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ROYAL COMMISSION ON THE HISTORICAL MONUMENTS OF ENGLAND

THE POWER STATIONS OF THE LOWER THAMES

September 1995

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INTRODUCTION

In 1993 the Royal Commission on the Historical Monuments of England, in consultation with other interested parties, undertook to carry out a series of surveys to promote the understanding of the historic environment in the Thames Gateway area, then referred to as the East Thames Corridor. This record of power stations forms a part of that initiative.

Power stations have been a prominent feature of the banks of the Thames east of London since the construction in 1888-90 of Ferranti's pioneering generating station at Deptford. As demand for electricity grew power stations spread, in this area choosing riverside sites for the convenient delivery of fuel and access to cooling water. The need for ever larger facilities and open sites away from other development took power generation for the metropolis out of London and into Essex and Kent, culminating in the vast Grain Power Station, built in the 1970s as Europe's largest oil-fired power station. The historical range of electricity generating buildings in a concentrated area around the Thames estuary is exceptional, providing an informative microcosm of the development of the building type.

There are reasons beyond the integrity of the subject for the making of this record. Recent changes in the economy and structure of power generation have meant that many power stations have become redundant, generally leading to demolition. This applies to quite recent buildings, as well as to those of an earlier and more obviously "historic" character. Those power stations that continue to generate are in many eyes contributors to the negative image of the Thames Gateway area as presently developed. Yet these often monumental buildings have great historical importance from economic, technological and even architectural perspectives. They are significant features of the area's recent past that represent more than their primary functional existence. They were once major employers and their sheer size gives them importance in terms of landscape. Preservation will be a practical option in very few cases, but Battersea and Bankside Power Stations provide evidence that power stations, if only once redundant, can be accommodated with public affection.

Many of the buildings covered here have been demolished in recent years; this record is intended to register the passing of some buildings as much as it serves to note surviving landmarks. It is hoped that the study will have value in a context beyond the regional and contribute towards a broader understanding of an under-recorded building type as a whole. It sets out to inform conservation and regeneration-based concerns as well as academic interest and posterity.

The record is limited in its depth. Its purpose is to identify and establish the extent of the subject and to make a first and provisional assessment of its historic character. The subject is the buildings; technical matters relating to plant and output are addressed only in so much as they influenced the overall appearance of the buildings. This report comprises 14 individual site reports, most of a summary nature, with selected bibliographic information and photographic illustrations. An appendix lists photographs arising from the survey. Fieldwork has not included internal inspection of the buildings, except at Greenwich, Gravesend, and in the surviving parts of Barking "A" and "B". Further recording is anticipated at West Thurrock and Tilbury. Otherwise assessment of the buildings has been based on external observation, including aerial photography, and documentary sources, though consideration of the available documentation has by no means been exhaustive. Primary archive material, notably drawings,

is not easily traced, and it is a matter of urgency for the sake of future historical assessment that such archives as have survived the fragmentation of the industry following privatisation should be located, noted and selectively copied. Notes, photographs and other material arising from RCHME's survey are held in the National Monuments Record. The files for the London sites are at 55 Blandford Street, London W1H 3AF (0171) 208-8200, those for the Essex and Kent sites are at the National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ (01793) 414700.

The survey was carried out and the reports written by Peter Guillery and Michael Williams, with preliminary documentary research by Stephanie Taylor, photography by Derek Kendall, Peter Williams and Sid Barker, aerial photography by Roger Featherstone, and graphics support from Andrew Donald.

The Royal Commission is grateful to National Power for assistance with aspects of this survey and for permission to reproduce photographs. Co-operation from Michael Trueman (Lancaster University Archaeological Unit), English Heritage, PowerGen, Nuclear Electric and London Underground Limited is also gratefully acknowledged.

HISTORICAL DEVELOPMENT: A BRIEF ACCOUNT

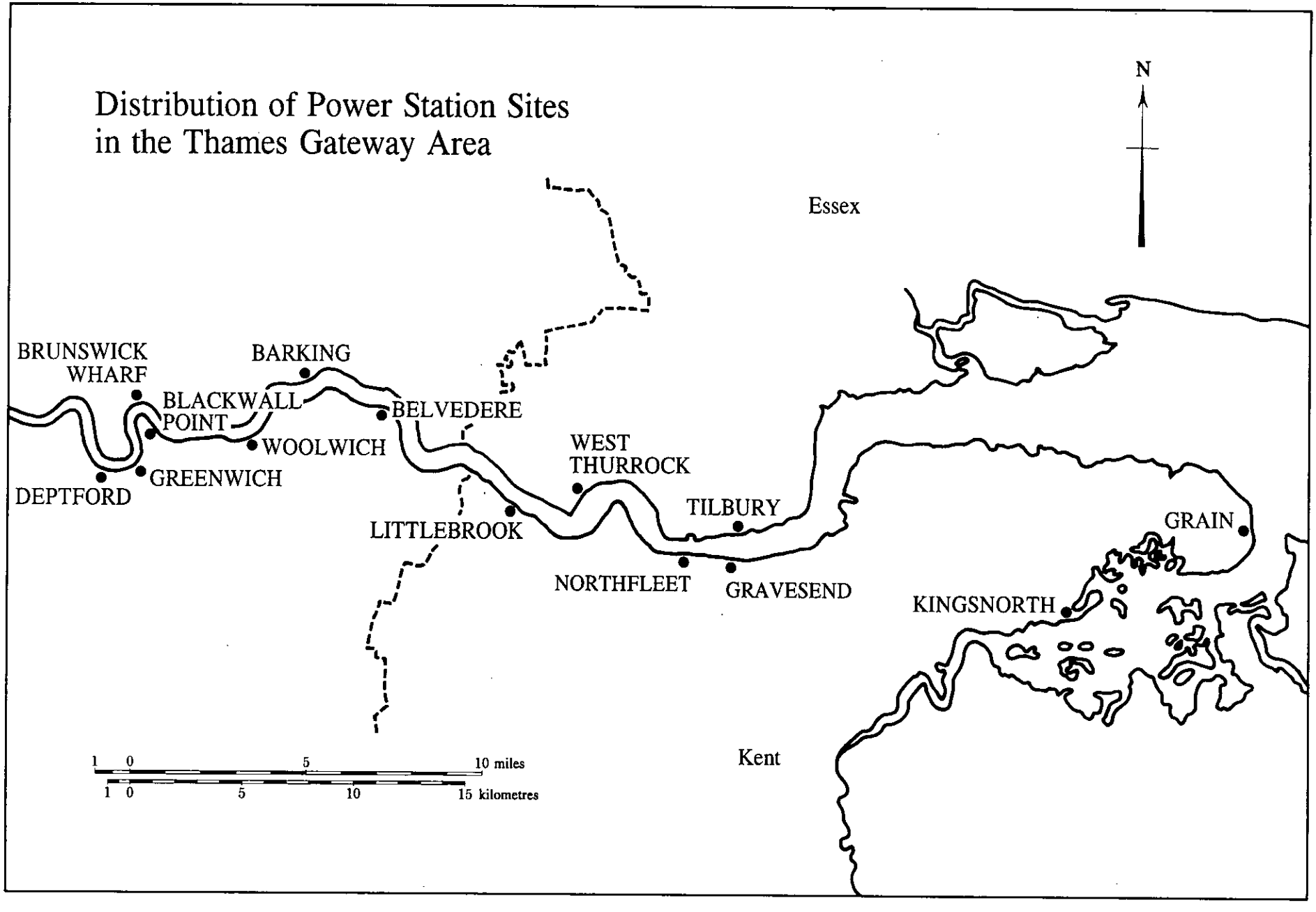
The banks of the Lower Thames have been used for the generation of electricity in large power stations since the earliest days of the electricity supply industry. This has resulted in a concentration of power station buildings reflecting many different stages in the development of the industry. The course of the river through London provided sites with both cooling water and direct access for ocean-going colliers close to the largest population centre in the country. Anticipated demand for electricity in the late 19th century attracted some of the most innovative entrepreneurs of the early electricity industry to London, which contained seven electricity companies as early as 1889. The banks of the Thames saw the construction of important and ground-breaking early power stations, while on later sites buildings reflected the development of power station scale, technology and architecture. Some of the most historically significant buildings have been demolished, but extant structures include the unusually well-preserved early power station at Greenwich and a particularly good range of buildings illustrating dramatic advances in power station design through the mid 20th century. For self-evident reasons no nuclear power stations were built in the London area.

Chronology and Distribution

In general the earliest power stations in the Thames Gateway area, which were all coal-fired, were built close to centres of population, notably London's more densely built-up suburbs. The larger later stations, which were both coal and oil-fired, were built more remotely and to the east. Of the earlier stations the most important was undoubtedly the original Deptford Power Station, which was built to the designs of Sebastian Ziani de Ferranti in 1888-90 for the London Electric Supply Corporation Ltd. Its last surviving parts were demolished in 1991-2. This was a building of international significance as it has been generally recognised as the forerunner of the central power station. When built it was of unprecedented scale and included a range of technical innovations by Ferranti. As a whole it was "conceived with a wonderful prescience of the line upon which the system of generation and supply of electricity was likely to develop in the future." (Peach, 1904)

In the early decades of electricity supply there was a multiplicity of private company and municipal undertakings, overlapping and competing in a haphazard fashion in a "scramble for powers and areas of distribution unmatched anywhere in the world in the history of electricity supply" (Irving, 1954). The early history of Woolwich Power Station (demolished 1980) presents an example of this disorder. Established in 1891-3 through the Woolwich Local Board of Health it was run by the Woolwich District Electric Lighting Company before being transferred to Woolwich Borough Council in 1903. Gravesend Power Station, built by Gravesend Corporation in 1902-3, is a notable surviving example of a small early municipal station, despite the loss of its boiler house. Blackwall Point (1900-06, rebuilt 1947-52, demolished c1987) was another small station, built for the South Metropolitan Electric Light and Power Company Ltd to serve a local market. There were several other such modest power stations in the area, all erected c1900, at Plumstead, Erith, Dartford and Grays. These were low-capacity, small, and almost certainly shed-like stations for local supply. Long since demolished they are not dealt with in this report.

The most significant surviving early power station in the Thames Gateway area is Greenwich Generating Station, built for the London County Council in 1902-10 to provide power for London's tramways. This was probably the last power station to be built with reciprocating steam engines; technically it represents an important transitional stage in power station design. It is still partly in use as a back-up station for London Underground and is


Distribution of Power Station Sites
in the Thames Gateway Area
N
Essex
BRUNSWICK
WHARF
BARKING
BLACKWALL
POINT
BELVEDERE
WOOLWICH
GREENWICH
DEPTFORD
WEST
THURROCK
TILBURY
LITTLEBROOK
GRAIN
NORTHFLEET
GRAVESEND
KINGSNORTH
Kent
1 0 5 10 miles
1 0 5 10 15 kilometres

therefore exceptionally well-preserved despite the removal of early plant.

Growing demand brought ever increasing chaos, fought without great success by the London County Council. Acts of 1925 made provision for a number of small companies to amalgamate to form the London Power Company which most famously carried forward the construction of Battersea Power Station (1929-35), but which also, in the area under consideration here, built Deptford West Power Station (1926-9, demolished c1978). The other large supplier in the London area in this period was the County of London Electric Supply Company which established at Barking in the period 1925-39 what was claimed as the largest steam-generating power station in Europe into the 1950s, largely demolished c1980. A measure of the Barking site's status was its formal opening in 1925 by King George V.

In 1926 the Electricity (Supply) Act set up the Central Electricity Board to coordinate electricity production nationally and concentrate electricity generation in a limited number of stations. The legislation led to the establishment of the 132 kV "Grid" in 1927-33 which enabled the transmission of power generated in one locality to remote consumption. Littlebrook Power Station, near Dartford, was established c1935 for the Central Electricity Board, and the previously local facility at Woolwich survived and grew to supply the Grid.

In 1947 electricity generation was nationalized and the British Electricity Authority established. Several new Thames-side sites were taken over for electricity generation in the immediate post-war period in a time of rapid expansion in supply. These were large sites, in some cases purposefully remote with space for future expansion as at Tilbury, acquired in 1947 for "A" Station which was built in 1949-58. Other power stations were established at Brunswick Wharf (1947-56, largely demolished 1989), Belvedere (1954-60, demolished 1993-4), Northfleet (1954-62, demolished 1993-4) and West Thurrock (1957-65). These stations also saw a corresponding increase in the scale of their coal-handling facilities, including larger jetties or wharfs, cranes, conveyor systems, and extensive open coal stores.

By the 1960s the Central Electricity Generating Board was building another generation of much larger oil-fired stations even further east. Belvedere had been a forerunner of these in so much as it had always been oil-fired, and some of the recently built coal-fired stations were converted for dual coal and oil firing. The newest sites required jetties and facilities for sea-going tankers and oil-storage tanks. Kingsnorth (1963-73) and Grain (1971-c1980) were built to utilise oil supplied from nearby refineries; Grain was claimed to be the largest oil-fired power station in Europe when completed in the mid-1970s. The latest oil-fired power station to be completed in the area, Littlebrook "D" (1974-c1983), was built further to the west as an addition to earlier coal-fired stations on the same site, which, to a remarkable degree, survive as a group.

Capacity, Scale and Plant

The range of power stations built in the Thames Gateway area illustrates the dramatic increase in the scale of power stations from the inception of the industry to the late 20th century. The table on the following page shows how the total designed output of the new power stations in the area continually increased throughout this period.

This increase in output has in large part been achieved through technical advance in boilers and generating units. However, it has also been reflected by huge increases in the size of the buildings. Latterly there has been a trend towards the use of a smaller number of much larger generating units in each station.

INCREASING POWER STATION CAPACITY 1891-c1983

Power Station	Date Completed	Units Installed	Total Output
Deptford "A"	1891	2 x 0.4 MW 2 x 1 MW	2.8 MW
Greenwich	1910	4 x 3.5 MW 4 x 5 MW	34 MW
Barking "A"	1925	4 x 20 MW 4 x 40 MW	240 MW
Barking "B"	1939	4 x 75 MW	300 MW
Brunswick Wharf	1956	4 x 55 MW 2 x 63 MW	346 MW
Tilbury "A"	1958	6 x 60 MW	360 MW
Belvedere	1960	4 x 60 MW 2 x 120 MW	480 MW
Northfleet	1962	6 x 120 MW	720 MW
West Thurrock	1965	2 x 200 MW 3 x 300 MW	1300 MW
Tilbury "B"	1969	4 x 350 MW	1,400 MW
Kingsnorth	1973	4 x 500 MW	2,000 MW
Grain	c1980	5 x 660 MW	3,300 MW
Littlebrook "D"	c1983	3 x 685 MW	2,055 MW

These power stations also illustrate dramatic changes in boiler design. The early stations at Deptford and Greenwich used large numbers of relatively small boilers of similar design to those used widely in other industries. However, both stations were equipped with coal-handling facilities that had scant precedent in their scale. By the middle of the 20th century power station boiler design had advanced considerably, with a single large boiler dedicated to each generator unit. Such boilers burnt pulverised coal and/or heavy fuel oil, and achieved high levels of efficiency through the use of plant such as superheaters and reheaters on a very large scale. Chimneys have ranged from the squat rectangular brick pair of stacks at Deptford, only 45 metres high, to the single 244 metre high and 20 metre diameter concrete chimney at Grain. Sites where there has been piecemeal extension, as at Deptford, Barking, and Littlebrook have in the past presented forests of chimneys.

Power station plant has, of course, been the subject of continual development, much

of which is of an innovative and highly technical nature the discussion of which is beyond the scope of this report. However, some features that appear to be characteristic of the power stations of the Thames Gateway area warrant mention here. The provision of facilities for unloading ships at power stations of all dates has already been mentioned. The use of river water for cooling has meant that cooling towers have not been necessary at Thames-side power stations. The construction of large pumphouses and systems of culverts for channelling river water to condensers is, however, a common feature. The larger later stations include examples of the use of unusually large circular concrete coffer dams within which the pumps were sited below ground level. Another distinctive feature is the unusually tall steel towers used to carry transmission lines from West Thurrock power station across the river.

Architecture

The general approach to power station layout has altered little since Ferranti designed Deptford in the late 1880s. Form has invariably followed function to a large degree with the two main structural components, the boiler house and the engine room or turbine hall, attached in a side-by-side, or occasionally T-plan, layout. Generally, with Deptford as an early exception, boiler houses have been taller than the engine room. Chimneys have been attached to or adjacent to the boiler house, which, in the context of the Thames, was generally linked to the river and a jetty by conveyors. External accretions have included economisers on the boiler houses and transformers and switch-houses on the turbine halls, with the functional array on the whole preserving a single directional path to the process of power generation. A distinctive feature of early stations, such as Greenwich, was an internal gallery overlooking the power hall and containing the main switchboard. In later stations, monitoring and control equipment was still located internally in a segregated room, sometimes between the boiler and turbines. From the 1950s the main station control rooms have been located in separate attached or detached buildings.

Within this overall rubric there has been great architectural variety that in some respects reflects broader trends in the history of architectural design through the 20th century. It also, of course, reflects developing constructional techniques and the application of new building technology to demand for larger power station output and buildings.

Early power stations had conventional load-bearing walls, but with substantial foundations to support the weight of engines and boilers. Deptford "A" was a plain brick box-like structure with Gothic blind arcading giving some relief to the walls. It had an internal frame of iron or steel supporting an overhead travelling crane above the engines, an essential feature that persisted in all later turbine halls.

Greenwich, as built in 1902-10, is quite different. By the turn of the century it was coming to be perceived by larger concerns that the scale of major power stations and their impact on townscape was such as to warrant a considered approach to their external appearance. The LCC eschewed the ornate showiness of some contemporary power stations such as Grove Road, St John's Wood (1902), opting, through the Arts and Crafts based strengths of its own architects, for an austere yet subtle design at Greenwich, "a most sophisticated monument to the self-consciously functional tradition in industrial building. Architecturally, it is much the most remarkable London power station built before Giles Gilbert Scott's Battersea" (Saint, 1981).The strength of this design endures despite some compromising alterations. Greenwich is also an early example of a largely steel-framed building in Britain, with lattice-steel construction including elliptically-arched roof trusses over the engine room. The surviving original coal bunkers in the upper part of the boiler house are

integral and appear to be of steel and concrete construction. Greenwich retains many other original structural features, including switchboard galleries, overhead coal bunkers and a massive coaling jetty in the river. The constructional interest of Greenwich is paralleled by another surviving early power station in London, Lots Road Generating Station in Chelsea (1902-4), also on the Thames, but upriver and therefore outside the scope of this report.

By the 1920s steel-framed construction had become the norm for power station construction. Frames continued to be concealed behind brick walls, with generally unprepossessing results, as at Barking "A" of 1925-8. This building makes the spectacular change in architectural approach at Barking "B" of 1931-9 the more remarkable. Described in 1933 as "a house of glass" (County of London Electric Supply Company, 1933) the huge steel frames of the turbine hall and boiler houses were entirely hung with patent glazing in a consciously and notably early Modernist work, paralleled by the better known but very similar Dunston "B" Power Station at Gateshead of 1933-4. Responsibility for design on both sites appears to have rested with Merz and McLellan as consulting engineers.

Early Modernism did not take hold in power station design. From the 1930s to the 1950s brick curtain walls were the norm, generally in the monumental "brick cathedral" style pioneered by Scott at Battersea in 1929-35. Examples of this approach in the Thames Gateway area are not of the first rank, ranging from Littlebrook "A" (1935-8) to Brunswick Wharf (1947-56) and Tilbury "A" (1949-58), the latter two contemporary with, but far more modest than, Scott's other great work in the genre, Bankside Power Station (1947-60).

In the meantime Modernism had established itself and by the early 1950s architectural polemicists were arguing for a more "functional" approach to power station design. Blackwall Point Power Station of 1947-52 was an early if pedestrian manifestation of an anti-monumental approach whereby the layout of plant dictated the external form of the building. Functionalism percolated into power station design only gradually, and chiefly through the work of the architectural partnership of Farmer and Dark, led by Frankland Dark after the death of F. Q. Farmer in 1955.

West Thurrock (1962-5) is a reworking of Farmer and Dark's influential design for Willington Power Station, Derbyshire (1959-62). In a foreshadowing of the exposed services and machine aesthetic of "high-tech" architecture the boilers are exposed to the open air. It had been maintained that brick cladding was unnecessary, uneconomic and, by implication, "dishonest". Early designs for Willington were praised as unprecedented for "the integration into a unity of the apparatus and the structure itself" (Jordan, 1953). The vertical and blockish forms of the uncovered boilers were eloquently countered through the bold horizontal wave of a multiple barrel-vault pre-stressed concrete roof over the turbine hall. Farmer and Dark explored other approaches to power station design in this period and at Belvedere (1954-60) were lauded for the directness of formal expression; the shapes of the main blocks were direct reflections of the space occupied by the plant, and surfaces were "skins" differentiated through a polychrome approach to cladding utilizing aluminium sheeting. Finally in this varied and transitional class came Northfleet (1956-62), another uncluttered functional design, distinctively detailed, carefully proportioned and clad in lightweight materials.

In the 1960s functionalism in power station design developed to exclude any unnecessary fenestration, detailing, or relief from the elevations of the plain, massive and block-like principal structures, as for example at Tilbury "B", completed in 1969 and reminiscent of Barking "B" and Dunston "B" in its simplicity, as well as at Kingsnorth (1963-73) and Littlebrook "D" (1974-83). In this reductionist approach architectural character depends very much on the massing of the main block or blocks in relation to a chimney or chimneys, and variation in the colour and texture of the cladding.

At Grain Power Station (1971-c1980) Farmer and Dark produced a return to monumentality without compromising on the functional expression of form and the elimination of superfluous detail. The visual impact of the huge buildings is both softened and made more dramatic through the incorporation of curved eaves and sloping roof lines. The "aerodynamic" or "jelly mould" profile of the main buildings was also said to increase airflow and improve internal ventilation. More poetically it was described as "the Chartres of the genre, one of the greatest in Europe" (*Building Design*, 16 Sept. 1977).

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LONDON

NBR INDEX NO: 93581

GREENWICH

NGR: TQ 375 780

STOWAGE, DEPTFORD

DEPTFORD POWER STATIONS

Summary Report

Deptford Power Station has great historic importance as the first central station from which electricity was generated at high tension for transmission over a long distance. The first power station was built in 1888-90 for the London Electric Supply Corporation Ltd under the close control of Sebastian Ziani de Ferranti (1864-1930). Up to this time electricity generation had been from small stations. In 1886 Ferranti, then aged 21, became Chief Engineer to the newly-formed London Electric Supply Corporation and quickly advocated the establishment of large remote power stations. A three-acre Thames-side site was chosen. Known as The Stowage, referring to its earlier use as a storeground for the East India Company, the site is just west of the mouth of Deptford Creek. Ferranti also chose alternating current at a time when it had not yet gained ascendancy over direct current. By 1891 the Power Station at Deptford was generating with a capacity of 2.8 MW at 10,000 volts. It was, however, incomplete and Ferranti resigned, his more ambitious plans unrealised. Deptford Power Station was not a paying proposition until 1896 following plant improvements. It was again refitted in 1900-1, 1904 and 1909 and by 1912 it had a 20 MW capacity. There was further expansion in 1924-5.

In 1926-9 a second free-standing but adjacent station (Deptford West) was built for the London Power Company Ltd, following the amalgamation of a number of generating companies including the London Electric Supply Corporation. Deptford West, designed by Leonard Pearce, the London Power Company's Chief Engineer, was an interim measure, in anticipation of the building by the company of a 'super-station' at Battersea.

The earlier station, now known as Deptford East, was substantially extended and part rebuilt in 1948-57 under the British Electricity Authority, with a much larger boiler house and a new engine room to the north of Ferranti's building.

The early parts of Deptford East were shut down c.1968 and demolished in the 1970s. Deptford West was demolished in the late 1970s. The later parts of Deptford East were closed in 1983 and demolished in 1991-2, including the last fragment of Ferranti's station - a single arcaded brick wall.

Ferranti's building was a plain brick structure on a concrete raft, about 210ft by 195ft and 100ft high. The boiler house to the north had two squat 150ft-high rectangular chimneys, one at each end. There were hoppers under the roof for 40,000 tons of coal to fire 24 boilers in four batteries of six. Over the boilers there was a tank for 800,000 gallons of water. The taller and broader engine room had two parallel bays each with a travelling overhead crane and a skylit roof. In 1889 two Ferranti 1 MW alternators driven by a Hick Hargreaves 1500 hp steam engine were installed, followed, in 1891, by two Ferranti 0.4 MW alternators each driven by a 700 ihp Corliss steam engine. A striking feature of the building as a whole was the use of Gothic or pointed-arch arcading in the main walls to articulate otherwise plain

expanses of brick. The Gothic style was rarely used in an industrial context. The station was sited well away from the river but linked by a railway from the quay.

To the west a long and large brick boiler house range with 10 squat stacks was added in two builds, probably in 1924-5.

In 1948-9 Deptford East was further extended with the demolition of the original boiler house and addition of a large reinforced-concrete boiler-house block to the north. This had a single polygonal stack on a tapering base at its north end. By 1955 the north end of the early-20th-century boiler house range west of the original block had been replaced by a new engine room immediately west of the 1948-9 boiler house. As fitted out in the 1950s Deptford East had three 55.5 MW turbo-alternators made by Metropolitan Vickers and seven coal-fired boilers. By this time the 1880s station was generating 70 MW for the railways.

Deptford West was a large brick and reinforced-concrete rectangular building of 1926-9 with its engine room on the west side of its taller boiler house. At the north and south ends of the boiler house there were tall fluted chimney stacks with classical mouldings. It had five turbo-alternators with a total capacity of 160 MW, increased to 222 MW by 1937.

Coal storage was on the ground between the East and West Stations with conveyors from a jetty or dolphin out in the river.

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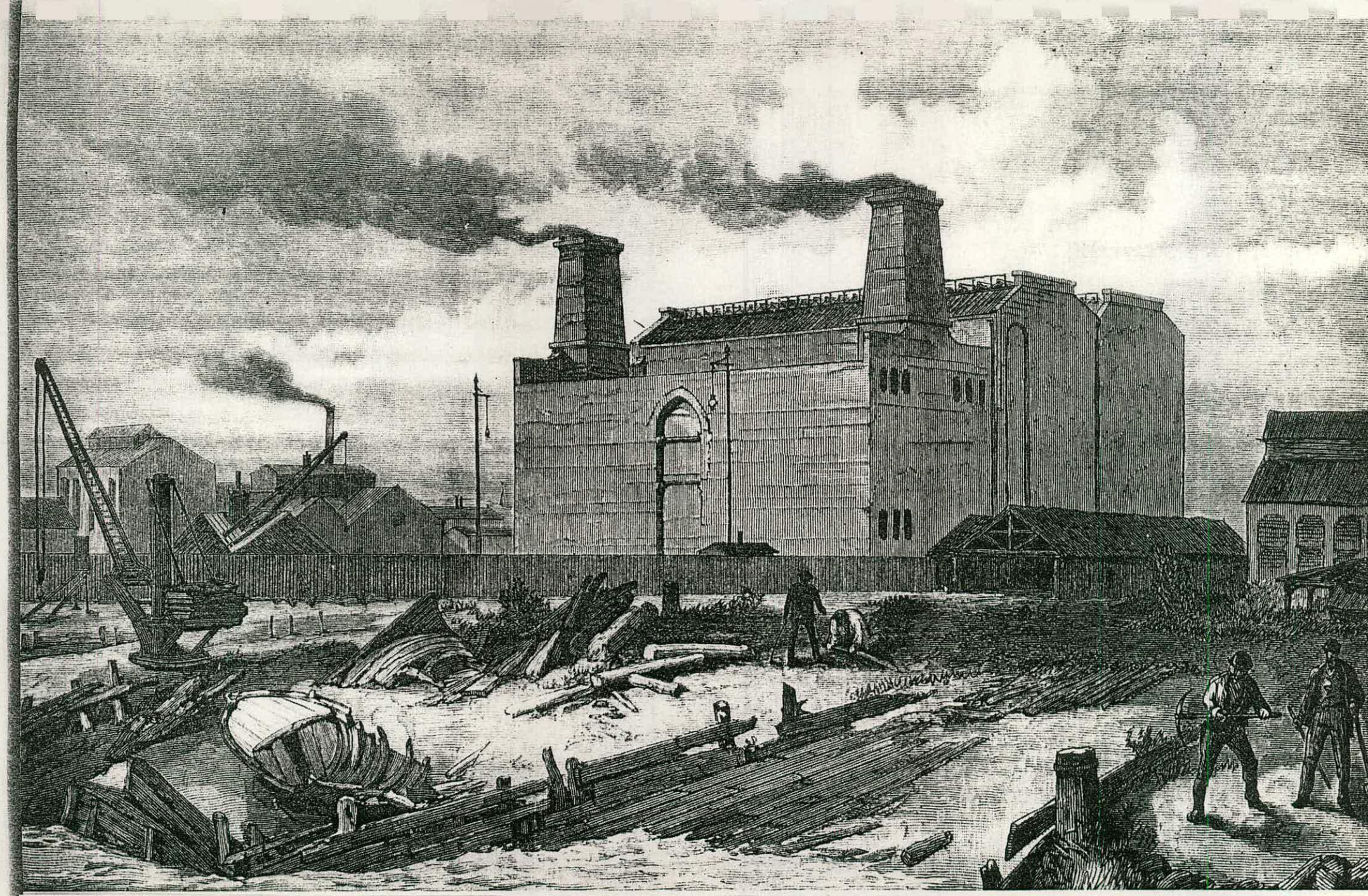
Report by Peter Guillery
May 1995



Deptford Power Station as built in 1888-90 under Sebastian Ziani de Ferranti, viewed from the river foreshore to the north.

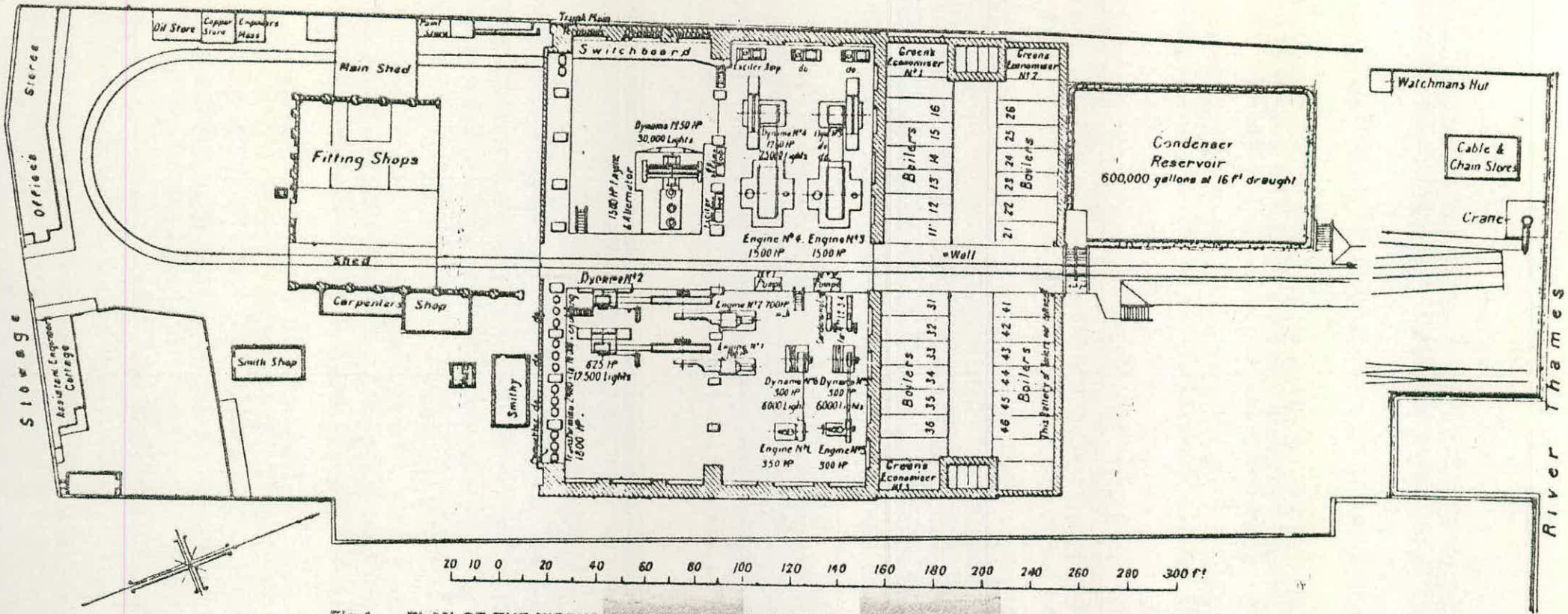
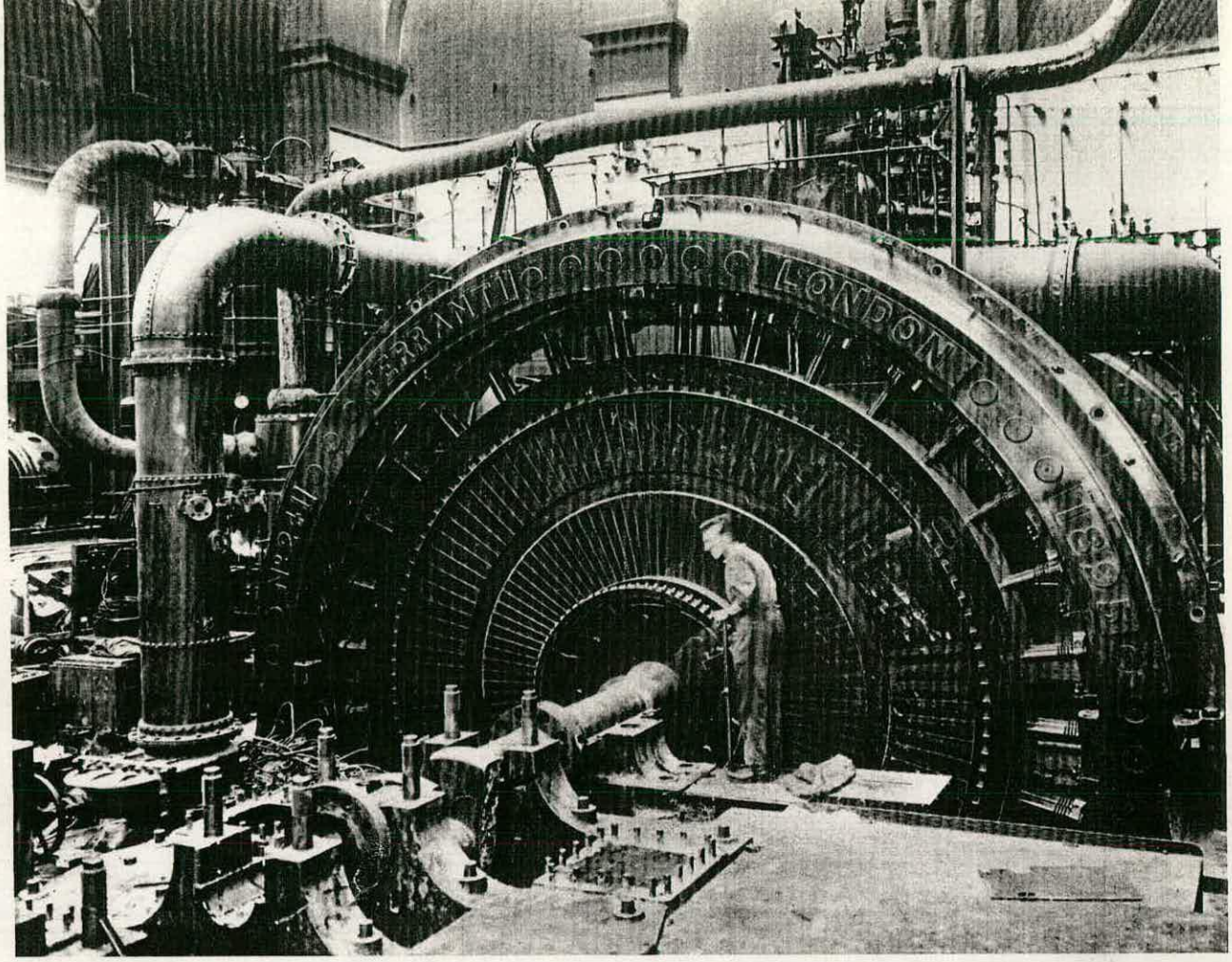
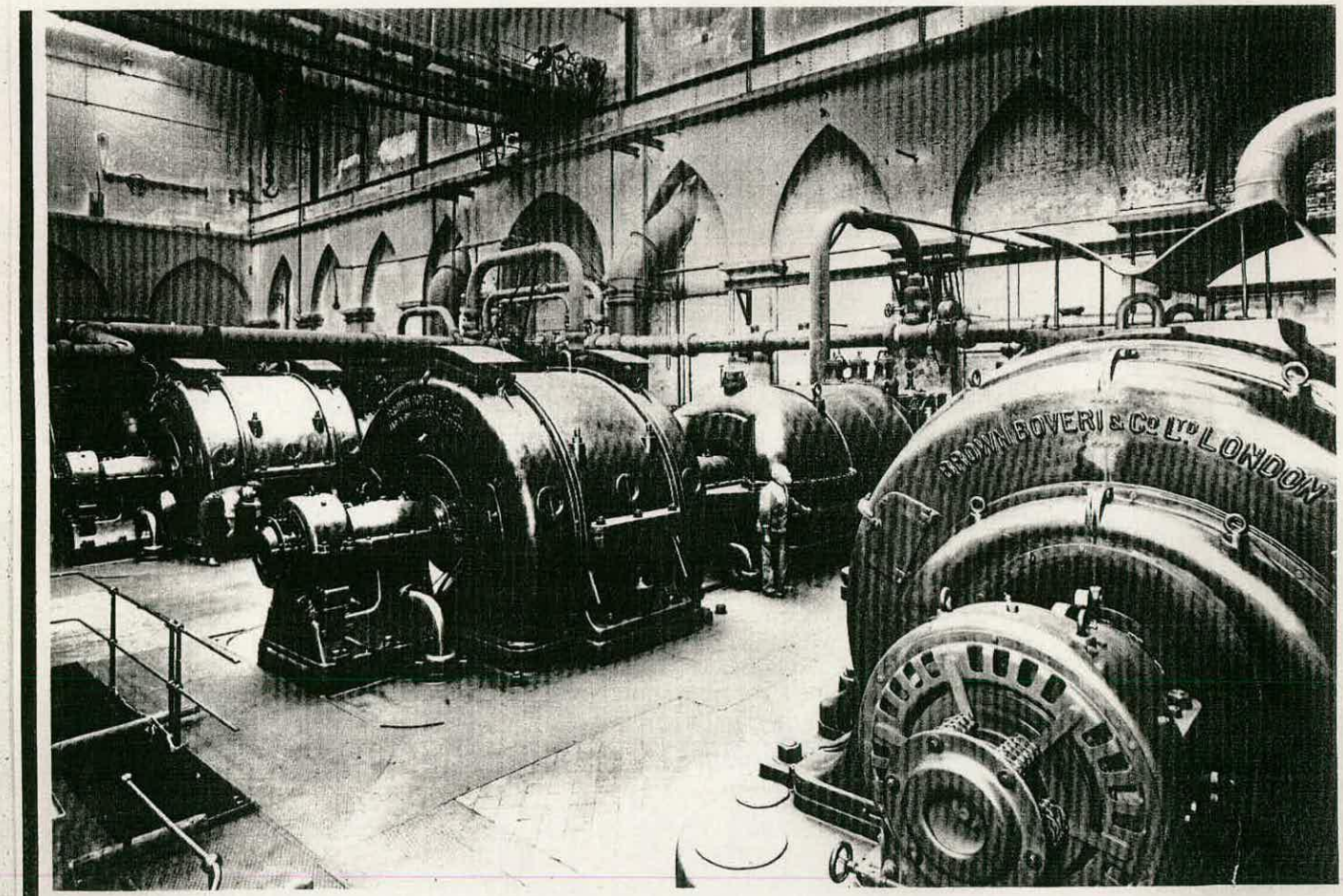


Fig 1. PLAN OF THE WORKS OF THE LONDON ELECTRIC SUPPLY CORPORATION AT DEPTFORD.

C. 1897.





Deptford Power Station, views of the engine room showing the installation of plant c1895 and a later view of early turbines (National Power plc).

LONDON NBR INDEX NO: 92245

GREENWICH NGR: TQ 389 781

OLD WOOLWICH ROAD

GREENWICH GENERATING STATION

Summary

Greenwich Generating Station was built in 1902-10 for the London County Council to provide electric power to the capital's tramways. A powerful manifestation of early LCC municipalization it continues in use as a back-up electricity source for London's underground railways. The station is one of few early power stations to continue in operation. It is also notable as an early example of a steel-framed building in Britain and, in its stone-dressed stock-brick skin, it has considerable architectural distinction. This quality is most evident in the north and south gable-end elevations and in the stone detailing. There are four chimneys; the pair to the north were once taller and ornamentally detailed. Originally coal fired the station generated current at 6,600 volts with a capacity of 34 MW when complete. Its first section, opened in 1906, incorporated a late example of the use of reciprocating steam engines; thereafter steam turbines were installed. All early plant has been removed and since 1972 the station has been equipped with eight gas-turbine alternators, originally burning oil, but later converted to oil/gas dual-firing. These are housed in what was formerly the boiler house, and have a total capacity of 117.6 MW, generated at 11,000 volts but stepped up to 22,000 volts for connection to the London Underground distribution system. The massive coal bunkers forming the upper part of the boiler house survive. Amongst a number of ancillary structures the most notable is the coaling pier in the River Thames which stands on 16 huge cast-iron columns.

Report

Background and General History

The electricity generating station at Greenwich was built by the London County Council in 1902-10 to power London's trams. It was 'the largest single building erected by the early LCC and the most manifest symbol of the Progressives' policy of municipalization' (Saint 1981). The LCC began to purchase tram lines from the 15 private companies controlling them in London in 1891 with a view to centralized public running of London's tramways. With the passing of the London County Tramways Act in 1896 the LCC gained the power to work the lines thus acquired. The takeover of the tramways was more aggressively pursued from 1898 once the Progressives had a majority on the council. Another Act passed in 1900 allowed for the electrification of the LCC's tramways, to replace horses as the motive power. Electrification began in south London in 1901-2 and was pursued steadily thereafter. In connection with this the Council decided in 1899 to build a large generating station on a tramway depôt at Camberwell. This site posed difficulties so in 1901 a decision was taken to build the station on the site of the Council's existing tramway depôt at

Greenwich, this affording the advantages of a river frontage, that is convenient coal delivery and water for condensing engines.

The station was designed to have the capacity to supply the whole of London's tramway system and was, when completed, one of the country's largest power stations. It generated current at 6,600 volts with a capacity of 34 MW. The building went up in two phases, to allow for the gradual growth in demand created by the programme of tramway electrification. The north half was erected from 1902 to 1906, the south half from 1906 to 1910.

The design of the station was handled within the LCC, though architectural executant responsibility is unclear. J H Rider, the tramways electrical engineer, was instrumental in selecting the site and devised the general arrangement of the building in consultation with LCC architects (General Section) under W E Riley. Rider and A L C Fell, chief officer of tramways and himself an electrical engineer, determined the fitting out of the building. The coaling pier was separately designed and constructed under Maurice Fitzmaurice, chief engineer. The building superstructure was contracted to H Lovatt Ltd, of London and Wolverhampton, with steel supplied by J Westwood and Co Ltd, of Poplar, (north section) and E C and J Keay Ltd, of Birmingham, (south section). The estimated cost of the station in 1906 was £900,000.

Plans by LCC Progressives to use the station for direct supply to consumers rather than for transport alone came to nothing in the 1920s. From 1930 onwards generating plant was gradually modernised and capacity was increased in numerous phases. In 1933 the station was transferred to the management of the London Passenger Transport Board with London's tramways. New plant at Greenwich and the use of its output for Underground extensions and trolleybus developments were made part of development plans. London's trams were scrapped in 1952 and the trolleybus network was abandoned between 1954 and 1962 since when the output from Greenwich has been used solely for the Underground railways.

In 1969 to 1972 the coal-fired boilers and steam turbo-alternators were replaced by eight gas-turbine alternators, burning oil, enabling the staff to be reduced by some 90%. Since then the station has served as a back-up to Lots Road Generating Station at Chelsea. In 1976-7 the gas turbines were modified for dual-firing with either gas or oil.

Site Description

The generating station occupies a site of about 3 3/4 acres with a 240ft (73m) river frontage just downstream from Trinity Almshouses and not far from Greenwich Hospital. The twin-naved main block, originally the boiler house to the west and the engine room to the east, occupies the bulk of this site. Linking the former boiler house to the river is a massive T-plan coaling pier. Ancillary structures occupy much of the limited yard space around the main block and the whole site is enclosed by a stone-coped brick perimeter wall.

Building Description - Exterior

The twin-naved main block of the station has a stock-brick skin with Portland stone dressings on a steel frame, founded on a 6ft-thick concrete raft. Roofs once slate covered have been recovered with corrugated sheeting. The overall dimensions of the main block are about 475ft by 195ft (144m by 59m) and 80ft (24m) tall. There are ornamental rainwater heads dated 1903 to the north and 1908 to the south.

Architecturally the generating station is a distinguished building - strong and austere. The LCC architects summed up their approach thus, 'The external elevation of the station has been treated severely in large masses and on broad lines, having in view the scale of the

building and the object for which it is constructed' (LCC 1906). Subsequently the building has been appreciated for 'its beautifully handled expanses of stock brickwork, its great end windows, and its tapering angled chimneys, [it] is a most sophisticated monument to the self-consciously functional tradition in industrial building. Architecturally, it is much the most remarkable London power station built before Giles Gilbert Scott's Battersea and makes a contrast to the more ornate conceptions of Curtis Green at Chiswick (1900-1) and Peach and Reilly at Grove Road, St John's Wood (1902).' (Saint 1981). The Old Woolwich Road (south) elevation has been described as a 'huge grand elevation...in an heroic Roman manner, tempered with an Arts & Crafts touch in the treatment of materials: two massive Diocletian windows, with brick mullions and voussoirs, fill the two big gables of the turbine hall and boiler house respectively. All the detail is big and bold, yet subtle - an example being the clever stone set-offs on the buttresses' (Stamp 1979).

Further examples of imaginative and powerful detailing are in a varied range of stone door surrounds, from very large, in the great arch over the west vehicular entrance to the south stores block, through the imposing 'official entrance' to the former offices on the east side, to the domestic scale of the front doorway to No. 10 Hoskins Street, formerly the Pier Foreman's lodge. It is worth noting that the shape of the west nave (boiler house) gable-end windows is purely for architectural effect as the upper sections are directly set against coal bunkers.

Another architectural gesture has been compromised. The four octagonal tapering chimneys rising from the former boiler house are shorter and plainer than intended. Those built first to the north rose to 250ft (76m) originally with prominent corbelled and machicolated bands. Those built later to the south had to be made lower (182ft or 25m) to meet objections from the Astronomer Royal at Greenwich who felt that views from the Royal Observatory were being affected. The taller chimneys were shortened to the height of the others in 1972.

The long east and west side elevations were less cleanly conceived and have been further confused by alterations and additions. To the east the engine room flank wall is largely blank. There is an original full-height central projection, for the switchboard galleries. To the north a low two-storey and ten-bay block housed offices. To the south a tall single-storey eight-bay block, formerly a substation, has had all but the heads of its tall windows blocked. On the west side there were once prominent Diocletian windows. These were obscured c.1927-8 by large concrete reserve coal bunkers that have a regrettable effect on the architecture of the whole. To the north of these bunkers there is a brick projection which appears to be an early addition or an afterthought as it too seems to obscure openings.

Building Description - Interior

The generating station is an early example of a steel-framed building in Britain. By the 1890s constructional steel was in wide use, notably, in terms of large-scale framing, in bridges, as, for example, in Tower Bridge of 1886-94. Yet the integral 'steel skeleton frame', onto which or around which masonry walls and roof coverings were placed to enclose large spaces, appears not to have been much adopted for British buildings before the turn of the century, despite its earlier acceptance in the USA and Germany. Exceptions appear to have been outside London. In the interpretation of early instances of steel framing there is ambiguity in most cases over the degree to which external masonry walls were loadbearing (Lawrence 1990). In London Lots Road Power Station, Chelsea, of 1902-4, has a steel frame, as did the now demolished Grove Road Power Station, St John's Wood, of 1902 (Peach 1904). The technology was taken up in prominent and prestigious London buildings at about this time, for example Oceanic House, Cockspur Street, of 1903-6, the Central Offices at the Royal

Arsenal, Woolwich, of 1903-11, and the Ritz Hotel, Piccadilly, of 1904-5, the latter generally hailed as London's first 'important' steel-framed building. Curiously, the LCC (through its enforcement of the London Building Regulations) was a significant agent of constraint in the development of steel-framed construction in London prior to 1909, yet clearly the Council was exploiting the new technology for its own purposes in a building type where the Acts were less limiting.

At Greenwich dependence on an internal steel frame is not as externally evident as it is at Lots Road. The frame may carry the brick walls only to a limited degree. The brickwork appears to be tied to the frame of the boiler house, to the west, but this does not seem to be the case in the engine house, to the east. The external buttresses, such a distinctive feature of the building's design, may reflect the independence of the brick walls from the steel frame.

Boiler House

The original direction of generation was from west to east, boiler to engine to switchboard. The west nave, originally the boiler house, is now the gas turbine hall. Its frame is a two-level structure divided into a 3 by 28 bay grid by I-section steel stanchions. Current use of the station is all but entirely concentrated in the lower level of the west nave. Originally the lower level housed 48 Stirling boilers in groups of six flanking each of the four chimneys on either side of a central stoking floor. These were replaced by Yarrow and other boilers in the 1920s and 1930s which were removed in 1969 to 1972 and their place taken by eight gas turbo-alternators powered by Rolls Royce engines each capable of generating 14.7 MW.

The outer bays to the upper level of the former boiler house have concrete slab floors on brick jack-arches in the steel frame. The upper level retains its original form with concrete-covered steel coal bunkers that are an integral part of the building's structure. Disused since 1972 the 50 bunkers (there are two 'extra' at the south end) are about 30ft (9m) tall and have a capacity of 13500 tons (270 tons each). They acted as hoppers, filled from above, feeding coal through chutes to the mechanical stokers of the boilers below. Within the roof space over these bunkers there ran two gravity bucket coal conveyors. The conveyor frame survives as an integral part of the steel-framed roof structure. This was a continuous or endless belt conveyor system. Coal originally entered the building at a low level to the north immediately rising on the conveyor behind the great north window to run the length of the building in the roof space. Here it was tipped into the bunkers through grids for grading the coal. The system allowed for the removal of ash from hoppers under the boilers on the conveyors' return; the ash was stored under the coaling pier and then discharged into barges. At some point the conveyor system was altered to allow coal to enter at a high level above the north window on an overhead conveyor running directly from the pierhead. Evidence of this is visible in a rectangular patch of brick repair above the window. The roof slopes over the boiler house have five rows of continuous louvres, for ventilation of the coal dust.

Engine Room

The east nave was originally the engine room. Since 1972 this area has been largely unused. None of the steam plant survives, though a concrete block to house the gas compressors was constructed at the north end of the space in 1976-7. There are raised concrete beds for steam turbines of the 1930s and later. The north half, complete by 1906, originally had four vertical-horizontal steam reciprocating engines driving flywheel-type alternators at 94rpm. Generators mounted on the engine shafts gave a capacity of 14 MW (3.5 MW each) delivering current at 6,600 volts. The engines, made by John Musgrave and Sons Ltd of

Bolton, were the last important installation of slow-speed engines in a British power station (Parsons 1939). Steam turbines had already rendered such equipment obsolete so, by 1910, the south end of the engine room was equipped with four 5 MW turbine-generators, at least two of which were supplied by the British Westinghouse Electric and Manufacturing Co Ltd. By 1922 the reciprocating engines had been replaced with more steam turbines. The turbine generators were themselves gradually replaced from 1930 to 1944.

The engine room is an entirely undivided hall, its steel frame open to view as 14 approximately 30ft (9m) long bays with square-section lattice piers supporting arcaded panel-girder gantries for overhead travelling cranes. These gantries appear to be important longitudinal stiffening for the frame. The approximately 80ft (24m) span roof is framed in lattice steel forming elliptically-arched trusses, with a continuous lantern along the ridge, no longer admitting light. Lattice purlins in five rows have 'flared' ends. The overhead travelling crane in place was made by Babcock and Wilcox and has a 50-ton capacity.

The engine room walls are faced with white and brown glazed bricks. The west wall is blank with steam-pipe openings blocked. The area below the working floor was originally the condenser pit.

Control Room, Switchboards, Offices and Substation

Eastern adjuncts to the main building accommodated from north to south, offices, the original control room and switchboards, and a substation to convert the electricity to 550 volts direct current for use by local tramways. The control room originally ran across the five central bays of the engine house at an upper level behind steel and glass panelling. Above this there are bus bar boxes on two high-level switchboard galleries. At the working floor level under the control room there is brown-glazed brick walling with 13cm-wide chases or recesses for the main cables that ran up to the control room and switchboard galleries carrying the current generated by the engines. A supervisor's cabin that stood over the engine room at gallery level to the west survives, moved to within the former control room area.

East of the five north bays of the engine room are the two-storey general offices. A dog-leg staircase from the 'official entrance' from the east yard has plain timber balusters and cyma-moulded tread soffits. There are panelled rooms with box cornices and simple neo-Georgian fireplaces. An early telephone switchboard survives here.

The former substation east of the south end of the engine room has been converted to other uses. Its lower part became washrooms, presumably replacing latrines to the west removed c.1927-8 for the reserve coal bunkers. On a floor above the washrooms there are large timber windows onto the engine room.

Ancillary Structures

The coaling pier of 1903-5 is an impressive structure in its own right. A 'T' on plan it extends about 120ft (36m) into the river and is about 200ft (60m) long by 40ft (12m) wide. It has 16 baseless Doric columns (arranged 7:7:2) rising about 50ft (15m) above the foreshore. These are cast-iron cylinders filled with concrete, about 5ft9in. (1.75m) in diameter at mid-height. The steel-girder superstructure originally had a timber platform from which cranes unloaded coal (about 1000 tons a day) from colliers into trucks that ran to the station's external coal bunker, to allow rapid discharge of the ships. The trucks were later replaced by conveyors which carried the coal from the cranes to the centre of the pier, and from there it passed up an inclined conveyor to the upper level of the boiler house.

The area over the 1900-ton capacity steel external coal bunker at the inner end of the pier was converted in 1969-72 to accommodate 12 fuel-oil tanks. It retains its original louvred and steel-framed roof. In the north yard in front of the former engine room there are

five 112,500 gallon capacity fuel-oil storage tanks of 1969-72, to which the oil is pumped direct from tankers, and from which it is transferred to the tanks in the former coal bunker. The large tanks are on the site of a pump house and associated buildings that supplied water for condensing the steam from the original engines. A fuel-oil metering and filtering house was also built in 1969-72 on the pier adjoining the former external coal bunker.

The wharf walling with river stairs was built with the station and pier. On the quayside there are original railways leading into the station site, for the station's own internal perimeter railway line, and further west for a 30-ton travelling electric crane.

To the west are the massive high-level white reinforced-concrete reserve coal bunkers that were added c.1927-8 alongside the original boiler house over the narrow west yard. They are 11 in number and their internal high-level conveyor survives. Coal was transferred into the reserve bunkers from the boiler house at the high level via a conveyor in a cross-gallery from the boiler house. When coal was needed from the reserve it was released onto another conveyor under the bunkers and taken back to the pier from where it was conveyed up to the boiler house again.

Over the east yard adjoining the control room and switchboard projection is an 8-bay stock-brick switch-house block that appears to be an addition of the 1920s. It is at first-floor level and stands on reinforced-concrete piers; it was built over the pre-existing perimeter railway the tracks of which survive here. Since 1972 it has housed 22,000 volt switchgear.

To the south fronting Old Woolwich Road there is a triangular stores block with 7 bays of tall windows, that to the west removed for the insertion of a vehicular entrance. More of the internal railway, with a turntable, survives near the stores block's original west entrance. The perimeter wall has been opened up at the south end of the east yard. Along Hoskins Street secondary brick rises above and within the perimeter wall to house transformers. The original wall was partially rebuilt to the east in 1994-5 where there was originally a large archway leading to the offices.

In the southeast corner of the site is No. 10 Hoskins Street, formerly the Pier Foreman's lodge. This is a delightful architectural flourish reinforcing at a domestic scale the picturesque qualities of the station, most notably in a machicolated octagonal turret of unknown purpose.

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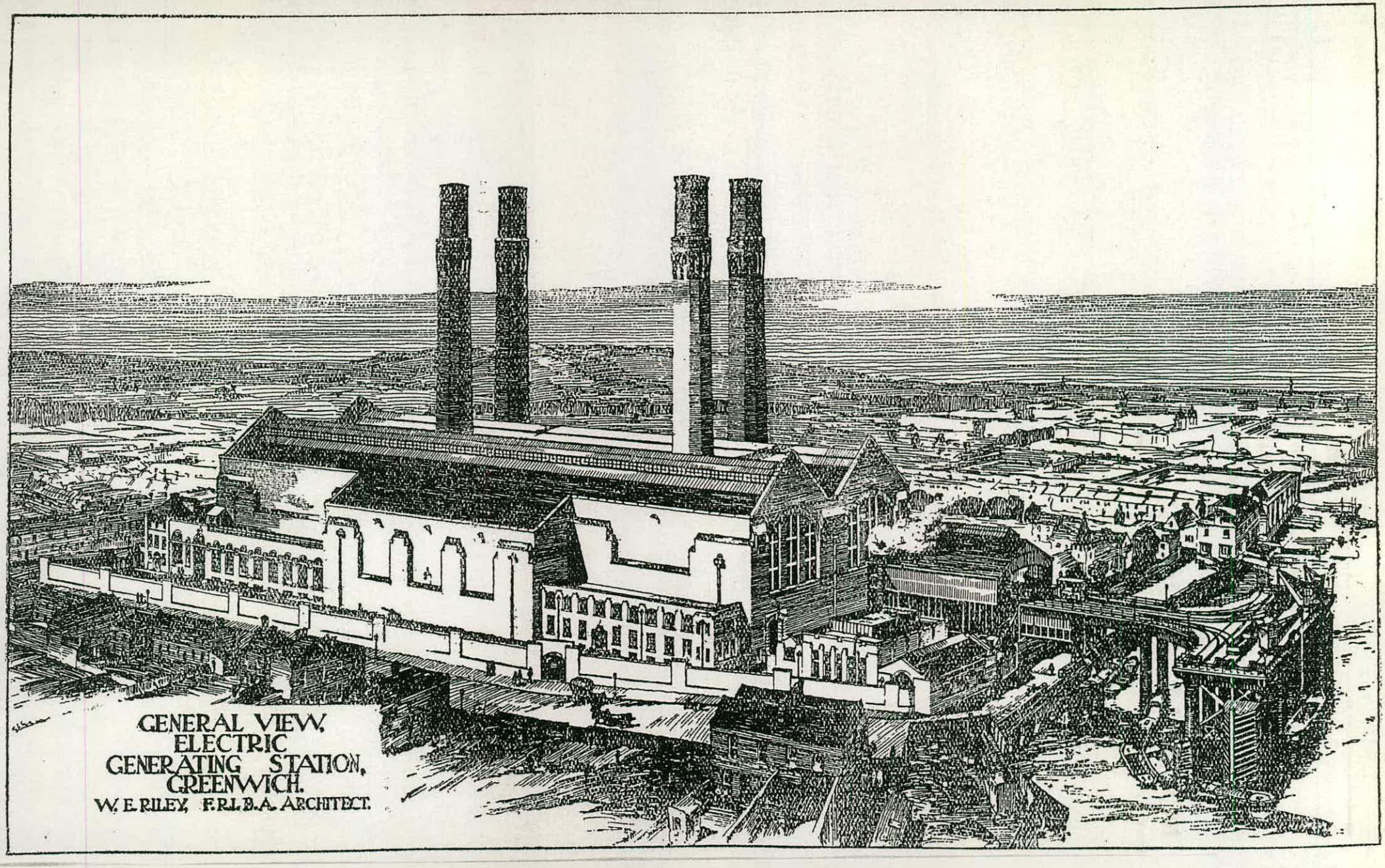
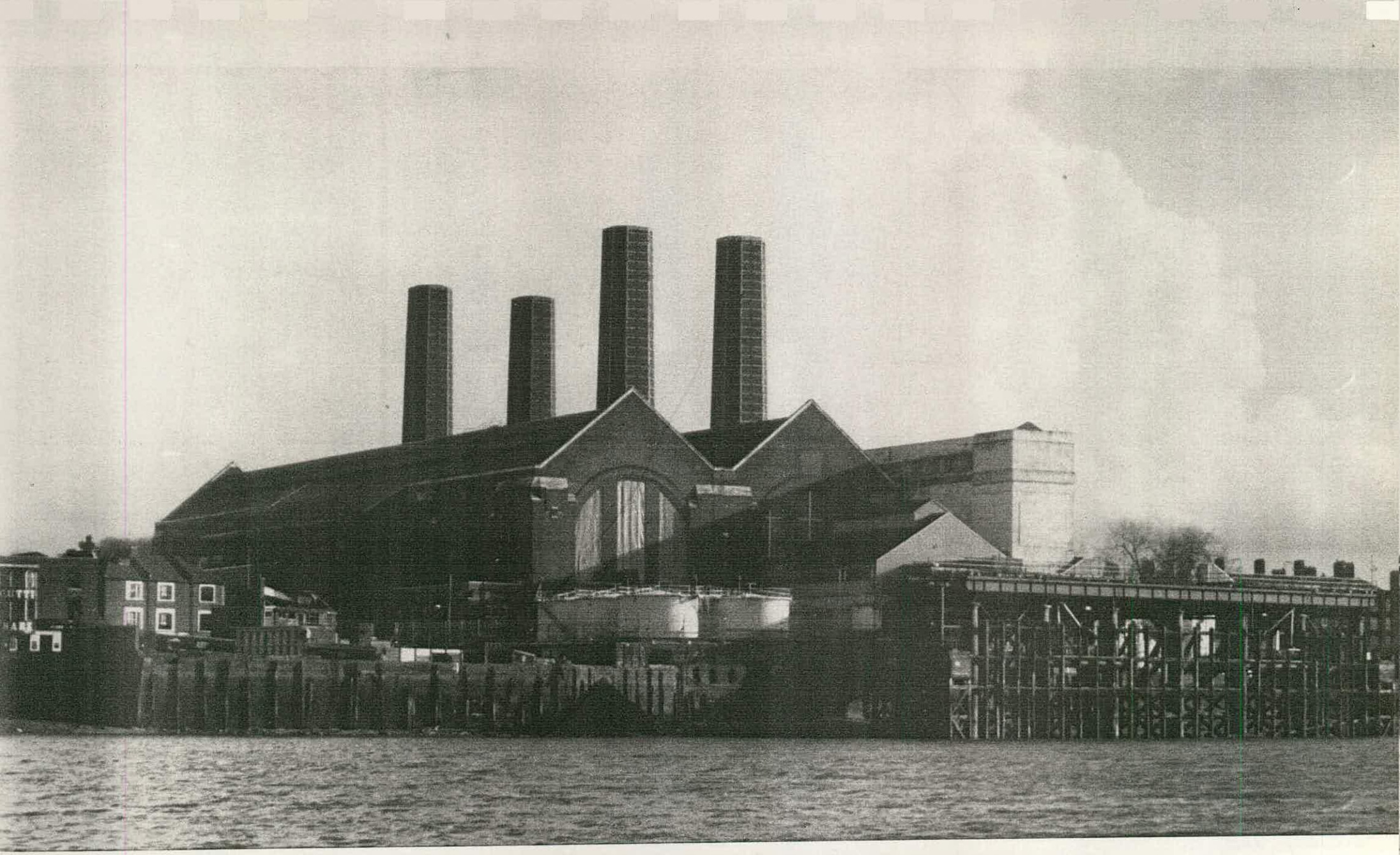
Report by Peter Guillery
May 1995
Photographs by Derek Kendall
January 1993 and March 1994



Greenwich Generating Station, perspective sketch as published in the London County Council pamphlet, *Opening of the London County Council Electricity Generating Station at Greenwich*, 1906.

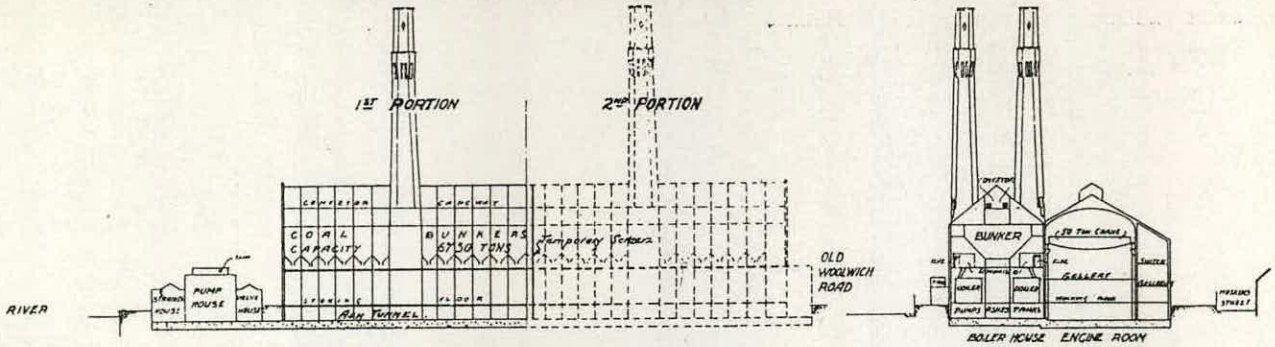
Greenwich Generating Station, aerial view from the north in 1987 (NMR 4007/63, TQ 878/9).



Greenwich Generating Station from the north in 1994 (272/D/1).

— GREENWICH GENERATING STATION —

— PLAN AND SECTIONS. —



LONGITUDINAL SECTION

FIG. 2.

CROSS SECTION

FIG. 3.

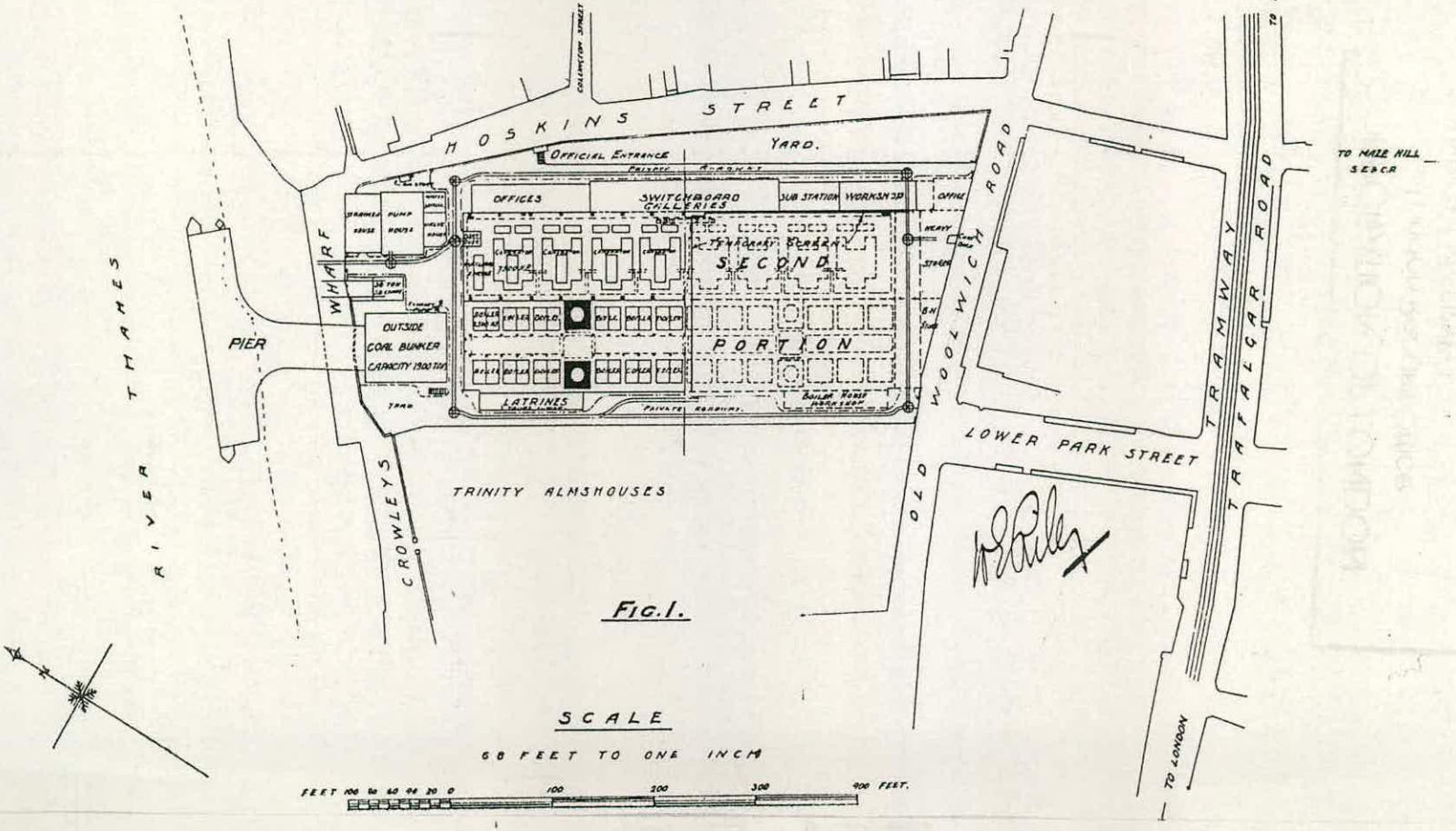


FIG. 1.

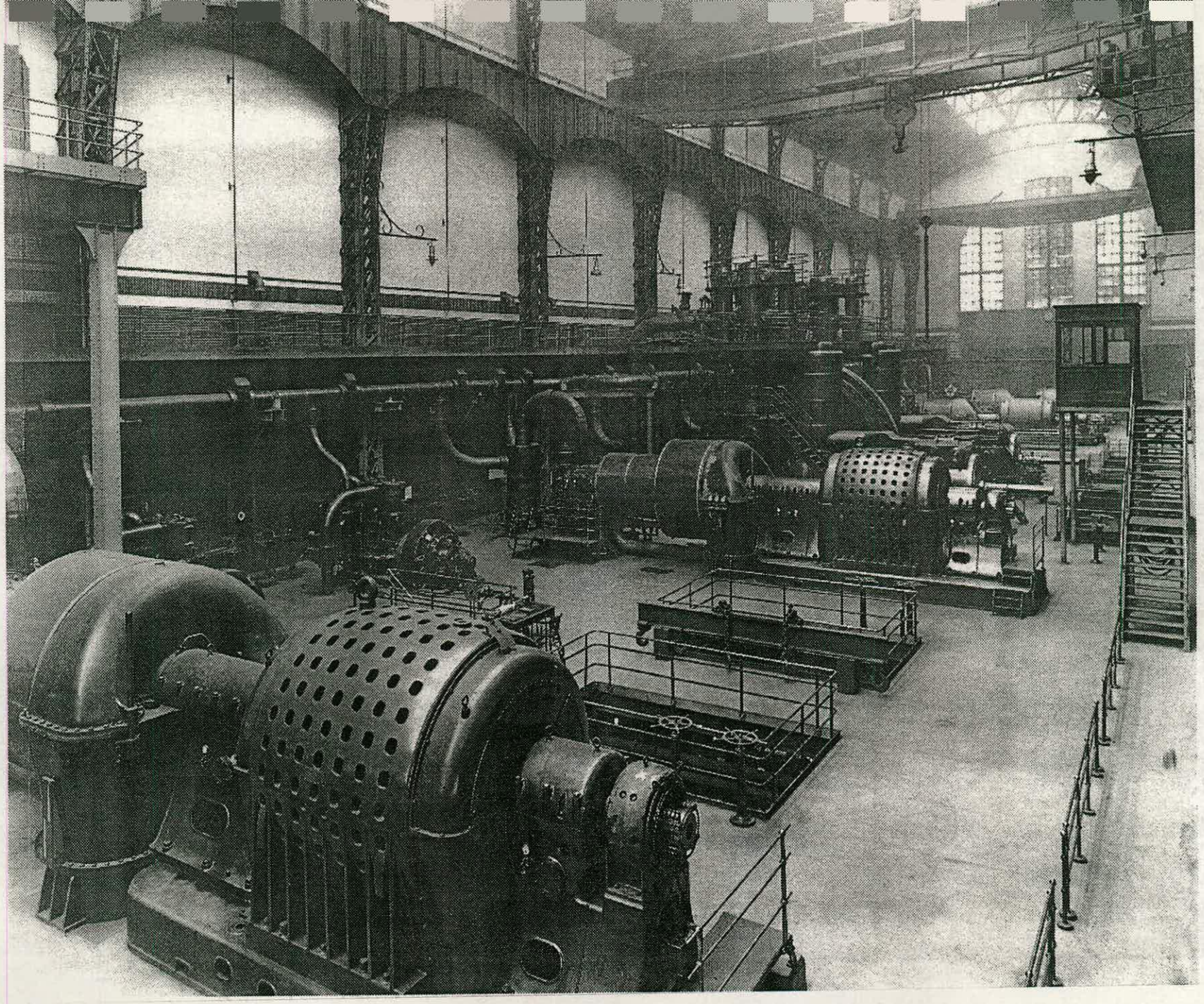
SCALE

68 FEET TO ONE INCH

FEET 100 50 60 40 30 0 100 200 300 400 FEET.

Greenwich Generating Station, plan and sections as published in the London County Council pamphlet, *Opening of the London County Council Electricity Generating Station at Greenwich*, 1906.

Greenwich Generating Station, view from the foreshore in 1993 showing the coaling jetty (BB93/5512).



Greenwich Generating Station, the engine room from the south in 1917 showing turbine generators in the foreground and steam reciprocating engines beyond (RCHME Bedford Lemere Collection, 23750).

Greenwich Generating Station, the former engine room from the south in 1994 showing steel framing (BB94/11441).

Greenwich Generating Station, view across the former engine room to the switchboard galleries (BB94/11439).

Greenwich Generating Station, view from within the former boiler house at roof level showing heads of coal bunkers (BB94/11451).

LONDON

NBR INDEX NO: 93584

TOWER HAMLETS

NGR: TQ 388 808

BLACKWALL

BRUNSWICK WHARF POWER STATION

Summary Report

Brunswick Wharf Power Station was built in 1947-56 on the site of the East India Export Dock, a convenient riverside position that the Port of London Authority made available. Conceived in 1939 by Poplar Borough Council it was designed through the Central Electricity Board during the war to supply the National Grid. John Bruce was the consulting engineer and Farmer & Dark were brought in as consulting architects. The station was completed under the British Electricity Authority following nationalization and first came into service in 1952. It was converted from coal to oil firing in 1970-1. The changing economics of power supply led to its closure in 1984 and it was largely demolished in 1988-9. The switch house to the north survives.

Sited at the head of a major bend in the river the power station occupied its prominent position with a long (740ft) and low (101ft) main building. It was steel-framed, but entirely brick clad in 'the rather dated monumental tradition of the brick-built 'cathedrals of power' established by Scott at Battersea'. Farmer & Dark, called in at a late stage to make a well developed project more presentable, utilized projecting vertical strips to break up the building's horizontality in a manner reminiscent of Croydon 'B' Power Station of 1939-50 by Robert Atkinson. In their later power station architecture Farmer & Dark broke decisively with this tradition. Two fluted reinforced-concrete chimneys rose 300ft on the south or river side of the boiler house which, unusually and owing to the use of a site that had been a dock, was lower than and subordinate to the engine room.

The principal plant was two 63 MW and four 55 MW Metropolitan-Vickers Electrical Company turbo-alternators, giving a total capacity of 346 MW, and 11 pulverised-coal boilers made by Clarke, Chapman & Company and John Brown & Company. An 855ft-long concrete wharf was built to serve the power station and coal storage was in front or to the south of the building.

Sources

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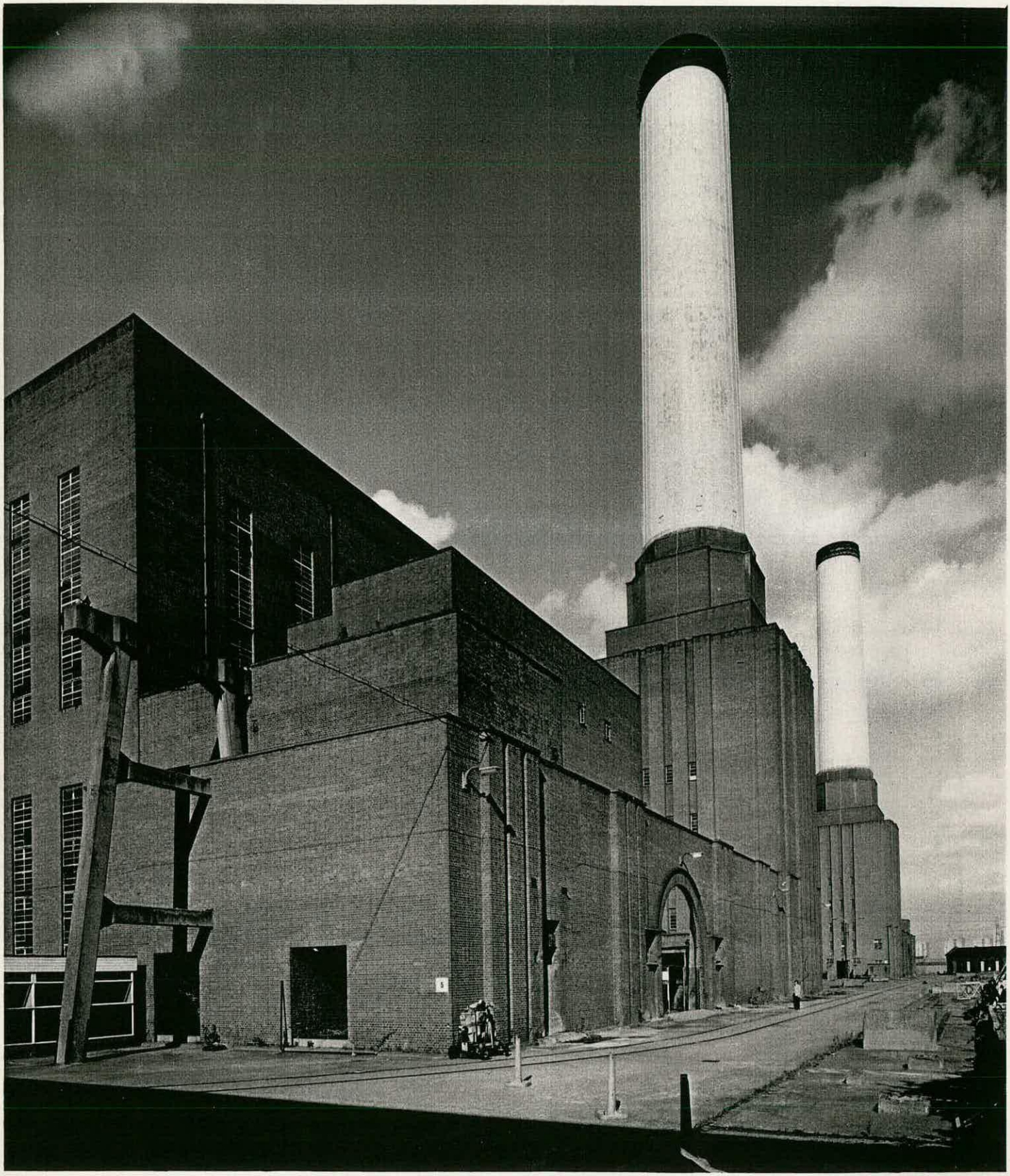
May 1995



Brunswick Wharf Power Station, the exterior from the south-west in 1987 (BB87/8472).

Brunswick Wharf Power Station, the turbine hall in 1987 (BB87/8478).

LONDON

NBR INDEX NO: 93582

GREENWICH

NGR: TQ 397 796

EAST GREENWICH

RIVER WAY

BLACKWALL POINT POWER STATION

Summary Report

The first Blackwall Point Power Station was built in 1900 and extended in 1906 for the South Metropolitan Electric Light and Power Company Ltd. The site adjoined to the south the South Metropolitan Gas Company's East Greenwich Gasworks. The power station was evidently a small facility generating at 3000 volts alternating current. It was replaced in 1947-52, the work planned and commenced by the South Metropolitan Company, but completed after nationalization under the British Electricity Authority. The site was cleared c1987.

The later station was a small and compact power station on a 3.5 acre site. Its main buildings were steel framed with brick and glass cladding. There was a tall box-like boiler house with a low engine room on its south side, a switch house to the west, and a single tall reinforced-concrete chimney. Architecturally it was an early if pedestrian manifestation of an anti-monumental functionalist approach whereby the layout of plant dictated the external form of the building. There were three pulverised-coal fired boilers and three 30 MW turbo-alternators made by English Electric.

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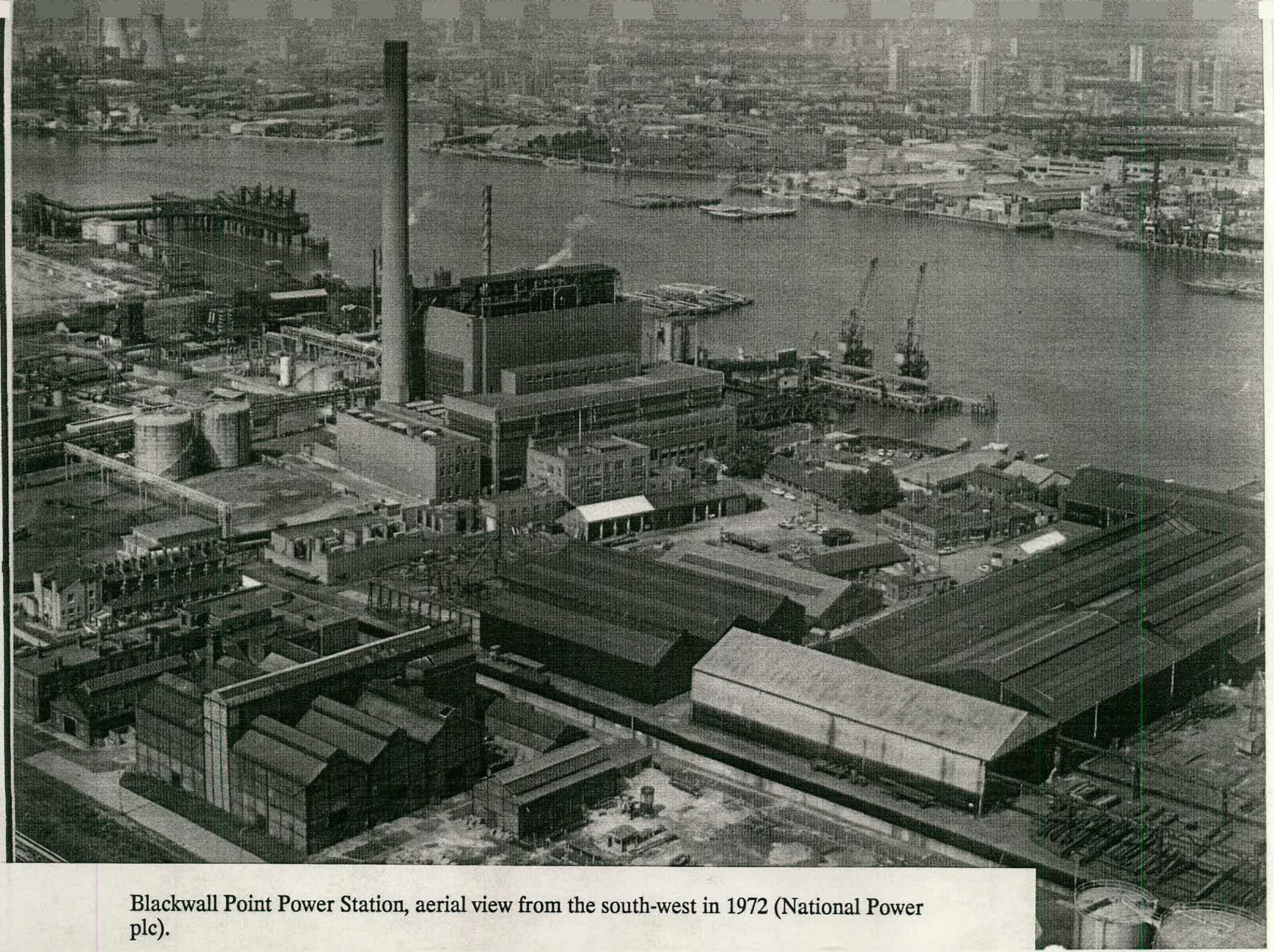

Blackwall Point Power Station, aerial view from the south-west in 1972 (National Power plc).

LONDON

NBR INDEX NO: 93583

GREENWICH

NGR: TQ 434 793

WOOLWICH

BELL WATER GATE

WOOLWICH POWER STATION

Summary Report

Following an 1891 initiative by the Woolwich Local Board of Health to bring electric light to the district a power station was formed on the riverside at Woolwich opening in 1893. Known as Globe Lane Power Station it was run by the Woolwich District Electric Lighting Company through the transfer of powers obtained by the Board of Health. From 1903 Woolwich Borough Council ran the power station. The early buildings were apparently replaced in 1924-8, then selected to supply the National Grid. Under the Central Electricity Board the power station was extended in 1940-8. Further additions went up in 1952-7 under the British Electricity Authority (Central Electricity Authority from 1955). Woolwich Power Station was demolished in 1979-80.

The first power station was a conversion of the repair shops of the Woolwich Steamboat Company. Operating on a small scale its original plant, manufactured by Richardson Gould & Easton Anderson, was probably locomotive-type boilers supplying steam to reciprocating engines powering alternators through rope drives. By 1906 alternating and direct current was being supplied by turbine plant supplied by C A Parsons Ltd. This had a 2.5 MW capacity generating at 6,000 volts. From 1912 to 1927 additional capacity was provided in eight separate phases through new turbo alternators ranging from 1.5 to 6 MW in capacity.

The later power station complex appears to have grown somewhat haphazardly from the 1920s in an eastwards and upwards direction. The earliest sections were low gabled brick and steel-frame roofed sheds with single chimneys. The main later engine room and boiler house blocks rose in steps to three tall fluted chimneys along the station's east side, for 'balance and dignity'. These steel-framed blocks had decorative vertical 'special brick' strips in walls of largely glazed panels with a white reinforced-concrete flat roof resulting in a light and loosely Art Deco appearance.

The 1924-8 station (which later became known as the low-pressure section) was equipped with four Babcock & Wilcox boilers (removed in 1963) and a 12.5 MW Fraser & Chalmers/GEC turbo-alternator generating at 6,600 volts. The 1940-8 block (the intermediate-pressure section) had six Babcock & Wilcox boilers and three 34.5 MW Fraser & Chalmers/GEC turbo-alternators generating at 22,000 volts. The 1952-7 high-pressure section had four John Thompson 'La Mont' boilers and two 30 MW Fraser & Chalmers/GEC turbo-alternators generating at 22,000 volts.

There was a coaling jetty with conveyor belts to a large coal storage ground to the east of the station.

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Report by Peter Guillery
May 1995

Woolwich Power Station from the south (National Power plc).

LONDON

NBR INDEX NO: 92243

BARKING AND DAGENHAM

NGR: TQ 465 818

BARKING

RIVER ROAD

BARKING POWER STATION

Summary

Barking Power Station was three distinct stations grouped together as a massive electricity generating complex. The first two (A and B Stations) were built for the County of London Electric Supply Company in 1925-8 and 1931-9. C Station was built in 1952-4 for the British Electricity Authority following nationalization. From the early 1930s into the 1950s Barking was claimed to be the largest steam-generating power station in Europe. B Station was notable as an early instance of steel and glass modernist architectural design. Virtually all of the power station buildings were demolished in the late 1970s and 1980s, leaving only the Offices and Control Room that adjoined A Station, B Station Switch House, with a remarkably unaltered back-up Control Room of 1938-9, and C Station Switch House. These buildings survive with an additional 1960s Switch House to the north east as Barking Switching Station.

Report

Historical Development

Electricity generation was established at Barking Creekmouth by the County of London Electric Supply Company in 1925. An open and remote riverside site of about 80 acres was chosen as it allowed good communications, cheap delivery of coal and disposal of ashes, room for expansion, and, perhaps most importantly, plentiful water for condensing steam. What was to become a vast group of three power stations developed rapidly, particularly in the period up to 1939, reflecting massive growth in demand, especially for domestic electricity.

The first station, later known as A Station, had its first section (the east half) opened in 1925 by King George V, a measure of the site's anticipated status. Its capacity was 100 MW, generating at 6,600 volts. The west half of A Station followed quickly, opening in 1928 and bringing capacity up to 240 MW.

Immediately to the east B Station's first section (its west half) was built in 1931-3, for about £2m, taking capacity to 390 MW. The east half of B Station opened in 1939 giving a new total output of 540 MW, with B Station generating at 12,500 volts. It was claimed that through the 1930s and into the 1950s Barking was the largest steam-generating power station in Europe. To put its size into perspective Battersea Power Station had a capacity of 345 MW in 1948 (Pugh 1957).

C Station was planned from 1948 upon the nationalization of electricity supply by the British Electricity Authority. It was built in 1952-4 to the east of B Station. In 1955 it was

converted to burn oil, making it notable as an early oil-fired power station (Pugh 1957). It provided additional capacity of 225 MW, to give the site a total output of 765 MW.

A proposed D Station was never built, but a large Switch House was added to the north on the west side of Renwick Road c.1965. The Power Station closed in 1981 and all the earlier structures were demolished in the late 1970s and 1980s, excepting the Offices and Control Room that adjoined A Station, and the Switch Houses to B and C Stations. A back-up Control Room survives at B Switch House. The site continues under National Power as Barking Switching Station.

Site Layout

A and B Stations were built alongside each other and were roughly comparable in their overall scale. Each was basically a U on plan with twin parallel boiler houses to the south with their short ends to the river. To the north the engine rooms or turbine halls ran east-west linking their respective boiler houses. C Station, further east, broke with this layout, and had its single boiler house and engine room aligned in an integrated east-west block. To the north of the sites of the engine rooms near River Road are the surviving buildings: the Offices and Control Room from A Station, the Switch House (with the back-up control room) from B Station, and the Switch House from C Station. A further survival is the jetty that was built as wharf walling along the river frontage of the whole site. This reinforced-concrete jetty grew eastwards in phases. In 1925 it was about 460ft long, extended in 1931-3 to about 1000ft, with another 400ft section added in 1952-4. Between the jetty and the power stations were vast coal storage grounds, served by belt conveyors that shifted the coal into the boiler houses at a rate of 1400 tons an hour in 1933.

Building Description

A Station had steel-framed buildings with red-brick external walls, stone dressed for limited classical detailing. In appearance they were of a type widespread in 1920s industrial design that can be characterised as engineer's neo-Georgian. That is they were architecturally unambitious, functionally disposed with mitigating embellishment, and no hint of the aesthetics of the later brick cathedral approach to power station design. The engine house was a long (22-bay) pediment-gabled shed. The two boiler houses, very similar save in the positioning of the overhead conveyors and the disposition of chimneys, were more starkly functional 10 by 5 bay blocks. No. 1 Boiler House housed 14 boilers, eight made by Babcock & Wilcox, six by Yarrow, all served by four short brick chimneys. No. 2 Boiler House, to the west, had ten International Combustion pulverized-coal boilers, the only such boilers in London prior to 1948 (Pugh 1957). There were five somewhat taller chimneys, apparently of exposed steel. The engine room had exposed lattice-steel framing and two girder gantries for overhead cranes. Laid crosswise in the hall were four 40 MW and four 20 MW turbo-alternators, all of Parsons two- or three-cylinder double-reaction type.

The Offices and Control Room block that formed part of A Station survives, with the Control Room continuing in use for its original purpose. It is a red-brick building with stone dressings, flat reinforced-concrete roofs, and metal-frame windows. It is straightforwardly classical in appearance, though less purfunctorily treated than the rest of the A Station complex. It has three storeys, with its north entrance front appearing as 4:5 bays. The five bays to the west are of 1925, but the building appears to have been enlarged to the east and south, probably in 1931-3 for the addition of B Station. The original façade is symmetrical with steps up to a central entrance with a rusticated aedicular door surround. Within there is a lobby with a reception booth, polychrome blue dado tiling, a panelled ceiling and a large open-well staircase with latticed iron balusters and a moulded, ramped and wreathed

mahogany handrail. The control room is on the first floor to the rear. An originally smaller room of 1925 appears to have been enlarged to the east. It is a substantial space rising through the two upper storeys with twin skylights. The room is divided by four piers with moulded caps, reflected by pilasters around the walls. There are panelled doors and yellow and blue dado tiling. Doors to the west are part-glazed as they formerly led into the Switch House. The Control Room was refitted in the 1950s and later, but the position of the original pedestal controls to the west remains evident in the floor. The four-bay east section of the north front has a blocked entrance that was a way through for internal rail traffic. To the west there are fragmentary remnants of the A Station Switch House which adjoined the Control Room. It was 22 bays long, built in two phases like the rest of A Station.

Despite only a three year gap in the building programme B Station, of 1931-9, was designed in an utterly different idiom to that of A Station, though imitating the general layout. With Merz and McLellan as consulting engineers it was given a functional and consciously modernist appearance, glass and steel boxes closely comparable to the better-known Dunston 'B' Power Station at Gateshead, of 1933-4, also by Merz and McLellan. These buildings represented a leap in architectural conception from earlier power stations. Their modernism, early in British terms, did not, however, establish itself as a general power station style. Until the 1960s it was the brick-cathedral style represented by Battersea and Bankside that was dominant. B Station seemed 'at first sight, a house of glass' (CLES 1933). Its main blocks, the two boiler houses and the engine room, were notably integrated. They had steel frames, with steelwork by Babcock & Wilcox Ltd, entirely hung with patent glazing above brick plinths. There were continuous rooflines to flat roofs on lattice-girder beams. The engine room had twin internal gantries and its frame was articulated externally as five bays. Conveyor housings over the boiler houses and six brick chimneys, each 250ft tall, broke up the architectural unity. The taller chimneys may reflect a 1930 recommendation by the Electricity Commissioners that power station chimneys needed to be at least 2.5 times the height of their main building to avoid down-draught pollution.

Nos 3 and 4 Boiler Houses each had eight boilers, all made by Babcock & Wilcox Ltd. B Station's engine room had four powerful turbo-alternators, made by British Thomson-Houston Co Ltd, installed in pairs and laid lengthwise along the hall. In 1933 the first pair were, at 75 MW each, the largest turbo-alternators in service in Britain. At this time Barking also boasted 'the largest transformers in the world' to the north of the B Station engine room, and the tallest (at 487ft) transmission towers or electricity pylons in the country, crossing the Thames nearby.

The surviving B Station Switch House, built in two phases in the 1930s, was a reversion to the simple brick classicism of A Station. It is a plain structure with red-brick walls, minimally dressed in concrete, moulded for cornices. It was built by Holloway Bros Ltd and accommodated switchgear supplied by A Reyrolle & Co Ltd, of Hebburn. It is an H on plan, 16 bays long with 2-bay returns to each arm. Internally the building has been largely refitted and, in parts, gutted.

A remarkable survival at Barking is the back-up Control Room attached to the B Station Switch House. It was probably built in 1938-9 with the completion of B Station, as a precaution against enemy attack. It was inserted as infill at the west end of the west yard of the Switch House. It has been scarcely altered and it may be that it was scarcely used. It is a striking example of 1930s industrial design. Externally it is unprepossessing, with a Fletton-brick wall to the inner yard, metal-frame windows and a flat reinforced-concrete roof. The control room itself, about 20ft square, is on an upper level and is approached by stairs from the inner yard. It contains a 16-panel distribution board to the north, 6 pedestal controls to the centre, and 12 console control boards to the south. There are also 7 units of

relays along the south wall, and 10 units of relays along the north wall, with more relays behind the distribution board. These fittings were largely supplied by A Reyrolle & Co Ltd. There are a few alterations, some later meters and neon-tube lighting, but the room is essentially as fitted out in 1939.

C Station of 1952-4 was designed under V A Pask, Chief Engineer to the British Electricity Authority. Sir Alexander Gibb and Partners were the consulting engineers and Sir Robert McAlpine and Sons were the main building contractors. Architecturally it echoed B Station in its functionalism, though advances in boiler technology permitted a much more intimate relationship between the boiler house and engine room. The scale of the plant housed was reflected in the much greater height of the boiler house. The main blocks were steel framed, with concrete, brick and glass cladding. The boiler house had five Babcock & Wilcox boilers, converted from pulverized-coal to oil firing. These five boilers were capable of doing about the same amount of work in the 1950s as the 24 boilers of the 1920s could in A Station. The engine room had three 75 MW turbo-generators made by British Thomson-Houston. There were two tall concrete chimneys and two fuel-oil tanks to the south near the river.

C Station Switch House, which survives, is a very plain building with stark concrete elevations. It has an H layout, on a somewhat larger scale than at B Station Switch House. The 1960s Switch House to the north east is a rectangular steel and glass box. These buildings were not internally inspected.

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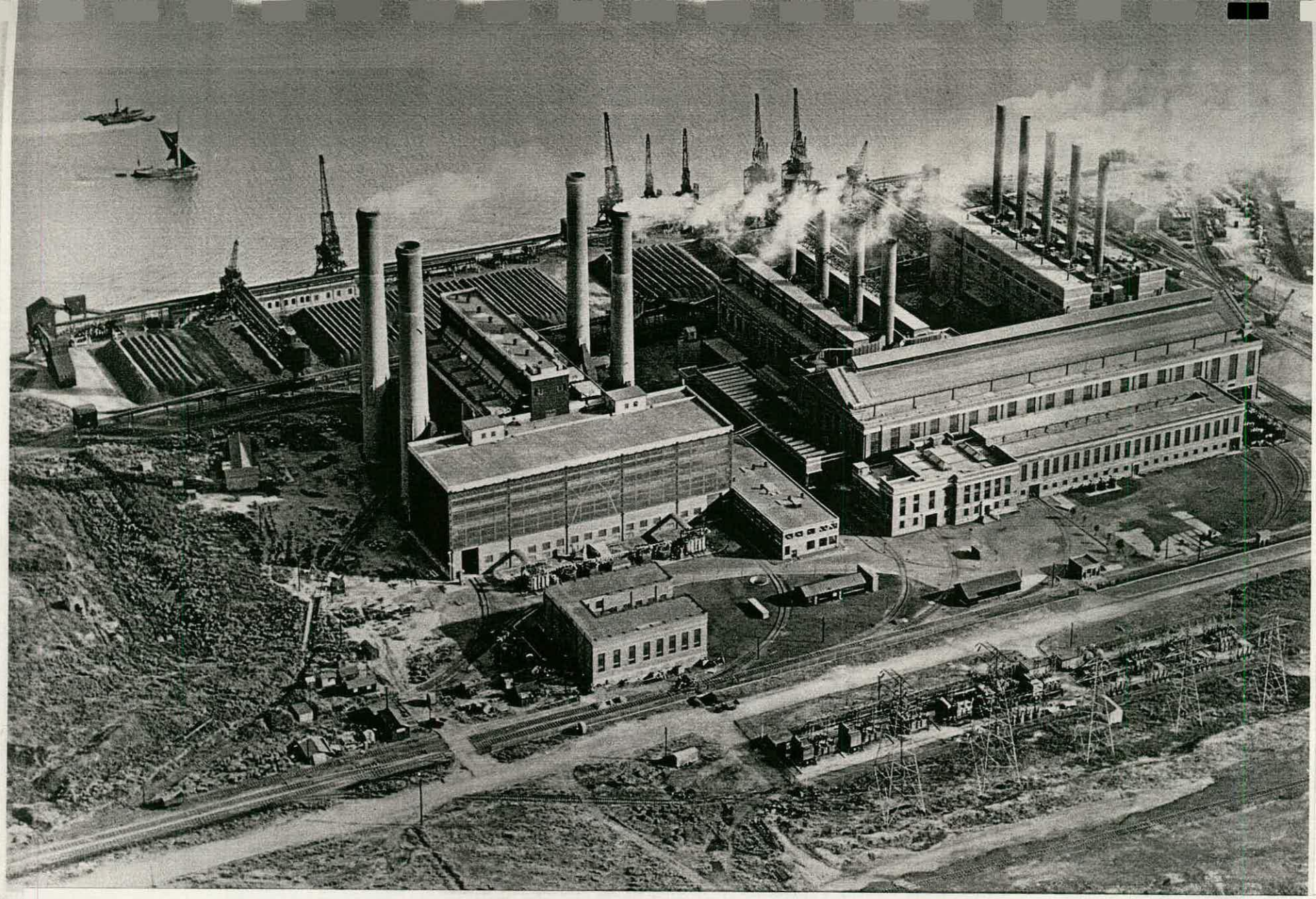
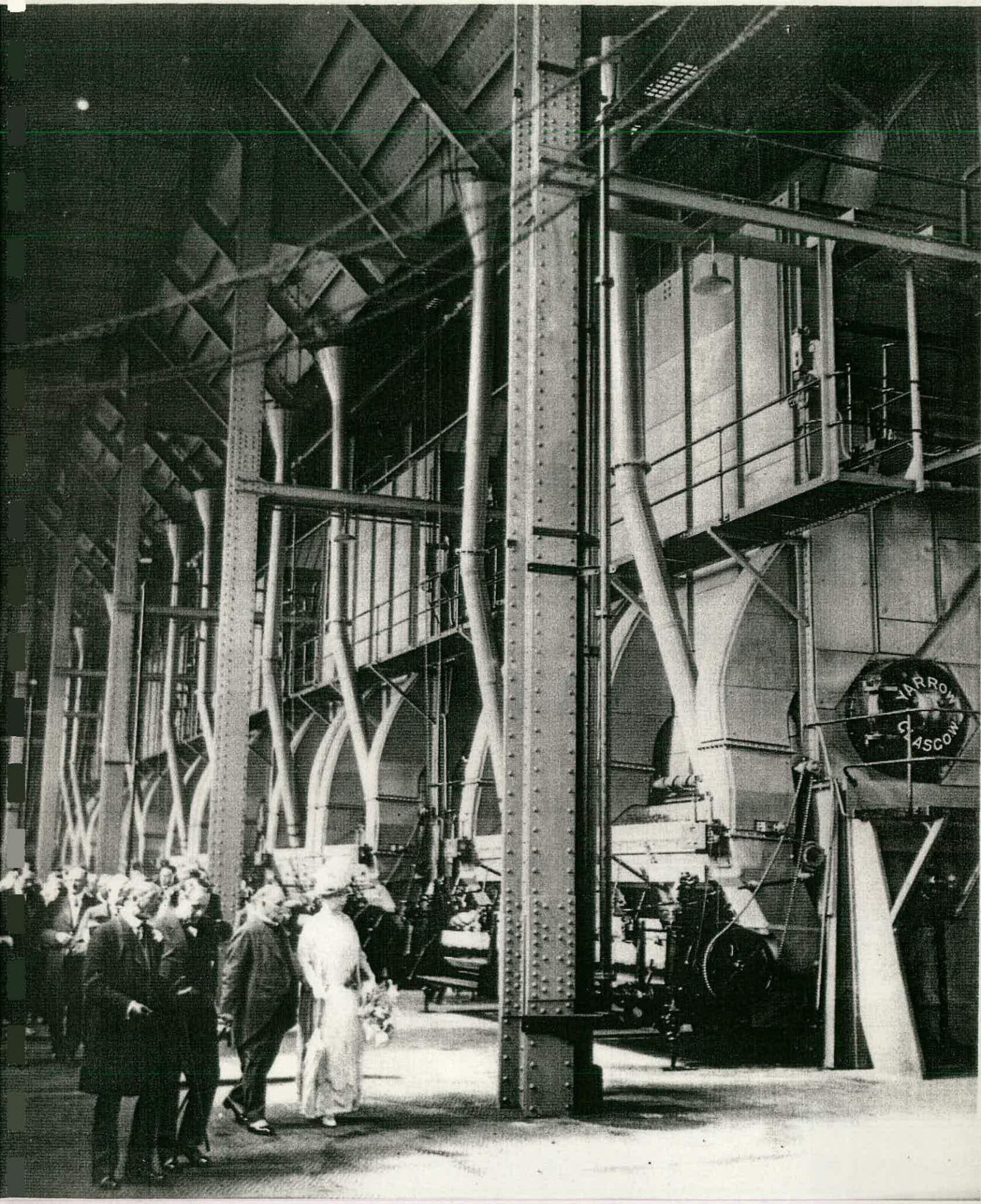
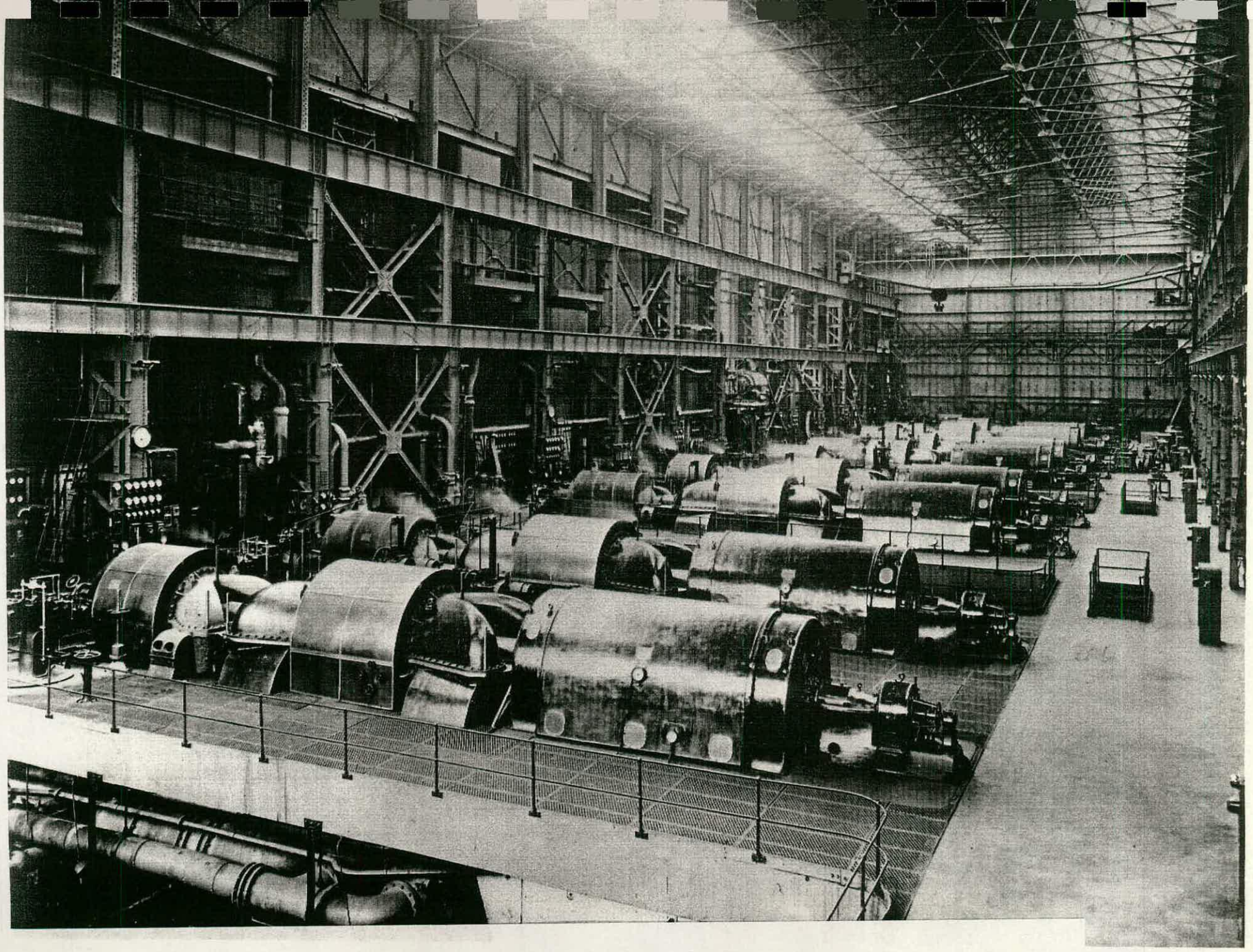
Report by Peter Guillery
May 1995
Photographs by Derek Kendall
June 1992



Barking Power Station, aerial view from the north c1935 showing "A" Station to the right and "B" Station (incomplete) to the left (BB89/10279).



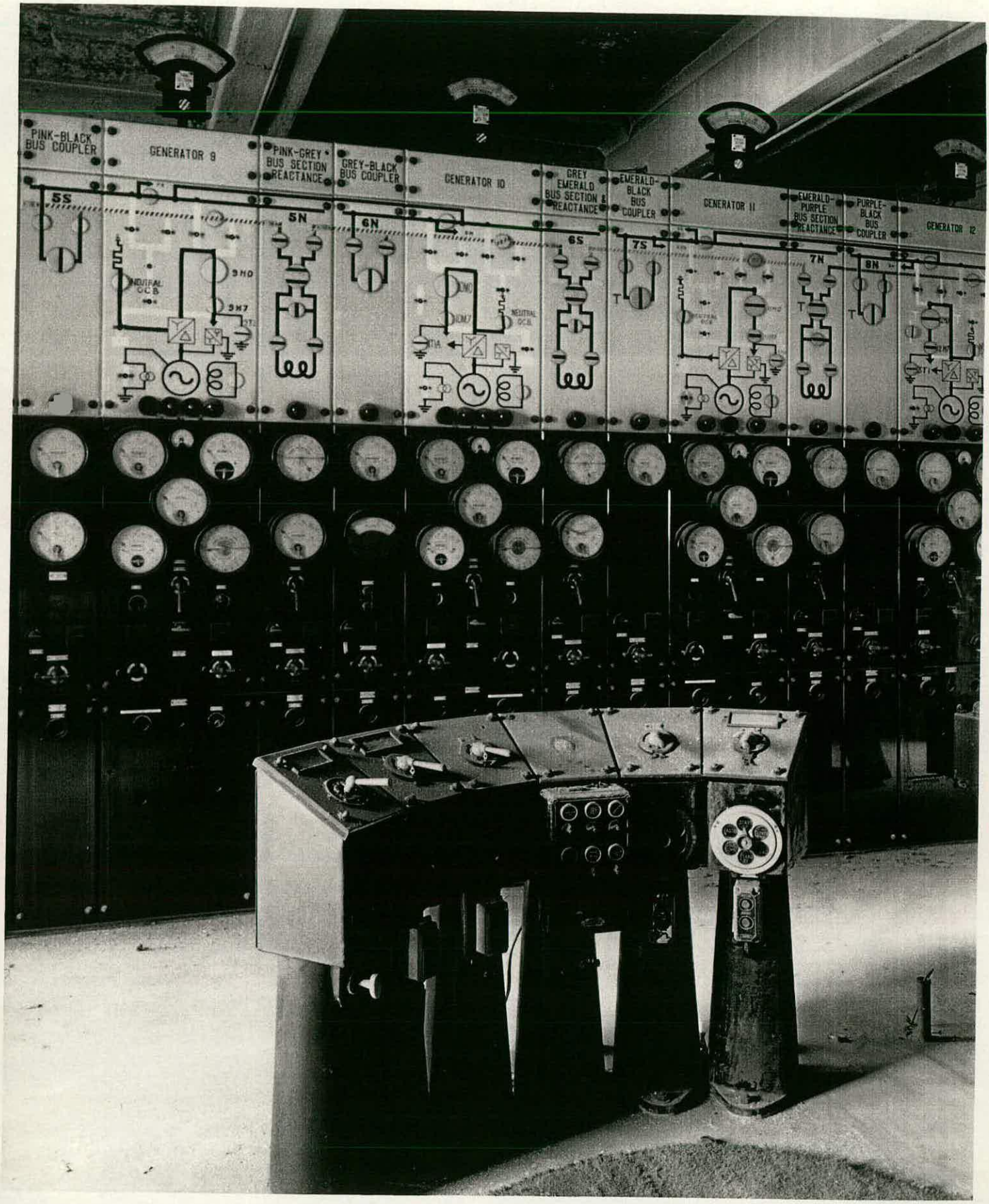
Barking Power Station, the boiler house at the official opening of "A" Station by King George V in 1925 (National Power plc).



Barking Power Station, "A" Station turbine hall in 1928 (National Power plc).

Barking Power Station, "A" Station control room c1928 (National Power plc).

Barking Power Station, "B" Station turbine hall in 1949 (National Power plc).



Barking Power Station, pedestal controls and distribution board in back-up control room attached to "B" Station switch house, photographed in 1992 (BB92/20518).

LONDON NBR INDEX NO: 93576

BEXLEY NGR: TQ 498 806

ERITH MARSHES

BELVEDERE POWER STATION

Summary Report

Belvedere Power Station was built in 1954-60 for the British Electricity Authority, later the Central Electricity Generating Board. It was demolished in 1993-4. Its architectural design was by Farmer & Dark (A C Murray, job architect). Plant, electrical and civil engineering was initially by the Construction Department of the London Division of the BEA, then, in the later stages, by the Southern Project Group of the CEGB. Mowlems were the building contractors.

The Thames-side site, suited to the delivery of raw materials and the supply of cooling water, was selected for development as a power station in 1950, it having been acquired by the West Kent Electric Company as early as 1919. The station was originally intended to be coal fired but it was adapted to take heavy fuel oil following changes in national energy policy. The first half was completed with four low-pressure units of 60 MW each (generating at 11,800 volts). Advances in the manufacturing of generators allowed the second half to be equipped with two high-pressure units of 120 MW each (generating at 13,800 volts). All these units comprised boilers supplied by John Brown Land Boilers Ltd and turbo-alternators supplied by the English Electric Co Ltd.

The steel-framed main building constituted the turbine hall to the west and the substantially taller boiler house to the east. The control room was incorporated in the centre of this block. There was aluminium-sheet corrugated wall cladding in three colours, silver and two types of black. The turbine hall was black-clad and skylit. Both main sections had strips of patent glazing and there was a yellow-brick plinth. Overall it was a functional and severely rectangular design. The shapes of the boiler house and turbine hall were direct reflections of the space occupied by their plant. This approach was hailed in 1960 as an exemplar of the move away from 'brick cathedral' power station architecture: 'there is now a strong sense that the visible architecture, far from being a monumental composition in its own right, is simply a suitable skin drawn over these mechanical parts, and also acknowledges the differences in function between them, so that the boiler installation and the turbine houses can be distinguished even by an outside viewer' (AR 1960). Beyond this the visual effect of the power station on the flat tidal surroundings was admired.

Other parts of the power station complex were scattered around a large site. Three 14,000 ton fuel-oil storage tanks were sited southeast of the boiler house, well away from the river. The oil was shipped up the river from Shell Haven and piped to the tanks from a 630ft-long reinforced-concrete river jetty. Cooling water for the turbo-alternators was taken from the Thames by seven pumps at a rate of 21 million gallons per hour. The water was discharged downstream.

Twin 420ft-tall precast concrete chimneys stood to the east of the boiler house with an elegant tapering profile. Switch equipment was housed in a substation 600 yards from the

main building to the southwest. Other ancillary buildings to the west of the turbine hall included an administration block, a canteen for 300, and a brick welfare block with a tubular-steel roof.

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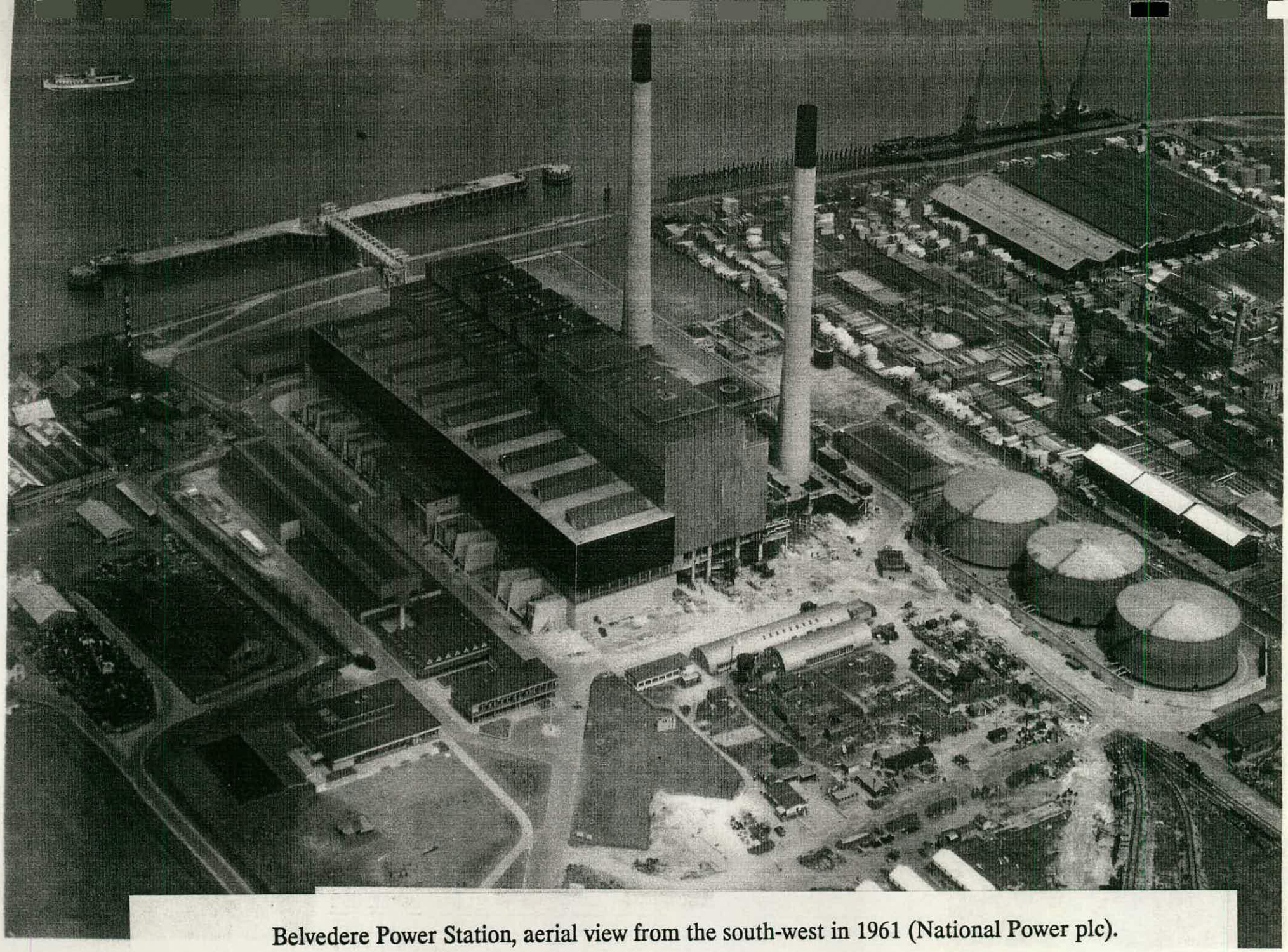
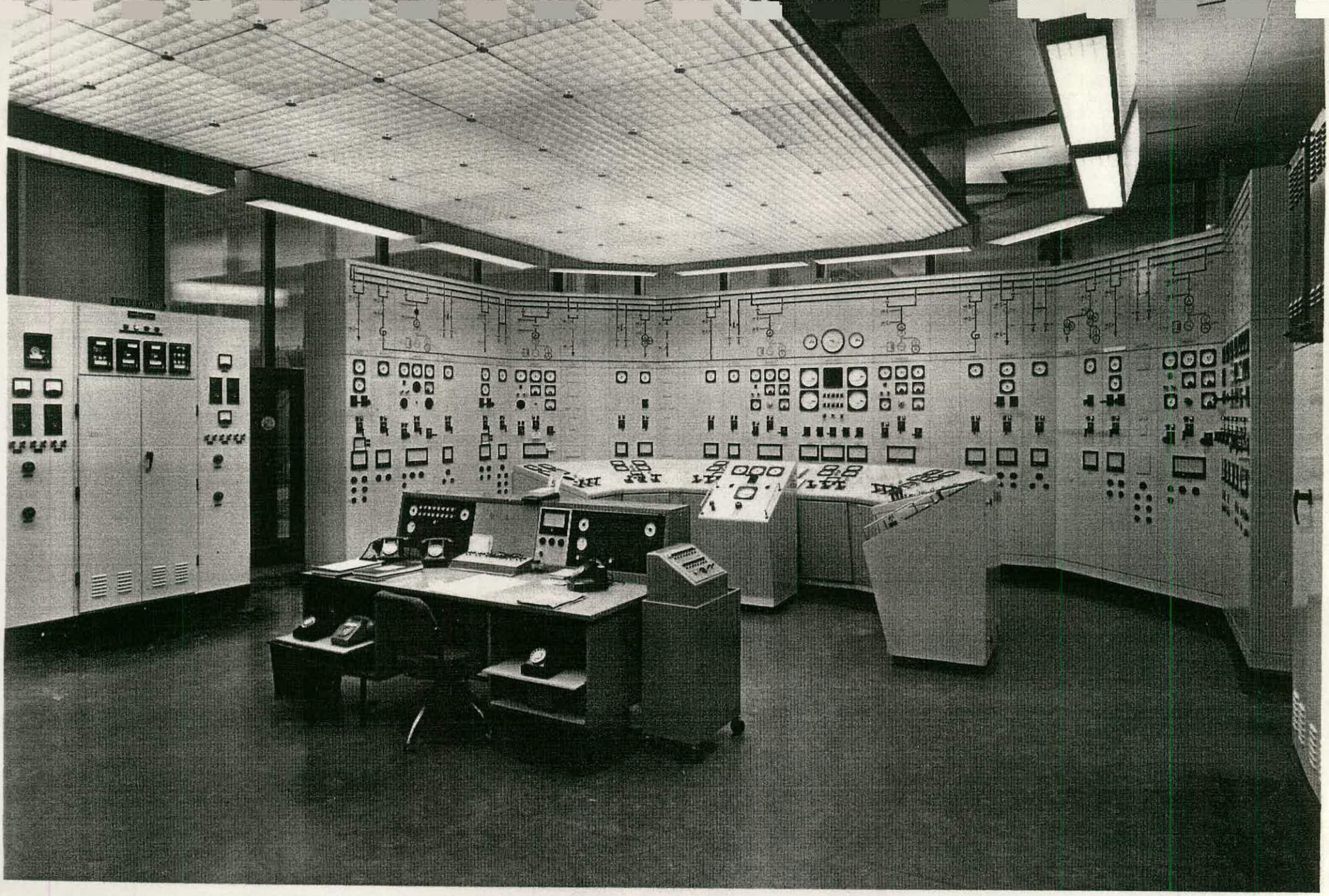
Report by Peter Guillery
May 1995

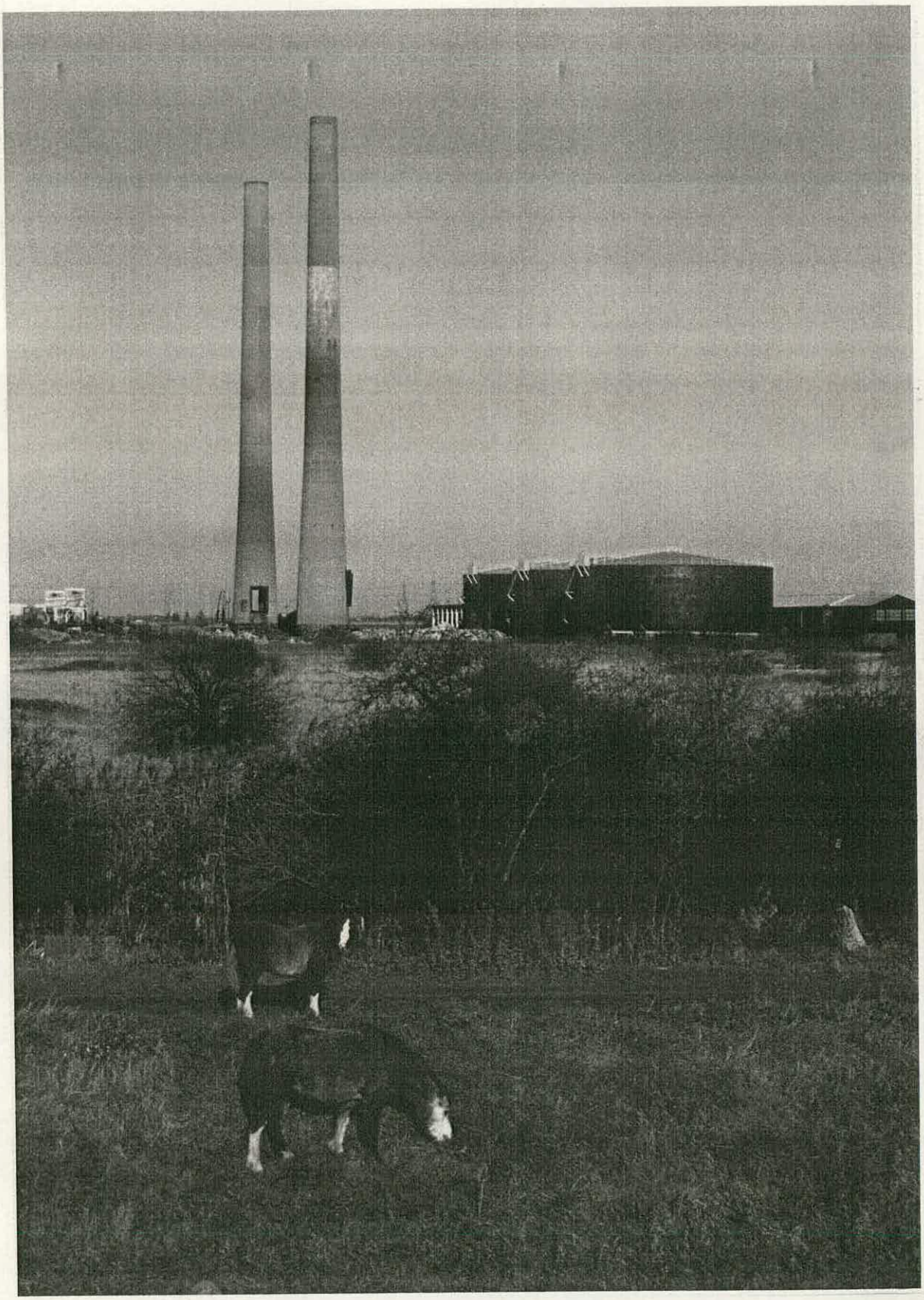


Belvedere Power Station, aerial view from the south-west in 1961 (National Power plc).

Belvedere Power Station, turbine hall in 1962 (National Power plc).



Belvedere Power Station, control room in 1961 (National Power plc).



Belvedere Power Station, chimneys and oil tanks in 1994 following demolition of main buildings (272/D/2).

KENT

NBR INDEX NO: 91004

DARTFORD

NGR: TQ 560 764

LITTLEBROOK POWER STATION

Summary Report

Littlebrook Power Station is located on the south bank of the Thames immediately west of the Dartford Tunnel and the Queen Elizabeth II Bridge. The 72 hectare site comprises four power stations which illustrate the development of power station design between the late 1930s and the early 1980s. The first three, Littlebrook "A", "B" and "C", were built end-to-end on a north-south axis on the eastern half of the site. They are no longer used for electricity generation and have been partially demolished. The fourth, Littlebrook "D", is a much larger modern oil-fired station on the western half of the site. This is one of the largest power station sites in the Thames Estuary area and retains the widest chronological range of surviving buildings.

"A" station was built by the south bank of the Thames for the Central Electricity Board from c.1935 and was operational by 1938. Photographs show steel-framed principal buildings with concrete external walls and flat roofs. It comprised a T-shaped layout with a north-south turbine hall and an east-west boiler house projecting from its west side. The coal-fired boilers were gravity-fed from overhead bunkers. A concrete chimney was sited to the north-west. The upper part of the turbine hall was lit by large horizontal-rectangular windows, in "functional" style, which occupied most of the east elevation. Smaller ancillary buildings, possibly including the control room, were attached to the north end of the turbine hall. The boiler house and chimney have been demolished. The upper part of the turbine hall may survive behind later cladding but the lower part is intact along with the adjoining ancillary buildings to the north. The chimney has been demolished.

"B" station had been built by 1950 immediately to the south of "A" station. It was of similar materials and construction but with the turbine hall and the taller boiler house in a more conventional side-by-side layout. Both structures were built with similar large windows to those of "A" station, in contrast with the general absence of fenestration in later power stations. Two concrete chimneys were built to the north-west and south-west of "B" station. The turbine hall appears to have been open to the boilers along its west side and contained turbo-generators arranged longitudinally (north-south). The chimneys have been demolished, but the turbine hall and boiler house buildings survive mostly intact. The station included a coaling jetty and an open coal store to the west of the boiler house.

"C" station, built to the south of "B", is shown under construction in an aerial photograph of 1950 and nearing completion in another of 1954. It was of similar layout and architectural style to "B", but roughly double its size. Two further concrete chimneys were added to the site, to the west and south-west of the boiler house, and were of similar height and construction to the three earlier chimneys. The turbine hall contained Parsons turbo-generators in a longitudinal layout and was of broadly similar steel-framed construction to "A" and "B", with box-section columns and principal roof beams. The boiler house has now been lowered to the height of the turbine hall and the two chimneys demolished.

Construction of the much larger oil-fired "D" station started on the west half of the site in 1974 and the last turbo-generator was commissioned in 1983. It produces electricity at 400,000

volts for the Supergrid system. The huge boiler house - turbine house block is of similar plan to the earlier stations, with the taller boiler house adjacent to the river and the turbine house projecting from its south side. The control room block is located close to the east end. The external design of the main buildings is simpler than that of the earlier stations, the walls having a smooth cladding with little or no fenestration. The station contains three turbo-generators rated at 685 MW, each with dedicated boiler plant. A single concrete chimney, containing a separate flue for each of the three boilers, is located to the north of the boiler house. To the east of the boiler house is a detached smaller gas-turbine power station, containing three 35 MW units, to serve as an emergency backup to the main station. To the west of the boiler house is the water treatment plant; this includes the main pumphouse located below ground level within a large circular concrete coffer dam, similar to that built at Grain Power Station. A separate hydrogen generation plant is located to the south, hydrogen being used to cool the turbo-generators. The uncovered 400Kv substation is located to the south of the turbine house. Five large fuel oil storage tanks are located at the eastern end of the site, along with the fuel oil pumphouse and main jetty. The earlier coaling jetty to the west was later extended to serve as an auxiliary jetty.

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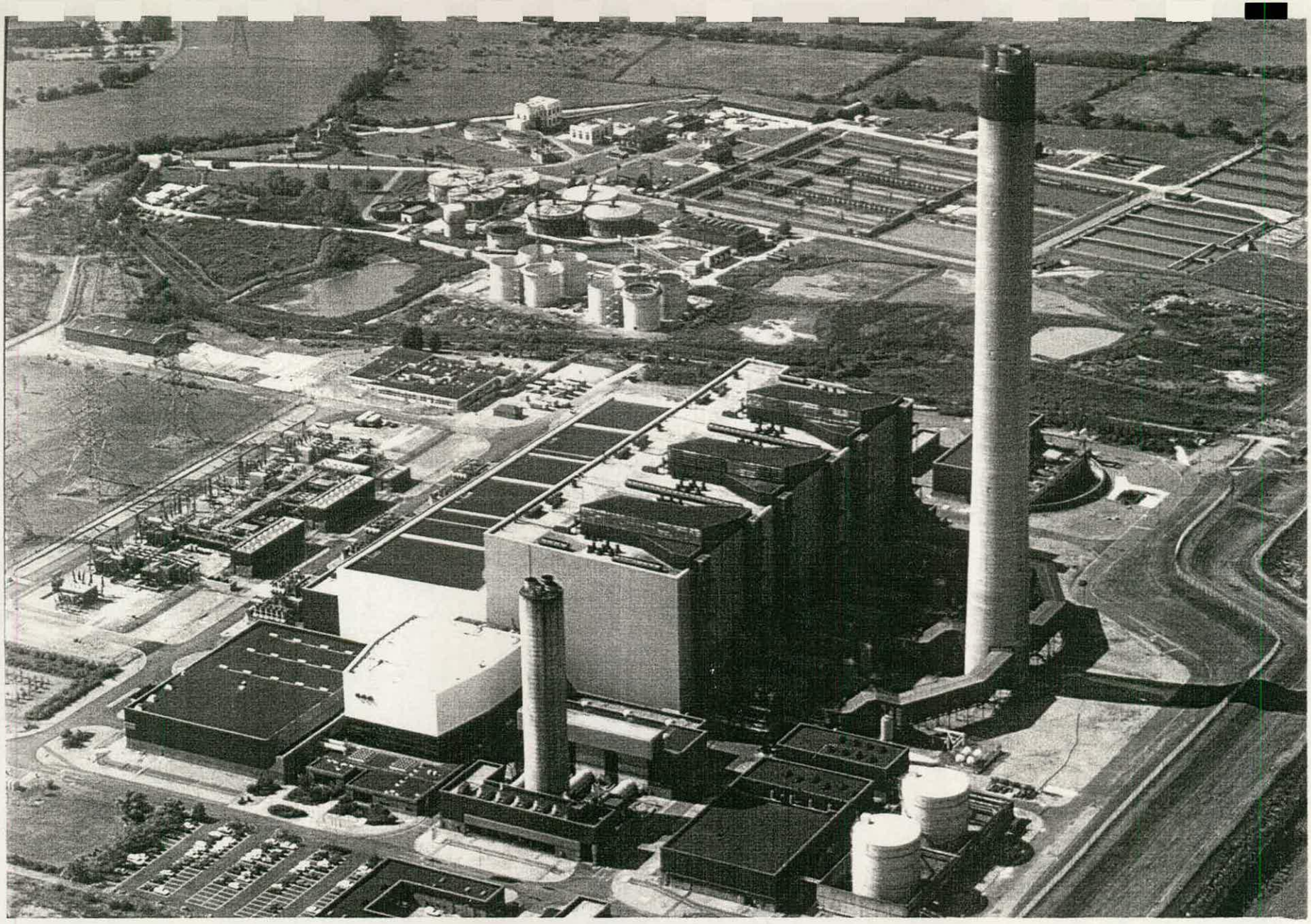
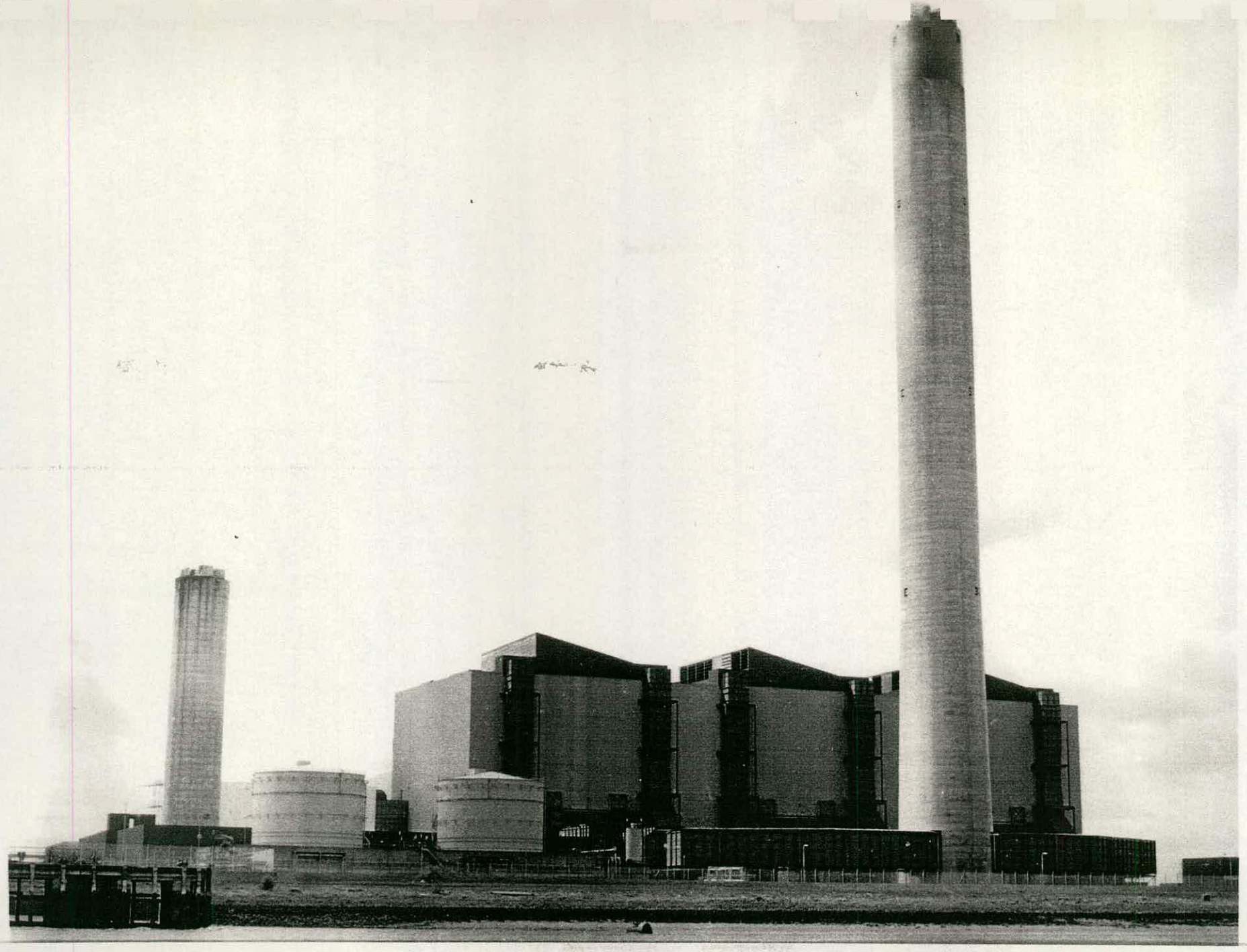
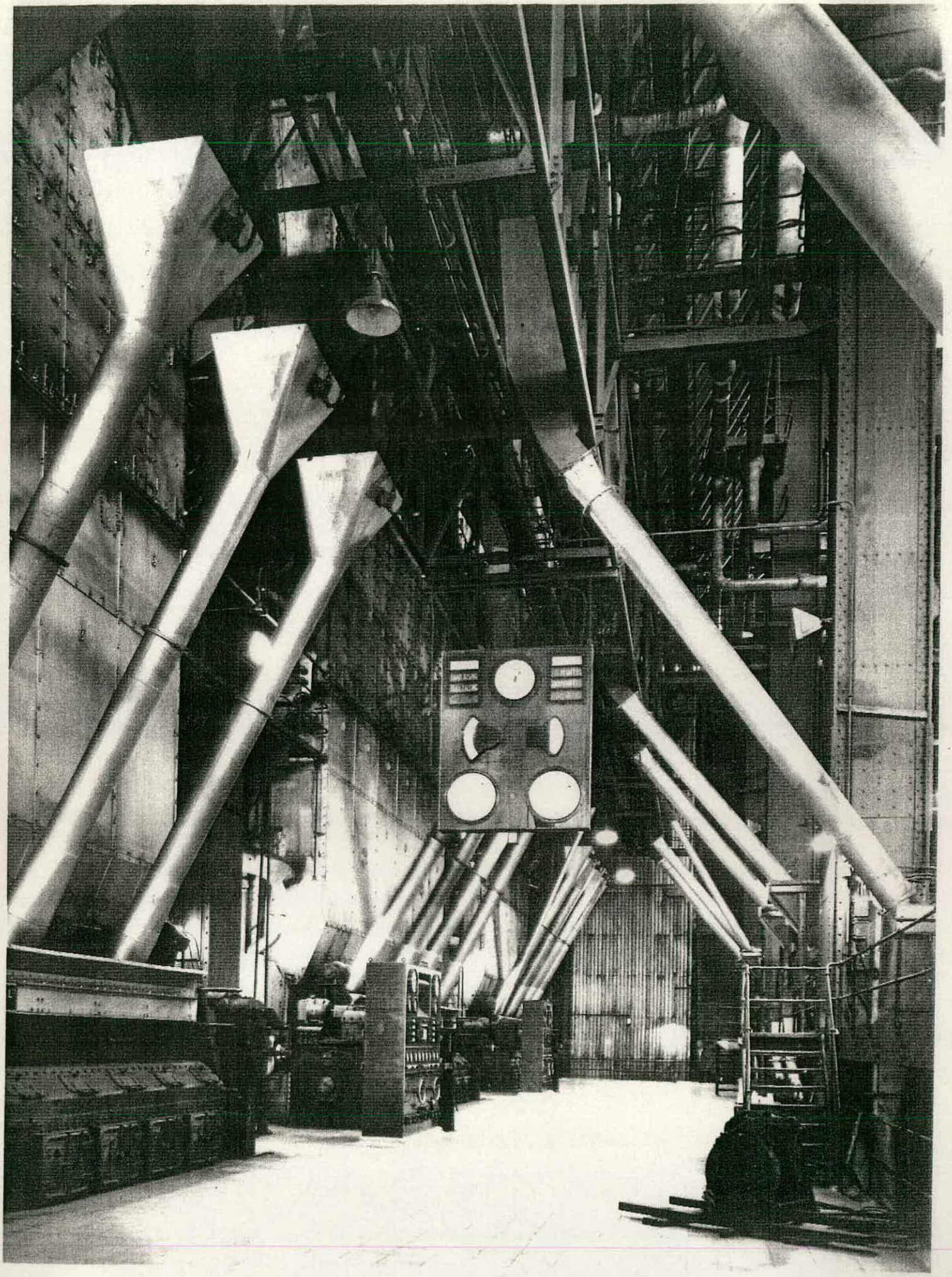
Report by Michael Williams
June 1995



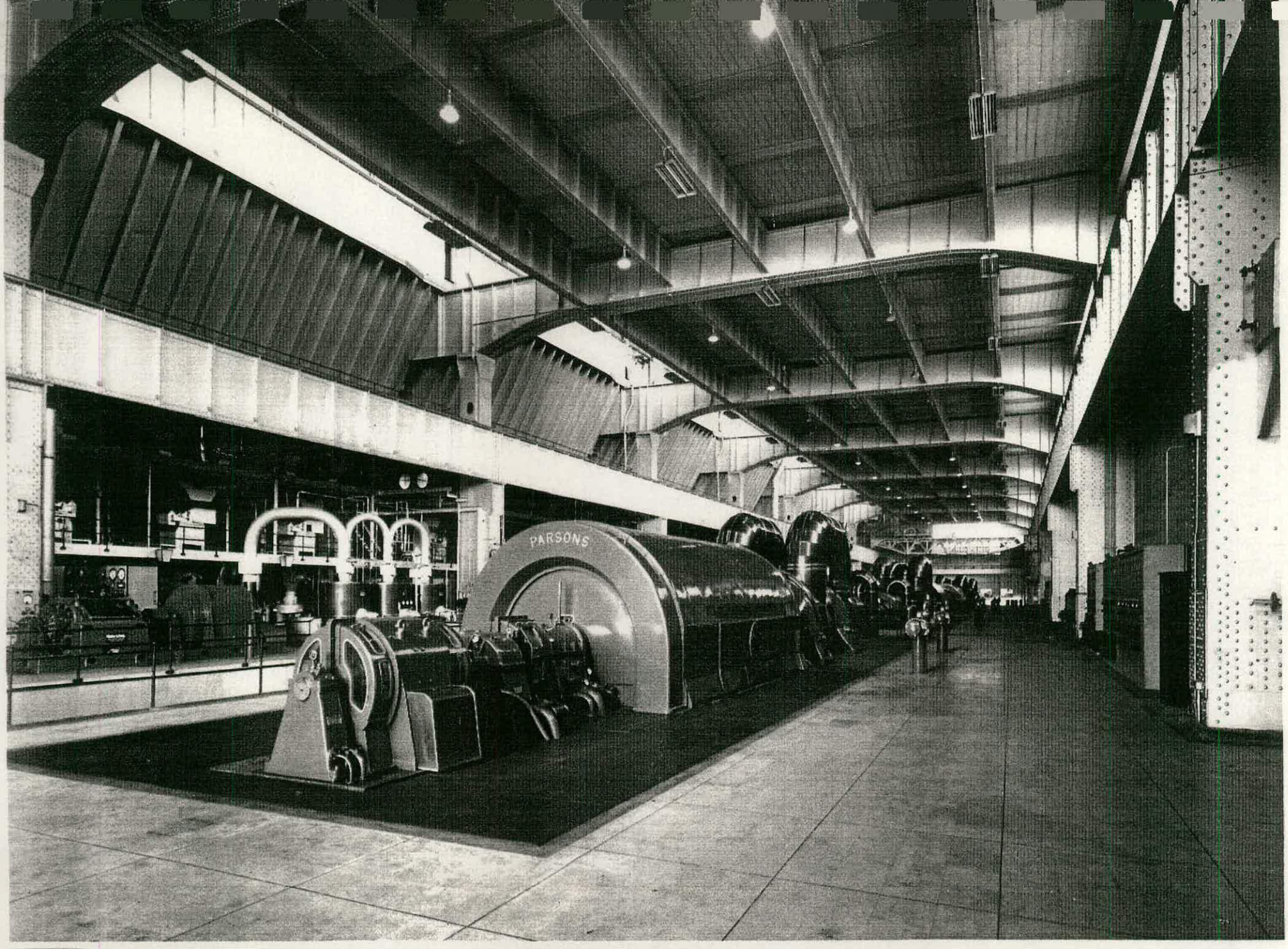
Littlebrook Power Station, aerial view from the north-east in 1994 (RCHME 1994 15178/1).



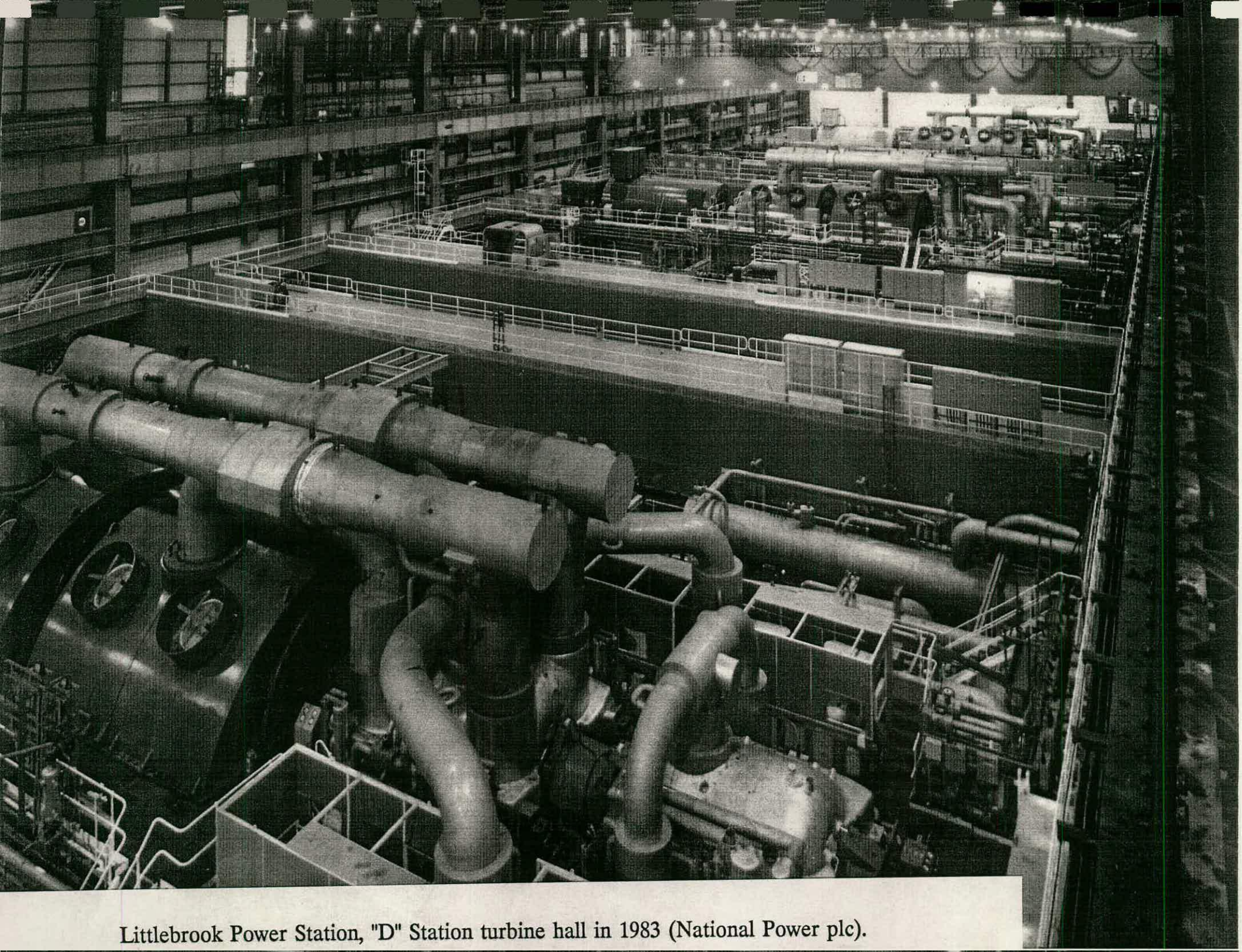
Littlebrook Power Station from the north in 1994 (AA94/3404).



Littlebrook Power Station, "A" Station boiler house c1938 (National Power plc).



Littlebrook Power Station, "C" Station turbine hall c1954 (National Power plc).



Littlebrook Power Station, "D" Station turbine hall in 1983 (National Power plc).

ESSEX **NBR INDEX NO: 91001**

THURROCK **NGR: TQ 589 770**

WEST THURROCK

WEST THURROCK POWER STATION

Summary Report

West Thurrock Power Station is located on a 37Ha site on the north bank of the Thames Estuary about 1.5 miles west of Grays. It was designed in the late 1950s, built between 1962 and 1965 and closed down in 1994. It was the first C.E.G.B. power station designed to exceed 1000 MW. It was also structurally and architecturally unusual, the boilers being open to the elements with a turbine house of reinforced concrete construction. Most of the principal buildings appeared to be intact in June 1995.

The station was designed to be coal-fired with a total output of 1,300 MW. This comprised two 200 MW units and three of 300 MW. The boilers were built to burn pulverised coal but were adapted to burn natural gas in addition to coal between 1971 and 1980. Heavy fuel oil-burning facilities were added in 1985 and used in combination with the coal-burning plant.

The low-lying site on West Thurrock Marshes necessitated the use of over 21,000 concrete piles during construction. The main civil engineering contractor was Richard Costain. The station included a coaling jetty with cranes and a conveyor system linked to a large open coal store to the south west.

The principal buildings are of a conventional side-by-side layout, the five tall boiler structures located along the south-west side of the turbine hall. The exposed boilers were built by Babcock and Wilcox. This was apparently the last attempt by the C.E.G.B. at an outdoor design whereby an architecturally Modernist reaction against the "brick cathedral" tradition dictated that "uneconomic" and "non-functional" cladding of the boilers should be avoided. In its design West Thurrock closely followed Willington Power Station, Derbyshire, of 1953-61, where Farmer and Dark were responsible for the architectural design and which was cited at the time as exemplary. However, the exposure of the boilers apparently had few practical advantages and resulted in problems of weatherproofing. Adjoining the west of the boilers were the coal conveyors and a system of flues leading to the two concrete chimneys.

The turbine house is architecturally distinctive and of reinforced-concrete construction, contrasting with the more widely-used steel-framed construction. The concrete columns were cast *in situ* but the principal roof beams were pre-cast. The roof covering is a pre-stressed structure of multiple transverse concrete barrel vaults, closely paralleled at Willington. The turbines were installed longitudinally, the two 200 MW units being manufactured by C.A. Parsons and the 300 MW units by Associated Electrical Industries. The latter were a four-cylinder tandem compound design and at the time were the largest units installed by the C.E.G.B.

Pulverised fuel ash was stored in bunkers on the site; large quantities were sold to a nearby factory for the manufacture of building blocks. Ash slurry was also pumped into ash lagoons. The station produced current at 275,000 volts for the National Grid. The open-air switch gear was sited to the north east of the turbine hall. Imported coaling cranes with continuous bucket grabs were installed in c.1988-90. A striking and unusual feature of the station is a pair of 192 metre

high transmission towers supporting a 400kV link across the Thames.

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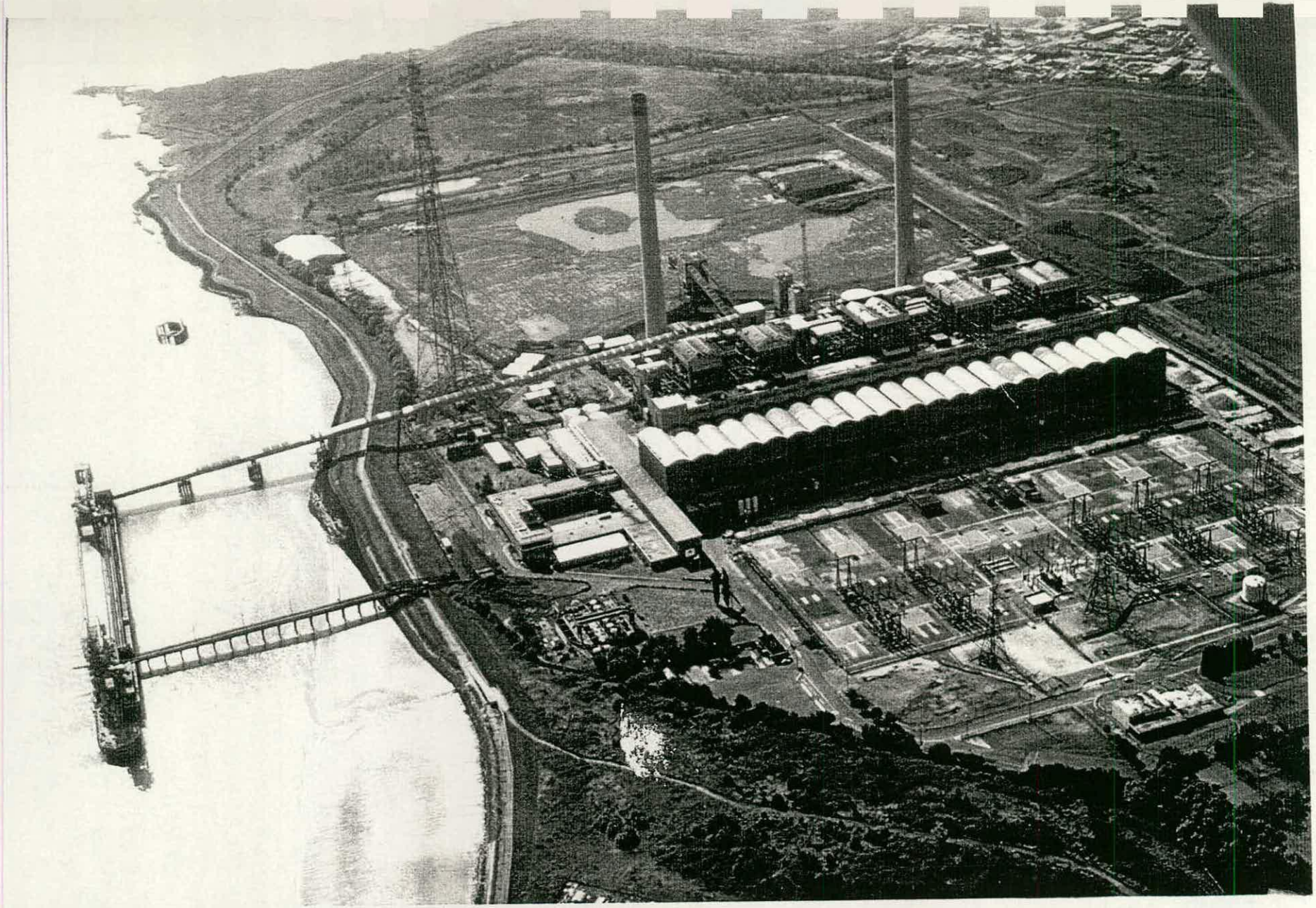
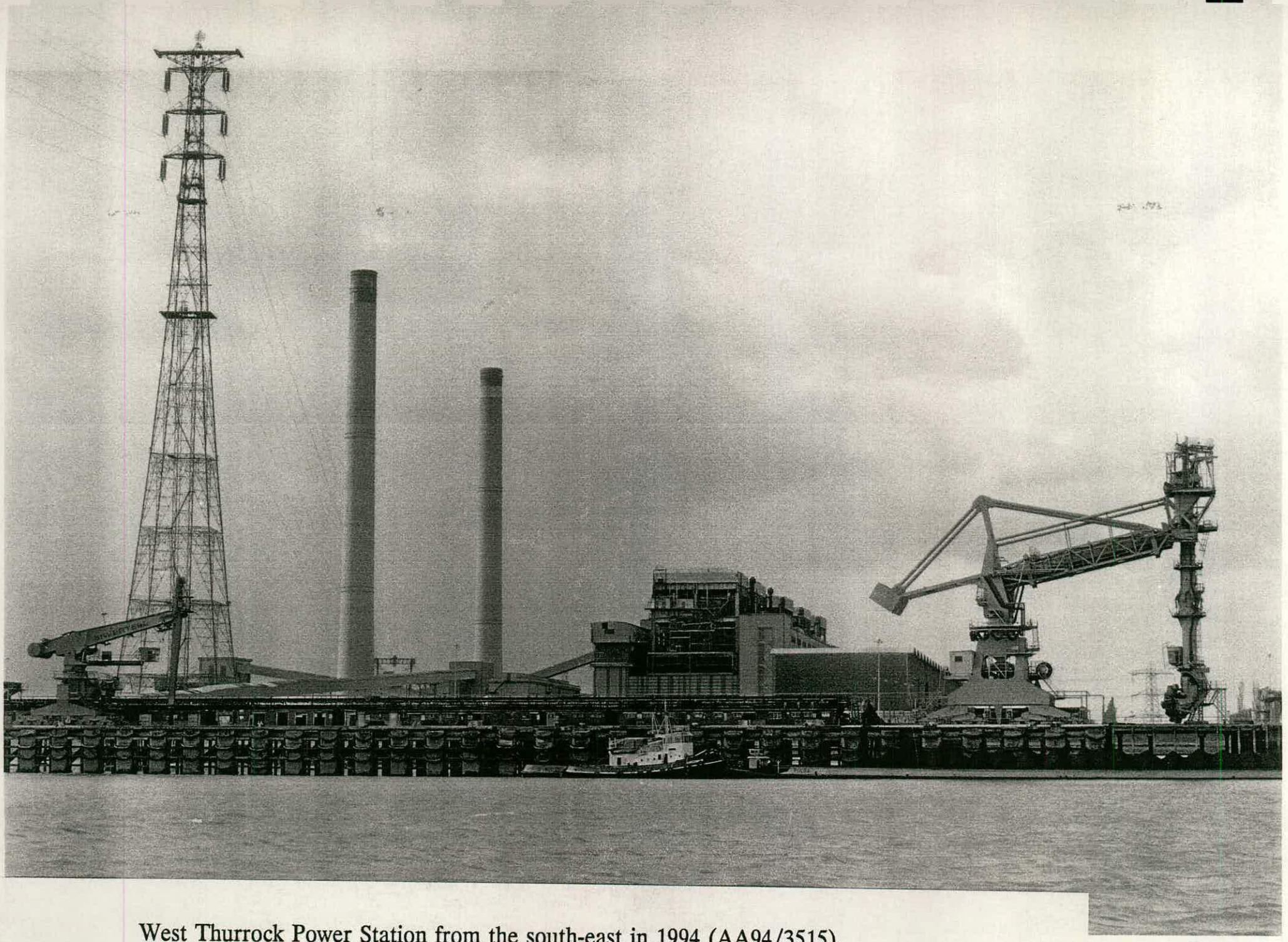
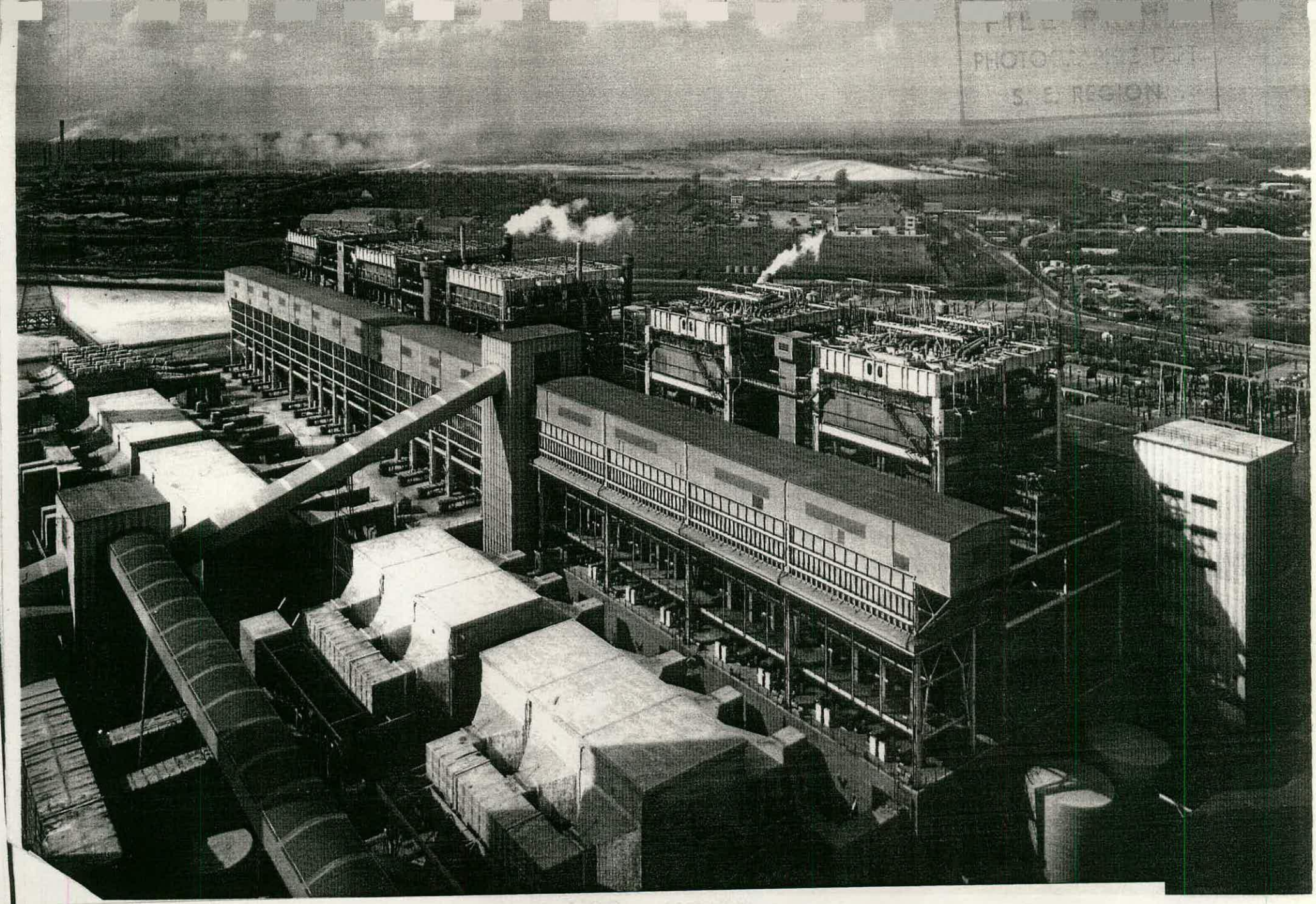
Report by Michael Williams
July 1995



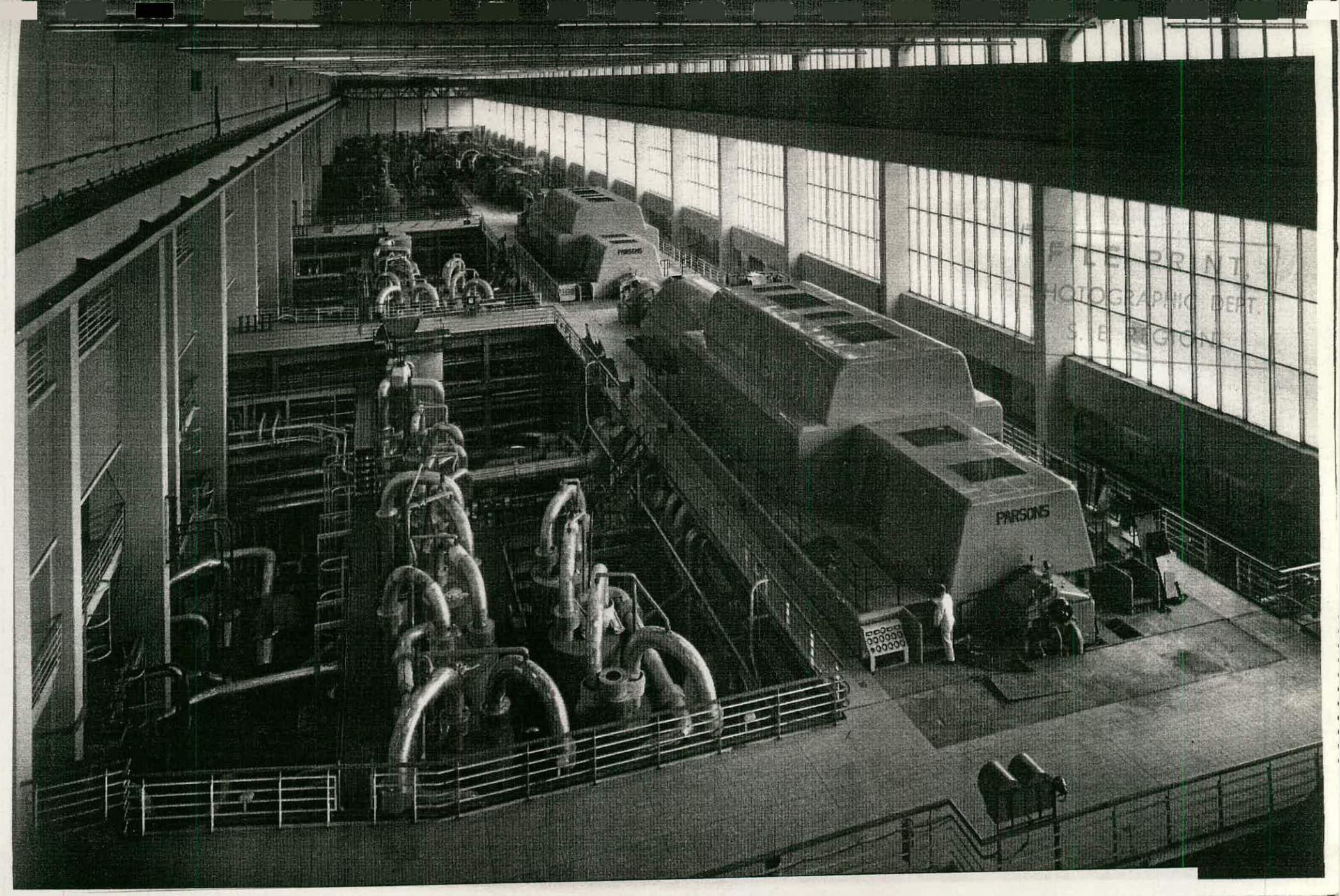
West Thurrock Power Station, aerial view from the north-east in 1994 (RCHME 1994, 15178/10).



West Thurrock Power Station from the south-east in 1994 (AA94/3515).



West Thurrock Power Station, the boiler house from the south-west in 1967 (National Power plc).



West Thurrock Power Station, the turbine hall in 1967 (National Power plc).

KENT

NBR INDEX NO: 91008

GRAVESHAM

NGR: TQ 632 744 (site A)

NORTHFLEET

NORTHFLEET POWER STATION

Summary Report

Northfleet Power Station was built between 1956 and 1962 about 1 Km west of Gravesend. It was demolished in 1993-4. At the time of writing only the exposed basement of the turbine hall and the site's iron railings along Crete Hall Road survive; this report is wholly based on documentary sources. The station originally comprised three adjoining sites. The main buildings were built on the south bank of the Thames at site A (TQ 632 744); the open coal store, site B, was located in a former chalk quarry to the south (TQ 630 742); waste ash and dust was dumped in a second former chalk quarry, site C, located further to the south (TQ 631 738). Northfleet was claimed to be a major step forward in power station design, being built to contain six 120 MW turbo-generators when the preceding generation of power stations had used turbo-generators of about 30 MW. It was the first conventional station to have automatic datalogging equipment. Northfleet also represented a transitional architectural design, combining extensive fenestration to maximise natural lighting, a characteristic feature of power stations completed in the 1950s, with a functional exterior of asbestos and aggregate cladding, which was more typical of stations completed in the 1960s.

The main site was located on chalk bedrock and did not require extensive piling in the foundations. The station was designed by the C.E.G.B. Southern Project Group, and the principal consulting engineers were L.G. Mouchel and Partners. It comprised a long rectangular boiler house built on a roughly east-west axis with a lower and slightly longer turbine hall attached to its south side. Between the north side of the boiler house and the river were the water treatment plant, ash precipitators and two 502ft-high concrete chimneys. A wharf was built out northwards from the original river bank and occupied the full width of the site. The cold water pump house was located at the west end of the wharf. Parallel to the wharf was an 809ft-long jetty with six unloading cranes which could accommodate two ocean-going colliers. A system of conveyors linked the west end of the jetty with the open coal store at site B. To the south of the turbine hall was the two-storeyed administration block.

The principal buildings were built in a functional style, comprising steel frames with walls of corrugated or smooth cladding. One advantage of this construction was a claimed reduction in the weight of the main buildings by 3,500 tons in comparison with the brick construction used in earlier power stations. An additonal notable feature of Northfleet, however, was the use of distinctive architectural detailing. Fenestration, which was not used extensively on later power stations, included the careful grouping of small rectangular windows (or ventilators), as for example in the upper part of the boiler house and at both ends of the south elevation of the turbine hall. The flat roof of the turbine hall was pierced by a symmetrical arrangement of five full-width "penthouses" with cambered roofs and glazing to the sides and south ends. The end walls of the boiler house featured full-height rectangular panels containing a diaper pattern of smaller square panels. The administration block was built to a narrow rectangular plan and had a flat roof with a central row of transverse asymmetrical skylights. It was an uncluttered functional design,

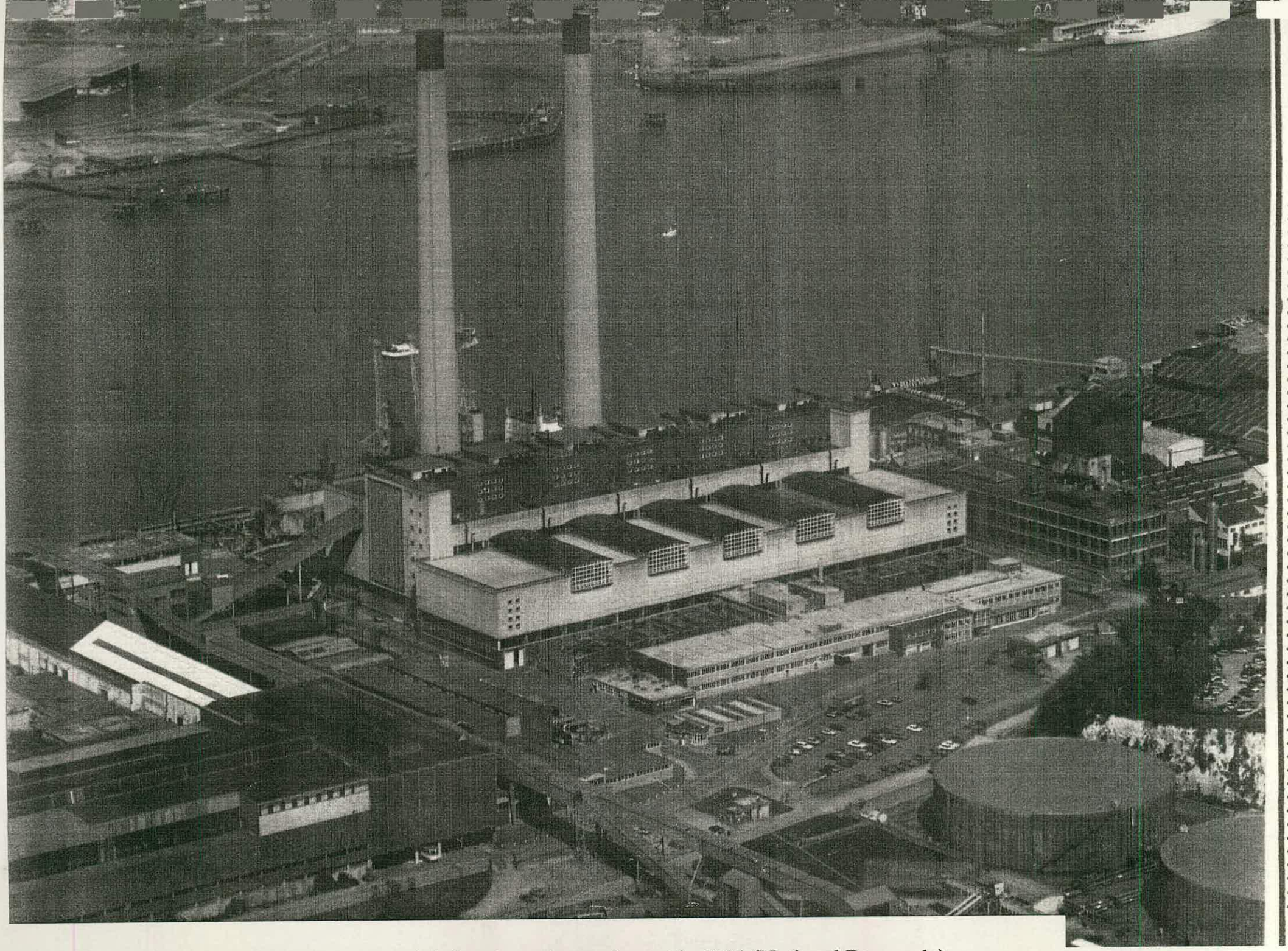
both storeys being lit by rows of rectangular windows which occupied most of the south elevation.

The six 120 MW turbo-alternators were manufactured by G.E.C. to a three-cylinder design and sited in a transverse north-south layout. Each was served by an in-line natural-circulation boiler, manufactured by Foster Wheeler, with superheaters, reheaters and economisers. The boilers originally burned pulverised coal but were later converted for oil burning. Current was supplied to the 132,000 National Grid and the 275,000 volt Supergrid via the Northfleet National Grid substation. Automatic datalogging equipment, located between the boilers and turbo-alternators, was an advanced feature of the station; this was an experimental installation which anticipated the later use of computerised equipment. The first four units were controlled by valve circuitry and the latter two by transistorised circuitry, which proved more reliable.

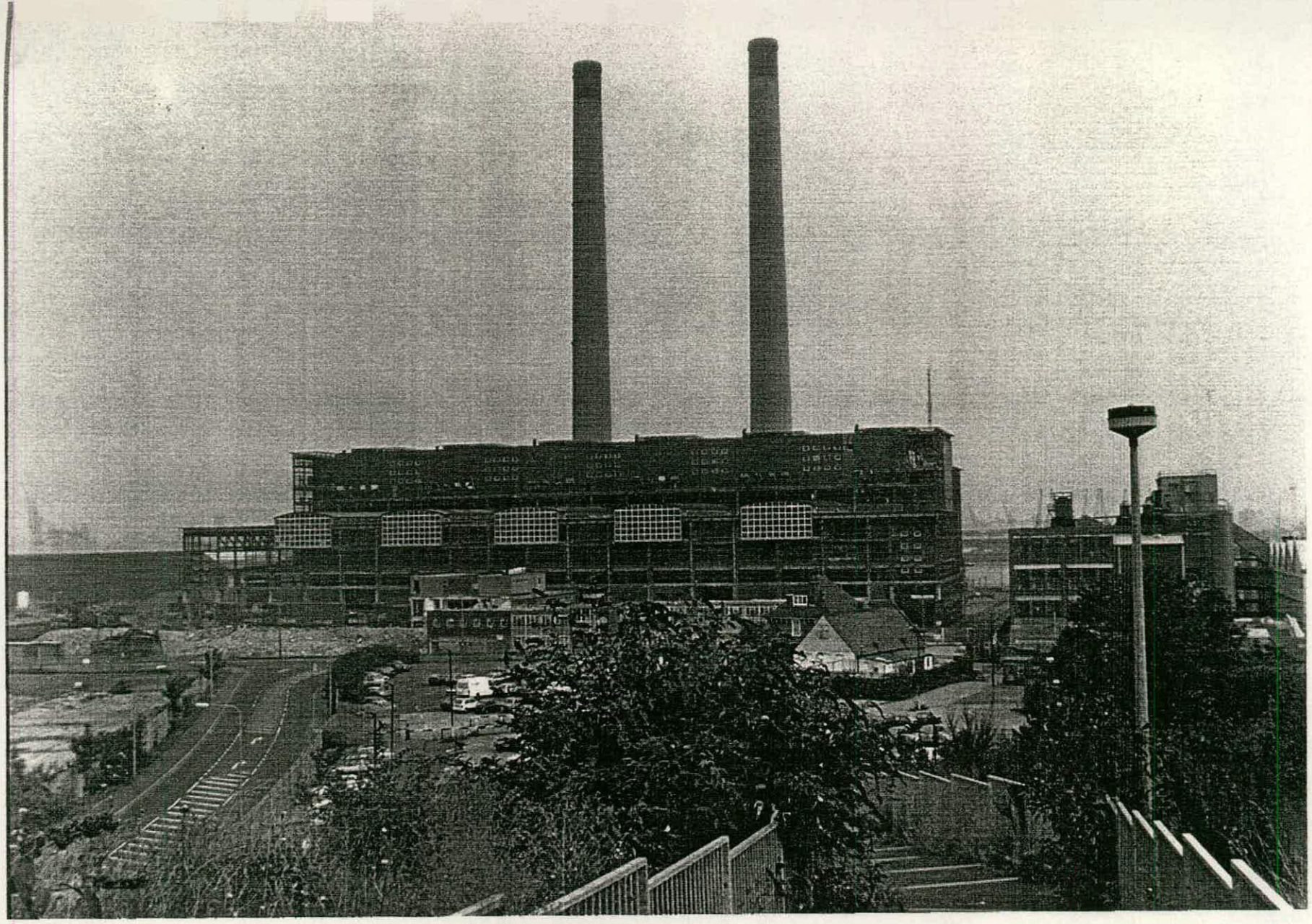
Sources

National Power Picture Library, photographs 1963 - 1984.
Northfleet, *Electrical Times*, 31st October 1963, pp. 660-664.
Northfleet Power Station, C.E.G.B., nd.
Extract from C.E.G.B. publication, *Northfleet Power Station*, nd, pp. 13 - 48.

Report by Michael Williams
August 1995



Northfleet Power Station, aerial view from the south-west in 1984 (National Power plc).



Northfleet Power Station, view from the south in 1993 during demolition (272/D/3).

KENT **NBR INDEX NO: 94564**

GRAVESHAM **NGR: TQ 6575 7413**

CANAL ROAD

GRAVESEND

GRAVESEND POWER STATION

Summary Report

Gravesend Power Station was an early municipal electricity generating station of a type that was once widespread. It was built in 1902-3 by Gravesend Corporation to supply local demand. It has survived largely because it continued in use long after nationalization, generating until the Central Electricity Generating Board converted the buildings to use as a scientific research base *c*1970. This use ceased in 1993 and the empty buildings were scheduled for demolition in 1995.

The site of the power station is not strictly on the riverside, though it did have direct access to water. It is on the south side of the basin that formed the west end of the Thames and Medway Canal, which is itself linked to the River Thames by a tidal lock.

The station appears originally to have comprised a long engine room with a shorter and taller boiler house to the north and a two-storey administration block to the east. The boiler house, possibly not itself the original structure, was demolished sometime after 1970. A long range was added on the south side of the engine room at right angles *c*1920, probably as a switch room.

The engine room has stock-brick walls with red-brick dressings. The south elevation has a row of 13 high-level oculi, or round windows, with low-level round-headed windows to the west where extensions have not been added. There are similar oculi in the north elevation, stepped up for the eight eastern bays reflecting the position of the boiler house. The west gable end has three bays of oculi over tall round-headed windows. There is a continuous lantern on the ridge of the roof. To the east is the lower two-storey flat-roofed administration or office block, latterly concrete rendered, with a single-storey lean-to further east, perhaps formerly a workshop or store.

Internally the engine room has been stripped of all plant in 1995, excepting the original overhead travelling crane, of 8-ton capacity and made by J. Carrick and Sons Ltd of Edinburgh. Some original joinery also survives in the shape of railings to what was a switch gallery to the south and a staircase in the southeast corner that led up to an east end control gallery, latterly enclosed to be a control room. Above this in the east wall of the engine room there is a canted bay window from the adjoining administration block that gave the station superintendent a clear view of the engine floor from his office. The engine room walls have low-level white-glazed tiling. Parts of the original tiled engine floor also survive. The roof is steel framed with L- and flat-section components. The engine room was originally fitted with four steam engines to judge from an early photograph. In 1970 there were British Thomson-Houston turbines in the engine room.

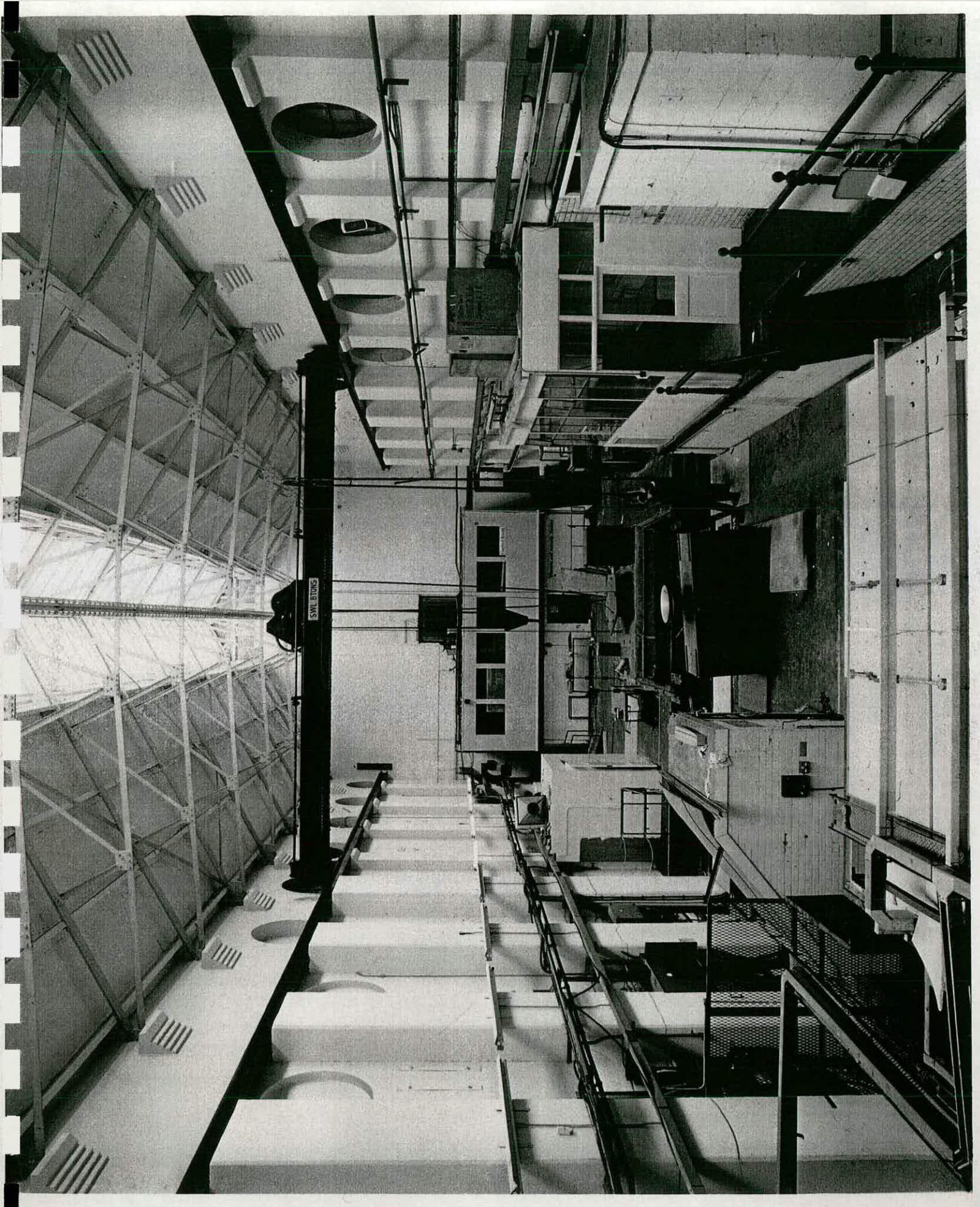
The early range added to the south is a low two-storey block in stock brick with red-brick dressings. It was added to the engine room extending from the position of the original switch gallery and may therefore have been built to house new switchgear, possibly at the time that turbines were installed in the engine room. This range was lattery wholly rebuilt internally with a reinforced-concrete frame and roof inside the earlier brick shell.

Spaces below the engine floor were adapted for acoustic testing in or after 1970, to include an anechoic chamber.

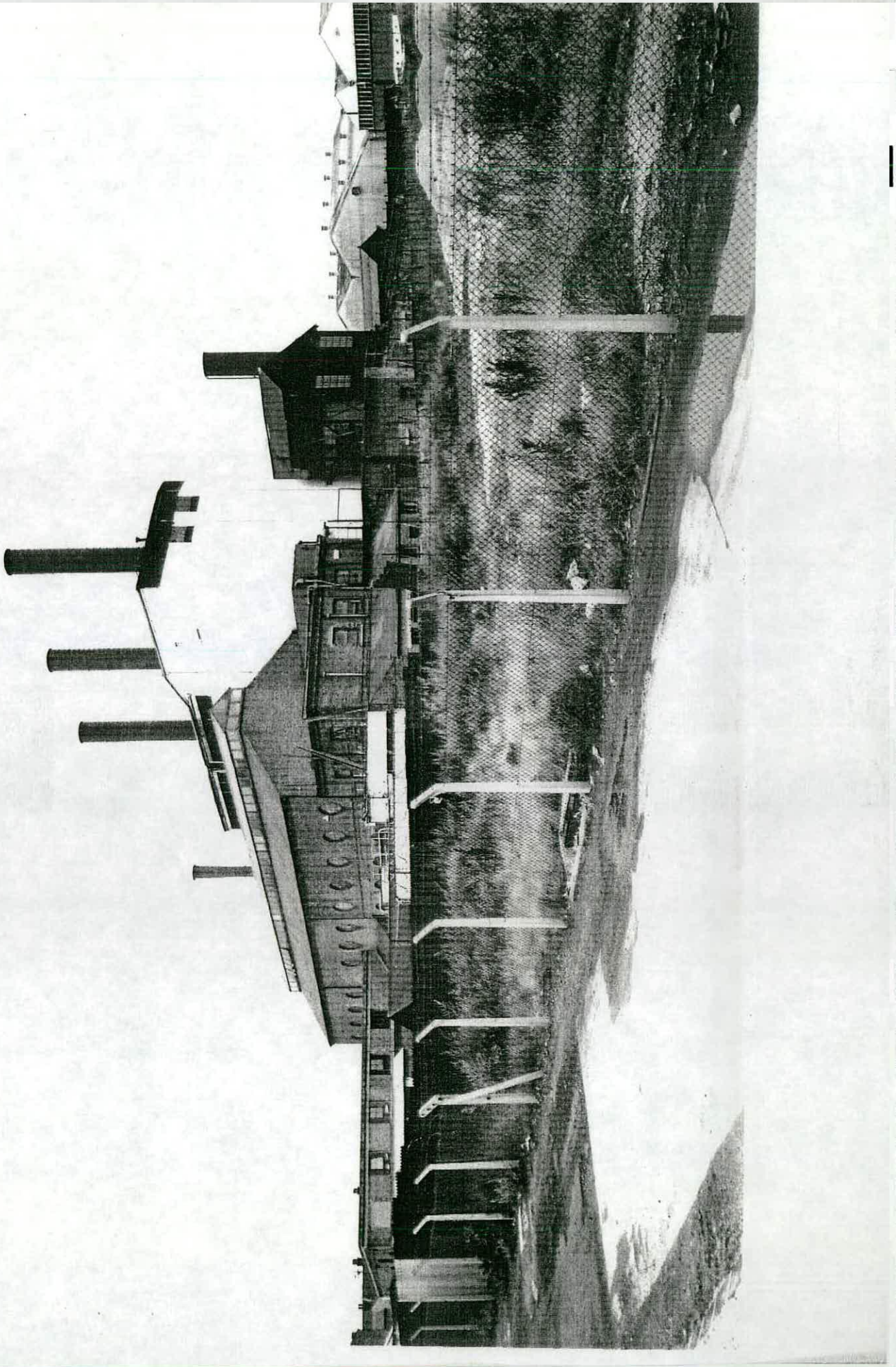
Sources
National Power Picture Library
Information supplied by David Eve, Kent County Council.

Report by Peter Guillery
December 1995

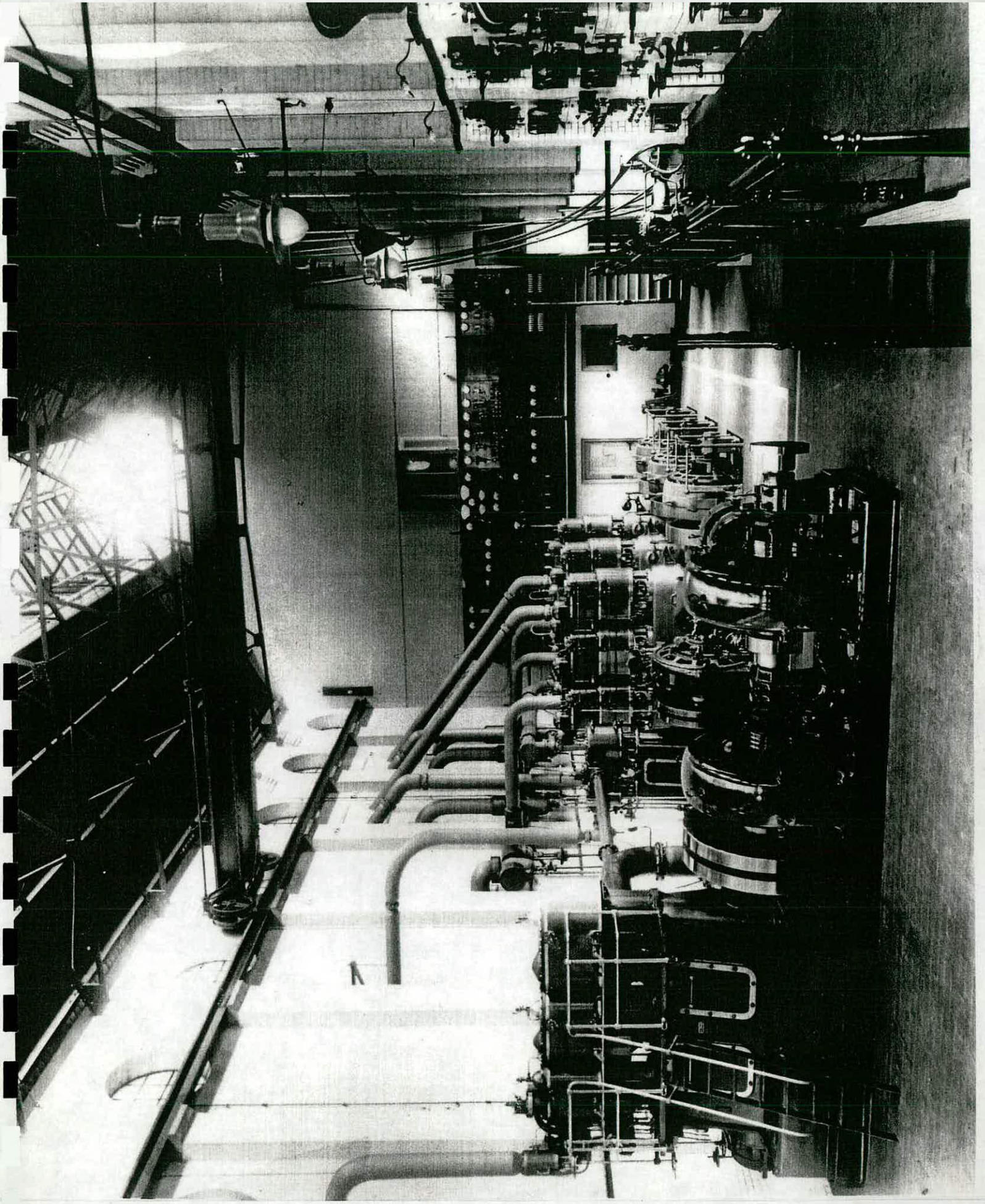
Gravesend Power Station from the north in 1995 (AA95/6545).



Gravesend Power Station, interior from the west in 1995 (AA95/6551).



Gravesend Power Station from the south-east in c1970 (National Power plc).



Gravesend Power Station, interior from the west in 1914 (National Power plc).

ESSEX **NBR INDEX NO: 91005**

THURROCK **NGR: TQ 662 756**

TILBURY

TILBURY POWER STATION

Summary Report

Tilbury Power Station is located on the north bank of the Thames Estuary about one mile east of Tilbury Docks. The site contains two large power stations, each with a full complement of ancillary buildings. Tilbury 'A', first planned by the County of London Electricity Supply Co Ltd in 1947, was carried forward by the British Electricity Authority from 1948 and completed for the C.E.G.B. in 1958. Tilbury 'B' followed on and was completed in 1969. Although they were only built a decade apart the two stations represent successive generations of power station construction, illustrating significant developments in both scale and design.

The Civil Consulting Engineers and Architects of Tilbury 'A' were Sir Alexander Gibb and Partners, the main consulting engineers being Merz and McLellan. The buildings were under construction from 1949 to 1957 and illustrate the general approach to power station architecture which was prevalent in the mid 20th century. The buildings essentially comprise an integrated and uniform composition with dignified elevations in London stock brick. The functional layout of the main components is similar to that used in many power stations throughout the 20th century, with the boilers and related plant located in a long rectangular building, attached to one side of which is the parallel turbine hall. The site has been laid out to face the Thames, with the offices and control rooms in a roughly symmetrical range around a quadrangle attached to the south end of the much larger boiler house - turbine house block.

In contrast to the absence of windows in later types of power stations, fenestration is used to emphasise the uniformity of the whole site. The boiler house and turbine house are lit by tall rectangular windows, the lower adjoining buildings by smaller square windows.

The buildings are of steel-framed construction. The foundations required the use of 13,000 pre-cast reinforced-concrete piles. When complete the station contained six turbo-alternators, each with dedicated boiler plant. Each unit generated current at 11,400 volts and 60MW. The boilers were designed to burn coal which was gravity fed from bunkers via pulverising mills. They were soon adapted to burn heavy fuel oil, however, which was stored in tanks to the east of the boiler house. Coal and oil was delivered by ships to a reinforced-concrete jetty built parallel to the shore. The jetty also contains the inlet and outlet caissons of the station's cooling water circulation system. Two reinforced-concrete chimneys, 330 feet high, formerly stood to the east of the boiler house but were removed following the construction of Tilbury 'B' power station.

Tilbury 'B' dwarfs the earlier station and was built in the 1960s specifically to supply the 275,000 volt national grid system. There is also a direct 400,000 volt connection with Kingsnorth Power Station via a tunnel beneath the Thames. It was built on the site of the former coal store to the east of the original station, which was always intended to be used for the construction of a second power station. When built, Tilbury "B" was cited as a prototype of the forthcoming generation of 2,000 MW power stations. Architecturally, it is of similar functional design to other power stations of the period such as Kingsnorth, with no fenestration to the main buildings and

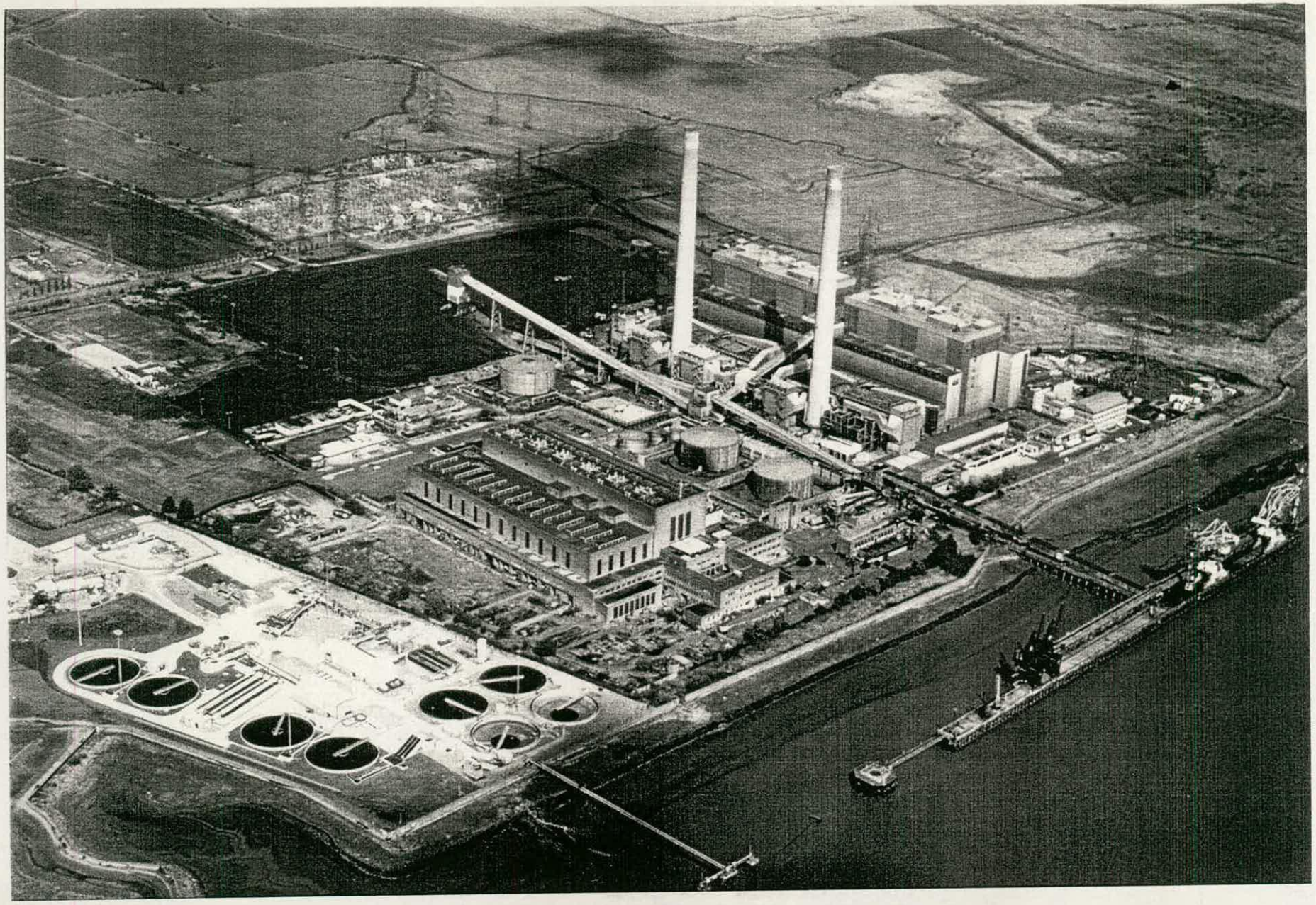
no attempt to create the dignified facades seen at Tilbury 'A'. The overall layout of buildings is similar, however, with the taller boiler house block orientated north-south to the west of the adjoining turbine hall, and with offices and control rooms at the south end.

The station contains four 350 MW units orientated north - south parallel with the sides of the turbine hall. The boilers were designed to be coal-fired but were modified to use a combination of coal and heavy fuel oil. The site also includes a separate smaller gas turbine power station, adjoining the north end of the boiler house, containing four 17.5 MW units. The two chimneys of Tilbury 'A' were replaced by two 168 metre-high chimneys of similar design. The jetty was lengthened to the east, probably when Tilbury 'B' was constructed, and its original coal-handling cranes replaced. In 1990 two 800-tonne coal unloaders were installed on the jetty.

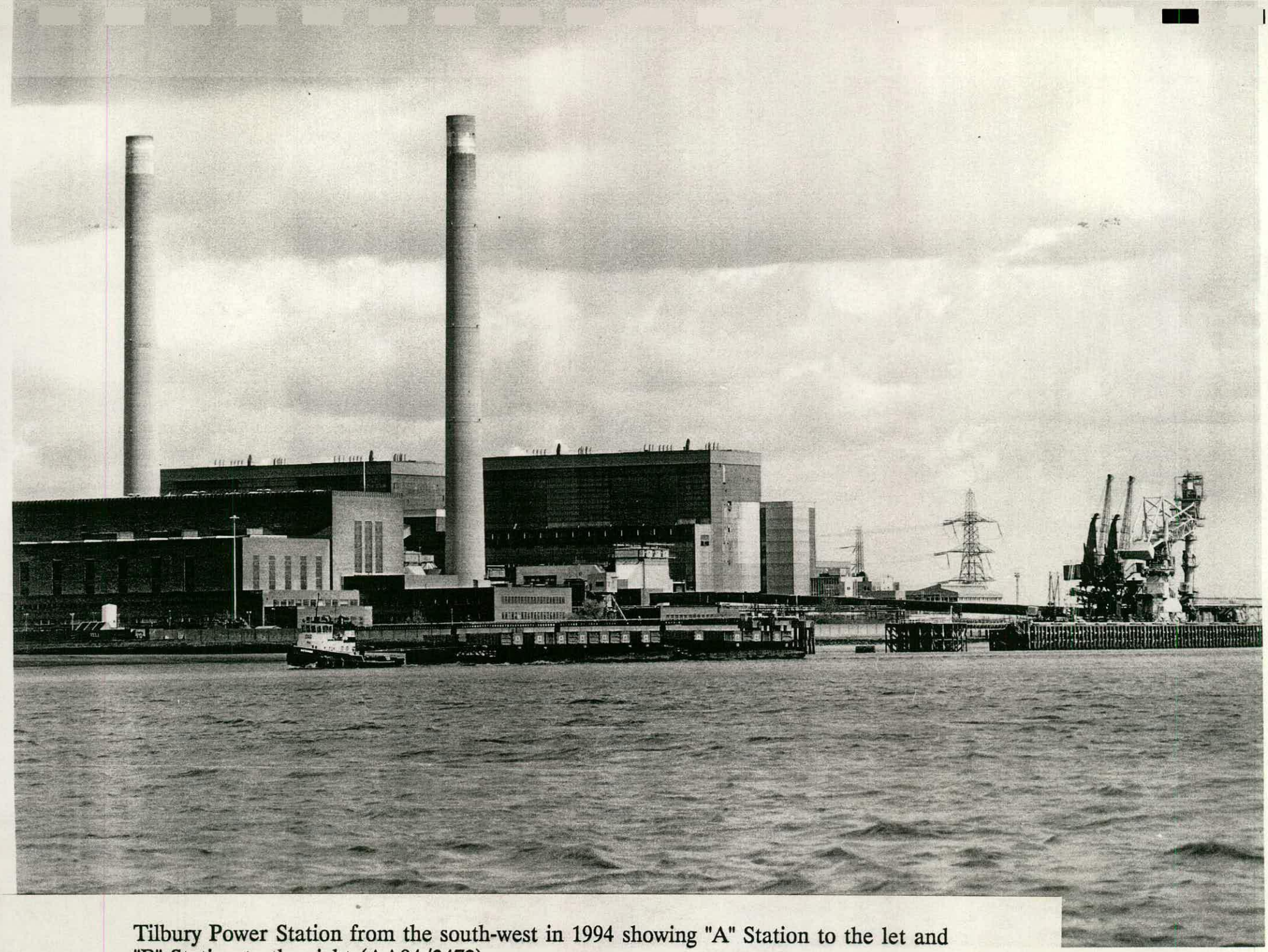
Sources

National Power Picture Library, photographs 1958 - 1987.
C.E.G.B., 1958, *Tilbury Power Station.*
C.E.G.B., nd, *Tilbury 'B' Power Station.*

Report by Michael Williams
June 1995

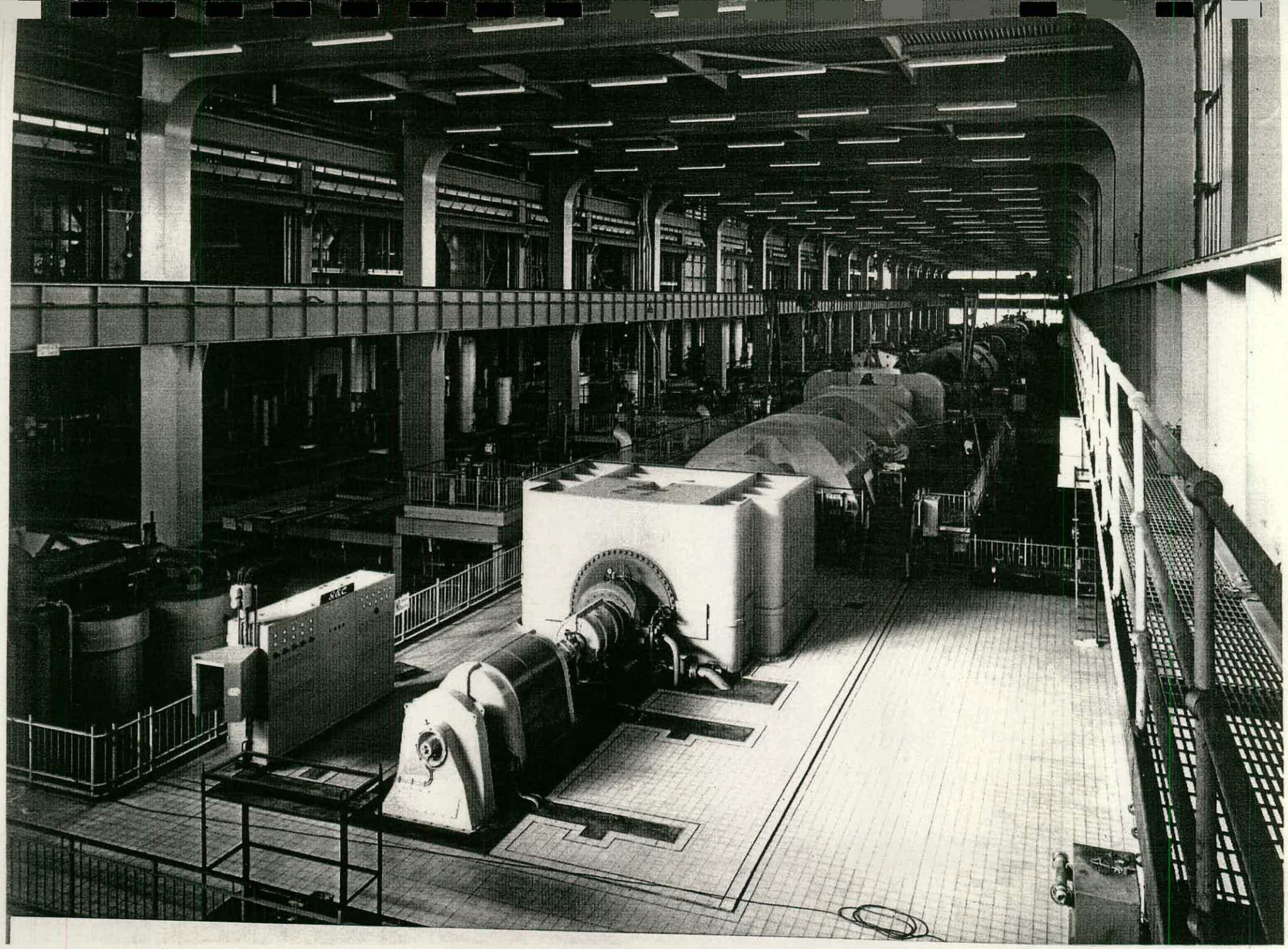


Tilbury Power Station, aerial view from the south-west in 1994 showing "A" Station to the left and "B" Station to the right (RCHME 1994, 15178/26).

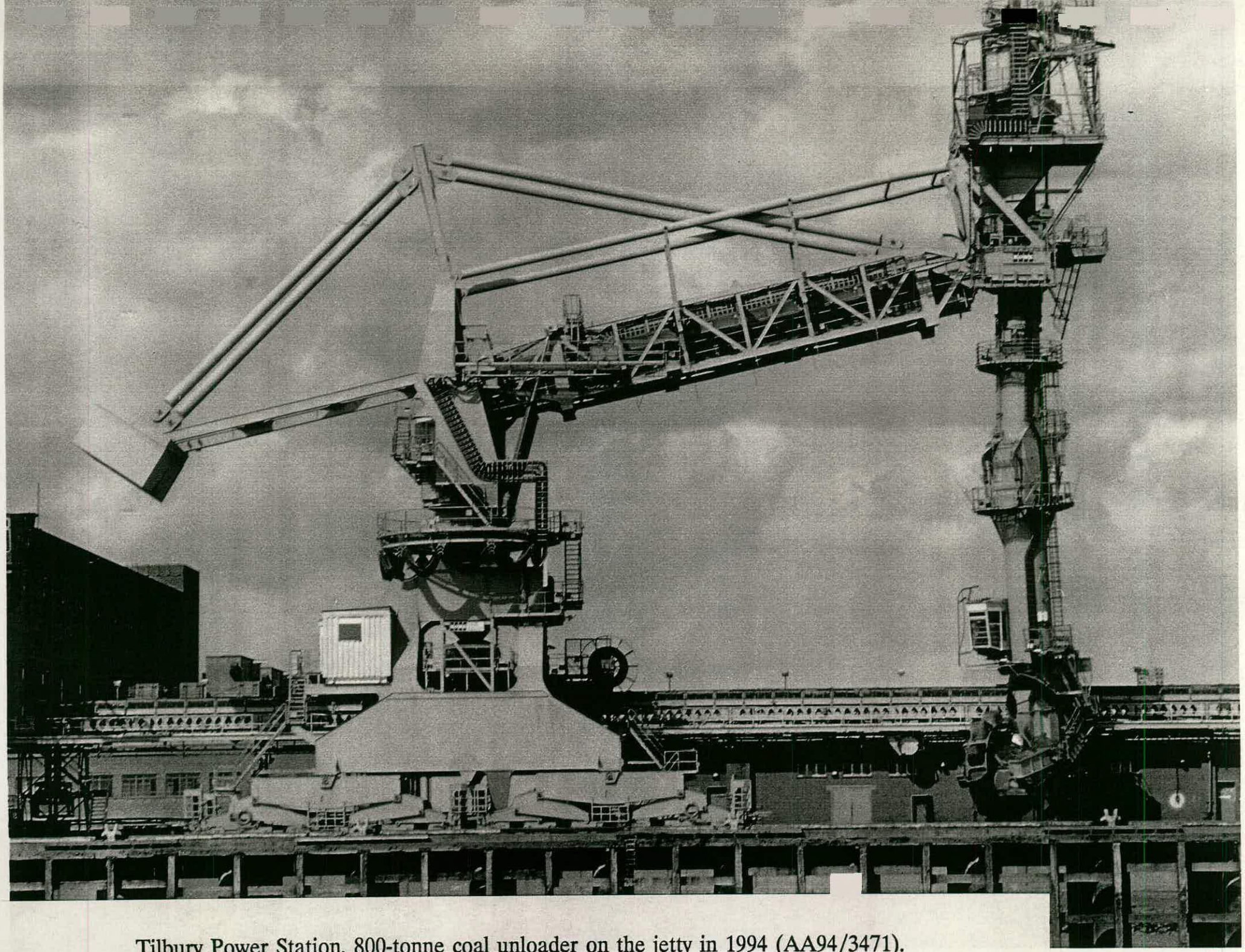


Tilbury Power Station from the south-west in 1994 showing "A" Station to the let and "B" Station to the right (AA94/3472).

Tilbury Power Station, "B" Station from the south in 1994 (AA94/3470).



Tilbury Power Station, "B" Station turbine hall in 1969 (National Power plc).



Tilbury Power Station, 800-tonne coal unloader on the jetty in 1994 (AA94/3471).

KENT **NBR INDEX NO: 91002**

ROCHESTER **NGR: TQ 885 755**

ISLE OF GRAIN

GRAIN POWER STATION

Summary Report

The construction of Grain Power Station began in 1971 and electricity was first produced in 1975. The complex was completed c.1980. It is located on a low-lying coastal site about 1 Km south of Grain. It comprises a huge block of steel-framed buildings which when opened was claimed to be the largest oil-fired power station in Europe, with a design output of 3,300 MW. The site, between the River Medway to the south and the Thames Estuary to the north, was chosen to utilise oil from the adjacent Shell oil refinery; other advantages included plentiful water supplies and proximity to the 400 kV grid system. Grain Power Station is architecturally distinctive and includes the use of some types of steel-framed and reinforced-concrete construction on an unusually large scale. Despite its great size, however, the station was apparently technically similar to other smaller stations which were under construction or already in use by the early 1970s. It was built as part of a C.E.G.B. programme involving the construction of 13 large power stations. It is now run by Powergen and managed from the nearby Kingsnorth Power Station.

The executive architects were Farmer and Dark, assisted by Donald Rudd and Partners. Construction work was limited by the C.E.G.B. to five main sub-contractors, namely John Laing (civil engineering), Redpath Dorman Long (structural steelwork), G.E.C. Turbines (turbo-generators), Babcock and Wilcox (boiler plant) and N.G. Bailey (electrical work). Civil engineering design was by the C.E.G.B. in collaboration with L.G. Mouchel and Partners.

The principal buildings at the station comprise the main boiler house - turbine house block, an attached central control wing, the nearby free-standing chimney, a detached range of offices and a smaller detached gas-turbine power station for use during periods of peak demand. The latter is located close to the south-east corner of the main block and contains five 29 MW gas turbine generators with a separate chimney. There are also numerous ancillary structures including oil storage and pumping facilities and an extensive open-air 400 kV switching station. Because of the low-lying topography the original ground surface was covered with a 1.2 m layer of dredged sand prior to construction. The foundations comprise reinforced-concrete slabs on deep piles. The larger buildings have a number of distinctive design features, notably the use of curved eaves and slightly pitched roofs, which were an attempt by the architects to lessen the visual impact of the site. It was also claimed that improved air flow around the building would assist internal ventilation. The steel-framed walls are clad with concrete panels up to a height of 6.1 metres with stucco-embossed aluminium sheeting above.

The main boiler house - turbine house block is almost half a kilometre long and was built to contain five 660 MW turbo-generators with associated boiler plant. The boilers are located in towers which project from the north-east side of the generator house. The roofs of the boiler house are of concrete cast on permanent steel shuttering. A notable external feature is the general absence of fenestration, although narrow acrylic windows are used on the south-eastern side of

the turbine hall. These are 15 metres long, extending from the upper part of the walls around the curved eaves to the outer part of the roof. Internally, the plant is arranged to give through-access from the boilers to the generators. The boilers comprise 24 steam-atomised oil burners with superheaters and reheaters in the upper part of the furnace and economiser plant to the rear. They were designed to produce 4,600,000 lb / hr of steam at 2,400 lb / in. The turbo-generators are located in an open hall measuring 400 metres by 38 metres with a roof height of 36 metres. The walls are framed by boxed steel columns and the roof supported by 40 metre long triangular-section boxed steel trusses. The five-cylinder turbines operate at 3,000 rpm. The generators are hydrogen-cooled and rated at 776 MVA.

The reinforced-concrete main chimney is 244 metres high and was the second highest in the country when built (Drax Power Station has a 260 metre chimney). Its external diameter is 20 metres, broadening to 40 metres near the base. It contains 7 metre diameter flues from each of the five boilers and two auxiliary 1.2 metre flues.

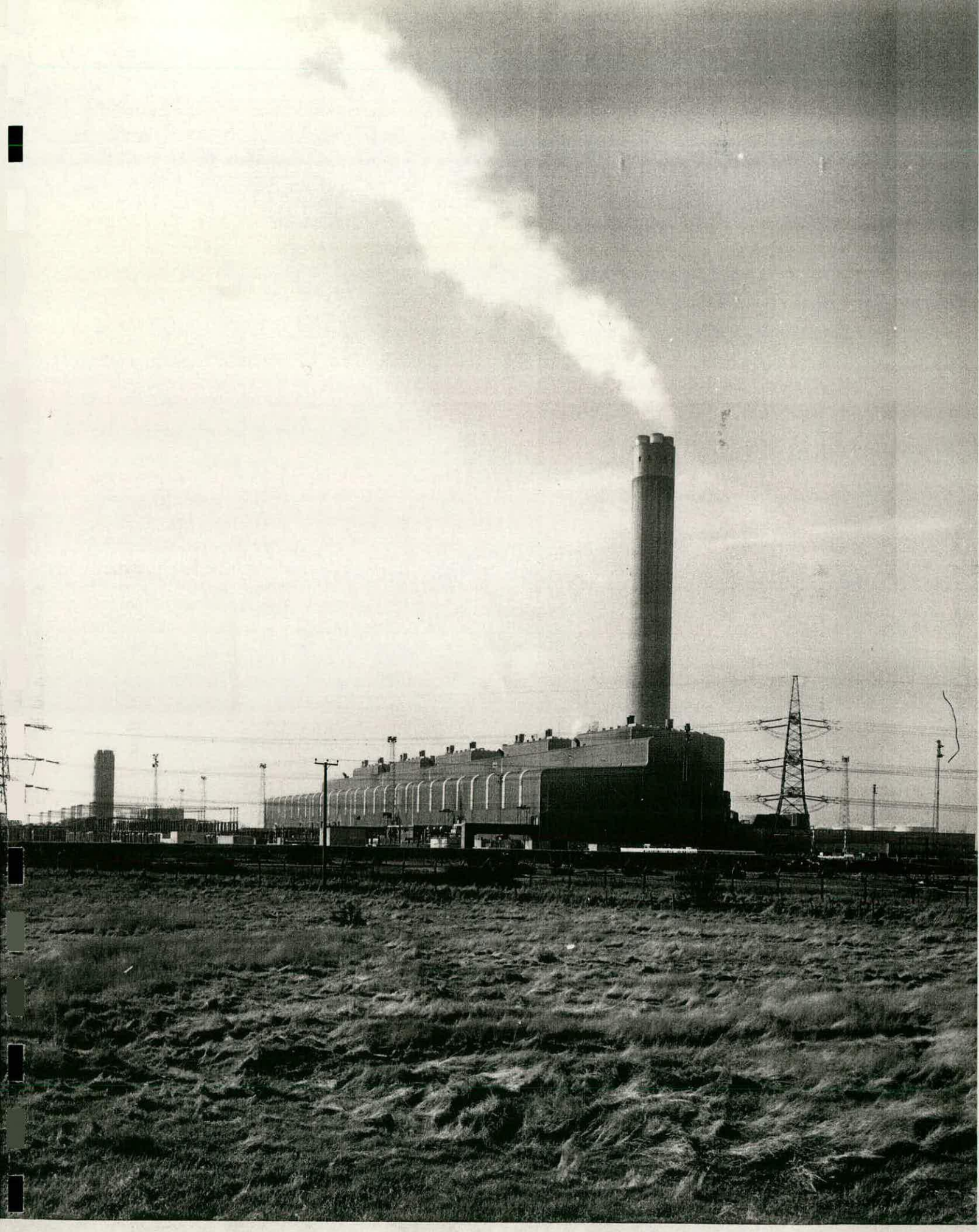
The central control room is located in a lower wing projecting to the east of the boiler house. This is of similar steel-framed construction and cladding to the main block, with similar external detailing. The wing also contains water treatment plant.

A network of reinforced-concrete ducts beneath the site supplies cooling water for the condensers attached to the turbo-generators. Five water pumps are located in a pump house to the south-east of the main block. The pump house is of unusual design and construction, comprising a circular reinforced-concrete wall 70 metres in diameter and 30 metres deep, forming a coffer dam within which the pumps are located. This structure is mostly located below ground level. It was said to be one of the largest circular coffer dams in the world.

Sources

Rationalising large-site sub-contractors, *Building*, 19th October 1973, pp. 147-148.
Grain Power Station, *The Steam and Heating Engineer*, December 1973, pp. 32-36.
Power on a Massive Scale, *Building Design*, September 16th 1977, pp. 20-21.
C.E.G.B., *Grain Power Station.*

Report by Michael Williams
June 1995



Grain Power Station from the north-east in 1994 (BB94/5834).

KENT

NBR INDEX NO: 91003

ROCHESTER

NGR: TQ 810 720

KINGSNORTH POWER STATION

Summary Report

Kingsnorth Power Station was built between 1963 and 1973 on the north bank of the Medway estuary. It is one of ten 2,000 MW stations built by the C.E.G.B. in that period. It was unusual because it was designed to be dual-fired, with facilities for handling both oil and coal. It was the largest dual-fired power station in Europe and the only example in Great Britain. It was built to supply electricity to the national Supergrid, to local towns in the Medway area and directly to London via a d.c. link. The engineering design was by the Southern Project group of the C.E.G.B. The main consulting engineers were Ewbank and Partners and the civil engineering consultants were L.G. Mouchel and Partners.

The power station is built on 162 Ha of reclaimed coastal marshland which was 1.22 metres below the highest tide level. Reclamation work included spreading a c.2 metre layer of earth across the site and the extensive use of concrete piling in the foundations of the buildings. The site was chosen primarily because of the availability of deep-water berths in the Medway estuary. Two large jetties were constructed for use by both colliers and ocean tankers. The coastal topography was also utilised in the layout of the station's water circulation plant; cooling water is taken from the Medway to the south of the station and discharged into Damhead Creek to the north. This flows back into the Medway 1.5 miles downstream of the station, thus avoiding any chance of mixing with cold water at the intake.

The ability to burn either oil or coal, and thereby to exploit variations in the cost of the two fuels, had a major influence on the design of the boilers and on the overall layout of the site. The station used only oil for the first five years, after which the emphasis was on maximising the use of coal. This may be related to the construction of the nearby Grain Power Station, which is larger and entirely oil-fired, from 1972.

The main block, the boiler house - turbine house, is a steel-framed structure which is essentially a functional design with little of the distinctive styling used at Grain Power Station. The four boilers are arranged in pairs in two towers projecting to the rear of the turbine house, which is a continuous lower building. The boilers are roughly the height of a six storey building, each containing 48 oil burners and 40 pulverised coal burners. The detached reinforced-concrete chimney, 198.5 metres high and 26.2 metres in diameter at the base, is located to the rear. It contains separate flues from each of the boilers. The 300 metre long turbine house contains four G.E.C. - Parsons tandem compound turbo-generators, each set being 52 metres long. The turbines operate at 3,000 rpm and the 500 MW generators rated at 588 MVA.

The site also includes a separate smaller gas turbine backup power station. This contains four 22.5 MW turbogenerators powered by Rolls Royce Avon jet engines.

The administration and control room block is detached to the north of the main block. Power station control rooms are normally in a more central position. At Kingsnorth the control room was sited to allow for the possible addition of a second boiler house - turbine house to the north.

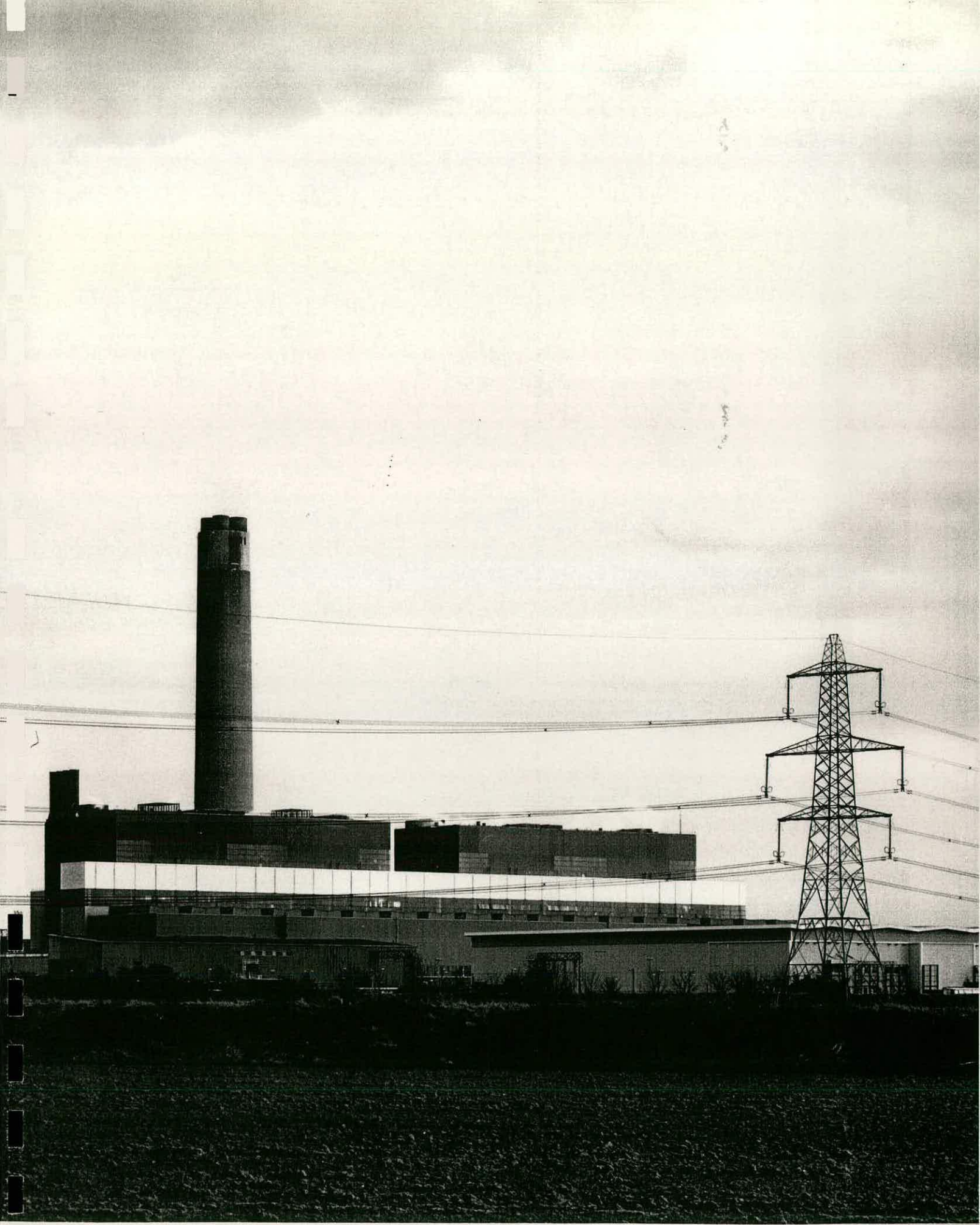
A large single-storeyed building to the west of the main block is a covered area for the 400

kV switchgear, which is more commonly exposed to the elements at large power stations.

Sources

Kingsnorth Power Station, *The Steam and Heating Engineer*, October 1972.
Kingsnorth Power Station (booklet), C.E.G.B., nd.

Report by Michael Williams
June 1995



Kingsnorth Power Station from the north-west in 1994 (BB94/5858).

Appendix: List of RCHME Photographs

Deptford
BB92/7547-9
Air - NMR 1959/406-7

Greenwich
Bedford Lemere Collection - 23750/1917
BB93/5509-13, BB94/11433-55, AA94/3291
Air - NMR 4007/63, 1987

Brunswick Wharf
BB87/8472-8, BB88/3624-74
Air - CUCAP BIJ 77-8, 1972

Barking
BB92/20507-23
Air - BB89/10279, 1994/15177/33

Belvedere
Millar and Harris Collection

Littlebrook
AA94/3404
Air - 1994/15178/1

West Thurrock
AA94/3515, BB94/18254-5
Air - 1994/15178/10

Northfleet
AA94/3435
Air - 337/788, TQ6274/2, 1971

Gravesend
AA95/6544-6554, 6592

Tilbury
AA94/3470-2
Air - 1994/15178/22, 26

Grain
AA94/2215, BB94/5834-6

Kingsnorth
BB94/5857-8