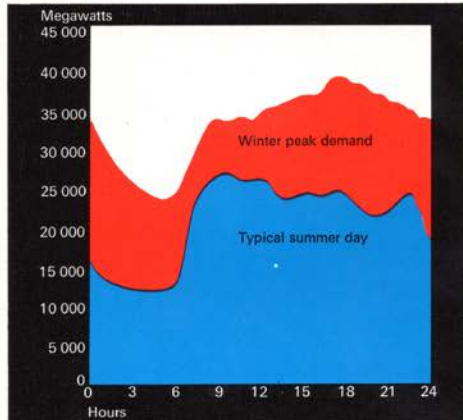
ones running most of the time, with the more expensive producers coming in to meet peak demand.

Coal still accounts for nearly two thirds of this output but rather than rely on one source of heat the CEBG has developed power stations to use oil, natural gas and nuclear power. Oil fired plant accounts for about a quarter of output and nuclear 8%. The rest is made up of natural gas, diesel, hydro-electric and gas turbine plant.

In a world of increasing fuel scarcity the CEBG continues to investigate previously uneconomic sources of power such as tidal barrages in river estuaries but all the signs are that nuclear power is the realistic answer to our long term energy needs.



Transfynydd Nuclear Power Station.



# Ratcliffe power station guide

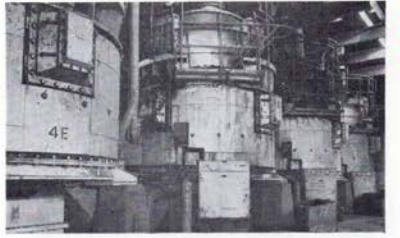
**1 Coal handling plant.** Coal is delivered five days a week in 1,000 tonne train loads using special bottom-opening wagons. The coal is automatically unloaded into hoppers below the rail lines as the trains pass through at a non-stop 1/2 mph. Conveyor belts take the coal from the hoppers either to the stock area or for immediate use.

**2 Pulverising mill.** The pulverised fuel mill grinds up the coal to a face powder consistency before it is fed to the boiler. Each of the station's four boilers has eight ball-type mills, each capable of grinding 33 tonnes of coal an hour. Six mills can keep a boiler operating on full load.

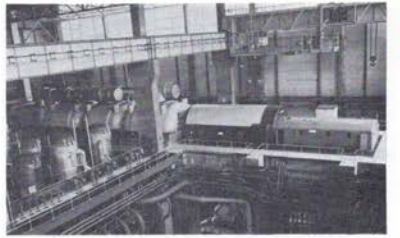
**3 Turbine and Generator.** The four turbines run at 3000 revolutions a minute. Each has high pressure, intermediate and low pressure cylinders developing a power twelve times greater than Concorde's jet engines and six times that of the Q.E. 2. The 60-tonne generator rotor, coupled to the turbine shaft, rotates within the stator to induce electrical power. The stator consists of large coils of hollow copper bar cooled by pure circulating water. Electricity for the rotor electromagnet comes from the exciter coupled to the end of the generator shaft.



1



2



3

**4** Control room. Operation of all four generating sets is co-ordinated from the control room. Performance of all important plant is monitored and alarms pinpoint areas where corrective action is needed. Most of the complex machinery on the station can be controlled from here.

**5** Water treatment plant. Water used in the boiler is repeatedly turned into steam and condensed back into water so a high degree of purity is vital. Tap water would make the boiler dangerous within hours and fur it up completely in two weeks. River water is made a thousand times more pure before it can be used in the boiler.

**6** Circulating water pumps. Each generating set has a circulating water pump to draw water from the cooling tower ponds, through concrete culverts under the floor of the turbine house to the condensers. Each pump delivers 15,000 litres a second (200,000 gallons a minute).

**7** Cooling towers. Circulating water from the condensers is cooled 10°C in the natural draught cooling towers before returning to ponds for re-circulation. The water is cooled by being sprayed on to wedge-shaped wooden laths in the lower 6 metres (20ft.) of the towers. The tower ponds hold 3 million gallons.

**8** Dust bunker. This collects the dust extracted from the exhaust gases by the electrostatic precipitators. Up to 6,600 tonnes can be stored here ready for discharge into sealed rail wagons for transport to the Peterborough land reclamation scheme.

**9** Nature trail. Old and new woodland along one edge of the site, near the coal stocks, has been set aside for field studies by visiting parties of school children. A field study centre houses reference and record books and other equipment.

**4**



**7**

**5**



**8**

**6**



**9**