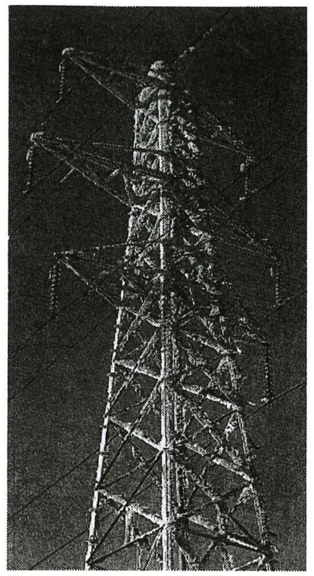


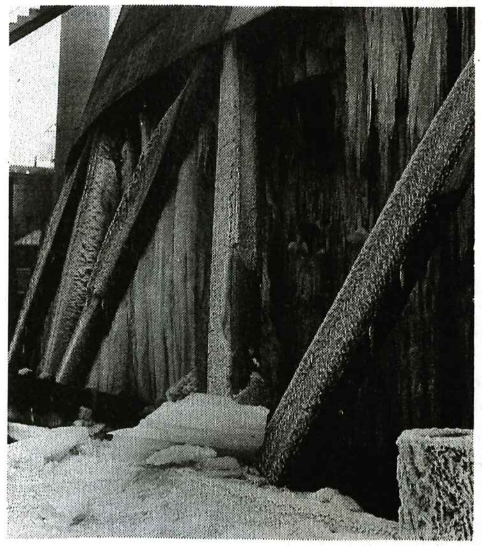
Crisis amid the winter snows

NO ONE involved "at the sharp end" — transmission engineers, linesmen, station staff or grid control engineers — is likely to forget the start of 1963. The New Year came in with gales and a blizzard... heavy, driving snow with temperatures plummeting to minus 15 degrees C even in the daytime. Grid lines sagged and broke under the weight of ice, with line gangs staggering through snowdrifts to make repairs.

As Andrew Cooper, Board Member for Operations and Personnel, wrote in a special article in *Power News:* "There is a story behind the events which is worth telling, so that we in the industry may be made aware of the devotion which inspired men to perform feats of almost superhuman endurance to keep supplies going under Arctic conditions." To quote just one example:

Part of Birmingham lost supplies because insulators on three towers were covered with ice — and so were the 150-foot towers. Working through the night in sub-zero conditions the men managed to climb the towers, but discovered that the ice couldn't be chipped off without damaging the insulators. Eventually the ice was dissolved using aeroplane de-icing fluid; but each insulator had to be dried by hand before the line could be put back into service.

Stations had their own problems. Coal stocks were frozen to a depth of two feet. Fires were lit under coal trucks so they could be emptied. Frozen jetties were a hazard for staff unloading colliers. Even so they managed to generate the supplies needed until January 24 when — for the only time that winter — there wasn't enough plant to meet the demand. For periods of 10 minutes to an hour there were widespread disconnections. But worse was to come. The next night the grid faced the worst disruption in its history.



Heavy fogs in December had polluted insulators and substation equipment with industrial dirt. A slight thaw during the day was followed by a quick freeze — and the trouble started. That night there were 700 flashovers on lines and electrical equipment. Grid control engineers could see the possibility of the grid being split, with some areas not having sufficient generation to meet the load. Phone calls warned stations to restart plant that had been shut down for the night.

But as the morning demand grew and flashing lights on wall circuit diagrams showed that switches had "tripped out" the emergency procedures were implemented. Instructions were given to "shed load"... stage by more severe stage so as to safeguard the grid from total collapse. The situation was becoming critical — though they still didn't know just how critical it would get.

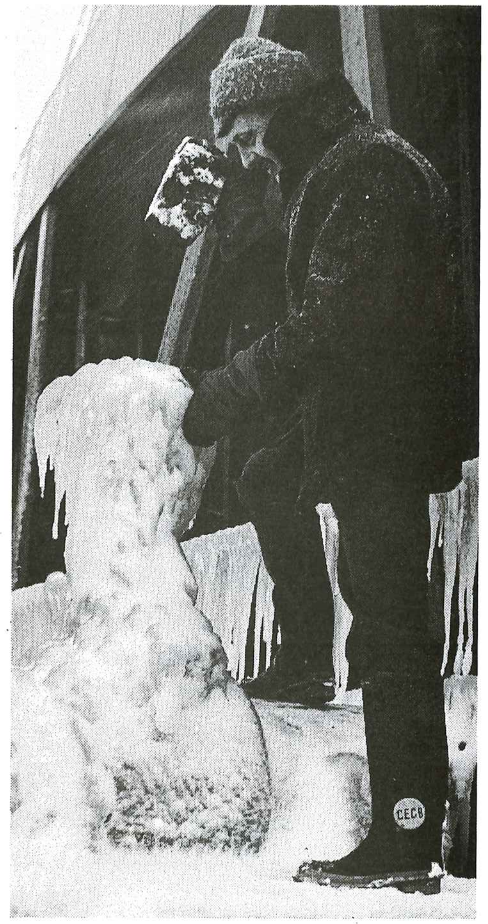
Many stations were isolated from the grid. As the morning demand grew, widespread disconnections were inevitable — in some areas up to a fifth of normal consumption. The worst hit part was the south of the country which had been relying on six grid lines from the Midlands, but one by one these failed. Stations which had become disconnected were trying to get supplies flowing again, sometimes by highly unorthodox means. A West Thurrock engineer remembers:

"We'd had to shut down completely when we got isolated from the grid. So there we were, huddled round a paraffin heater in the Charge Engineer's office, trying to puzzle out some way to get rid of the ice on the station busbars (heavy metal conductors) because until that was done there was no way to restart the plant.

Even putting braziers under the busbars hadn't worked, and every time we tried to bring in supplies from another station the circuits just tripped out again. Eventually we managed it by defeating the automatic electrical protection systems and feeding in supplies, so that the permanent short circuit would generate enough heat to melt the ice."

Before the night was out, the grid was being operated in four separate groups. Crisis point came at 9.0 am when engineers in the National Control room gave the instruction "Shed Stage 6 — and quick." This was the most desperate step ever taken to safeguard the system. The message was transmitted to three separate parts of the country and passed on to Area Board engineers who in turn opened switches to disconnect sufficient supplies to avoid potential disaster — all within the space of 60 seconds.

Just a few hours later, the grid was operating again as a single system and supplies had been largely restored. It says a lot for those who had designed the grid to withstand almost anything — and just as much for the staff in grid control, transmission districts and power stations who saved a crisis from becoming a catastrophe.



It only takes a spell of bad weather to remind everyone that it can be a tough job at the sharp end of power generation.

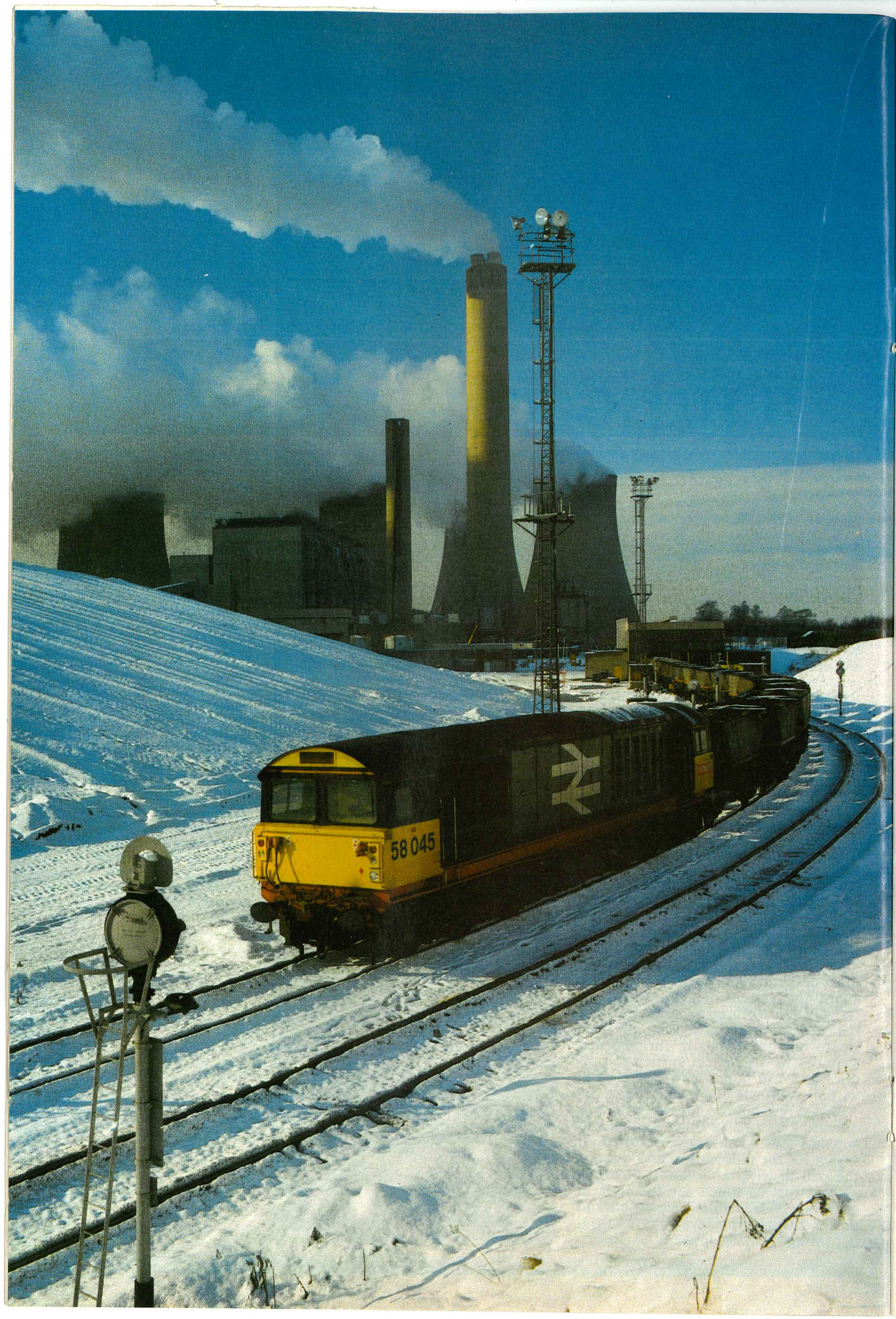
The winter of 1962/63 was one to remember. It was marked by Arctic conditions with gales and blizzards, with temperatures plummeting to minus 15 degrees Centigrade in daytime.

At power stations it was cold enough to freeze the curtain of water at the foot of cooling towers, restricting air flow — leaving staff the job of smashing a way through the wall of ice. Thick layers of ice had to be patiently chipped away when external valves needed adjusting.

Coal stocks were frozen to a depth of two feet. Coal wagons froze, making them difficult if not impossible to unload. Frozen jetties were a hazard for staff unloading colliers.

For some staff in the transmission districts the conditions were even tougher. Frozen insulators had to be cleared by hand and that meant climbing ice-coated transmission towers.

Teams called out to damaged lines in exposed areas like the Pennines faced snow driven by gale force winds in their efforts to keep the power flowing.



The pattern for development

THAT winter of 1962 had been another landmark in the rapid developments taking place. The first 275MW set had come into service at Blyth, and this was followed the next year by two 550MW units at Thorpe Marsh — Europe's largest at that time.

Those early sixties also saw the start of an even more significant range — one that would alter the whole pattern of generation in this country.

Since the early days of electricity, stations had been built where the demand was highest — in the major industrial areas, cities and the like. London still had more than 30, from "cathedrals of power" like Battersea to tiny stations like Poplar with an output of only 11MW. That was about to change dramatically.

With stations of 2,000MW being proposed, Donald Clark and his team of planners had to decide where to site them. As one explained:

> *"We knew those stations would burn something like 20,000 tons of coal a day, and that if we could build them nearer to coalfields we could slash fuel transport costs: but in the past it had always been cheaper to take coal to the stations than build grid extensions to get the power away. Now it was different. Because the new supergrid lines could carry much more power it became cheaper to transport electricity — 'coal by wire.' So the new stations were built close to coalfields with merry-go-round trains supplying them non-stop. In the same way oil-fired stations were built on estuaries close to refineries."*

As Sam Goddard (the System Planning Director) has said: "It set the pattern for tremendous developments through the sixties and seventies. You can see the stations along the Ayr and Trent valleys almost like a string of pearls, and it led to power movements of a size that had never previously been envisaged."

The first of the 2,000MW stations to come into service was at Ferrybridge in Yorkshire, followed by West Burton in the Midlands. But then came the start of troubles that would bedevil new plant for years to come.

The No. 1 unit at West Burton was still being commissioned when severe damage occurred. It was caused by design problems, but the inquiry report showed vividly the sort of pressures under which staff commissioning plant were operating. Here's a brief summary of what happened:

> **"The rotor had already needed to be replaced because experimental turbine blades were shed during earlier operation. Then, just when the set was due to be brought back into service, the manufacturers requested further modifications. The restart was put back for another 24 hours; but then vibration during the run-up caused a further delay until the fault was found and rectified. Staff who had been working flat out since the day before decided to stand by to complete the final tests that Sunday night."**

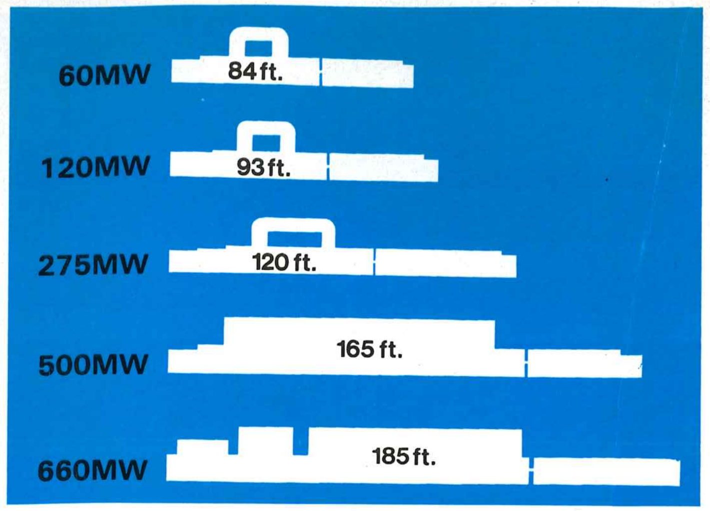
As the report commented: "Inevitably the atmosphere was fraught with a sense of urgency and barely suppressed frustration as each successive incident caused further delay." Then when at last the run-up started and the stop-valve failed, it was decided to replace it with the machine in operation. By midnight other faulty conditions were being observed, and the staff were still trying to correct these when an hour later "sudden and violent vibrations occurred" and the machine was shut down.

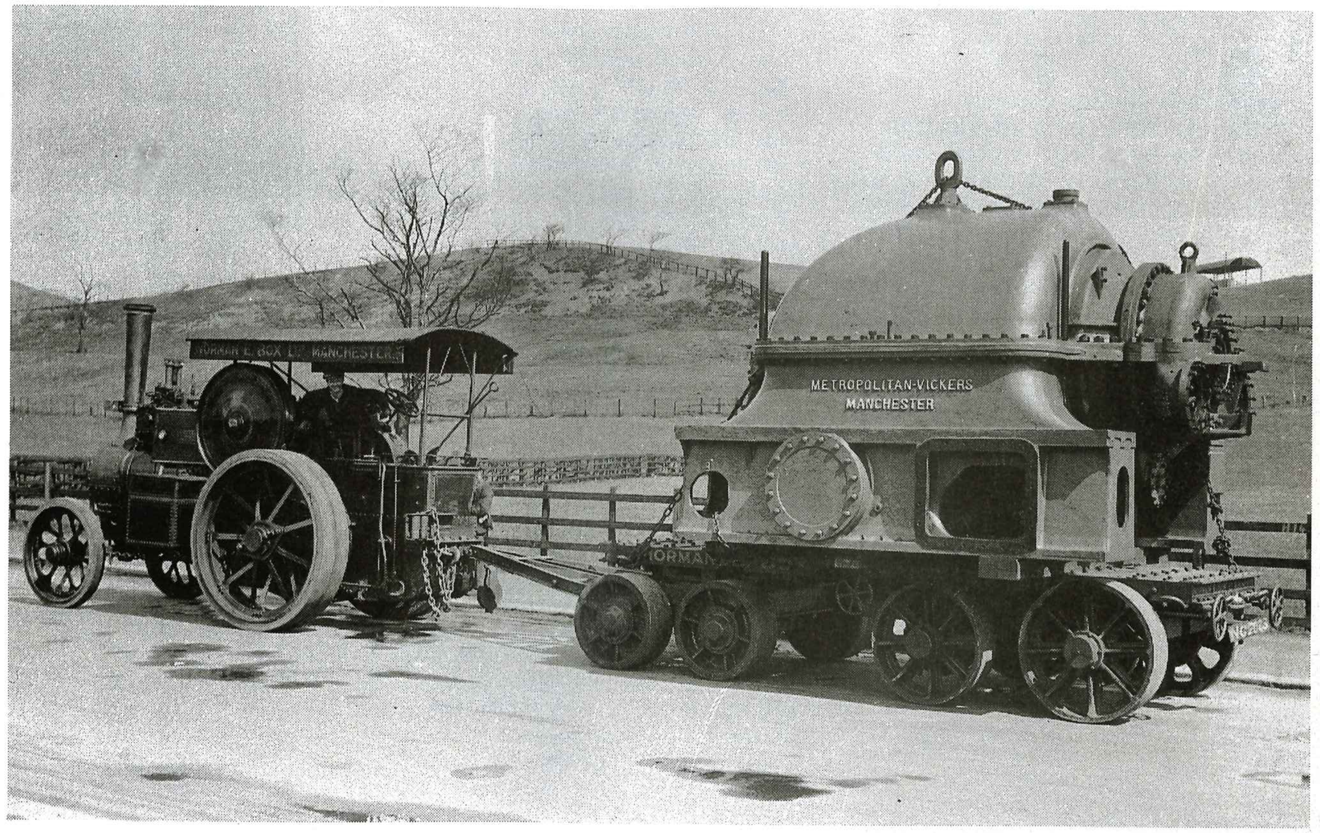
The damage was extensive, including bent rotors. The inquiry revealed several "design shortcomings," but those weren't the only weaknesses.

Gil Blackman (then a Midlands Assistant Regional Director) recalls: "At that time we were flying blind on our major units. There had been no chance to develop sound operating instructions and without adequate instrumentation we couldn't know what was happening in the unit." He went on to say how Regional Scientific Services Departments worked with Design and Construction staff on improvements needed feeding the results back to the manufacturers.

> *"When you see those same turbines nowadays they are smothered in instrumentation which*

Opposite page: Big power stations are big users of coal. A 2,000 megawatt power station can burn six million tonnes or more of coal a year. Transport was recognised as a major problem and the solution was the merry-go-round system with trains shuttling between pit and power station. This train at Ratcliffe power station, near Nottingham, has just dropped its 1,000 tonnes of coal into ground hoppers as it moved slowly through the unloading house before returning to the colliery.



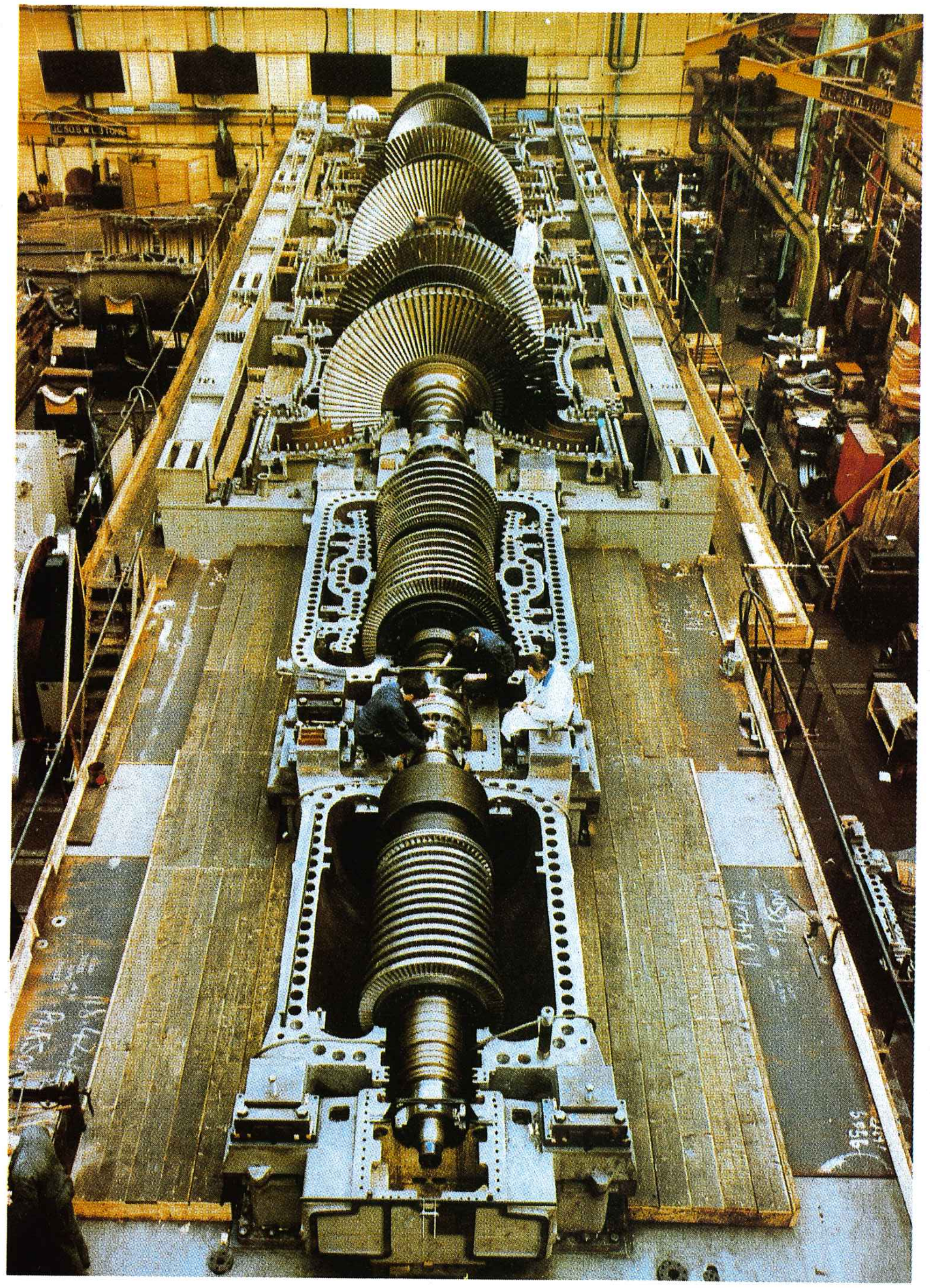


wasn't there when we first ran the plant. In the same way, we looked for quality assurance on things like boiler welds and made sure the right materials were used. A lot of work was done in the Marchwood and Leatherhead laboratories. There were enormous problems in getting things right. Almost all the alternators had to go back to the manufacturer's works. We would take the rotor out of one machine, repair it and then put it back somewhere else to keep the maximum amount of plant in service."

Getting the plant right took another 10 years and a lot of effort all round. But as Gil Blackman added: "With that knowledge and experience in our locker, we now have some of the best plant operating anywhere in the world."

Even in those latter 1960s the picture was anything but doom and gloom. The CEGB's policy of siting big coal-fired and oil-fired stations close to their fuel sources was being proved right. Generating costs were being cut still further. And by then there had been developments in the nuclear fields.

The earlier magnox stations were still performing well. With their reliability and low running costs they were being called the workhorses of their regions. Taking their high capital costs into account, they weren't as economic as other new plant. On that score they had been regarded as prototypes, built and operated to gain ex-



The enormous changes that 40 years of development brought to the electricity supply industry are graphically illustrated by these two turbines.

On the opposite page, a steam turbine on its way to Barton power station, Manchester, in the 1930s. On the left, pictured at the manufacturers in 1973, a steam turbine intended for Drax power station in Yorkshire.

Economies of scale drove the CEGB first to 500 megawatt and then the 660 megawatt turbines. Big turbines use relatively less material, making them cheaper to build and house, as the graphic illustrates. They also proved very much more efficient — once the technical problems were solved.

The Drax turbine in the picture spins at 50 revolutions a second. The high pressure end, the section at the bottom of the picture, takes steam at a pressure of 2,300 lb a square inch and a temperature of 565 degrees Centigrade — heating the high-pressure turbine a cherry red colour when it is running.

perience. The Board was looking to the next generation of plant to provide the economic breakthrough.

They had looked at the various types of reactor systems available in the early sixties. Given a free choice, it's doubtful if they would have selected the Advanced Gas Reactor design which had been developed by the Atomic Energy Authority. Christopher Hinton had openly expressed his doubts about it — and got his knuckles rapped by the Minister over his outspokenness. But in the end it was that AGR system which became the basis of the next nuclear programme.

The more advanced design would enable larger and more efficient 660MW sets to be installed, so when work on Dungeness B started in 1966 expectations were high. The troubles that would bedevil construction of the reactor were still something for the future.

Another major development was taking place at the same time. Already some sections of the 275kV supergrid had been modified for operation at 400kV, but in 1965 the first 150-mile length of new 400kV line had been completed. It was only the start of a major network, and before that could be completed wayleave permissions would have to be obtained for the miles of line across the countryside.

It would be a major task. But then, environmental problems were nothing new.