

Electricity Supply in Great Britain

A Chronology

1977

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**A Chronology—From the beginnings of
the industry to 31 December 1976**

The Electricity Council

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Preface

This annotated chronology records the principal developments in the technology of electricity supply and utilisation; legislation and reports of official committees; regulations governing electricity; and organisations of the electrical industry.

Although primarily concerned with Great Britain, this chronology also includes references to some of the outstanding developments abroad. It is necessarily highly selective.

In dealing with "official" information, such as annual reports and reports of Select Committees, the original sources have been consulted wherever possible. But some reliance has had to be placed on other "authoritative" sources.

Among the large number of publications that have been consulted are those set out at the end of the chronology. Grateful acknowledgment is made to the authors and publishers concerned.

Supporting the chronology is a comprehensive Alphabetical Index (p. 86).

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* Denotes developments abroad.

- 1831** *Michael Faraday* made his fundamental discovery of *electro-magnetic induction*—demonstrating that electricity could be generated by mechanical means. But many years were to elapse before machinery was available for its production on a commercial scale and apparatus for its utilisation had been devised.
- 1837** *First electrical journal*—"The Annals of Electricity, Magnetism and Chemistry; and Generation of Experimental Sources". Conducted by W. Sturgeon, etc. in London from 1837 to 1843.
- 1837** The first practical electric truck ("*electro-magnetic locomotive*") constructed by Robert Davidson of Aberdeen. Electricity supply was from primary batteries. In 1842 a number of successful runs were made on the Edinburgh and Glasgow railway.
- 1837** *Professor M. H. Jacobi, a Russian, invented the process of *electro-plating*.
- 1839** *In a letter to Faraday, written from St. Petersburg, Jacobi described how he had successfully driven a *boat* by an electro-magnetic engine, supplied from a primary battery.
- 1844** Using horseshoe magnets, Woolrich produced a continuous uni-directional current from his *electro-magnetic generator*. This was used in an electroplating works in Birmingham.
- 1846–48** Development of the *carbon arc lamp* by W. E. Staite and W. Petrie. Many demonstrations were given including the lighting of the portico of the National Gallery, London, on 28 November 1848. The experiments failed because the primary cells from which the lamps were supplied were too costly in up-keep.
- 1847** **Siemens & Halske* founded in Berlin to manufacture electric telegraph cables using gutta-percha as insulation.

- 1847** *Gas Act*, including a clause giving rights to break up streets for the construction or repair of pipes. (Cf. "Electric Lighting Act", 1882)
- 1856–70** Professor F. H. Holmes pioneered the *illumination of lighthouses* by carbon arc lamps, supplied by magneto-electric generators for which he took out a series of patents during those years. The lighthouses involved were:
 1857 Experiments at Blackwall and South Foreland
 1862 Dungeness
 1870 Souter Point, Nr. Sunderland. This installation remained in service until 1900
 The Holmes machines were still too costly for general application.
- 1858** *Siemens & Halske & Co of London* founded. The partners were William Siemens & Halske of Berlin and Newall & Co.
- 1859** *Vulcanized rubber cable* introduced. W. T. Henley built his main cable factory at North Woolwich.
- 1859** *G. Planté in Paris produced a lead secondary cell or *storage battery*. But this did not find much industrial application at the time and it was not until 1881 that a fresh impetus was given to the study of the secondary cell by the discovery of another French inventor, C. Fauré.
- 1866–67** Development of the principle of *self-excitation of magneto-electric machines* ("dynamos") independently by Dr. H. Wilde, the brothers C. & S. A. Varley, Dr. Werner Siemens (in Germany), and Sir Charles Wheatstone.
- 1870** *The Tramways Act*, with its limitation of concessions to twenty-one years and subject to local authority consent, was to prove an unfortunate precedent for the first electricity legislation twelve years later.
- 1871** *Z. T. Gramme—a Belgian—produced a dynamo with a ring-wound armature, (the "Gramme Ring"), which *brought matters to a point where the industrial generation of electricity became a practical question*. The machine, after many changes and improvements, became the first generator to be used commercially.
- 1871** Foundation of the Society of Telegraph Engineers. (In 1880 the title was broadened to the Society of Telegraph Engineers and Electricians, and in 1888 it became the *Institution of Electrical Engineers*.)
- 1872** Dynamos in wide use for *electroplating*.
- 1872** Foundation of "The Telegraphic Journal and Electrical Review"—later to become "*The Electrical Review*".
- 1874** *"*The Electrical World: An Illustrated Weekly Review of Current Progress in Electricity and its Practical Applications*" established in the USA.
- 1876** *P. Jablochhoff, a Russian officer working in Paris, invented his famous "*electric candle*", consisting of two carbon rods placed side by side—the *first arc lamp* to be used on a large scale.
- 1877–79** The *first large installations of arc lighting*, principally by Jablochhoff candles, installed by French engineers:
 *The Grands Magasins du Louvre, in Paris.
 The Gaiety Theatre—the first public building to be electrically lighted in London; Billingsgate Market; street lighting on the Thames Embankment, Holborn Viaduct and the Mansion House; and industrial and private installations, including the commercial ironworks of

Wells Co., Shoreditch; London Bridge and St. Enoch (Glasgow) railway stations; Wills tobacco factory at Bristol; the British Museum Reading Room; Pullars Dye Works at Perth; and Cammells steelworks near Chesterfield. "The Electrician" Vol. 1, 1878 reports a football match played during October of that year under electric light before nearly 30,000 spectators at Bramall-lane Grounds, Sheffield.

- 1878** The first practical *incandescent carbon filament lamp*—demonstrated by Sir Joseph Swan at a meeting of the Newcastle-on-Tyne Chemical Society, on 18 December 1878. (His first lamp patent was January 1880.)
- 1878** Thirty-four *Private Bills* were introduced in Parliament with the object of *seeking powers to supply electricity* in various towns and break up streets and lay the necessary mains.
- 1878** *A de Meritens, in France, invented a magneto-electric machine (alternator) in which coils were replaced by a *distributed winding* to give a more uniform current.
- 1878–79** *C. F. Brush of the USA produced an efficient form of *open-coil dynamo and electric arc lamp* suitable for working in series. He promoted the formation of district street-lighting companies, raising local capital and negotiating terms favourable to his company, particularly in respect of the use of Brush equipment. The first of these was the California Electric Light Company of San Francisco whose generating station, supplying street lighting exclusively, was in operation during 1879.
- 1879** Appointment on 28 March of a *Parliamentary Committee under the chairmanship of Sir Lyon Playfair to consider all Private Bills seeking powers to supply electricity*. Their terms of reference were:
 "to consider whether it is desirable to authorize Municipal Corporations or other local authorities to adopt any schemes for Lighting by Electricity; and to consider how far, and under what conditions, if at all, Gas or other Public Companies should be authorised to supply Light by Electricity."
 The substance of the committee's recommendations, in a report published on 13 June, was to extend local authorities' power to break up streets for the laying of electricity mains—but that such power should not be given to companies in their own right, i.e. without local authority consent.
 The committee also considered the application of the principle of a reversionary purchase right to local authorities. Their recommendation was incorporated in the subsequent legislation.
- 1879** **First fatal accident due to electric shock* reported in France through contact made with a 250 V a.c. circuit.
- 1879** *Electric arc furnace* constructed by Sir William Siemens for melting iron and steel. Siemens showed that the electric furnace could compete in economy with the gas regenerative furnace, but there were no further developments until 1898.
- 1879** *Siemens and Halske exhibited an *electrically-driven locomotive* at the Berlin Exhibition, for transporting the visitors through the grounds.
- 1879** *Thomas Edison (of the U.S.A.) patented his *incandescent carbon filament lamp* in the U.S.A. and in Great Britain, and began production on a commercial scale.
- 1880** Sir Joseph Swan's House, 99 Kells Lane, Low Fell, Gateshead was almost certainly the *first house in Britain, and possibly the first in the world, to be lighted by incandescent lamps*.

- 1880** *First commercial Edison incandescent lamps* shown in London in February. The first public demonstration of electric lighting on a large scale by means of incandescent lamps was given in Newcastle, 10 October.
- 1880** Sir William Armstrong had a small hydro-electric plant (6 h.p.) constructed to light his picture gallery at Crag-side, Northumberland, a mile away—possibly *the world's first hydro-electric installation*.
- 1881** V. B. *vulcanized bitumen cable* developed by W. O. Callender and manufactured by a new company set up at Erith under the management of Thomas Callender, son of "W. O.". V. B. cables laid in compound-filled troughing (the "solid system") were used extensively for many years for low-voltage distribution.
- 1881** *Invention by C. Fauré in France of pre-formed accumulator grids revolutionised the original Planté cell of 1859 and laid the foundation of the modern *lead accumulator*.
- 1881** *First public supply* of electricity—when current generated by the waters of the River Wey was used to light the streets of Godalming. As there was no legal power to break up streets, the cables had to be laid in the gutters. (The supply was *discontinued* in 1884.)
- 1881** Swan Electric Lighting Co. formed early in the year. Independently, the Edison Electric Light Co. of London was formed to exploit Edison's inventions in electric lighting. Later in the year, the two companies merged to form the *Edison & Swan United Electric Light Co Ltd*.
- 1881** The possibility of *solar sea power* from a thermal engine utilising the temperature differences between the warm surface layer and deeper colder layers in tropical waters was pointed out by D'Arsonval in "Revue Scientifique" (Paris) 17 September.
- 1881** Many installations of *incandescent lamps* put in service, one of the most noteworthy being for the lighting of the Savoy Theatre, London, on 28 December.
- 1882** Parliament passed the *Electric Lighting Act, 1882—the first public measure dealing with electricity supply*. This enabled the Board of Trade by Licence or Provisional Order to authorise the supply of electricity in any area by any local authority, company or person—and to grant powers to install a system of supply, including breaking up streets. Licences, which could not be granted without the consent of the local authority concerned, were to be for periods not exceeding seven years, although they could be renewed. The Act gave local authorities the right to take over the assets of companies after a period of twenty-one years. For this reason, it discouraged enterprise. Regulations inserted in the Licences and Provisional Orders prohibited the amalgamation of undertakers and the erection of overhead lines without local authority consent. The Act provided the first statutory right for an individual within an area of supply to demand a supply of electricity; and it prohibited undue preference between consumers. Although 74 Provisional Orders and 7 Licences had been granted by the year 1888, the powers obtained were never exercised. Limited development did take place, however, by avoiding the Act, e.g. by obtaining the consent of the local authority for the use of overhead lines. (It is of interest to note that in this and subsequent Acts, the ultimate public ownership of the supply industry was envisaged.)
- 1882** *First steam power stations in the country for public supply:* *Holborn Viaduct* power station, financed by the Edison Electric Light Co. of London commenced operation on the *12 January*, initially with a supply of 110 V direct current. It claims the distinction of being the first

public steam power station in the world to cater for the needs of the private consumer as well as for public lighting.

Brighton power station, owned by the Hammond Electric Light Co. was opened on *27 February*—to provide the *first permanent public supply* in England to all consumers who desired it. It is generally regarded, too, as the *first viable* public supply station. The initial supply, provided by overhead lines, was direct current.

Two other power stations that were operational this year were *Hastings* and *Eastbourne*, where the system in each case was owned by the local electric light company and cables were laid in the streets with the assent of the local authority.

- 1882** *Thomas Edison's *Pearl Street* power station in *New York* served its first consumers in *September*, and a few weeks later the U.S.A.'s first hydro-electric plant started up in *Appleton, Wis.*
- 1882** Electrical Exhibition at the Crystal Palace, providing the first opportunity to the public of seeing electric *incandescent lighting on a large scale*.
- 1882** First application of *electricity underground*, at the Trafalgar Colliery, Forest of Dean, to drive a small pumping set.
- 1882** L. Gaulard and J. D. Gibbs obtained British patents for *alternating current distribution* by means of transformers connected in series.
- 1882** *Wiring Regulations*—"Rules and regulations for the prevention of fire risks arising from electric lighting" issued by the Society of Telegraph Engineers and Electricians. (This constituted the first edition of what became known as the I.E.E. "Regulations for the Electrical Equipment of Buildings", now in its 14th Edition.)
- 1883** Dr. John Hopkinson expounded the *principle of the two-part tariff* method of charging for the supply of electricity, incorporating a fixed or service charge in addition to the charge for the quantity of energy consumed.
- 1883** Brighton undertaking (Hammond Electric Light Co.) introduced a tariff requiring a payment of 6/- per lamp-week, plus an additional 1/6d for every carbon consumed—probably the *first instance of a two-part tariff*.
- 1883** Installation of electric lighting in the *Grosvenor Gallery*, Bond Street, by Sir Coutts Lindsay, the proprietor of the Gallery. The supply was from a small portable plant in the yard behind the Gallery. The success of this installation led to applications for a supply of electric light from many private and commercial premises in the neighbourhood, with the result that the small installation became overloaded.
- 1883** *First electric traction*. On 3 August a quarter-mile length of electric railway was opened for traffic at *Brighton* by Magnus Volk. Current was taken from a third rail at 140 V d.c.
A few weeks later the famous *Portrush to Giants Causeway* line (eight miles) in Northern Ireland started operating, at 550 V d.c. carried by an overhead trolley wire, the power being supplied from a hydro-electric plant at Bushmills.
- 1884** On 23 April the *Hon. C. A. (later Sir Charles) Parsons* filed two patents on the *steam turbine*. In the same year he built, at the works of Clarke, Chapman, Parsons and Co. the *first turbo-generator in the world*—a d.c. unit capable of developing about 7.5 kW at 100 V and at a speed of 18,000 r.p.m.
- 1884** Dr. John Hopkinson showed mathematically that, contrary to general

opinion, *alternators* could be *run in parallel*. Later that year this prediction was verified in experiments carried out by Prof. W. Grylls Adams at the South Foreland lighthouse.

- 1884–85 Construction of a permanent generating station on the *Grosvenor Gallery* site on a considerably larger scale by the Sir Coutts Lindsay Co. Ltd. The plant, of capacity 1,000 kW, was installed under the Gallery and provided a supply at a pressure of 2,500 V, alternating current. *Each consumer had a transformer installed in his house* and the primaries of all the transformers on a circuit were connected in series with the line, in accordance with the Gaulard and Gibbs system of distribution. The high-voltage current was carried by rubber-insulated cables strung upon poles and roof-top insulators over an area extending from Regents Park in the north, to the river Thames in the south, and from Knightsbridge in the west, to the High Courts of Justice in the east.
- 1885 Trials of first *electric tramway*—on Blackpool Esplanade.
- 1885–87 Introduction by Siemens Bros. of *lead-sheathed armoured cables*, insulated with rubber or gutta-percha.
- 1886 *Sebastian Z. de Ferranti* became chief engineer of the Sir Coutts Lindsay Co. which operated the Grosvenor Gallery generating station. He decided to adopt the “parallel” system of transformers and had the whole plant changed over to that system which has become universal today.
- 1886 *Oil-impregnated *paper insulated lead covered cables* introduced in the U.S.A. by the Norwich Wire Co. of New Jersey.
- 1886 Beginnings of the *General Electric Co. Ltd.* when Mr. Hugo Hirst (later to become Lord Hirst of Witton) joined Mr. Gustav Byng, in the proprietary of an electrical warehouse in the City of London called “The General Electric Apparatus Co.”
- 1886 Lord Rayleigh and Lord Bury, two members of the Society of Telegraph Engineers, introduced *Bills amending the Electric Lighting Act, 1882*. Although the Bills did not become law, the pressure exerted was to a large extent responsible for the passing of the 1888 Act—*q.v.*
- 1886 Sir Oliver Lodge installed the world’s first *electrostatic precipitator* in a lead smelter, but development was impeded by lack of high-voltage facilities.
- c. 1886–
1900 The so-called “*battle of the systems*” to be used for distribution ; with Col. R. E. B. Crompton, Dr. John Hopkinson, Lord Kelvin and others fighting a rearguard action on behalf of direct current against progressive Sebastian Z. de Ferranti, W. M. Mordey and Prof. Sylvanus Thompson pressing the claims of alternating current.
- 1887 Publication of the *first electrical catalogue* by Hugo Hirst for the General Electric Apparatus Co.
- 1887 *Kensington Court* power station, owned by the Kensington Court Electric Light Co. and designed by Messrs. R. E. B. Crompton & Co. opened in January—*one of the very earliest plants to be working in the London area*, providing a d.c. supply.
- 1887 Inauguration of the *London Electric Supply Corporation Ltd.*, formed from the Sir Coutts Lindsay Co. to take over the Grosvenor Gallery station as the nucleus of Ferranti’s *scheme for supplying electricity to London on a really large scale*. The project in view was the establish-

ment of a "vast" generating station at Deptford, from which power was to be transmitted seven miles to Central London.

- 1887** **Electric welding* introduced by Elihu Thomson, of the U.S.A.
- 1887–88** **Nikola Tesla*, a Serbian who emigrated to the U.S.A. where he did most of his work, and G. Ferrari, of Turin, independently produced *rotating magnetic fields* by two-phase currents. *Tesla* went on to invent the *induction motor* and to establish the fundamentals of the *polyphase system*, which underlies electrical power transmission as we know it today.
- 1888** Four 75 kW Parsons *single-phase turbo-alternators* ordered for the Newcastle and District Electric Lighting Co. Ltd., registered on 14 January 1889. The first two sets were commissioned in January 1890 (*q.v.*)
- 1888** *Institution of Electrical Engineers ("I.E.E.")*—formed from the Society of Telegraph Engineers and Electricians.
- 1888** *Electric Lighting Act 1888*. This Act *extended the period prior to the exercise of the reversionary purchase right of local authorities* to forty-two years, with further optional stages of ten years, and favourably amended the reversionary purchase price. As a concession to local authorities, their consent was now required for Provisional Orders, but their refusal could be overruled by the Board of Trade.
A clause was inserted in the Act to make it clear that the granting of supply rights to any body did not constitute exclusive rights within any area. The extreme case of *London*, however, presented special complications owing to the need to overlap local authority boundaries.
The Act *gave a new impetus to the establishment of electricity supply undertakings*. In the following ten years 316 Provisional Orders were granted of which 274 were exercised, but of 25 Licences granted only 3 were exercised. In London there were so many competing applications for Provisional Orders that in the following year (1889) the *Board of Trade* decided to hold an *Inquiry, presided over by Major (afterwards Sir Francis) Marindin*—see below.
- 1888** *Discovery by O. B. Shallenberger, Westinghouse's chief engineer, of a *workable principle for an a.c. ampere-hour meter*.
- 1889** *First electric tram service in Europe* opened at Northfleet, Kent.
- 1889** *Marindin Report* laid down the *general principles which were afterwards adopted as the basis for Provisional Orders granted to electricity supply undertakings in the London area*.
This Inquiry was the first of many attempts that were to be made to settle the electricity supply of London on regional lines.
The point round which the greatest controversy raged was whether it was better to adopt *direct or alternating current* for distribution; there was also contention regarding whether or not supplies to large areas should be dependent on one station. On engineering grounds, a.c. distribution generally found little favour. Major Marindin expressed himself as being wholeheartedly in favour of encouraging any experiment that was likely to be for the public benefit; and he equally emphatically *upheld the proposal to supply large areas from one power station*.
Where a local authority agreed to allow *competing companies* within its area, the number should be restricted to two, but both should not supply a.c. because of its unsuitability for the electric motors then available—i.e. *one supply should be d.c.*
Electricity should be available to all, even despite local authority objection, and all overhead lines should be removed within two years of a Provisional Order being granted.

- 1889** Start-up of the London Electric Supply Corporation's *famous Deptford power station*—later to be known as Deptford East—designed by *Ferranti*, for the transmission of power at the then extreme pressure of *10,000 V a.c.* to transformers placed in the central London area, which would reduce the pressure, in two steps, to that convenient for working incandescent lamps, i.e. 100 V. The frequency of supply was 5,000 cycles per minute, i.e. $83\frac{1}{3}$ Hz. The initial installation comprised four alternators of capacity 250 h.p. (two), 400 h.p. and 750 h.p., transferred from the Grosvenor Gallery station. These generated at a pressure of 2,500 V stepped up to 10,000 V for transmission. Two 1,500 h.p. 10,000 V alternators were manufactured and erected in 1889—by far the *largest in the world*. Transmission at this voltage over the seven miles to central London was by *underground cables*. Initially the cables were of the jute-insulated concentric type supplied by a manufacturer. But these proved unsatisfactory because of many breakdowns. Ferranti therefore decided to design and manufacture the cables at the power station itself. The Ferranti cables were of concentric copper tubes with wax impregnated paper insulation—a milestone in the history of cable making. The cables were run, in the first instance, for a considerable portion of their length on the walls or arches of the South Eastern Railway Co.'s lines. But later, owing to the risk of fire, the whole cable run was laid underground. About 28 miles in all of Ferranti's cable were laid and some of it had a working life of over 40 years. This was the *pioneer of all high-voltage paper-insulated cables in the world*. Ferranti had plans for installing even larger machines, i.e. of capacity *10,000 h.p.* driving 10,000 V alternators. But these machines were never completed because the Board of Trade granted so many Provisional Orders to rival companies that the area allocated to the Deptford scheme was much less than that for which it had been designed. Turbo-alternators of various sizes were installed in 1912 and later years, the earliest ones operating at the original frequency of $83\frac{1}{3}$ Hz, followed by machines at 25 Hz for providing the Southern Railway with traction supplies, culminating in the installation of 52.5 MW machines in the 1950s operating at the standard frequency of 50 Hz.
- 1889** *C. A. Parsons & Co.* established. (Previously the firm was Clarke, Chapman, Parsons and Co.)
- 1889** Foundation of the *Electrical Trades Union* ("E.T.U.").
- 1889** **Electric fan*, powered by a *one-sixth h.p. a.c. motor*, introduced by Nikola Tesla and the Westinghouse Co. of the U.S.A.—probably the *first of the commercial small power units employed in the home*.
- 1889** Inauguration of the Bradford Corporation's electricity supply system on 20 September—the *first municipal power station in the country*.
- 1889** *General Electric Co. Ltd.* incorporated (previously, the General Electric Apparatus Co.).
- 1890** In January the *Forth Banks* power station of the Newcastle and District Electric Lighting Co. Ltd. went into commission with an initial equipment of two 75 kW Parsons turbo-alternators constructed by Clarke, Chapman, Parsons and Co. of Gateshead—the *earliest instance of the use of the steam turbine in any public power station*. The single-phase alternators supplied current at 1,000 V and 80 Hz: the speed of the sets was 4,800 r.p.m.
- 1890** *Oil-impregnated paper insulated cables*—the newly formed British Insulated Wire Co. of Prescott acquired from the Norwich Wire Co. of

New Jersey the rights of that Co.'s tape lapping process, enabling them to manufacture paper/lead cable. By the end of the following year, the manufacture of both low—and high-voltage cable had been commenced at Prescott.

- 1890** *Domestic electrical appliances*—the General Electric Co. by now were selling electric *flat irons, fans, immersion water heaters*, and an "*electric rapid cooking apparatus, which boiled a pint of water in twelve minutes*".
- 1890** *Electric cooking*—first practical experiments in this country.
- 1890** City and South London Railway began operating from King William St. to Stockwell—the first electrically-operated *underground railway* in the world.
- 1890** *First Scottish public supply*—from Fort Augustus, comprising an 18 kW oil engine and a similar size water wheel.
- 1890** **First legal electrocution*—on 6 August at Auburn prison, New York.
- 1890** Establishment of "*The Electrical Standardising, Testing and Training Institution*", later to become the *Faraday House Electrical Engineering College*. Founded by Robert Hammond of Hammond Electric Light Co., the Institution was opened to be responsible to the Board of Trade for inspecting plant, apparatus, meters etc in electricity undertakings. Faraday House was the pioneer training school for electrical engineers. It closed down in 1967.
- c. 1890** *First overhead transmission lines* erected in this country.
- 1891** *First electric street tramway*—installed by Leeds Corporation.
- 1891** C. A. Parsons & Co. supplied a 100 kW turbo-alternator set to the Cambridge Electric Lighting Co.—the *first turbine to work condensing*.
- 1891** **Long distance power transmission by three-phase alternating current* foreshadowed by a demonstration by Oskar van Miller at the International Electrotechnical Exhibition at Frankfurt-on-the-Main, Germany. A load of 240 kW was supplied from Lauffen to Frankfurt, over a distance of 110 miles, by three-phase a.c. at 25,000 V. This provided an impetus for the famous Niagara Falls project which began to be considered in or about 1892.
- 1891** The periodical "*Lightning*"—now "*The Electrical Times*"—began publication.
- 1891** *Electric cooking*—brought into the limelight at the Electrical Exhibition at the Crystal Palace.
- 1891** **Speed control of d.c. motors*—introduction by Ward-Leonard of the U.S.A. of a system of control making possible numerous applications of electric drive not so far contemplated, as in colliery winding gear.
- 1892** *Oil-immersed circuit breaker*—invented by G. W. Partridge, Chief Engineer and Managing Director of the London Electric Supply Corporation Ltd.
- 1893** *Superheated steam*—first experiments for power station work by W. H. Patchell, engineer to the Charing Cross and Strand Electricity Supply Corporation.
- 1893** First section of the Liverpool Overhead Railway (in Liverpool Docks)

was opened for traffic this year. Electrically equipped from the beginning it was the *first example of an elevated electric railway* in the world.

- 1893** *First generation of electricity from town refuse* was demonstrated at Halifax—a refuse fired Livet steam generator powered a Parsons turbo-alternator of 25,000 candlepower capacity. At Cheltenham in 1895 a new electricity station was built adjacent to the town's refuse destructor taking from it 60–70 h.p. equivalent of steam. New refuse-fired generation projects opened at Shoreditch in 1897 and at Shipley, Stepney, Beckenham, Accrington, Fulham and Nelson in 1900. By 1905 there were over 40 of them.
- 1894** *Electric cooking*—cookers were used for a promotional “all-electric” banquet, organised by the City of London Lighting Co. Ltd. This was the first public dinner cooked by electricity—six large ovens with hot-plates etc. serving 120 guests.
- 1894** Inauguration of the Worcester Corporation's power station, the generators of which could be *driven either by water power or*, if sufficient water were not available, *by steam engines*. The aggregate capacity of the combined water/steam plant was 400 kW, with an additional 60 h.p. turbine and alternator.
- 1895** *Inauguration of the *Niagara Falls hydro-electric project*, primarily for the production of aluminium by the Hall process. Power generation was at 5,000 V on a two-phase 25 Hz system based on Tesla's polyphase a.c. concept. In the following year, 1896, three-phase transmission at 11,000 V was initiated from Niagara Falls to Buffalo, 22 miles.
- 1896** *First geared Parsons turbo-alternator* erected at the Forth Banks power station of the Newcastle and District Electric Lighting Co.—capacity 150 kW, 9,600/4,800 r.p.m.
- 1896** A hydro-electric power station commissioned at Foyers in Inverness-shire, Scotland, for the British Aluminium Co. Ltd. 5,000 kW of d.c. generating plant was installed for aluminium production—the *first large scale hydro-electric development in Scotland*.
- 1896** *First Board of Trade regulations* for securing the safety of the public and a proper and sufficient supply of electrical energy included a provision that the variation of pressure at any consumer's terminals from the declared constant pressure should not exceed four per cent. Regulations made in 1905 restricted also the variation from the declared frequency in the case of an a.c. supply to not more than two-and-a-half per cent. The same limits were included in regulations made by the Board of Trade in 1915 and by the Electricity Commissioners in 1927 and 1929. Regulations made by the Commissioners in 1934 altered the permissible variation from the declared voltage to up to six per cent, and in 1937 altered the permissible variation from the declared frequency to up to one per cent.
- 1896** *H. Becquerel, in France, discovered *radio-activity*—the natural disintegration of an element—in the case of uranium.
- 1896** *Incorporated Municipal Electrical Association (“I.M.E.A.”)*—the first annual convention held in Brighton, in June.
- 1896** First issue of the *“Manual of Electrical Undertakings”* compiled by Emil Garcke (*“Garcke's Manual”*). This annual publication ceased with the 1959/60 edition.
- 1897** *The electron* discovered by Sir J. J. Thomson.

- 1898** Report of the "*Cross Committee*"—a Joint Select Committee of both Houses of Parliament under the chairmanship of Viscount Cross—which recommended compulsory powers of acquisition of sites for generating stations, even though these were not within the areas of supply; that powers might be given for an electricity supply over an area including districts of numerous local authorities and involving plant of exceptional dimensions and high voltage; and that reversionary purchase rights of local authorities should not apply in the case of bulk supplies. (The *recommendations* were not the subject of legislation until the Electric Lighting Act, 1909—*q.v.*—but they *were used by Parliament in the consideration of Private Bills promoted by "Power Companies"*.)
- 1898** First "*Power Bills*" were promoted for the generation of electricity on the large scale and its transmission at high pressure over wide areas—a feature was perpetual tenure, i.e. no reversionary purchase rights.
- 1899** *Electric Lighting (Clauses) Act*, laying down common principles to be incorporated in all Provisional Orders *other than those for within the London area*. The Act also expressly prohibited any amalgamation or association of electricity undertakers, or the supply of electricity outside the prescribed area and made the construction of overhead lines subject to Board of Trade as well as local authority consent.
- 1899** *Cable Manufacturers' Association ("C.M.A.")* formed.
- 1900** Several special Acts of Parliament were passed, under which "*Power Companies*" were set up with rights in perpetuity to supply electricity to authorised undertakings and for industrial and manufacturing purposes over wide areas, and to give general supplies in the parts of the areas not already covered by distribution rights. The conditions under which the power company may give a supply are contained in what was known as the "*Kitson Clause*"—which resulted from the deliberations of a Committee of the House of Commons presided over by Sir James Kitson in the Session of 1900, when the first of the Power Bills were being considered. The clause safeguarded the privileges of existing company and local authority undertakers.
- 1900** First 1,000 kW turbo-alternators, with the first tandem cylinder arrangement, supplied by Parsons to the City of Elberfeld in Germany. Single-phase current was generated at 4,000 V and 50 Hz.
- 1900** *Cooper Hewitt *mercury discharge lamp* introduced in the U.S.A. An arc was drawn between electrodes by switching on and then tilting the lamp slowly.
- 1900** First three-phase turbo-alternator in the U.K. and, as far as is known, in the world, built by Parsons for the Ackton Hall Colliery, Featherstone, Yorks—output 150 kW, frequency 40 Hz. The machine was to provide power for coal cutting.
- 1900** First public supply of three-phase current:
A supply at 6,600 V and 40 Hz was provided from the *Neptune Bank power station*, built by Charles Merz, and officially opened by Lord Kelvin in 1901. This station, originally owned by the Walker and Wallsend Union Gas Co., was later taken over by the Newcastle-upon-Tyne Electric Supply Co., which *pioneered electric power for industry* in the north east coast heavy engineering area, including some of the leading shipyards. The station, equipped with three reciprocating steam engines each of 800 kW provided the *first example of bulk supply*.
Wood Lane power station, constructed as a joint enterprise by the

Kensington Court and Notting Hill companies, started a three-phase supply at 5,000 V—raised after forty years to 6,600 V in accordance with other systems.

- 1901 Formation of the firm of *Merz and McLellan*, consulting engineers, from a partnership of Charles Merz and William McLellan (late of Siemens).
- 1901 Formation of the *Engineering Standards Committee* (to become in 1918 the British Engineering Standards Association and in 1929 the *British Standards Institution*).
- 1901 Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board Act. At this time many municipalities were aware of the need for larger areas of supply and this was the *first Private Bill for joint municipal action* to be promoted and passed. (Joint Committees or Joint Boards of two or more local authorities were authorised by the Electric Lighting Act 1909—*q.v.*)
- 1901 *First prepayment meter* (Long Schattner) approved—for direct current. The first a.c. prepayment meter approved in 1908 (Aron).
- 1901 Bradford Corporation, by means of a Private Act, obtained *powers to sell or hire electric fittings or apparatus*—the first undertaking to obtain such powers.
- 1901 Formation of the *Electrical Contractors' Association* ("E.C.A.").
- 1902 National Electrical Manufacturers' Association formed—to become, in 1911, the *British Electrical & Allied Manufacturers' Association (Incorporated)*.
- 1902 Parsons supplied for the Neptune Bank power station Newcastle-upon-Tyne a *1.5 MW three-phase alternator* of the revolving armature type, generating at 6,600 V 40 Hz. This machine—the largest size yet manufactured—gave trouble and was replaced by one with a rotating field, a radical change which has never been abandoned.
- 1903 *Supply of Electricity Bill* introduced by the Board of Trade. The object was to remove some of the restrictive features of the general Electric Lighting Acts, but the Bill, though re-introduced several times in subsequent years, was not proceeded with in its original form.
- 1903 *First alternator with a rotating field*, rating 2.0 MW 6,000 V three-phase 40 Hz installed by Parsons at the Neptune Bank power station.
- 1903 Experiments with *pulverized fuel* at the Willesden power station of the Metropolitan Electric Supply Co.—later the C.E.G.B.'s Acton Lane "A" station.
- 1904 *Carville "A" power station* of the Newcastle-upon-Tyne Electric Supply Co. commissioned. This station, designed by Charles Merz and equipped entirely with turbo-alternators, was *world-famous as the first large generating station of the modern type*. The initial plant comprised 2×3.5 MW and 2×1.5 MW units, the 3.5 MW units being nearly double the capacity of any turbine which had been made up to that time. This was the first power station to have a *control room*.
- 1904 Sir Ambrose Fleming patented the *rectifying valve*.
- 1904 Development of the *Merz Price system of protection* and other methods which led to the safe operation of large *interconnected networks*, the first example being the Newcastle-upon-Tyne Electric Supply Co's system on the North East coast.

- 1904** Completion of the electrification of the Liverpool–Southport section of the former Lancashire and Yorkshire Railway, comprising 83 single-track miles—the first example in the U.K. of *main line electrification*.
- 1904** **Geothermal energy*—Prince Ginori Conti installed a reciprocating engine driven by the earth's steam which, coupled to a d.c. generator, supplied lighting in the Italian town of Larderello, Tuscany.
- 1905** Start-up of the *Lots Road Power Station*, Chelsea—to supply *London's underground electric railways*. When built it was the largest in Europe and third largest in the world.
- 1905** *First turbo-alternators to generate at 11 kV* were supplied by Parsons to the Kent Electric Power Co. for their Frindsbury Station.
- 1905** *Tantalum lamp* introduced (patented 1901 and 1902).
- 1905** *Metalclad compound-filled draw-out type switchgear* designed by H. W. Clothier and B. Price of A. Reyrolle Ltd.
- 1905** Formation of the *Incorporated Association of Electric Power Companies ("I.A.E.P.C.")*.
- 1905** Formation of the *London Electricity Supply Association ("L.E.S.A.")*.
- 1906** **Tungsten filament lamps* introduced—based on squirted filaments (Just and Hannaman's process).
- 1906** Foundation, in London, of the *International Electrotechnical Commission ("I.E.C.")*.
- 1906** Newcastle-upon-Tyne Electric Supply Co. raised their *mains transmission* to 20 kV—the highest in the country.
- 1906** London County Council (General Powers) Act, 1906. A clause of this Private Act *empowered Metropolitan Borough Councils to supply electric fittings, etc.*
- 1906** Start-up of the *Greenwich power station* of the London County Council, with four 3,500 kW units to power London's electric tramway system. These were the *last large reciprocating engines* to be installed in Britain.
- 1906** Formation of the *Batti-Wallah's Society*—society of electrical engineers, the term Batti-Wallah being the Hindustani for "lamp-man", applied in the early days to sea-going electrical engineers with the P. & O. Line.
- 1906** Commissioning of the *Cwm Dyli hydro-electric station* of the North Wales Power Co., capacity 2,000 kW, erected to supply nearby slate quarries with three-phase 50 Hz.
- 1906–08** Municipal undertakings brought pressure to bear—unsuccessfully—to include in the Supply of Electricity Bill, originally introduced in 1903, *provision for the sale and hire of apparatus and installation wiring* (Many municipalities already had such powers through Private Acts).
- 1907** *Dolgarrog hydro-electric station*, North Wales, capacity 5,200 kW opened by the Aluminium Corporation to supply power to its *aluminium works*: taken over by the North Wales Power Co. in 1920.
- 1907** *Lee de Forest of the U.S.A. invented the *triode valve*.
- 1907** **Electric washing machines* introduced in the U.S.A.
- 1908** Electricity (Factories Act) Special *Regulations* 1908.

- 1908** Midland Railway equipped its Lancaster Morecambe and Heysham line to operate at 6,600 V a.c. 25 Hz single phase—the *first a.c. railway line* in the country.
- 1908** **Vacuum cleaners* introduced in the U.S.A. under the title “electric suction sweepers”.
- 1909** *Electric Lighting Act, 1909*, which took the place of the Supply of Electricity Bill (promoted in 1903), accepted the need for reorganisation of supply to take account of technical development in generation and transmission. It gave effect to some of the essential recommendations of the Cross Committee of 1898, including *authorising local authorities and companies*, as distinct from “power companies” to *supply electricity in bulk*, and the formation of joint committees or joint boards by two or more local authorities. The Act requires the *consent of the Board of Trade for the erection of generating stations*. (This consent is still required as amended by the Electricity Acts 1947 and 1957.) A clause enabling local authorities to provide electrical appliances was included in the Bill but was dropped because of an amendment in the House of Lords to the effect that local authorities might do this work “through a contractor but not otherwise”. The Act authorised the Board of Trade to make “*fringe*” *Orders*, that did not require confirmation by Parliament, for the supply by an undertaking to specific premises situated outside their defined area of supply. It prohibited unauthorised undertakers from competing with statutory undertakers.
- 1909** **Improved tungsten filament lamps*—Coolidge in the U.S.A. produced tungsten in a ductile form, by sintering and swaging, enabling it to be drawn into strong tough wire suitable for incandescent lamps.
- 1910** *Steam turbines* now the general form of prime mover.
- 1911** P. V. Hunter invented the split conductor *protective gear*.
- 1911** Formation of the *British Electrical and Allied Manufacturers’ Association (Incorporated)* (“*B.E.A.M.A.*”) to succeed the National Electrical Manufacturers Association.
- 1911** Lord Rutherford formulated his *nuclear atomic theory*. The atom was pictured as consisting of a central positively-charged nucleus, around which negatively-charged electrons revolved.
- 1911** *First commercial trolley buses*, at Leeds and Bradford.
- 1911** **Superconductivity*—discovery by Kamerlingh Onnes in Holland of that property of a metal of apparently offering no resistance to electric current at temperatures near to absolute zero. It was not until 50 years later, however, that materials could be found that could be employed to operate under conditions required in practice for electrical engineering equipment.
- 1912** On 12 December, the Institution of Electrical Engineers appointed a *Research Committee* whose objects would be two-fold—(i) to co-ordinate research and (ii) to originate research. The Committee’s first work (1914) was in connection with magnet steels, the heating of buried cables and the properties of insulating oils.
- 1912** Parsons installed a *25 MW turbo-alternator* set running at 750 r.p.m. at the Fisk Street power station of the Commonwealth Edison Co. in Chicago. Its steam conditions were normal for the time and it had no revolutionary features beyond its size—the largest yet built in Great Britain.

- 1912** **Electric refrigerators* introduced in the U.S.A.
- 1913** **Gas-filled incandescent lamps* introduced by Irving Langmuir of the U.S.A., using inert gas (argon) and having a coiled filament.
- 1913** Formation of the *Electrical Power Engineers' Association ("E.P.E.A.")*.
- 1913** *Neon lamps* used at a West End, London, cinema.
- 1914** Foundation of the *Association of Supervising Electrical Engineers ("A.S.E.E.")*, which registered as a trade society in 1918.
- 1914** *Carville "B" power station* commissioned by the Newcastle-upon-Tyne Electric Supply Co. This station, a *great advance in design*, was laid out for five 11 MW units—the largest it was possible to build at the time for the maximum speed of 2,400 r.p.m. permitted by the 40 Hz supply. The steam conditions were 250 lb/sq. in. and 650°F. The station was superior both technically and thermodynamically to anything that had preceded it, and for many years held the record for thermal efficiency.
- 1915** White Paper "*Scheme for the Organisation and Development of Scientific and Industrial Research*", Cd. 8005.
- 1916** Government established the *Department of Scientific and Industrial Research ("D.S.I.R.")* to deal with proposals for instituting specific researches, proposals for establishing research establishments and the establishment of research fellowships.
- 1916** *Charles Merz*, in his paper on "Electric Power Distribution" presented at the meeting of the British Association for the Advancement of Science in Newcastle, stated: "What is fundamentally and immediately necessary is the establishment of a *national electric trunk mains distribution system*".
- 1916** Introduction of *regenerative feed heating*—in the 3 MW Parsons turbine installed at the Blaydon Burn waste heat power station.
- 1916** Joint Committee of the I.M.E.A. and I.A.E.P.C. urged that *generation should be considered as a major national problem* irrespective of the separate issue relating to the area of distribution undertakings.
- 1916** *Coal Conservation Sub-Committee* (Chairman: *Viscount Haldane*) appointed a *Sub-Committee to investigate the question of electric power supply*. The report (issued in 1918) recommended the re-organisation of generation and main transmission on a regional basis under the central supervision of a "*Board of Electricity Commissioners*".
- 1916** *Electrical Trades' Committee* appointed by the Board of Trade under the chairmanship of *Sir Charles Parsons*. Their report, published in 1918, stated that past electricity legislation had restricted the proper expansion of the supply industry, resulting in electricity areas too parochial and entirely unrelated to the economic area of electrical supply, and hence in the growth of small uneconomical stations. The report recommended that the development of electricity supply should be in the hands of a new and independent *Board of Commissioners* free from political control and *untrammelled by past traditions*.
- 1916** *National Electrical Contractors Trading Association ("N.E.C.T.A.")* formed to deal with commercial matters affecting electrical contracting. (Ceased to exist in 1970.)
- 1916** *National Federated Electrical Association ("N.F.E.A.")* formed to deal

with industrial relations in electrical contracting industry and to negotiate with the E.T.U. wages and working conditions in that industry. (Ceased to exist in 1970.)

- 1917 D.S.I.R. appointed an *Electrical Research Committee* consisting of members nominated by the I.E.E and B.E.A.M.A. to control the research grants made by the Department.
- 1917 Board of Trade set up an *Electric Power Supply Committee* under the chairmanship of *Sir Archibald Williamson* to consider what steps should be taken to "ensure that there should be an adequate and economical supply of electric power available for all classes of consumer, particularly industries which depended upon cheap supplies of power for their development". The committee's report, published in 1918, led to the Electricity (Supply) Act 1919—*q.v.*
The committee concluded that *concentration of larger generating units in fewer power stations* was urgently required, and that one central authority should be created to regulate generation and distribution of electricity to be known as "*The Electricity Commissioners*". Generating stations and main transmission lines should be *publicly owned*, the ownership being transferred to District Electricity Boards.
- 1917 Inauguration of the *Provincial Electrical Supply Association* ("*P.E.S.A.*").
- c. 1917 *Electric washing machines* introduced (U.S.A. in 1907).
- 1918 *Electric refrigerators* introduced (U.S.A. in 1912).
- 1918 Formation of the *English Electric Co.*
- 1918 Reports of the "*Haldane*" Coal Conservation Sub-Committee 1916, the "*Parsons*" Electrical Trades' Committee 1916, and the "*Williamson*" Electric Power Supply Committee 1917—See under years mentioned.
- 1919 *Negotiating machinery* for agreements on wages and salaries and working conditions in the electricity supply industry—formation of the *National Joint Industrial Council* to cover manual grades, and of the *National Joint Board of Employers and Members of Staff* to cover the technical staff.
- 1919 Ministry of Reconstruction, Advisory Council—*Report of the Committee of Chairmen* on Electric Power Supply* appointed in 1918 under the Chairmanship of *Sir Henry Birchenough*. The committee were asked to submit general comments or suggestions on the broad administrative and commercial issues arising out of the Williamson Report. They recommended that generation and transmission should be a *single unified system with state regulation and finance*. Means should be found for including distribution as well.
- * Haldane, Williamson and Parsons.
- 1919 *Electricity (Supply) Act, 1919*, based essentially on the Williamson and Birchenough reports, introduced *central co-ordination* by establishing the *Electricity Commissioners*, an official body responsible for securing reorganisation on a regional basis. The Commissioners, whose first Chairman was Sir John Snell, delineated *Electricity Districts* and investigated a number of regional schemes for centralising generation in a relatively small number of large generating stations owned by Joint Electricity Authorities. But in general this method of dealing comprehensively with the problem was handicapped by the lack of compulsory power.
The Act granted powers to undertakings to hire—but *not* to sell—electrical appliances.

- 1919** *First large pulverised-fuel fired boilers*—three units at the Hammersmith Borough Council's power station, using the bin-feed system.
- 1919** *Hydraulic coal delivery* introduced at the Hammersmith Borough Council's power station.
- 1919** The *first district heating scheme* in the UK was completed at Gorton and Blackley, Manchester, but it failed as a result of pipeline corrosion.
- 1919** *British Electrical Development Association ("E.D.A.")* formed.
- 1919** Lord Rutherford's experiments on *nuclear disintegration*. He bombarded a nitrogen nucleus with alpha particles and obtained a hydrogen nucleus—the first "smashing of the atom".
- 1919** *First totally-enclosed air-cooling system for alternators*, at Blaydon Burn power station.
- 1920** *L. Emanueli in Italy introduced his *oil-filled cable*, designed to operate at 80 kV.
- 1920** **Screened (Hochstadter or "H"-type) three-core cable* introduced—in the U.S.A., where it was patented in 1916.
- 1920** *Electrification of Railways Advisory Committee* appointed by the Minister of Transport, with *Sir Alexander Kennedy* as Chairman, recommended that regulations be made on standardisation of methods and equipment.
- 1920** Incorporation of the British Electrical and Allied Industries Research Association—commonly known as the *Electrical Research Association ("E.R.A.")*.
- 1920** *Regulations relating to extra high voltage*. Under the electricity supply acts 1882–1919 the Electricity Commissioners issued Regulations (Ref. ELC.13) as to extra high pressure—(a) for securing the safety of the public and (b) for ensuring a proper and sufficient supply of electrical energy.
- 1921** Commissioning of the *North Tees* power station of the Newcastle-upon-Tyne Electric Supply Co., notable as the first to use really *high steam pressure*, i.e. 450 lb/sq. in. at 650°F at the turbine stop valve, and the *reheat cycle*.
- 1921** *Water Power Resources Committee* appointed by the Board of Trade in 1918 with *Sir John Snell* as chairman, reported that it was vital that natural resources in Great Britain should be developed, and they proposed schemes providing potential water power of some 270 MW, of which four-fifths related to Scotland.
- 1921** *Lochaber Water Power Act*, sanctioning the construction of hydro-electric works to be carried out by the Lochaber Water Power Co., a subsidiary of the British Aluminium Co Ltd. It included a Section concerning the *preservation of visual amenity*. The plant was commissioned in 1929—q.v.
- 1921** *Inauguration in Paris of the *Conférence Internationale des Grands Réseaux Electrique à Haute Tension—"C.I.G.R.E."*
- 1921** *The first *underground hydro-electric power station*, in Norway.
- 1922** British *turbine* manufacturers began to adopt *two-cylinder designs* for

machines of increasing output at speeds of both 1,500 r.p.m. and 3,000 r.p.m.

- 1922** *Grampian Electricity Supply Co.* obtained Parliamentary powers for the construction of important hydro-electric works in Northern Scotland, but these schemes were not immediately proceeded with. (See under 1930)
- 1922** *Electricity (Supply) Act, 1922.* This cleared the financial position of *Joint Electricity Authorities* to enable them to take effective action where they were set up, as regional schemes were agreed. But it restricted their right to give a supply of electricity within the area of a power company.
- 1923** Electricity supply undertakings brought into membership of the *E.R.A.* when the Associate Member class was introduced.
- 1923** *National Register of Electrical Installation Contractors ("N.R.E.I.C.")* incorporated. Superseded by the National Inspection Council in 1956—*q.v.*
- 1923** **First 220 kV transmission* in the USA.
- 1924** Electricity Commissioners published their first *Overhead Line Regulations* ELC. 39, based on the recommendations of a committee set up by the I.E.E.
- 1924** *Lanarkshire Hydro-electric Power Act*, providing for the harnessing of the water power of the Falls of Clyde—i.e. the Lanark hydro stations, commissioned in 1927–1928—see under that date.
- 1924** Foundation of the *Electrical Association for Women ("E.A.W.")*.
- 1924** First meeting of the *World Power Conference* (from 1968 the World Energy Conference).
- 1924** Appointment in March of an unofficial *Committee on Coal and Power*, under the chairmanship of *Lloyd George*. The Committee's aim was to make proposals for resolving the difficulties of the interlinked questions of coal and electricity. Their proposals, made in a report on "Coal and Power" issued in July, were the *basis of Government policy*, announced the same month, which included promising the introduction of a Bill to give additional powers to the Electricity Commissioners.
- 1925** *Severn Barrage Committee*—on 25 October, the Prime Minister appointed a Sub-Committee, under the Chairmanship of Lt. Col. J. T. C. Moore-Brabazon, of the Committee of Civil Research, with the following terms of reference: "To enquire into, and report upon the practicability of a Severn Barrage". (The Committee reported in 1933—see under that year.)
- 1925** *Electricity supply regulations*—Under the electricity supply acts 1882–1919 the Electricity Commissioners issued Regulations (Ref. ELC.38) (a) for securing the safety of the public and (b) for ensuring a proper and sufficient supply of electrical energy.
- 1925** Commissioning of the *Barking "A"* power station of the County of London Electricity Supply Co., comprising 4 × 20 MW and 4 × 40 MW turbo-alternator sets. The 40 MW size were cross-compound units, two of which worked on the reheat cycle. There were to be two other stations—"B" and "C"—on the Barking site; see under 1933.
- 1925** *Foundation in Paris of the *Union Internationale des Producteurs et Distributeurs d'Énergie Électrique ("U.N.I.P.E.D.E.")*.

- 1925** Appointment by the Minister of Transport of the "*Committee to review the national problem of the supply of electrical energy*", under the chairmanship of Lord Weir. The recommendations of the *Weir Committee* published in 1926, were embodied in the Electricity (Supply) Act of that year.
- 1926** *Electricity (Supply) Act 1926*, introducing the *first effective national co-ordination*. It provided for the creation of a public corporation, the *Central Electricity Board*, to concentrate the generation of electricity in a limited number of "*Selected*" stations, and to interconnect these stations, linking up the existing regional system into a national "*Grid*", by the erection of a high-tension main transmission system. The Act also required the Board to standardise the frequency of alternating current throughout the country, so that effective interconnection could be established; and to supply, either directly or indirectly, local undertakings which required electricity for distribution, and for this purpose to purchase the output of the Selected Stations and sell it to the local undertakings.
A clause conferred full trading powers on those undertakings who did not already possess them.
- 1926** *Hochstadter patented the application of gas pressure through a flexible diaphragm, leading to the *compression cable* in 1931—*q.v.*
- 1926** **First oil-filled cable at 132 kV*—some 36 miles of single-core cable ordered by the New York Edison Co. (First use in the U.K., 1931.)
- 1926** Invention of the *air-blast circuit-breaker* by W. B. Whitney and E. B. Wedmore. Developed experimentally by the E.R.A. this design was first produced commercially in Germany and Switzerland.
- 1926** *First experimental *hydrogen-cooled alternators* put into service in the U.S.A.
- 1927** *Railway Electrification Committee* appointed by the Minister of Transport with *Sir John Pringle* as Chairman, endorsed the recommendations of the Kennedy Committee of 1920. As a result of its recommendations the Minister made the Standardisation of Electrification Order of 1932—*q.v.*
- 1927** *Foundation at Arnhem of the *N.V. tot Keuring van Electrotechnische Materialen* ("*K.E.M.A.*"), the Dutch national research and testing laboratories for electrical equipment and appliances.
- 1927** Appointment by the Minister of Transport in March of the first members of the *Central Electricity Board* ("*C.E.B.*"), under the chairmanship of *Sir Andrew Duncan*.
- 1927** *Grid Scheme Areas*—for the purposes of the Grid construction programme, England, Wales and South of Scotland were divided into nine Scheme Areas adopted by the C.E.B. during the years 1927–1930. These Schemes were so designed that they would connect into each other to complete the national plan. The *first* to be adopted was for *Central Scotland* in June 1927.
- 1927** Sir Archibald Page's Presidential Address to the I.E.E. on 20 October reviewing the development of electricity supply up to 1927 and the main features of the *Grid system*. Published in the "I.E.E. Journal", December 1927.
- 1927** Electricity Commission—*Report of the Advisory Committee on Domestic*

Supplies of Electricity and Methods of Charge appointed by the Electricity Commissioners in 1925.

The committee were to consider what methods of charge for domestic supplies could be authorized as standard methods in place of flat rates. They were unable to recommend exclusive adoption of any of the forms of two-part tariff considered.

- 1927 *Single core *132 kV paper-insulated cable* in commercial use in the U.S.A.
- 1927 **Electricity Supply Board, Ireland* established by statute to generate, distribute and sell electricity.
- 1927–28 Commissioning of the *Lanark hydro-stations* on the Falls of Clyde: Bonnington, capacity 9.84 MW, and Stonebyres, 5.68 MW—owned by the Lanarkshire Hydro-electric Power Co.
- 1928 First *oil-filled cable in the U.K.*—a single-core cable at 66 kV
- 1928 *Maentwrog hydro-electric* station of the North Wales Power Co, capacity 24 MW, commissioned
- 1928 Electricity Commission—*Report of Proceedings of Conference on Electricity Supply in Rural Areas*, convened by the Electricity Commissioners in November 1927.
The Conference appointed two Sub Committees to report on (i) the nature and extent of the potential demand for electricity in rural areas and (ii) the bearing and general effect upon rural development of the price of supply and the cost of electrical equipment. The reports of the two sub-committees were generally adopted by the Conference.
- 1928 Electricity Commissioners, after consultation with the I.E.E. and the electricity supply industry, published a new Code of *Overhead Line Regulations*, as ELC 53.
- 1928 First turbo-alternator to *generate direct at 33 kV*—a Parsons 25 MW unit at the *Brimstown "B"* station of the North Metropolitan Power Station Co.
- 1929 Commencement of construction work on the *Grid system*.
- 1929 Commissioning of the *Hams Hall "A" power station* of the Birmingham Corporation, planned by Frank Forrest and F. W. Lawton. The installed capacity was 249 MW based on main generating sets of 30 MW and 50 MW with steam conditions 350 lb/sq. in. and 700°F. There were to be two other stations on this site, the "B" station, 321 MW, commissioned in 1942—*q.v.*; and "C", 360 MW commissioned in 1956.
- 1929 *Galloway Water Power Act*, for developing water power on the River Dee and its tributaries in the Stewartry of Kirkcudbright—the Galloway scheme, which came into operation in 1935—see under that year.
- 1929 Commissioning of the *Deptford West* power station—adjacent to the historic Deptford East station—being the first major construction undertaken by the London Power Company, based on sets of 50 MW and 35 MW with steam conditions of 350 lb/sq. in. and 780°F.
- 1929 A. Reyrolle & Co. installed the country's *first short-circuit testing station* at Hebburn-on-Tyne.
- 1929 *Commissioning of the *Ardnacrusha hydro plant* on the River Shannon, capacity 100 MW from four generating units, constituting the *Shannon Scheme* of the Electricity Supply Board of Ireland.

- 1929 *First electrostatic precipitators* to be installed in a *power station* in the U.K.—at Taylor's Lane, Willesden, owned by the North Metropolitan Electric Power Supply Co.
- 1929 *Lochaber hydro-electric scheme* of the Lochaber Power Co., a subsidiary of the British Aluminium Co. Ltd.—completion in December of the first stage comprising 36.4 MW of plant. Of ultimate capacity 85.75 MW, this was the *first large scale water power development in the country to be planned on comprehensive lines*.
- 1929 Formation of *Associated Electrical Industries Ltd.* ("A.E.I.").
- 1929 Johnstone Wright and C. W. Marshall presented to the I.E.E. on 24 January a paper on "*The construction of the 'Grid' transmission system in Great Britain*". Published in the "I.E.E. Journal", June 1929, this paper gave an outline of the chief constructional features of the high voltage (132 kV) lines of the Grid.
- 1929 *Heat Pump*. I.E.E. Paper "The heat pump—an economical method of producing low-grade heat from electricity" by T. G. N. Haldane, read before the Institution on 19 December. Included a description of an experimental plant installed in the author's home in Scotland, used for operating the central heating system and for the production of a supply of hot water for domestic purposes.
- 1930 First use of *mercury arc rectifiers* for railway traction in this country.
- 1930 Electricity Commission—*Report on Assisted Wiring and the Hiring and Hire-purchase of Electrical Apparatus* by a Committee appointed by the Electricity Commissioners in March 1929. Among their recommendations was that all undertakings who had not hitherto done so should be urged to put into force their powers to provide and sell complete wiring installations on a deferred payment system and provide electrical apparatus to consumers on hire and/or hire-purchase terms.
- 1930 **Solar sea power*—The French engineer Georges Claude attempted to build a 40 kW ocean—heated engine off Cuba to produce electricity through a "boiler" operating in the warm ocean surface layer and a "condenser" in the colder lower layers—described in "Mechanical Engineer", vol. 52, p. 1039.
- 1930 *Research* by the electricity supply industry—the beginnings on a *national basis*, with the establishment by the C.E.B. of laboratories at Croydon and Waddon to investigate *h.v. transmission problems*.
- 1930 Electricity Commission—*Report on Uniformity of Electricity Charges and Tariffs* by a Committee appointed by the Electricity Commissioners on the 16 March 1929. Committee recommended legislation to make it compulsory for undertakings to offer *two-part tariffs* as an alternative to flat rates.
- 1930 *Oil circuit breakers*—invention of the side-blast baffle arc-control pot, generally known for short as the *baffle switch*, by W. B. Whitney and E. B. Wedmore. Developed experimentally by the E.R.A., this formed the basis of most modern designs of high-voltage oil circuit breakers.
- 1930 Electricity Commission—*Rural Electrification*. Description of *Bedford Demonstration Scheme*.
- 1930 On the 30 April, the *first Grid Scheme*, viz Central Scotland, was officially inaugurated by the Minister of Transport.

- 1930–33** Commissioning by the Grampian Electricity Supply Co. of the *Loch Rannoch* (48 MW) and *Tummel Bridge* (34 MW) *hydro-electric stations*.
- 1931** Completion of the construction of the *first Grid Scheme*.
- 1931** Electricity Commission—*Rural Electrification*. Description of *Norwich Demonstration Scheme*.
- 1931** Electricity Commission—*Statement by Minister of Transport at Conferences with Electricity Undertakers, 1931*.
As part of the Government's efforts to stimulate economic development and employment, the Minister addressed a series of conferences at each of which he made the following appeal:
"I would like strongly to endorse the views which have been expressed by the Commissioners that undertakers who have not yet done so *should institute schemes of assisted wiring* and of hiring or *hire-purchase* of apparatus, establish *showrooms* and adopt an active publicity campaign."
- 1931** *Oil-filled cable*—runs of 132 kV single core and 66 kV three-core installed by the C.E.B. By the following year, the latter cables were being extensively used.
- 1931** Ministry of Transport—*Report of the Committee on Main Line Electrification*. Appointed in 1929 under the chairmanship of *Lord Weir*, the Committee reported in favour of large-scale electrification and estimated that a return of about 7% could be shown on a capital expenditure of some £261 million on the necessary track equipment, traction etc.
- 1931** *Faraday Centenary Exhibition* in London
- 1931** English Electric Co. installed the first "*topping turbine*" at the Valley Road, Bradford, power station—a unit of 2.5 MW, 6,000 r.p.m., steam conditions 1,100 lb/sq. in. and 800°F exhausting to the existing steam mains at 205 lb/sq. in.
- 1931** Contract for the world's first pipe line *compression cable*—a 2½ mile length of three-core 66 kV cable between Hackney and Walthamstow, London—based on the Hochstadter patent 1926, for the application of gas pressure through a flexible diaphragm.
- 1932** Sir John Cockroft and Dr. E. T. S. Walton achieved the *first artificial splitting of the atom*. They used protons to bombard lithium, resulting in the formation of helium. This inaugurated the era of "atom smashing".
- 1932** Sir James Chadwick announced the existence of uncharged particles of mass slightly greater than protons, i.e. *neutrons*. The neutron was found to be a most valuable missile for bombarding nuclei to produce changes, because, being uncharged, it was not deflected by the electrical forces in the atom.
- 1932** *The Labour Party* issued a *Policy Report* outlining their proposals for the *nationalisation* of the electricity supply industry, ie bringing the industry under full public control. Another argument for nationalisation was published (by "G.H.") under the auspices of the New Fabian Research Bureau.
- 1932** *Thames 132 kV grid crossing* between Dagenham and Woolwich completed. The towers, of height 487 ft, were the highest on the grid; the span between towers was 3,060 ft.
- 1932** *Railway electrification*. Standardisation of Electrification Order 1932 permitting only the 1500 V d.c. system with overhead current collection

and a lower voltage system of 750 V d.c. with conductor rail, as general standards for main line operation.

- c. 1932** *Lighting*—high-pressure mercury and low-pressure sodium lamps introduced for street lighting.
- 1933** Commissioning of the *Barking "B"* power station. With the completion of this station in 1940, with 4×75 MW turbo-alternator sets, the total capacity on the site reached 540 MW—the highest in Europe. A third station—"C"—comprising 3×75 MW units was commissioned in 1952.
- 1933** *Report of the Severn Barrage Committee* of the Economic Advisory Council, set up by the Prime Minister in 1925 under the chairmanship of Lieut. Col. J. T. C. Moore-Brabazon. The committee's investigations of the technical possibilities and merits of a barrage indicated there was a balance of advantage in such a scheme. (The conclusions of the committee were reviewed in a report dated 1945—*q.v.*)
- 1933** Introduction on 1 January of a *Grid tariff* and the beginning of normal trading operations in the two Grid areas so far complete, namely Central Scotland and Mid-East England.
- 1933** Commissioning of *Battersea power station*, built by the London Power Co. to the design of *Sir Leonard Pearce* for the main purpose of supplying the central and western areas of London. The architectural features were to the design of *Sir Giles Gilbert Scott* and the station was popularly referred to as a "*cathedral of power*". "*Battersea*" was planned as two separate stations "A" and "B". The steam conditions of the "A" station were 600 lb/sq. in. and 830°F, the plant comprising two turbo-alternator units each of 69 MW and a third of 105 MW—the largest set then operating in Europe. The "B" station commissioned in 1944—see under that year.
- 1933** Commissioning of *Dunston "B"* power station of the North Eastern Electric Supply Co. (formerly the Newcastle-upon-Tyne Electric Supply Co.). Designed for six 50 MW turbo-alternator sets working on the re-heat principle with initial steam conditions of 600 lb/sq. in. and 800°F, this station ranked consistently *among the leading stations in the country* both in respect of thermal efficiency and cost per unit.
- 1933** *A watershed area covering parts of seven States in the U.S.A. was put under a Federal-controlled authority—the *Tennessee Valley Authority (T.V.A.)*.
- 1933** "*E.L.M.A.*" developed out of the Electric Lamp Manufacturers Association of Great Britain Ltd.
- 1933** C. W. Marshall presented to the I.E.E. on 9 November a paper on "*The lower-voltage sections of the British grid system*", published in the "I.E.E. Journal" February 1934. The paper dealt with the main constructional features of the 66 kV and 33 kV lines.
- 1934** *Completion of the construction of the initial Grid system at 132 kV*
- 1935** **First fluorescent lamps* demonstrated in the U.S.A.
- 1935** *Galloway hydro-electric scheme*, based on the River Dee and its tributaries in the Stewartry of Kirkcudbright, in commercial operation. The total installed capacity planned was 103.25 MW from five stations—Tongland, Glenlee, Earlstoun, Carsford and Kendoon.
- 1935** *Electricity (Supply) Act 1935* empowering the C.E.B. to enter into

- arrangements with the owners of non-selected stations* concerning their operation under directions of the Board for peak load and standby purposes.
- Another Clause gave effect (in part) to a recommendation of the Weir Committee on Main Line Electrification by empowering the C.E.B. to give *supplies direct* to any railway company *for traction purposes*.
- 1935** *Grid in full commercial operation* from 1 January throughout the country with the exception of North-East England, and South Scotland—and of the North of Scotland, for which no Grid scheme was contemplated.
- 1935** Formation of *London Associated Electricity Undertakings Ltd.* as a merger of six companies.
- 1935** **Electroslag refining process* for melting metals—invented by R. K. Hopkins in the U.S.A.; but industrial development was delayed for over twenty years.
- 1936** *Fulham* power station commissioned. Of total installed capacity 360 MW from six 60 MW turbo-alternator sets, steam conditions 600 lb/sq. in. and 800°F, this station returned the *highest thermal efficiency of any power station in the country in 1948*.
- 1936** *Report of the Committee on Electricity Distribution*, appointed by the Ministry of Transport, under the chairmanship of *Sir Harry (later Lord) McGowan*.
Committee recommended legislation to give adequate compulsory powers for reorganisation based on the absorption by the larger and more efficient undertakings of the smaller and less efficient. Whilst they considered that there were not adequate grounds for immediate regional reorganisation under public control, they suggested that provision should be made in the *new schemes to be prepared for the possibility of ultimate public ownership of all undertakings*, including those not then subject to purchase by local authorities. In developing this approach they envisaged consolidation of undertakings under existing power companies and ultimate purchase, after not more than fifty years, by some form of public authority. To set such a reorganisation in motion they suggested the setting up of Advisory Committees representing the undertakings in each area, under a District Commissioner who would have the duty of preparing the schemes for submission to the Electricity Commissioners.
- 1936** *World's first commercial installation of *220 kV underground cable*—in Paris, comprising 11 miles of three single-core oil-filled cable in concrete troughs.
- 1936** P.E.P. (Political and Economic Planning) issued a report on "*The Supply of Electricity in Great Britain*", putting forward proposals for the reorganisation of distribution largely coinciding with those of the McGowan Committee.
- 1936** **Boulder Dam* hydro-electric scheme in the U.S.A. commissioned—designed for ultimate capacity 1,217 MW, based on 115,000 hp turbines.
- 1936** *Electricity Supply (Meters) Act 1936*, providing for the *testing* of meters used in connection with the supply of electricity by authorised undertakers and their *certification* by the Electricity Commissioners.
- 1937** Electricity Commission issued two papers relating to the *Electricity Supply (Meters) Act 1936*, viz:
(i) *Explanatory Memorandum* concerning the testing of electricity meters; the apparatus approved for use in Meter Testing Stations;

and the procedure contemplated by the Electricity Commissioners in connection with the certification of meters.

(ii) *Approved Apparatus for Testing Stations*

- 1937** *Minister of Transport* announced that the Government had decided to adopt in principle the main recommendations of the McGowan Committee, subject to certain modifications in detail, and a memorandum on "*Electricity Distribution—Outline of Proposals*" was issued, as a basis of discussion with representative associations. One of its proposals was that the Electricity Commissioners should themselves review each District and prepare schemes for consolidation into groups, instead of delegating that duty to District Commissioners, as envisaged in the McGowan Report. Provisional groupings of undertakings in the suggested Distribution Districts were set out. The recommendations were not, however, implemented before the war.
- 1937** **Hydrogen-cooling* of alternators coming into general use in the U.S.A. (The first hydrogen-cooled alternator in Great Britain was a 60 MW set installed in the Littlebrook "B" power station in August 1949.)
- 1937** Electricity Commission issued their "*Electricity Supply Regulations 1937*, for securing the safety of the public and for ensuring a proper and sufficient supply of electrical energy"—also "*Explanatory notes on the Electricity Supply Regulations 1937*".
- 1937** *Gas-filled cable* system developed by C. J. Beaver and E. L. Davey of W. T. Glover & Co—first commercial use at 33 kV and field trials by C.E.B. at 132 kV.
- 1938** *Association of Short-Circuit Testing Authorities ("A.S.T.A.")* formed—a co-operative association of short-circuit testing stations.
- 1938** E.R.A. were asked to prepare a specification for "*light rural lines*" with a view to submitting the proposal to the British Standards Institution, so that a complete specification could be prepared. (This resulted in BS.1320—1946 "High voltage overhead lines on wood poles for line voltages up to and including 11 kV".)
- 1938** Commissioning in December of *pioneer high pressure plant at Brimsdown "A"* power station of the Northmet Co., operating at steam conditions of 1,900 lb/sq. in. and 930°F on a reheat cycle. The two boilers were of the Loeffler forced-circulation type, capacity 210 k lb/hr. continuous maximum rating.
- 1938** Arrangements were perfected by the C.E.B. for establishing a *National Control* organisation at the Bankside control room in London and during the latter part of the year the Grid in all the nine areas was *normally operated as one inter-connected system*. From the beginning of the war it has been continuously operated as a single unit.
- 1939** In January the decision was taken to establish a *national reserve* of switchgear, transformers and ancillary equipment as a *precaution against war risks*. The cost was estimated at £3 million—the Government to undertake half of this liability, the C.E.B. being authorised to borrow the remaining half.
- 1939** Early in the war, a *Joint committee of Electricity Supply Undertakings* was set up, representing both company and municipal undertakings. The immediate object was to enable undertakings to keep in touch with one another in *dealing with common problems resulting from the war*.
- 1939** Presidential Address to the I.E.E. by Johnstone Wright, on 26 October, dealing with the *construction and operation of the Grid*, published in "I.E.E. Journal", January 1940.

- 1939–1941** *Fuel Efficiency Committees:*
 Government appointed, in succession, three Committees to report on measures for effecting economies in fuel under war conditions, but the reports were unpublished, viz:
 Home Produced Fuels, Chairman *Sir William Bragg*, appointed September 1939
 Efficient Use of Fuel, Chairman *Sir Clement Hindley*, appointed February 1940
 Efficient Use of Fuel—Second Committee, Chairman *Dr. E. S. Grumell* appointed September 1941, "to review the recommendations of the 1940 Committee . . ."
 The two latter Committees led to the setting up of twelve *Regional Fuel Efficiency Committees* and the recruitment, on a part-time basis, of voluntary engineers from industry to give specialist advice to factories on plant maintenance and operation.
- 1940** Twenty-sixth Thomas Hawksley Lecture by *Sir Leonard Pearce* on "*A Review of Forty Years' Development in Mechanical Engineering Plant for Power Stations*", presented to the Institution of Mechanical Engineers on 10 January. Published in "I. Mech. E. Proceeding" Vol. 142, 1939.
- 1940** **First gas turbine* for public electricity supply commissioned at Neuchatel, Switzerland.
- 1940** *Electricity Commissioners*, in July in agreement with the *C.E.B.* recommended an *emergency programme of new generating capacity, to minimise war risks* and to deal with the rapid growth of load in the North West England and North Wales and the South West England and South Wales Grid Areas consequent upon the concentration of new munitions factories in those areas.
 The programme provided for the installation of about 180 MW of plant divided between four existing selected stations and two new selected stations—Earley and Castle Meads, referred to under 1942—so as to spread the risks due to possible war damage.
- 1941** Government's war-time Production Executive, in March, took the view that *C.E.B.'s programmes for new generating plant* to commission in 1943 and 1944 were not necessary to the war effort and *withdrew the priorities* formerly granted.
- 1941** Functions of the *Ministry of War Transport* in relation to *electricity* were transferred in September to the *Board of Trade*, which had administered the various statutory electricity provisions prior to the Electricity (Supply) Act 1919.
- 1941** *Battersea "B"* power station—commissioning of the low-pressure unit of 84 MW of the 100 MW cross-compound turbo-alternator set—see under 1944.
- 1942** *Ministry of Fuel and Power* formed in June, taking over the responsibilities of the Board of Trade in relation to the control of electricity, along with that of gas, coal and other fuels.
- 1942** Commissioning of *Hams Hall "B"* power station of the Birmingham Corporation, designed for an installed capacity of 321 MW, based on main generating sets of 50 MW, with steam conditions 650 lb/sq. in. and 825°F. This station returned the *highest thermal efficiency for the country in 1947*.
 With the completion of the "B" station, the two stations on the site represented the *greatest concentration of generating plant in Europe*. A third station on the site, Hams Hall "C", 360 MW commissioned in 1956.

- 1942** Commissioning of the two “war emergency” power stations in December, viz:
Earley Nr. Reading, owned by the C.E.B. and operated by Edmundson’s Electricity Corporation. This station, the only one owned by the C.E.B., comprised 2×40 MW turbo-alternators, the first of which had originally been ordered for an undertaking in South Africa. “Earley” was in commercial operation in 22 months after the start of the work on site. *Castle Meads*, owned by the Gloucester Corporation, comprising 2×20 MW turbo-alternator sets. Sanctioned in 1940, the first set went on load almost exactly two years after the start of the work on site.
- 1942** Report of the Committee on *Hydro-Electric Development in Scotland*—Chairman, *Lord Cooper*—presented to Parliament in December and published as Cmnd. 6406, 1943.
 The main recommendations were that a North of Scotland Hydro-Electric Board should be created to be responsible for initiating and developing all future generation of electricity in the northern area for public supply and its transmission and supply in bulk to the existing undertakers. It should further be responsible for generation, transmission and distribution in all areas outside the limits of existing undertakers.
- 1942** **First atomic pile or nuclear reactor*, put into operation in the U.S.A.
- 1943** Publication on 20 January of the Hydro-Electric Development (Scotland) Bill leading to the *Hydro-Electric Development (Scotland) Act 1943*, making provision for the establishment of a public corporation called the *North of Scotland Hydro-Electric Board*, as envisaged by the Cooper Report of 1942—*q.v.* The first Chairman of the N.S.H.-E.B. was the Rt. Hon. The Earl of Airlie.
- 1943** *First three-core 132 kV cable* in the world—a mile and a quarter length of *impregnated gas pressure cable* manufactured by the Callender Co. put into service by the C.E.B. at Burford, Oxon.
- 1943** **River Liffey Scheme* of the Electricity Supply Board of Ireland—comprising three hydro-electric stations at Pollaphuca (30 MW), Golden Falls (4.24 MW) and Leixlip (4 MW); Golden Falls commissioned at end of 1943 and the whole Scheme was completed in 1949.
- 1943** *Future development of the grid system*—to reduce to the minimum the delay in putting a new construction programme in hand after the war, the C.E.B. gave preliminary consideration to the future *use of higher voltages* than 132 kV. (The 1946 Annual Report of the C.E.B. indicated that they were then thinking in terms of 264 kV).
- 1943–44** In response to a request from the Minister of Fuel and Power, *proposals for the reorganisation of the electricity supply industry* were put forward by individual undertakings, trade associations, and staff associations, viz.—the London and Home Counties J.E.A., Conference of Joint Electricity Authorities and Joint Boards, the E.P.E.A., the I.A.E.P.C., the I.M.E.A. and the Joint Committee of Electricity Supply Undertakings. For the most part, attempts to secure agreement on a common policy for the industry as a whole broke down owing to *disagreement over the question of ownership*.
- 1944** **Geothermal energy*. Italian geothermal capacity reached 136 MW, but equipment destroyed in this year. New developments after the war started up again in 1956 in the Larderello field, Tuscany.
- 1944** Publication of the *Report of the Institution of Electrical Engineers Sub-Committee on Electricity Supply Distribution and Installation*, of their Post-War Planning Committee—in the “I.E.E. Proceedings” Part 1, Vol.

- 91, March 1944. Among other matters, the report made recommendations on the *Standardisation of Voltage and System*.
- 1944** Electricity Commissioners and Secretary of State for Scotland approved the *North of Scotland Hydro-Electric Board's development scheme*, which listed 102 projects.
- 1944** Electricity (Factories Act) *Special Regulations* 1944.
- 1944** *First commercial *cyclone-fired boiler*—installed by Babcock and Wilcox at the Calumet power station, Chicago, U.S.A.
- 1944** Commissioning of the *first section* of the *Battersea "B"* power station, consisting of a *100 MW cross-compound set*—comprising a 16 MW *high pressure unit* (1,350 lb/sq. in.) exhausting to a twin-cylinder 84 MW secondary unit. The second and third sections comprised a 60 MW machine with hydrogen-cooled alternator (1951) and a further cross-compound machine of 100 MW (1953) of similar design to that of the first section.
- 1944** The *Fuel and Power Advisory Council* (Chmn. Sir Ernest Simon) appointed by the Minister of Fuel and Power to consider and to advise on questions concerning the development and utilisation of national fuel and power resources.
- 1945** *Report on Heating and Ventilation of Dwellings*, by the Heating and Ventilation (Reconstruction) Committee of the Building Research Board of the D.S.I.R., under the chairmanship of *Sir Alfred Egerton*. Ministry of Works Post-War Building Studies No. 19.
- 1945** *Experimental heat pump* put into operation for the heating of administrative buildings in Norwich by J. A. Sumner, City Electrical Engineer. The source of low grade heat was the neighbouring river.
- 1945** *Report on the Severn Barrage Scheme*, by A. G. Vaughan-Lee, Sir William Halcrow and S. B. Donkin, issued by *Ministry of Fuel and Power*. The panel of engineers, mentioned above, were appointed by the Minister to review the conclusions of the 1933 Committee. The principal conclusion of the present report was that "The Barrage scheme is practicable from the engineering point of view and it *can be economically justified* under the conditions stated".
- 1946** Foundation on 1 January of the *Atomic Energy Research Establishment*, Harwell, under the aegis of the D.S.I.R.
- 1946** *Coal Industry Nationalisation Act* under which the Coal mines passed into public ownership and which set up the *National Coal Board* in 1947 as a statutory corporation to manage the industry.
- 1946** Publication of E.R.A. Report Ref. KT116 "*Characteristics of the domestic load*".
- 1946** Electricity Commissioners, on 17 July, appointed a *Uniformity of Tariffs Committee* under the chairmanship of *Sir John Dalton* to examine the whole range of tariffs for supply of electricity for all purposes, other than bulk supplies to other undertakers. They turned their attention first to domestic tariffs but were only able to make an interim report on this question (see under 1947) before new legislation again changed the outlook.
- 1946** **International Commission on Rules for the Approval of Electrical Appliances* ("C.E.E.") founded in Amsterdam.

- 1946** *Report on Domestic Fuel Policy*, by the Fuel and Power Advisory Council (Chmn. Sir Ernest Simon).
- 1946** Interim Memorandum on *District Heating*, by the District Heating Sub-Committee of the Heating and Ventilation (Reconstruction) Committee of the Building Research Board, set up in October 1942, under the Chairmanship of *Sir Alfred Egerton*. (The final report was published in 1953.)
- 1946** British Standard for "*light rural lines*", viz—B.S. 1320—1946 "High voltage overhead lines on wood poles for line voltages up to and including 11 kV".
- 1946** Introduction on 20 December of the *Electricity Bill* for the "*nationalisation*" of the supply industry.
- 1946** *Standardisation of consumers' voltage*—the Minister of Fuel and Power in the House of Commons on 12 February stated that the *Electricity Commissioners* in a report to him had reached the conclusion that "the most practicable and economical method of obtaining complete standardisation of low voltage alternating current supplies at one voltage would be to adopt 240 volts as the standard . . ." This was made mandatory for all new systems from 1 October 1947.
- 1946** **Electricité de France* became the nationalised electricity undertaking, created under legislation of April 1946.
- 1946** *Atomic Energy Act*, giving statutory form to the transfer of the responsibility for work on atomic energy from the D.S.I.R. to the Ministry of Supply.
- 1946** Paper by J. Hacking and J. D. Peattie on "*The British Grid in War-time*" presented to the I.E.E. on 6 November and published in the "I.E.E. Journal", October 1947.
- 1946** In December the first village received a supply under the North of Scotland H.-E.B.'s distribution schemes for remote areas—Finstown, Orkney.
- 1947** White Paper Cmnd. 7007, of January, gave the *Electricity Supply Areas* envisaged in Part I of the Electricity Bill 1946.
- 1947** *Isle of Wight connected to the mainland for the first time* by a 33 kV submarine cable from Nursling, near Southampton to Cowes.
- 1947** *Formation in Brussels of the *Organisme de Liaison des Industries Métalliques et Électriques Européennes* ("*ORGALIME*").
- 1947** *Report of the Electricity Sub-Committee of the Joint Consultative Committee*, Ministry of Labour and National Service—Chairman: initially *R. M. Gould*; from 1954, *Sir Wilfred Neden*. The Sub-Committee were set up on 4 March "to examine the measures necessary to *reduce peak industrial loads* on the electricity supply system . . ." The report published on 12 May, recommended that the Regional Boards for Industry make arrangements immediately for "*load spreading*".
- 1947** *First atomic reactor in the U.K.*—the Graphite Low-Energy Experimental Pile ("*G.L.E.E.P.*") at the Atomic Energy Research Establishment, Harwell, started up on 15 August.
- 1947** *Minister of Fuel and Power*, on 13 May, in anticipation of the passing of the Electricity Act, appointed an "*Organising Committee*" for the

- electricity supply industry under the chairmanship of *Lord Citrine*, who was to be the Chairman of the new Central Authority in due course.
- 1947** *Interim Report on Domestic Tariffs for Residential Purposes* by a Committee appointed by the *Electricity Commissioners*, 6 June.
- 1947** *Electricity Bill* received the Royal Assent, 13 August.
Electricity Act 1947 brought the supply industry of England and Wales and Southern Scotland under *public ownership*, and the existing undertakings, which then numbered 560, were integrated into new statutory Electricity Boards appointed by the Minister of Fuel and Power. Fourteen *Area Electricity Boards*, twelve in England and Wales and two in southern Scotland, shared responsibility for the retail distribution of electricity to consumers.
 Generation and main transmission together with central co-ordination and policy direction, were the responsibility of the *British Electricity Authority*.
Electricity Consultative Councils, comprising representatives of consumer and general public interests, were established for the areas of the Area Boards.
The North of Scotland Hydro-Electric Board (q.v.) had already been formed in 1943 to develop the hydro-electric resources of that area, although the existing undertakings maintained their responsibilities for distribution. Under the 1947 Act, the Board absorbed these undertakings and became responsible for all public generation, transmission and distribution throughout the north of Scotland.
- 1947** *British Electricity Authority ("B.E.A.")*, the Central Authority, established on 15 August, under the Chairmanship of *Lord Citrine*.
- 1947** *Meaford "A"* power station, near Stone, Staffs., owned by the North West Midlands J.E.A.—*first power station to come into operation after the war*: capacity 4×30 MW sets.
- 1947** Control of Turbo-Alternators (No 1) Order, (S R & O 1947 No.2386), issued by the Ministry of Supply on 7 November, *standardised the production of steam turbo-alternators* of over 10 MW capacity to two set sizes with prescribed steam conditions—*30 MW* operating at 600 lb/sq. in. and 850°F, and *60 MW* at 900 lb/sq. in. and 900°F: it applied retroactively to all contracts made from 1 November 1946. 30 MW sets with the prescribed steam conditions were already well established; the first to commission after the vesting date on 1 April 1948 was at Ocker Hill in the following month. The first 60 MW set with the standard steam conditions was at Staythorpe "A" (Newark) in March 1950.
- 1948** The fourteen *Area Electricity Boards* established on 1 January.
- 1948** *Negotiating machinery*—on 31 March, based largely on pre-vesting arrangements, the Central Authority made agreements with the *National Joint Industrial Council*, for the manual workers; with the *National Joint Board*, for the technical engineering staff; and with the newly established *National Joint Council*, for administrative and clerical grades.
 An agreement later in the year (23 November) provided for a *National Joint (Building and Civil Engineering) Committee* for building and civil engineering workers.
- 1948** *Vesting Day, 1 April*—B.E.A. and the fourteen Area Electricity Boards became responsible for the public system of electricity supply throughout Great Britain, except in the north of Scotland.
- 1948** *E.D.A. Testing House* established in London, to provide testing facilities for the *Joint E.D.A./B.S.I. Advisory Committee on Electrical Appliances and Accessories* which had just been formed (for B.E.A.B. from 1960, *q.v.*).

- 1948** *North of Scotland H.-E.B.* commissioned its *first new stations*—at Morar (600 kW) and Lochalsh (1000 kW). The former believed to be *Britain's first underground power station*.
- 1948** B.E.A. introduced an *interim bulk supply tariff* operative from 1 April. The uniform tariff incorporated a fuel cost adjustment with regional effect. But surcharges and discounts were applied to avoid abrupt changes in the cost to Area Boards, compared with pre-vesting.
- 1948** Report of the *Committee to Study the Electricity Peak Load Problem in Relation to Non-Industrial Consumers* (Chairman: *Sir Andrew Clow*), published in July. Recommendations included seasonal variations in tariffs. At the request of the Minister of Fuel and Power the Area Boards introduced a surcharge of 0.35d per unit on the domestic running charge in three months of the 1948–49 winter, followed by a rebate of 0.1d per unit in the ensuing nine months. The measure had no appreciable effect on peak loads and was not repeated.
- 1948** Publication of E.R.A. Report Ref. KT125 "*A large-scale sampling-survey of domestic consumers*". (An abridged version was published as Ref. KT125A.)
- 1948** *Gas Act 1948* received the Royal Assent on 30 July. The vesting date set for nationalisation of the gas industry was 1 May 1949.
- 1948** Commissioning in October of the first of four 30 MW sets at the Kingston "B" power station—the *first new post-vesting station*.
- 1949** A 220 kV *impregnated pressure-type cable* designed for continuous 200 MVA duty was manufactured by B.I.C.C., installed in the grounds of the Clamart Laboratories of Electricité de France and connected to the 220 kV grid for field testing.
- 1949** *Report on a visit to the United States and Canada* of a delegation from the B.E.A. led by *Sir John Hacking*. Reported in particular on the latest practices adopted by U.S. electric utility companies in the design, construction, maintenance and operation of generating plant, transmission developments, costs of production and tariffs.
- 1949** An inter-departmental committee of the B.E.A. recommended a substantial increase in grid interconnection capacity by means of a higher voltage system additional to the existing 132 kV system. B.E.A. decided that *planning of a 275 kV system* capable of meeting requirements for at least twenty years should begin immediately.
- 1949** Publication of E.R.A. Report Supp. to Ref. KT125 and 125A, "*A large-scale sampling-survey of domestic consumers. A condensed repeat survey for 1948*".
- 1949** "*Top-hat*" kiln—an electrically-fired horizontal intermittent pottery kiln, designed by Midlands E.B. in conjunction with manufacturers.
- 1949** *National Joint Advisory Council* for the electricity supply industry held its inaugural meeting on 27 January.
- 1949** *Nationalisation of gas industry*. On 1 May 1949, 1,037 gas undertakings in Great Britain vested in twelve Gas Boards.
- 1949** *Electricity Supply Research Council* established by the B.E.A. in July (Chairman: *Sir Harold Hartley*) to review research matters and advise the Central Authority. Membership included eminent academic authorities as well as supply industry engineers.

- 1949** Commissioning in August of the *first hydrogen-cooled alternator* in the U.K.—a 60 MW unit at the Littlebrook “B” station.
- 1949** Statement of principles governing the conduct of *electrical contracting and retailing* agreed in August by the B.E.A., Area Boards, Electrical Contractors’ Association and the Electrical Contractors’ Association of Scotland.
- 1949** *Liverpool Street to Shenfield railway electrification scheme* inaugurated on 26 September. The *1,500 V d.c. overhead conductor system* was introduced over 25 route miles of the densest steam-operated train services in the world.
- 1949** First large-scale application in this country of the *unit boiler* arrangement *with reheat steam cycle* was commissioned at the *Dunston “B” II station*. This was the first of two 50 MW sets, with a unit boiler of 410 k lb/h capacity and steam conditions 600 lb/sq. in. 849/849°F. One of the earliest unit boilers was at Stockport H.P. in 1943, when a 30 MW set was installed steamed from a single 300 k lb/h boiler.
- 1940’s late** *Linear induction motors*. Professor E. R. Laithwaite began his long-term research and development work.
- c.1950** *Storage radiators*—Eastern E.B. developed the prototype storage radiator; and models became available in the U.K. market for commercial and industrial premises.
- 1950’s early** Introduction of *plastic insulated mains cables*.
- 1950** *O.E.E.C. published “*Interconnected Power Systems in the U.S.A. and Western Europe*” the report of the “*Tecaid*” Mission of European engineers to U.S. utilities to study methods of co-ordinating the use of generating plant and network interconnection. A consequence of the “*Tecaid*” Mission was the creation of the Union for the Co-ordination of Production and Transmission of Electricity (U.C.P.T.E.) in 1951.
- 1950** **Ireland’s first peat-fired station commissioned*. Portarlinton station has two 12.5 MW sets, consuming 120,000 tons of peat a year.
- 1950** The Retail Tariffs Committee of the B.E.A. and Area Boards recommended general principles on which *uniform tariffs* for domestic, commercial, farm and industrial supplies should be based. They were approved by the Minister of Fuel and Power in February 1951. By 1 April 1956 all Boards had standardised their domestic tariffs and the standardisation of other tariffs was completed by about 1958–59.
- 1950** The grid’s *National Control Centre* and the *Control Centre for South East and East England* moved from premises in the lift-shaft of the former Post Office station of the underground railway system at King Edward Street, EC4, which they had occupied since 1941, to new temporary buildings in Paternoster Square, EC4. At the same time the South East and East England Control Area was divided into new grid control areas named Thames North and Thames South.
- 1950** Commissioning of the *first standard 60 MW unit*, at the Staythorpe “A” station—the *first of the new Trent valley stations* using East Midlands coal. Its building design gained an R.I.B.A. Bronze Medal.
- 1950** Start-up of a 32.5 MW set at the Sloy station of the Loch Sloy scheme—the *first of the North of Scotland H.-E.B.’s schemes* to come into service. By the end of the year the Clunie and Pitlochry stations of the Tummel-Garry scheme and the Grudie Bridge station of the Fannich scheme were also in commission.

- 1950** *Cross-Channel cable link.* Joint E.D.F./B.E.A. Cross Channel Inter-connection Study Committee held its first meeting on 23 March. Interim report issued in May 1952 recommended that the construction of a 132 kV cable was practicable and economic. Cable-laying trials were carried out in 1953. In 1956 the C.E.A. approved in principle the construction of a d.c. link, and approval of the Ministry of Power was obtained in September 1957. The cross-Channel cable was commissioned on 8 December 1961—*q.v.*
- 1950** Midlands E.B. began an investigation of the use of *auto-reclosing circuit breakers on 11 kV overhead line networks* which led ultimately to their wide-scale use throughout the country.
- 1950** B.E.A. introduced on 1 April a *uniform bulk supply tariff* for supplies to Area Boards. Earlier tariffs included a provision to avoid abrupt changes in the cost to Area Boards compared with pre-vesting.
- 1950** Commissioning of the Stourport "B" L.P. station. A feature of the single 60 MW unit was its *slag-tap furnace*—the first in Britain.
- 1950** "*The Economics of Electricity Supply*". Paper by Sir Henry Self to the British Electrical-Power Convention, June. Published in "Proceedings B.E.P.C." 1950, pp. 17 etc.
- 1950** *British Electricity Laboratories* (now the Central Electricity Research Laboratories) at Leatherhead opened by Lord Citrine on 15 July.
- 1950** Recommendation by an inter-departmental committee of the B.E.A. that *275 kV transmission* lines superimposed on the existing grid should be constructed, was adopted by the Authority in July.
- 1950** *Control of Turbo-Alternators (No 2) (Revocation) Order* (SI 1950 No 1221) revoked the Control of Turbo-Alternators (No 1) Order (1947) thereby freeing the production of steam turbo-alternators from control by the Minister of Supply with effect from 1 August 1950.
- 1950** *Anglo-American Council on Productivity* published in September "Electricity Supply", the *report of a visit to the U.S.A.* in 1949 of productivity teams representing the British electricity supply industry.
- 1950** *Load controlling devices.* Working Party drawn from B.E.A. and Area Boards to investigate possibilities afforded by load controlling devices, reported in November. Their recommendation that at least two large-scale pilot tests should be mounted was not finally adopted. A Joint Working Party, set up in 1951 to examine the whole subject de novo, reported in 1952—*q.v.*
- 1951** E.R.A. installed a *heat pump*, drawing its energy from the ground, to heat a laboratory building at the E.R.A. Agricultural Establishment at Shinfield, Reading.
- 1951** Experimental *heat pump* installation commissioned at the *Royal Festival Hall* under the auspices of the Chief Scientist's Division of the Ministry of Fuel and Power, driven by two Rolls-Royce Merlin aircraft engines converted to run on town gas. The main source of heat was provided by the River Thames. Aim was to compare heating costs with those of the permanent gas-fired boiler installation.
- 1951** *Union pour la Co-ordination de la Production et du Transport de l'Electricité ("*U.C.P.T.E.*"), (Union for the Co-ordination of the Production and Transmission of Electricity), founded in Paris.
- 1951** "*Electrification of Railways*"—Report of a committee (Chairman:

- C. M. Cock) appointed by the Railway Executive and the London Transport Executive, published in March. Its principal recommendation was that the d.c. system with an overhead line at 1500 V should be adopted as standard in all future electrification schemes (confirming main conclusions of the 1927 Railway Electrification Committee (the Pringle Report)).
- 1951 *"Problems of Decentralization in a Large Scale Undertaking. The Organisation of the Central Authority and Area Boards of the Electricity Supply Industry"*. Paper by Sir Henry Self at the British Institute of Management, Winter Proceedings, 6 March, published by B.I.M. in May.
- 1951 **European Coal and Steel Community (E.C.S.C.)* established by the Treaty of Paris 18 April.
- 1951 Working Party on *District Heating* in Relation to Public Water Supplies (Chairman: G. S. Wells). Set up by the Ministry of Health in 1948, an interim report was published in June 1951. Recommended that district heating schemes should be designed with distribution by the 2-pipe or 3-pipe system, and if practicable with a separate calorifier or indirect cylinder in each dwelling.
- 1951 *Pimlico District Heating Scheme* officially opened in July. Steam was taken from the main boiler-house range at Battersea "A" power station, passed through 2×1.35 MW back-pressure turbines to a heat exchanger from which heated water was pumped through a tunnel under the Thames to a large thermal storage tank providing space heating for adjacent blocks of flats.
- 1951 *Fuel Efficiency Advisory Committee* established to advise the Minister of Fuel and Power on aspects of fuel efficiency, on the setting up of committees for special problems, and on the reports of such committees. It replaced the former Fuel Efficiency Committee.
- 1951 *Negotiating Machinery*. An agreement establishing the *National Joint Managerial and Higher Executive Grades Committee* was signed by the Central Authority and Area Boards and N.A.L.G.O., E.P.E.A. and A.M.E.E. on 1 August.
- 1951 *Monopolies and Restrictive Practices Commission* report on the *supply of electric lamps* published in October.
- 1951 A Parsons *100 MW generator* commissioned at the Richard L. Hearn station of the Hydro-Electric Power Commission of Ontario—at the time probably the largest two-cylinder tandem set yet built in Britain.
- 1952 *Electricity Supply in Great Britain: Its development and organisation* by Sir Henry Self and Elizabeth M. Watson, published by Allen and Unwin.
- 1952 *Manchester–Sheffield–Wath railway electrification*. The first stage of the trans-Pennine scheme, Wath to Dunford Bridge, opened to traffic in February. It employed a catenary system operating at 1,500 V d.c.
- 1952 *Ownership of transmission lines*. A large proportion of the B.E.A.'s 66 kV and lower voltage lines was transferred to Area Boards.
- 1952 *North Wales Hydro-Electric Power Act 1952*. Provided for the extension of the Maentwrog and Dolgarrog catchment areas and a 10 MW extension at the latter station. Proposals for a scheme at Ffestiniog were superseded by new proposals in a 1955 Act—q.v.
- 1952 Eastern E.B. introduced standard *day/night tariffs* for domestic, commercial and farm consumers.

- 1952** Commissioning in April of the first of six 60 MW units at the Keadby station of the Hydro-Electric Power Commission of Ontario—at the time probably the largest two-cylinder tandem set yet built in Britain. mission. The 550 k lb/h boilers were the largest to enter service in the U.K.
- 1952** *Monopolies and Restrictive Practices Commission* Report on the *supply of insulated electric wires and cables* published in April.
- 1952** “275 kV *Developments on the British Grid System*”, by D. P. Sayers, J. S. Forrest and F. J. Lane. I.E.E. Paper read before the Supply Section on 21 May, reporting progress made by the B.E.A. on the new 275 kV system.
- 1952** A 15 MW open compound cycle *gas-turbine* set was put on load in August at the Trafford power station, Manchester. It did not enter commercial operation until 1957.
- 1952** *Report of the Committee on National Policy for the Use of Fuel and Power Resources* (Chairman: *Viscount Ridley*) published in September. Recommendations urged greater efficiency in the use of fuel, research into total gasification of coal, and a move away from coal on the railways.
- 1952** *Load controlling devices*. Joint Working Party drawn from Ministry of Fuel and Power, B.E.A. and Area Boards examined the question of load controlling devices and reported in October. Majority view was that automatic and centrally-controlled load limiters offered no prospect of a clear-cut margin of national advantage as would warrant their adoption.
- 1952** A 500 kW *experimental gas turbine* at Clydebank completed in November an endurance test of 1000 hours’ running on pulverised peat.
- 1952** Commissioning of the first 60 MW set at Bankside “B” L.P. the *first large public supply station to be specially designed for oil-firing*. The station building was designed by Sir Giles Gilbert Scott to harmonise with surrounding buildings. Bankside and Battersea were the only stations in Britain with *full-scale gas washing plant*.
- 1953** **Union Internationale d’Electrothermie* (“U.I.E.”), (International Union of Electroheat), founded in Paris.
- 1953** *Nuclear power*. B.E.A. established a nuclear power branch in their Chief Engineer’s Department to study, plan, design and eventually arrange for the construction of nuclear stations.
- 1953** *National Industrial Fuel Efficiency Service* (“N.I.F.E.S.”) established, following a recommendation of the Committee on National Policy for the use of Fuel and Power Resources (Ridley Committee), to assist industrial and commercial fuel users in improving their fuel efficiency. It replaced the Fuel Efficiency Service provided by the Ministry of Fuel and Power. In 1972 Government financial assistance ended and it became a private commercial concern.
- 1953** *Pithead power stations*—Bold “A” (St. Helens), 4 × 30 MW sets, started up. *Had belt conveyor link with colliery*.
- 1953** **Association Internationale des Entreprises d’Equipment Electrique* (“A.I.E.”) (International Association of Electrical Contractors) founded in Paris. Electrical Contractors’ Association was a founder member.

- 1953** *A 100 kW wind generator* at Costa Head in Orkney under development by North of Scotland H.-E.B. ran at full output for the first time. The experiments were taken over by the E.R.A. in 1956. In 1955 an experimental 100 kW Andreau wind generator developed by Enfield Cables Ltd. was commissioned by the B.E.A. at a temporary site near St. Albans. The plant was sold to a foreign undertaking in 1956.
- 1953** *British Productivity Council* published in April "The British Electricity System", the report of a productivity team from the U.S. electric utility industry on the B.E.A. system.
- 1953** *Rural electrification*: On 19 June the House of Commons resolved that steps should be taken to develop the supply of electricity in rural areas as much and as fast as possible. The Minister of Fuel and Power relaxed restrictions on capital expenditure and the supply industry announced a *rural electrification programme* with a target of 85 per cent of farms connected by 1963. The target was achieved eighteen months ahead of schedule.
- 1953** First section of the 275 kV *grid*—41 miles of single-circuit line between Staythorpe (Newark) and West Melton (Sheffield)—commissioned on 15 July. This was a trial section originally designed for 264 kV and already under construction when the 275 kV scheme was adopted in 1950.
- 1953** *Railway electrification*—experiments with alternating current. In August the *Lancaster–Morecambe–Heysham line*, some 15 route km in length, began electric operation on the single-phase 50 Hz a.c. system, using 6.6 kV to an overhead contact wire. Powered coaches were fitted with mercury-arc rectifiers and d.c. traction motors. *Germanium and silicon rectifiers were tried out for the first time* anywhere in the world.
- 1953** *District Heating*: Report by the Heating and Ventilation (Reconstruction) Committee of the Building Research Board of the Department of Scientific and Industrial Research (Chairman: *Sir Alfred Egerton*) (Ref. Post-War Building Studies Nos. 31 and 32, Ministry of Works) dealt with possible district heating developments in Britain, practice abroad, and heat pumps. Principal conclusion was that the national case for district heating rested generally on fuel savings obtainable through linking the service with electricity generation.
- 1953** *Report of the Committee of Enquiry into Economy in the Construction of Power Stations* (Chairman: *Sir Hugh Beaver*) published in October. Established in August 1952 to consider possible savings of materials or manpower in power station construction in regard to scarcity of materials at that time. Recommendations included introduction of larger units in stations of at least 400 MW capacity, use of uncovered or semi-clad plant where practicable, and greater simplification and standardisation in finish and design of plant and buildings, with use of lighter cladding.
- 1953** *Nuclear energy. "Future Organisation of the United Kingdom Atomic Energy Project"* (Cmnd. 8986). This White Paper, issued in November, accepted the recommendations of the Waverley Committee (report unpublished) and dealt with the *transfer of responsibility for nuclear energy from the Ministry of Supply to a non-departmental authority*. An Order in Council, operative from 1 January 1954, made the *Lord President of the Council* the Minister responsible for nuclear energy. A Bill was introduced providing for the establishment of the United Kingdom Atomic Energy Authority which received the Royal Assent on 4 June 1954. (Atomic Energy Authority Act 1954.) *The U.K.A.E.A. came into being on 19 July 1954*. During the period 1 January to 18 July 1954 responsibility for nuclear affairs was exercised by a Department of Atomic Energy reporting to the Lord President.

- c.1954** *Installation practice.* Moulded-case circuit-breakers ("m.c.c.b.'s.") seriously introduced to the British market as an alternative to the conventional fused switch.
- 1954** *Oil burning programme.* As part of the Government's fuel policy to meet a likely coal shortage, plans were put in hand to burn oil at 17 power stations representing an annual oil consumption of $5\frac{1}{2}$ million tons by 1960–61, equivalent to 9 million tons of coal. Improved supplies of coal and uncertainty about future oil supplies led to a modification of the programme in 1957, reducing the number of stations to 14 and the oil burn to $4\frac{1}{2}$ million tons a year. Marchwood station, Southampton Water, with 8×60 MW units, which commissioned in 1955, was included in the programme, supplied by the near-by Esso Refinery. Other oil-fired stations sited near developing refineries, were later commissioned—Fawley in 1969, Pembroke and Kingsnorth in 1970. From about 1965 relative fuel prices provided a case for an increased oil burn, but until 1970, conversions to oil were largely prevented by the Government's support for coal policy.
- 1954** **Submarine cable link*, capacity 20 MW at 100 kV d.c. between Swedish mainland and Island of Gotland (63 miles) commissioned.
- 1954** *Highest transmission line in Great Britain* completed—over the Corrieyairack Pass in Inverness-shire, some 2,500 ft. above sea level at summit.
- 1954** *Electric floor heating.* South East Scotland E.B.'s experiment in conjunction with Kirkcaldy Corporation in a prototype eight-storey block of flats.
- 1954** *Pottery manufacture—intermittent electric kiln for biscuit firing of china* designed by Shelley Potteries in conjunction with Midlands E.B.
- 1954** *Arc furnaces*—start-up by Samuel Fox & Co. Ltd. of a 60-ton unit for the melting of alloy and special steels and believed to be the largest electric furnace in Europe.
- 1954** *Report of the Scottish Peat Committee* published. Appointed 1949 under the chairmanship of *Sir Edward Appleton*, to advise the Secretary of State for Scotland upon a survey of Scottish peat deposits; a programme of research into peat-burning gas turbines; and the commercial exploitation of Scottish peat deposits generally. Proposed that the North of Scotland H.-E.B. should bring into operation two peat-fuelled gas turbo-alternators. The Board should be invited to order a 2,000 kW closed-cycle gas turbine and instal it at Altnabreac Moss, Caithness.
- 1954** *Diesel plant*—start-up of the *Ashford "B"* power station. With 5×2 MW sets, this was the largest diesel station operated by the C.E.G.B.
- 1954** *Domestic heat pumps.* Development of a refrigerator/hot water system, called the Duo-Therm, by G. O. McLean, Chief Engineer, South Western E.B. and in production by Brentford Transformers Ltd.
- 1954** *"Nuclear Reactors and Power Production"* by *Sir Christopher Hinton*. James Clayton Lecture to the Institution of Mechanical Engineers on 26 February, published in "Proceedings I.Mech.E", 1954, Vol. 168, pp. 55 etc.
- 1954** *Testing of 275 kV cables* began at a new cable testing station, near Staythorpe power station, inaugurated on 25 March. Test lengths

submitted by manufacturers were connected to Staythorpe/West Melton 275 kV grid line.

- 1954** *Electricity Reorganisation (Scotland) Act 1954*, provided for the transfer to the Secretary of State for Scotland of practically all the functions of the Minister of Power in relation to electricity supply in Scotland, and for the setting up of a new public authority, the *South of Scotland Electricity Board*, to be responsible, from 1 April 1955, for the generation and supply of electricity in the part of Scotland outside the area of the North of Scotland H.-E.B. Also provided for the title of the British Electricity Authority to be changed to *Central Electricity Authority* ("C.E.A.") from the same date.
- 1954** *Enlarged generation division*—inauguration on 1 April of the North West Merseyside & North Wales Division, a *merger* of the Merseyside and North Wales and the North Western Divisions of the B.E.A.
- 1954** *Organisation of the supply industry in England and Wales*—appointment by the Minister of Fuel and Power in July of a committee of inquiry under the chairmanship of *Sir Edwin Herbert*. The committee reported in January 1956—see under that year.
- 1954** "*Report on the Design of Underground Distribution Systems for New Housing Estates*" prepared by the C.E.A. and Area Boards—published July 1955.
- 1954** *United Kingdom Atomic Energy Authority (U.K.A.E.A.)* established on 19 July.
- 1954** Commissioning of *Stourport "B" H.P.* The 60 MW unit had the *most advanced steam conditions* on the public supply system—1500 lb/sq. in. 1050°F at the turbine stop valve.
- 1954** *Report of the Committee on Air Pollution*, Chairman: *Sir Hugh Beaver*; Cmd. 9322, November. Looked into the causes and effects of air pollution and the efficacy of preventive measures. Its recommendations were embodied in the Clean Air Act 1956.
- 1954** Commissioning of the *Ince "A" station*—the first British station with the *semi-outdoor design of boiler plant*.
- 1955** *Railway electrification*—publication of the British Transport Commission's Plan for the modernisation and re-equipment of British Railways, to be started within five years and completed within fifteen. Provision made for the electrification of certain main lines and other routes.
- 1955** **Overhead line crossing*—completion of the crossing of the Messina Straits from Sicily to the mainland of Italy, said to be the longest overhead link in the world, comprising a double circuit 220 kV line, 11,950 ft. total length with two towers of height 735 ft.
- 1955** **Sulphur hexafluoride (SF₆) circuit breaker rating 115 kV 1,000 MVA* put into service in the U.S.A.—one of the earliest in the world. Westinghouse Electric Corp'n. had been installing lower power SF₆ load-break isolator switches since 1953.
- 1955** *Domestic heat pumps*—announcement of the "Fridge-Heater", for water heating and larder cooling, developed by Basil Z de Ferranti, for marketing by Ferranti Ltd.
- 1955** *Oil-filled cables*—Henleys develop three-core 132 kV cable.

- 1955 *British Nuclear Energy Conference* inaugurated—sponsored by the Institutions of Chemical, Civil, Mechanical and Electrical Engineers, and the Institute of Physics.
- 1955 *Research*—Extension to Central Electricity Research Laboratories (C.E.R.L.) Leatherhead, officially opened.
- 1955 *Joint Meter Reading*. Reports on the joint reading of electricity and gas meters prepared by a firm of industrial consultants for the C.E.A. and the Gas Council were submitted between August 1954 and September 1955. The reports were summarised in the Weir Committee report of 1959—*q.v.*
- 1955 *North Wales Hydro-Electric Power Act 1955*. Conferred powers upon the C.E.A. for the construction of hydro-electric projects at Ffestiniog and Rheidol.
- 1955 “*A Programme of Nuclear Power*”, Cmnd. 9389, February, announcing a ten-year programme for the United Kingdom comprising about 1,500 to 2,000 MW of gas-cooled graphite-moderated stations, using natural uranium canned in magnesium alloy (“*Magnox*”). This *first nuclear power programme* was expanded in 1957 with the further technical progress in nuclear design and because of the Suez crisis which drew attention to the security aspects of oil supplies. The programme was subsequently re-phased because of the easing of the fuel situation, restrictions on capital expenditure, and a number of factors which affected its economics—rising interest rates, a reduction in the price of recoverable plutonium, and the rate at which conventional generation costs were falling. In its final form the programme comprised nine stations with a design output capacity of nearly 5,000 MW. The last reactor commissioned in 1971.
- 1955 Vesting day 1 April for the *South of Scotland Electricity Board* established under the Electricity Reorganisation (Scotland) Act 1954—*q.v.* There were consequential reductions from 14 to 12 in the number of Area Boards and from 13 to 11 in the number of the C.E.A.’s Generation Divisions.
- 1955 *O.E.E.C. published in June “*Some Aspects of the European Energy Problem*” (*Armand Report*) its first important energy survey for Western Europe.
- 1955 A 12 MW *gas turbine* of the “closed cycle” type at the Carolina Port station in Dundee was connected to the system for the first time in July. Trials continued until in 1959 the project was abandoned, as reliable commercial operation seemed unlikely. Experimental 15 MW gas turbines were commissioned by the C.E.A. at Dunston “A” in November 1955 and at the Trafford station in February 1957, but were taken out of service in 1960–61.
- 1955 *United Nations *International Conference on the Peaceful Uses of Atomic Energy* in August, in Geneva. About 80 nations participated.
- 1955 *Heat Pumps*—“First Interim Report on Heat Pumps” issued by the C.E.A.’s Generating Station Operation—Research Liaison Committee, in December. Dealt with the study of heat pump installations at Meaford and Stourport power stations and other methods of heating similar power station administrative buildings.
- 1955 At the end of the year the British Transport Commission decided to adopt 50 Hz single-phase 25 kV as standard for railway electrification.
- 1956 *National Inspection Council for Electrical Installation Contracting*

incorporated, the C.E.A. and Area Boards, and the South of Scotland E.B. being among the member bodies.

- 1956** *Appliance Testing*—E.D.A. to undertake tests for the British Standards Institution in connection with the “Kite Mark” scheme.
- 1956** *Wind-power generation*—a 10 kW generator erected for tests at the E.R.A. station at Cranfield. Built by Dowsett organisation in conjunction with Ministry of Power.
- 1956** **Nuclear power stations*. The French Commissariat à l’Energie Atomique commissioned their first reactor, a natural uranium graphite-moderated gas-cooled type, designated G1, capacity 5 MW(e).
- 1956** *Rural electrification*. South of Scotland E.B. published their plan for completing in a systematic manner, by 1960, the electrical development of those parts of the rural areas not yet on supply.
- 1956** Commissioning of the first of two 30 MW sets at the *Barony station* of the South of Scotland E.B., the *first of its kind* in the U.K. using *colliery washery slurry as a fuel*.
- 1956** *Clean Air Act 1956*, based on the recommendations of the Beaver Committee on Air Pollution (Cmnd. 9322, November 1954). The Act provided for the establishment by local authorities of smoke control areas in which only authorised fuels might be used.
- 1956** White Paper “*Report of the Committee of Inquiry into the Electricity Supply Industry*”, Cmnd. 9672, published January. The committee was set up by the Minister of Fuel and Power in July 1954, under the chairmanship of *Sir Edwin Herbert*, “to enquire into the organisation and efficiency of the electricity supply industry in England and Wales in the light of its working under the Electricity Act 1947”. The main recommendation of the report was that the C.E.A. should hand over its responsibility for generation and transmission to a new statutory body with clearly delimited supervisory functions, and Area Boards should be given a greater degree of independence. The Government in a White Paper “*Proposals for the Reorganisation of the Electricity Supply Industry*”, Cmnd. 27, expressed their general agreement with the recommendations, and gave them effect by the Electricity Act 1957 (q.v.).
- 1956** *O.E.E.C. published in May “*Europe’s Growing Needs of Energy—How can they be met?*”, the report of a Group of Experts (Chairman *Sir Harold Hartley*). Reviewed energy problems of Western Europe and its recommendations led to the creation of the O.E.E.C.’s Energy Advisory Commission and Energy Committee.
- 1956** Government took over direct responsibility for financing the long-term borrowing requirements of the nationalised industries under section 42 of the Finance Act 1956. *Borrowing through stock issue was replaced by Exchequer advances*.
- 1956** Monopolies and Restrictive Practices Commission “*Report on the supply and exports of electrical and allied machinery and plant*” published in July.
- 1956** **Submarine cable link* between *Vancouver Island* and the mainland of *British Columbia*, Canada, length nearly 19 miles—two circuits, total capacity 250 MW each consisting of a 138 kV a.c. cable, the first circuit being commissioned in September 1956 and the second in July 1958.

- 1956** *World's first large-scale nuclear power station*—the U.K.A.E.A.'s *Calder Hall "A"*, in Cumberland, rating 4×23 MW generating sets, connected to grid after Royal opening 17 October. Its primary purpose was to produce the fissile fuel plutonium, essentially for military use.
- 1956** First *cyclone-fired boiler* in Britain commissioned at the Kynoch Works of I.C.I. The 200 k lb/h Babcock and Wilcox boiler provided heating and process steam at this non-ferrous metals producing works and also steamed a 6.5 MW turbo-alternator at steam conditions 900 lb/sq. in. 900°F.
- 1956** Commissioning of the *first 100 MW unit*, at Castle Donington station, near Derby. This station, with 6×100 MW turbo-alternators and 6×830 k lb/h boilers was the first to break away from the standard 30 MW and 60 MW sets. Its turbines incorporated a double shell high-pressure cylinder and the rigid coupled three bearing rotor, both novel to British practice. Steam conditions were 1,500 lb/sq. in. and 1,050°F. Sets of this size were later commissioned at the Willington "A", Ferrybridge "B", and Aberthaw "A" stations, the latter two having steam conditions of 1,500 lb/sq. in. and 975°F with reheat to 950°F.
- 1956** *Electricity Bill* presented to the Minister of Power 27 November provided for the dissolution of the C.E.A. and the establishment of C.E.G.B. and The Electricity Council. (See Electricity Act, 1957.)
- 1956** *Water cooling of turbo-alternators* Commissioning of a prototype 30 MW set at the Bold "A" station, the first machine in the world with water flowing through the stator bars.
- 1957** Electricity Bill received Royal Assent 17 July.
The Electricity Act 1957 based largely on the recommendations of the Herbert Committee report of January 1956 (q.v.) The Act established two new statutory bodies, *The Electricity Council*, a central council for the electricity supply industry in England and Wales as a whole, and the *Central Electricity Generating Board* ("C.E.G.B."), to take over from the C.E.A. the duties of generation and transmission. The vesting date for these two new bodies was 1 January 1958. Also, the Act gave *greater financial responsibility* to the Area Boards.
- 1957** Formation of the *British Lighting Council* (disbanded in 1967).
- 1957** *A 125 MW unit commissioned at the Philo station of the Ohio Power Co. with turbine stop valve *steam conditions of 4,500 lb/sq. in. at 1,050°F with reheat to 1,000°F.*
- 1957** *World's largest walking drag-line scraper*, designed and built by Ransomes and Rapier Ltd; weight 1,675 tons; equipped with 282 ft. long tubular jib, capacity of grab 30 tons; electricity taken from mains at 6.6 kV through trailing cable feeding two 1,500 h.p. motor-generator sets providing d.c. to the 14 main driving motors each of 225 h.p.—at work on open-cast ironstone quarry, near Stamford.
- 1957** **World's largest steam power plant* commissioned at Kingston by the T.V.A.—total rated capacity 1,440 MW (total capability 1,600 MW) from 4×135 MW and 5×180 MW sets.
- 1957** **The first commercial pressurised water reactor (P.W.R.) nuclear station* commissioned at Shippingport, near Pittsburgh. Owned by the U.S. Atomic Energy Commission, the station had a capacity of 60 MW(e).
- 1957** *Storage radiators:*
"E.D.A. Recommendations for the Design, Installation and Use of Thermal Storage Block Heaters", published.

Field trials of storage radiators suitable for *dwelling houses*.

- 1957 **Wind-power generation*—a 200 kW a.c. generator on trial at Gedser, Denmark.
- 1957 *Expansion of first nuclear power programme*—The Minister of Power, on 5 March, announced the Government's decision that planning was to proceed on the basis of 5,000 to 6,000 MW of nuclear capacity in operation *by the end of 1965*. This represented a *trebling of the 1955 programme*—q.v.
- 1957 **European Economic Community ("E.E.C.") and European Atomic Energy Community ("Euratom")* set up under the Treaty of Rome, on 25 March.
- 1957 First *cyclone-fired boiler* on the public supply system commissioned at the Barking "C" station. This 540 k lb/h Babcock and Wilcox boiler was scrapped in March 1971, having served as a prototype for the 860 k lb/h cyclone-fired boiler commissioned at the Padiham "B" station in 1962.
- 1957 *Automatic control in power stations*—commissioning of oil-fired station at *South Denes*, Gt. Yarmouth, notable at the time for the completeness of its automatic control.
- 1957 Commissioning of the 5 MW generating/pumping set at Sron Mor power station of the North of Scotland Hydro-Electric Board. This part of the Glen Shira scheme was the *first example of pumped storage* on any considerable scale on the British public supply system.
- 1957 *O.E.E.C. published "*Production, Transmission and Distribution of Electricity in Europe*", the report of a mission of American and European engineers, known as "*Project 350*", to European electricity undertakings in order to assess progress made since the "*Tecaid*" Mission of 1949.
- 1957 On 1 September the Minister of Power appointed *Sir Henry Self* Chairman of The Electricity Council and *Sir Christopher Hinton* Chairman of the Central Electricity Generating Board.
- 1957 **Hydro-electric developments in the U.S.S.R.*—visit by British delegation appointed by the three senior engineering institutions in association with the British Council, October 1956, led by *Sir John Hacking*—report presented 20 May 1957 to a joint meeting of the three Institutions.
- 1957 "*Report from Select Committee on Nationalised Industries (Reports and Accounts)*" H. C. Paper 304, October. The Committee examined the 1956 Reports and Accounts of the two Scottish boards. In the case of the *North of Scotland H.-E.B.* they also heard evidence on the Board's operations and functions, and on the state of rural electrification in the Highlands. The Committee's criticisms were on comparatively minor points and did not detract from the good opinion they had formed of the Board's achievements. Bearing in mind the satisfactory performance of the *South of Scotland E.B.* throughout its brief existence, the Select Committee decided not to pursue their investigations into the Board's operations at this time.
- 1957 **European Nuclear Energy Agency* established by O.E.E.C. Council in December to further the development of the production and uses of nuclear energy for peaceful purposes by the participating countries, through co-operation between those countries and a harmonisation of measures taken at national level.

- 1958** *H.V. aerial cable.* South Western E.B. energised the first 11 kV aerial plastic cable, designed for stringing through wooded areas in the National Parks.
- 1958** *Railway electrification.* The *first section to operate at 25 kV 50 Hz* was completed—the Styal Line pilot scheme between Wilmslow and Slade Green Junction.
- 1958** *Re-organisation of the C.E.G.B.*—Two main changes introduced :
 (i) to secure more delegation of authority from headquarters to the localities, the Board's territory was divided into five *Regions*, entrusted with the maintenance of the power stations and the transmission system and with their operation to the requirements of the National Grid Control ;
 (ii) because of the increased size of generating plant and power stations, the design and construction of new power stations and associated sub-stations were transferred to three *Project Groups* responsible direct to Headquarters.
- 1958** *First 275 kV transmission line in Scotland* brought into use by the South of Scotland E.B. between Clyde's Mill power station and the Harker substation, near Carlisle.
- 1958** *Grid system*—completion of new standardised system of Area Control Centres.
- 1958** *Pithead power stations.* Opening of N.C.B.'s Grimethorpe station, 3 × 20 MW sets, which used *high-ash coal*.
- 1958** *Water cooling of turbo-alternators.* Commissioning at Tilbury "A" power station of set No. 6, 60 MW, which employed a *stator cooled by distilled water*—a *prototype machine* used to obtain experience with this cooling system before applying it to the 200 MW sets.
- 1958** The Electricity Act 1957 came into effect on 1 January, establishing *The Electricity Council* and the *Central Electricity Generating Board* ("C.E.G.B.")—see under 1957.
- 1958** Appointment in March of the *Committee on Co-operation between Area and Scottish Electricity and Gas Boards*, under the chairmanship of *Sir Cecil Weir*. The Committee reported in 1959—*q.v.*
- 1958** *Battery train*, comprising two coaches, inaugurated in April on Aberdeen—Ballater branch, Scottish Region, British Railways.
- 1958** *Gas turbine designed to run on milled peat* at the Olgrinbeg power station, Altnabreac, of the North of Scotland H.-E.B., started up in June. Peat combustion proved difficult to control and the experiment was abandoned on economic grounds in June 1960.
- 1958** *Second United Nations *International Conference on the Peaceful Uses of Atomic Energy*, held August, in Geneva.
- 1958** **St. Lawrence Power Project*, International Rapids Section—official inauguration on 5 September of the adjoining Canadian and United States power stations, having combined capacity of 1,880 MW.
- 1958** *Hydrogen cooling of alternators*—direct cooling of all conductors. The no. 2 generator at Willington "A", which commissioned in October, was the first machine to employ internal hydrogen cooling of both stator and rotor conductors. Gas pressure was at 30 lb/sq. in.

- 1958** **Geothermal power generation* at Wairakei, New Zealand. Start-up of the first generating set, a 6.5 MW back pressure unit, in November. Completion of Stage I, at 69 MW, in March 1960. Stage II, total capacity 123 MW, completed in 1963.
- 1958** Commissioning of the *first 120 MW units* in the U.K. on 23 December at the Blyth "A" station on the Northumberland coast, and on 28 December at the Kincardine station, South of Scotland E.B., on the north bank of the Firth of Forth. Turbine stop valve steam conditions were 1,500 lb/sq. in and 1,000°F with reheat to 1,000°F. Altogether 44 of these standard units were installed in 14 stations in Great Britain.
- 1958** *Electrical Floor Warming Association* formed in December.
- 1958** **Electroslag refining* process for melting metals. U.S.S.R. built first pilot plant and by end of year had two production furnaces in operation.
- 1958** *Underground gasification of coal*. A 3.75 MW power station at Newman Spinney, Derbyshire, fired by gas from a National Coal Board underground gasification project, was completed at the end of the year. Intended as a prototype for a 60 MW station, it began operating in April 1959, but the trials ceased in the summer of that year because the results obtained did not warrant further expenditure. The station was demolished in 1960.
- 1959** *Microwave oven*, based on a continuous wave magnetron, demonstrated at a Catering Exhibition in London for reheating cooked food.
- 1959** **Water cooling of turbo-alternators*—Electrosila works in Leningrad commissioned a 60 MVA set at the Lenenergo station with *direct water cooling of both stator and rotor*.
- 1959** *Commissioning of the first 100 MW set of the *Kariba hydro-electric project* on the Zambesi River. The first part of the scheme (6 × 100 MW) was completed in March 1962. The total eventual capacity was expected to be at least 1,500 MW.
- 1959** South Western E.B. start up the 3 MW gas-turbine station at Princetown for operation at time of peak. Powered by Bristol Siddeley Proteus turbines, this was the *first installation of aircraft-type gas turbines on the British system*, and also the *first fully-automatic remote-controlled station* in England.
- 1959** Introduction in Britain of solid-core plastic insulated aluminium ("*Solidal*") cable—developed jointly by Aluminium Union Ltd., Northern Aluminium Co., Aluminium Laboratories, of Banbury, and Sterling Cables, and first manufactured for voltages up to 1,100 V. B.I.C.C. also produced some experimental 4-core cables.
- 1959** Spondon "*H*" *process steam station*, near Derby, commissioned. Of capacity 3 × 10 MW, this is unique among C.E.G.B.'s power stations in being designed primarily as a steam producing station, to supply a nearby British Celanese plant.
- 1959** *Automatic control in power stations*—Agcroft "*C*" started up, capacity 2 × 120 MW sets equipped with automatic control of *turbine output*.
- 1959** *Meters (Periods of Certification) Order 1959*—providing among other things that in general all meters will need *re-certification* at intervals of fifteen years.
- 1959** **Electron beam welding*—first commercial equipment available in the United States.

- 1959** *The grid*—commissioning of the *Severn and Wye 275 kV crossing* of 2½ mile length from Aust to Beachley, including a one mile span across the Severn and a 1,000 yard span across the Wye. The two high crossing towers were 488 ft. high.
- 1959** Start up in February of the U.K.A.E.A.'s *nuclear power station at Chapelcross*, Dumfriesshire. Like Calder Hall (1956), this station was based on gas-cooled natural uranium reactors and was designed primarily as a producer of plutonium for military purposes. Final capacity was 8 × 23 MW turbo-alternators operating on a dual-pressure steam cycle.
- 1959** *Report of the Committee on Co-operation between Area and Scottish Electricity and Gas Boards*, under the chairmanship of Sir Cecil Weir, published as Cmnd. 695, of March. The terms of reference aimed at improving the services provided by the two industries through co-operation, as in joint meter reading, but were not concerned with general policy or competition between the industries.
The committee reported that they did not consider that consumers would benefit if certain parts of the boards' activities were combined. They were satisfied that any formal co-operation along the lines they had been considering would not lead to worthwhile savings, even in theory.
- 1959** *Little Barford "B" station* commissioned. Had *completely remote operation* of the two 60 MW units. Boilers were of fully outdoor construction, The *automatic electronic boiler-control system* used single-analogue on-line computers and three-term process controllers—the *first comprehensive installation of its kind* in the country.
- 1959** 275 kV cables connecting the No. 5 generator transformer at the Drake-low "B" station to the grid were commissioned on 24 April—the *first operational use of 275 kV cables* on the British system.
- 1959** *Fuel cells*. On 24 August, F. T. Bacon demonstrated his "Hydrox" (hydrogen-oxygen) fuel cell on an airfield at Cambridge. Developed over some twenty-seven years of research at the University, this was a prototype unit consisting of forty cells having a total rating of 2½ kW. For short periods the unit could produce 5 kW at 24 V. Claimed to be the most advanced fuel cell in the world, and the *first to become a commercial proposition*.
- 1959** *Heat pump* installations at the Meaford and Stourport power stations—C.E.G.B. sub-committee set up to examine the operating conditions and costs of these heat pumps and to compare the results with the costs of alternative forms of heating, reported in October.
- 1959** Commissioning in October of *Europe's first 200 MW unit* at the High Marnham station on the River Trent, near Retford, Notts., steamed from a 1,400 k lb/h boiler, with the most advanced steam conditions yet introduced on the British system—2350 lb/sq. in. at 1,050°F with reheat to 1,000°F at the turbine stop valve. The last of five 200 MW units commissioned in June 1962, units 4 and 5 having more advanced boilers of 1,350 k lb/h capacity. Standard units of this size were later installed at the West Thurrock, Willington "B" and Kincardine H.P. stations. High Marnham was *Europe's first one million kilowatt coal-fired station*. It was the *first to employ the "merry-go-round" system of automatic discharge of rail coal wagons*.
- 1959** **Nuclear reactor research*—The *Halden Project* of the O.E.E.C. European Nuclear Energy Agency officially opened in October—the world's *first heavy boiling water reactor*, power 20 MW (thermal).
- 1959** *Nuclear reactor research*:

- U.K.A.E.A.'s experimental *fast breeder* reactor at Dounreay went "critical" in November.
Inauguration of the "*Merlin*" reactor of the "swimming pool" type, 5 MW, at the A.E.I. research laboratories at Aldermaston Court, built for fundamental and applied research.
- 1959** *Road heating*—first major installation, total loading of 900 kW covering about 55,000 sq. ft. of steep roadway, at the Mound, Edinburgh, connected in December by the South of Scotland E.B.
- 1959** Towards the end of the year the C.E.G.B. began to assemble research teams for work on *magnetohydrodynamic (M.H.D.) generation*. Interest became centred on developing a topping unit for conventional steam stations and ultimately for nuclear stations. Work was started on a 200 MW (t) open-cycle demonstration plant at the Marchwood Engineering Laboratories for commissioning in 1966, with electricity generation due to begin in 1967. By 1968 the plant had not yet been commissioned due to setbacks in experimental equipment, and changes in the long-term economics of power generation meant that the likely economic benefit could not justify the cost of further development. The work was, therefore, discontinued.
- 1959** *Rural electrification*—the South of Scotland E.B.'s development programme virtually complete at end of year, nine months ahead of schedule, when 93 per cent of all farms were connected or in process of being connected to the supply.
- late 1950's and early 1960's** **Underground Residential Distribution (URD)*. In the U.S.A., development of pad-mounted transformers and polyethylene insulated primary cable made possible significant cost reduction in underground distribution, marking the beginning of what was called U.R.D. I.E.E.E. national conference on underground distribution in 1964 stimulated the spread of U.R.D. Principal feature was high voltage single-phase distribution to transformers serving one or a few consumers, typically at 15 kV.
- 1960** *Foundation of the *European Committee for the Co-ordination of Electrical Standards in the Common Market countries*, for short "*CENELCOM*", with the general aim of harmonising electrical standards in the E.E.C. countries.
- 1960** Interim Report of the *Committee on Consumer Protection* (Chairman: *J. T. Molony*), Cmnd. 1011. The Committee "found no evidence to suggest the marketing on any widespread scale of consumer goods from which recognised hazards have not been eliminated as far as reasonably practicable". They called for standard plugs and sockets.
- 1960** **Electrostatic paint spraying*—the Ransburg process introduced in the United States.
- 1960** *Railway electrification*. Inauguration of the Manchester–Crewe section at 25 kV single-phase a.c.—the first main-line section with this system in the country.
- 1960** First of six 120 MW units commissioned at the *Northfleet power station* in Kent. *Data logging equipment*, the first to be installed in a British power station, provided a continuous scan of plant conditions.
- 1960** *O.E.E.C. published in January "*Towards a New Energy Pattern in Europe*", a report by their Energy Advisory Commission (Chairman *Professor Austin Robinson*) on the energy problems of Western Europe, in particular the shortfall between demand and domestic production.

- 1960 *The *first commercial boiling water reactor* (B.W.R.) *nuclear station* commissioned at Dresden, Illinois. The station, owned by the Commonwealth Edison Co., had a capacity of 200 MW(e).
- 1960 *First supercritical once-through boiler* commissioned at the Margam "B" power station of the Steel Company of Wales. The 240 k lb/h Benson boiler, designed and constructed by Simon Carves, steamed a 9.5 MW back-pressure set. Steam conditions at the turbine stop valve were 3,000 lb/sq. in. 1,050°F.
- 1960 *First low thermal mass electric furnace* commissioned in May at John Thompson (Wilson Boilers) Ltd. Lilybank Works, Glasgow. Designed by the South of Scotland E.B.'s Industrial Advisory Service, the furnace was used for stress relieving of welded structures.
- 1960 White Paper "*The Nuclear Power Programme*" Cmnd. 1083, published June. Since it appeared that nuclear power would not compete in costs with conventional power as early as had been expected, the Government decided that the period of the programme was to be extended to provide for the construction of about 5,000 MW by 1968.
- 1960 "*The Economics of Nuclear Power in Great Britain*" by Sir Christopher Hinton, F. H. S. Brown and L. Rotherham. Paper to 1960 World Power Conference, Madrid. Published in "Proceedings W.P.C.", 1960, Vol. VII, pp. 3887 etc.
- 1960 *Committee on Natural Resources in Scotland* of the Scottish Council (Development and Industry), Chairman: L. A. Elgood.
- 1960 *British Electrical Approvals Board for Domestic Appliances* formed—since 1971, *British Electrotechnical Approvals Board for Household Equipment* ("B.E.A.B")—for approving appliances tested to British Standards, and publishing a list of appliances so approved.
- 1961 Publication of "*Homes for today and tomorrow*"—a Report of the Housing Advisory Committee (Chairman: *Sir Parker Morris*) of the Ministry of Housing and Local Government—covering design and equipments, including electrical socket outlets.
- 1961 *Electric stress relieving furnace*—believed to be the largest in the world—installed for use in the fabrication of the boilers for Dungeness nuclear power station.
- 1961 Commissioning of the *Rheidol hydro-electric power station* near a beauty spot, the Devil's Bridge, some ten miles from Aberystwyth. Of capacity 53 MW, this scheme received *several amenity awards*.
- 1961 Commissioning of the *Ffestiniog pumped-storage* hydro station, N. Wales, capacity 300 MW from 4 × 75 MW turbine/pump units—the *first installation of this type in this country* and among the largest in the world at the time. (The plant was uprated to 4 × 90 MW units)
- 1961 **H.V. transmission*—750 kV a.c. achieved by the U.S. General Electric Co. on their 4.3 mile prototype transmission system.
- 1961 *Electroslag refining process* for melting metals—serious work first started in the U.K. by British Iron and Steel Research Association (B.I.S.R.A.).
- 1961 *Factories Act 1961—Memorandum on the Electricity Regulations* Ref. S.H.W. 928.
- 1961 **Niagara Project* of the Power Authority of New York State, four miles

below the Falls, inaugurated—ultimate capacity 2,190 MW, including a 240 MW pumped storage scheme, claimed to be the largest hydro plant in the Western World.

- 1961 *Domestic storage radiators* now being offered by some manufacturers.
- 1961 "*The Development of Rural Electrification. A Review of Progress*". Paper to the I.E.E. by G. F. Peirson and published in the "IEE Proceedings", Vol. 108 Part A, No. 38, April 1961.
- 1961 "*A Study of the Electrification of Four Farms*", Utilisation Research Report No. 25, published by The Electricity Council.
- 1961 *Lighting*—introduction of the *tungsten halogen* lamp.
- 1961 "*A Domestic-Heating Survey of England and Wales*", Utilisation Research Report No. 18, published by The Electricity Council.
- 1961 Commissioning in January of *Rugeley "A"* power station, the first station to be *built alongside the sinking of a new coal mine*, designed to supply most of the station's requirements.
- 1961 Appointment in March of a Departmental Committee under the Chairmanship of *Colin H. MacKenzie* to review the arrangements for *electricity supply in Scotland*. The Committee reported in November 1962, (q.v.).
- 1961 *Consumer Protection Act 1961*, based closely on proposals in the Interim Report of the Molony Committee April, 1960 (q.v.) permitted the Home Secretary to make regulations on design and construction of goods to reduce injury risk. Later legislation of this kind included the Trade Descriptions Act 1968 and the Fair Trading Bill introduced in 1972.
- 1961 White Paper "*The Financial and Economic Obligations of the Nationalised Industries*", Cmnd. 1337, April 1961. Laid down that the industries should aim to balance their accounts "taking one year with another" over a period of five years after providing for interest, and depreciation at historic cost. Provision should also be made for the difference between depreciation at historic cost and replacement cost, and allocations to reserve sufficient to make some contribution towards the industries' future capital development programmes. Financial objectives or "targets" were to be determined for each undertaking in the light of its needs and capabilities in relation to these criteria. In practice, targets were normally expressed as a rate of return on the undertaking's assets.
- 1961 *Fuel Oil*. Duty of 2d per gallon imposed—including oil burnt at generating stations—by the Finance Act 1961. In July this duty was increased to 2·2d per gallon.
- 1961 *Research*—Opening of the C.E.G.B.'s *Berkeley Nuclear Laboratories* in May, for research directed towards a better understanding of the behaviour and performance of nuclear reactors.
- 1961 Inauguration on 8 December of the *cross-Channel submarine cable* link between England and France—from Dungeness Point in Kent, to Boulogne, in the Pas de Calais, some 30 miles—operating on direct current at 100 kV above and below earth potential, permitting power exchanges between the two countries of up to 160 MW each way. It connected the British 275 kV system with the Electricité de France 225 kV network.

- 1961 *Dry cooling tower* commissioned in December at the Rugeley "A" station. The 3.6 mn. gal/h. tower based on the Heller System was associated with a 120 MW set. The tower used water/air heat exchangers and a special condenser.
- 1962 *Grid system*—inauguration of the new *National Control Room* at Bankside House, London to co-ordinate the seven Area Control Rooms.
- 1962 Second report of the *Scottish Peat Committee*, chairman *Sir Edward Appleton*, considered that whilst electricity generation based on Scotland's peat reserves could be undertaken on a substantial scale, the costs would be somewhat higher than the costs in the large new coal-fired stations. (The Committee's first report was in 1954—(q.v.).)
- 1962 First International Symposium on *Magnetoplasmadynamic (M.P.D.) electrical power generation* at Newcastle-upon-Tyne, held under the aegis of the I.E.E.'s North Eastern Centre.
- 1962 *Electric arc furnaces*—first of the six 110-ton furnaces for steel production at the Templeborough melting shop of Steel, Peach and Tozer, Rotherham, went into operation—the "Spear" project.
- 1962 Demonstration of the *linear motor*, fitted to a rail trolley, for traction purposes by Prof. E. R. Laithwaite, Manchester University.
- 1962 **Pumped storage*—commissioning of the 900 MW Vianden scheme in Luxembourg, operated as part of the Rheinisch—Westfälisches Elektrizitätswerk (R.W.E.)—the then largest pumped storage scheme in the world.
- 1962 **Establishment of the Ente Nazionale per L'Energia Elettrica ("E.N.E.L.")* the Italian National Electricity Board.
- 1962 *Computers for management information and accounting*. Yorkshire E.B. installed the first central computer for dealing with the needs of an entire Area Board.
- 1962 London E.B. opened a *Commercial Catering Centre* at Salem Road in Bayswater. Primarily to meet enquiries from London consumers, it assumed almost a national character and was re-named *The Electric Catering Centre* when taken over by The Electricity Council in 1969.
- 1962 "*The 400 kV grid system in England and Wales*"—paper by E. S. Booth, D. Clark, J. L. Eggington and J. S. Forrest to the I.E.E. on 14 March and published in the "Proceedings I.E.E." Vol. 109, Part A 1962. Paper outlined the plans for the 400 kV system.
- 1962 *275 kV/400 kV Super-grid crossing*. Commissioning in April of the Thames crossing between Northfleet, Kent and West Thurrock, Essex, designed for 275 kV initially and 400 kV ultimate operation. Tower height 630 ft—the *highest transmission towers* in the country: crossing span, 4500 ft.
- 1962 *Research*—new Central Electricity Research Laboratories (C.E.R.L.) at Leatherhead officially opened by the Minister of Power, in May.
- 1962 "*Planning for expansion in electricity supply*"—paper presented by

- R. S. Edwards and D. Clark to the British Electrical Power Convention in June, principally concerned with *demand forecasting* and the planning and financing of plant programmes.
- 1962** *First commercial nuclear power stations commissioned—Berkeley* (Glos.) design output 275 MW in June and *Bradwell* (Essex) design output 300 MW on 1 July. These and the later stations of the first nuclear power programme were equipped with gas-cooled graphite-moderated reactors using natural uranium fuel canned in magnesium alloy ("magnox")—they were known as "Magnox" stations.
- 1962** Final report of the *Committee on Consumer Protection* (Molony Committee), Cmnd. 1781, July. Reviewed merchandising legislation and suggested formation of a *Consumer Council* to ascertain and review problems experienced by the consumer and to devise and advance the methods of resolving them (Interim report published April 1960).
- 1962** In August The Electricity Council's *Working Party on the Characteristics of the Space Heating Load* reported on the feasibility of applying load limiters to domestic and other small loads. They concluded that even when savings on plant costs could be achieved, they were not sufficient to provide the financial inducement for consumers to accept load limitations.
- 1962** *Nuclear reactor research*—the advanced gas-cooled reactor ("A.G.R.") of the U.K.A.E.A. at Windscale operational in August.
- 1962** *Dounreay Fast Reactor (D.F.R.)*. This experimental reactor of the U.K.A.E.A., which produced electricity as a by-product, achieved a power level of 30 MW (t) in August. In November the reactor started exporting surplus electricity to the national grid.
- 1962** *Electricity in Scotland*—Report of the departmental committee, appointed in March 1961 under the chairmanship of *Colin H. MacKenzie* to review the arrangements for electricity supply in Scotland, published in November. The committee's central recommendation that the two Scottish boards should be merged was rejected by the Government on the grounds that it would be unwelcome to a wide range of interests, although there was to be closer consultation and co-operation between the two boards. This took effect in 1965 when the two Scottish boards established an arrangement which placed the control of generation and the planning of future power stations on an all-Scotland basis.
- 1962** A Simon Carves 860 k lb/h *slag-tap boiler* was commissioned at the Padiham "B" station to gain direct operational experience of this kind of boiler—might have an advantage over conventional pulverised-fuel fired boilers where there were problems of ash disposal.
- 1962** *15 MW gas turbine* unit went into service at the Hams Hall "A" station, powered by a Bristol Siddeley Olympus *aircraft-type jet engine*. Its purpose was to assess the performance of aircraft gas turbines for meeting peak-load and emergency requirements.
- 1962** "*The duty and development of modern power station plant*" by F. H. S. Brown. Parsons Memorial Lecture to the Institution of Mechanical Engineers on 12 December, published in the "*Proceedings I. Mech. E.*", Vol. 177, 1963, pp. 1133 etc.
- 1962** Commissioning of the *first of two 275 MW units* at the Blyth "B" station, Northumberland, in December. They were steamed from 1,900 k lb/h boilers and were the only units of this size on the system. Turbine stop-valve steam conditions were 2,300 lb/sq. in. at 1,050°F. with reheat to 1,050°F.

- 1963** *Domestic storage heaters*—E.D.A. launched their *Unit Plan* campaign; and followed up their earlier (1957) work by publishing *design recommendations*, the major item of which was to make a charge controller compulsory.
- 1963** *First large-scale application in The U.S.A. of the *combined-cycle* commissioned at the Horse-shoe Lake station of the Oklahoma Gas and Electric Co. A 220 MW gas-fired conventional steam unit was combined with a 27 MW gas-fired gas-turbine unit, the gas turbine's exhaust providing pre-heating for the steam unit's boiler.
- 1963** *400 kV grid*—completion of the first tower, at Thorpe Marsh, near Doncaster.
- 1963** *Research*—commissioning of the C.E.G.B.'s *Marchwood Engineering Laboratories* near Southampton, mainly concerned with large-scale experimental work involving large rigs and pilot plants.
- 1963** *Metal painting by electrophoresis*—first commercial application, following development by the Pressed Steel Co., Oxford, in conjunction with I.C.I.
- 1963** *Diesel plant*—Jersey Electricity Co. commissioned a station designed for a final capacity of 50 MW, making it the largest diesel station in Europe.
- 1963** *Use of helicopters*—for overhead line maintenance. Faulty insulators replaced on 132 kV line.
- 1963** **Vacuum circuit breakers*—in full scale production by the U.S. General Electric Co.
- 1963** **Electron beam welding*—first industrial use, in Germany (In the U.K., under development by the British Welding Research Association).
- 1963** *Electricity in mining*. The N.C.B. began their experiments in the application of *remote control* to longwall mining operations, at Newstead and Ormonde Collieries. These experiments led to the operational development of "*R.O.L.F.*" at the Bevercotes Colliery in 1967—*q.v.*
- 1963** "*C.A.N.D.U.*" *nuclear reactors*. Nuclear Power Demonstration (N.P.D.) reactor near Rolphton, Ontario commissioned. This 20 MW(e) demonstration plant, a joint project of Atomic Energy of Canada, Ontario Hydro and Canadian General Electric Co. served as a prototype for later Canadian deuterium uranium (C.A.N.D.U.) stations. It uses natural uranium fuel in pressure tubes with heavy water as coolant and moderator. During the war, Canada was assigned the task of developing the heavy-water moderated reactor system as a method of plutonium production.
- 1963** **District Heating*—scheme at Vastera, Sweden, commissioned with two generating units each of maximum electrical output of 44 MW, together providing heat sufficient for 13,000 flats.
- 1963** **Nuclear power stations*. E. de F. commissioned their first commercial station at Chinon 1, a natural uranium graphite-moderated gas-cooled type, capacity 70 MW(e). By 1972, the total nuclear capacity of E. de F. and the Commissariat à l'Energie Atomique was 2,300 MW(e) from eight reactors.
- 1963** U.K.A.E.A.'s prototype *advanced gas-cooled reactor (A.G.R.)* at Windscale reached design output in January, and was synchronised with the grid in February. Net electrical output is now 34 MW.

- 1963** *The Consumer Council* set up in March by the President of the Board of Trade, following a recommendation of the Molony Committee 1962 (q.v.). Its functions were to inform itself about consumers' problems and about matters affecting their interests, and promote action to deal with these. It was closed down at the end of 1970.
- 1963** **Report of "Ingrid" Mission*—of May 1961, published by the O.E.C.D. Under the leadership of *Sir Robertson King*, the Mission visited the United States primarily to study economic and technical aspects of *interconnected networks* and power system operation.
- 1963** *Electricity in Scotland*—publication in February by the North of Scotland H.-E.B. of their comments on the MacKenzie Committee Report, of November 1962 (q.v.).
- 1963** The National Economic Development Council's report "The growth of the U.K. economy 1961–1966" published in February. The electricity supply industry accepted a request from Government that it would base its forecasts on the assumption that the N.E.D.C.'s target of a *4 per cent growth rate* would be achieved.
- 1963** "*Report from the Select Committee on Nationalised Industries—the Electricity Supply Industry*"—Vol. 1 Report and Proceedings, Vol. II Minutes of Evidence, Vol. III Appendices and Index, H.C. Paper 236. The committee's remit was to report on the state of the electricity supply industry in England and Wales and the way in which the industry as a whole was proposing to deal with the problems that faced it—perhaps the most intensive examination of the industry yet undertaken. Among the major points made by the committee was that "the industry's structure appeared sound, and, if it was open to criticism, this should be confined to its performance."
- 1963** *Dounreay fast reactor (D.F.R.)* first operated at full design output of 60 MW (t) in July. Net electrical output was 12.5 MW (now 14 MW).
- 1963** First public demonstration of the *electrophoretic painting* process at the Industrial Demonstration Centre of the North Western E.B.
- 1963** *Thorpe Marsh* station, near Doncaster, started up in December. Two 550 MW *cross-compound* sets were each steamed from a single 3,750 k lb/h boiler, Europe's largest units at the time of commissioning. Steam conditions were 2,300 lb/sq. in. at 1,050°F. with reheat to 1,050°F.
- 1963** *400 kV grid*—commissioning of the *experimental 400 kV line*. The 64 mile long double-circuit 275 kV line from High Marnham to Monk Fryston had been re-insulated and then re-energised at 400 kV for the first time.
- 1963** White Paper "*Domestic Fuel Supplies and Clean Air Policy*", Cmnd. 2231, published in December, gave the background to the changes being made by the Minister of Housing and Local Government in the arrangements for grants under the Clean Air Act 1956, in an effort to overcome regional difficulties over supplies of suitable fuels and ensure that progress with smoke control was not impeded. *Ministry of Housing and Local Government Circular No. 69/63*, issued to local authorities, giving advice based on the findings of the White Paper, said that householders should be discouraged from installing, with the aid of the Clean Air Grant, all forms of electric space heaters other than storage heaters.
- 1964** *Computer control of 200 MW unit at West Thurrock* power station. The installation controlled the raising of boiler pressure, the run-up of the

turbine to full speed, and the subsequent loading of the generator—the *world's first application to a large coal-fired unit*.

- 1964** *"The Economics of the Domestic Space Heating Load"* by P. A. Lingard. Paper to Symposium on Electricity and Space Heating, in March, organised by the Power Division of the I.E.E. and the Institution of Heating & Ventilating Engineers. Published in "Electricity and space heating" edited by E. M. Ackery, London: Blackie, 1965.
- 1964** **"National Power Survey. A Report by the Federal Power Commission 1964"* (U.S. Government Printing Office: 1964 0-735-906). A major undertaking by the F.P.C. projecting U.S. power needs for the 1970s and 1980s and indicating how the supply industry could move towards fully co-ordinated power networks covering broad areas of the U.S.A. A second survey was published in 1971 covering future load growth, with fuller treatment of such aspects as changing power technology, environmental problems, commissioning delays and fuel supply problems. ("The 1970 National Power Survey", U.S. Government Printing Office 0-356-238, 239, 240, 241.)
- 1964** *Submarine cables*—first 132 kV oil-filled cable in British waters, laid by A.E.I. between mainland and Isle of Wight.
- 1964** *Electromagnetic forming* of metals introduced by the National Engineering Laboratory.
- 1964** *Institution of Electrical and Electronics Technician Engineers ("I.E.E.T.E.")* in course of formation, the Council governing its affairs to be appointed initially by the A.S.E.E. Council.
- 1964** **Nuclear district heating* in Sweden—a 65 MW (t) heavy-water cooled and moderated reactor in operation at Agesta, providing steam for central heating 12,000 flats and 10 MW of electricity.
- 1964** *Use of helicopters* to transport sections of 400 kV grid towers to sites in Kent.
- 1964** Introduction of the *integrated-system transformer*, usually 33/11 kV, the design of which was related to a continuous emergency rating for peak-load conditions with forced cooling.
- 1964** *"The 1961 Sample Survey of Domestic Consumers"*, Utilisation Research Report No. 42, published by The Electricity Council.
- 1964** The Electricity Council's Working Party on the *Characteristics of the Space Heating Load* reported in February.
- 1964** *Hunterston "A" nuclear station* near Largs on the north Ayrshire coast, started up in February. Design output was 300 MW from six 60 MW sets.
- 1964** White Paper *"The Second Nuclear Power Programme"* Cmnd. 2335, published April. Government decided that for planning purposes a programme of 5,000 MW of nuclear capacity should be adopted in England and Wales for commissioning during the six years 1970 to 1975. The programme was intended to be flexible and would be reviewed at regular intervals in the light of later information. The question of a further nuclear station in Scotland would be considered in these reviews. The C.E.G.B., after a most thorough assessment chose a design based on the Advanced Gas Cooled Reactor (A.G.R.) developed by the U.K.A.E.A.
- 1964** *Supply industry dispute*. "Report of a Court of Inquiry into the causes

and circumstances of a dispute between the parties represented in the National Joint Industrial Council for the Electricity Supply Industry", (Cmnd. 2361) published May, recommended the boards and unions to resume negotiations on a stage by stage approach to a *staff status scheme for manual workers*.

- 1964 *HV transmission research*—inauguration in May of test line at C.E.R.L., which could be operated at the equivalent of 800 kV system voltage.
- 1964 *EDA Testing House*, Leatherhead, integrated into The Electricity Council and given its present title, *Appliance Testing Laboratories* ("A.T.L.").
- 1964 *Magnetohydrodynamic (M.H.D.) generation of Electricity*:
 **Second International Symposium* on M.H.D. held in Paris in July under the aegis of O.E.C.D.'s European Nuclear Energy Agency. (The series was initiated by the Newcastle Symposium on M.P.D., September 1962.)
 **Electricité de France* had an experimental 8 MW M.H.D. generator at their Renardieres Centre.
 For the first time in the world—*M.H.D. generation was achieved below 1,800°C.* by the International Research and Development Co. Ltd.
- 1964 *Dragon experimental high temperature reactor (H.T.R.)* at Winfrith, Dorset, first operated at low power in August. Operation at high power began in July 1965. The 20 MW (t) reactor was a joint European project run through the European Nuclear Energy Agency of the O.E.C.D.
- 1964 **Third United Nations International Nuclear Conference*, held Geneva, 31 August–9 September.
- 1964 Commissioning of *the first* of two 300 MW units at West Thurrock station, Essex. The boilers, of outdoor construction, were rated at 2,050 k lb/h. Steam conditions were 2,300 lb/sq. in. at 1,050°F. with reheat to 1,050°F. Four other units of this size were later commissioned at the Cockenzie station of the South of Scotland E.B.
- 1965 The first of two 120 MW oil-fired units commissioned at the *Carolina Port "B" station* of the North of Scotland H.-E.B. It achieved the *highest thermal efficiency* of any steam station in the U.K. in the years 1966/67, 1967/68 and 1969/70 to 1972/73.
- 1965 **World's first 1000 MW set* commissioned—a cross-compound American G.E.C. unit at the Ravenswood station of Consolidated Edison Co. of New York, with steam conditions 2,400 lb/sq. in. at 1,000°F. and reheat to 1,000°F.
- 1965 Early in the year, The Electricity Council suggested the desirability of a *ducted warm-air storage system*—to be called "*Electrique*". By the end of the year the Council had published an *Electrique* Design Manual and an interim test specification had been prepared and was in use.
- 1965 *Plasma jet furnace* for refining steel now operating at the research laboratories of the English Steel Corporation.
- 1965 *Sulphur hexafluoride (SF₆) switchgear* in use in mines at voltages of 6.6 kV and 11 kV.
- 1965 *First radio-isotope generator*—the U.K.A.E.A.'s milliwatt generator, using a radioactive isotope heat source, for operating a marine light.
- 1965 *Dungeness "B" nuclear station*—Minister of Power announced the choice of an A.G.R. design.

- 1965** *First 400 kV transmission line*—inauguration of the 150-mile section between the Sundon substation (Beds.) and the West Burton power station.
- 1965** *District heating*—combined electricity/district heating station, operated by the Ministry of Works for the Ministry of Defence, opened at Aldershot with 4×2.14 MW diesel sets; final capacity was expected to be 20–24 MW.
- 1965** *Electroslag refining (E.S.R.)* under active investigation by steel industry (B.I.S.R.A. have been working for five years on this technique).
- 1965** *Nuclear Installations Act 1965*, provided for the restriction of certain nuclear installations to licensed sites and the prohibition of certain operations except under permit.
- 1965** *First main gas turbine stations* commissioned—at Earley power station a 56 MW machine powered by four Rolls Royce "Avon" jet engines, and at the Dunfermline station a 70 MW machine, powered by four Bristol Siddeley "Olympus" engines.
- 1965** Commissioning of the *first auxiliary gas turbine unit* at the Tilbury "B" station. The 17 MW unit, powered by a Bristol Siddeley Olympus jet engine, provided standby supplies for the auxiliary plant of one of the main steam units and also peak power when required.
- 1965** *Nuclear commissioning*—two 500 MW stations, viz: *Trawsfynydd* station in the Snowdonia National Park, the only inland nuclear station, with four 145 MW sets; *Hinkley Point "A"* near Bridgwater, Somerset, with six 93.5 MW main sets and three 33 MW auxiliary sets; and *Dungeness "A"* on the Kent coast adjacent to the Romney Marsh, with design output of 550 MW from four 142.5 MW sets.
- 1965** *Vacuum circuit breakers*. Eastern E.B. carrying out field tests on 11 kV units imported from the U.S.A.
- 1965** *11 kV "Pocket" substations* being ordered at the South Western E.B.
- 1965** *"Protective Multiple Earthing Approval (1965)."* With the relaxations introduced under these statutory Regulations, *p.m.e. began to be introduced on a significant scale* in medium-voltage distribution systems, leading to the development of *c.n.e. cables*—see under 1966.
- 1965** *"The 1963 Domestic Heating Survey"*, Utilisation Research Report No. 48, published by The Electricity Council.
- 1965** *Isotopic thermoelectric generators*. The U.K.A.E.A.'s *"R.I.P.P.L.E."* (Radio Isotope Powered Prolonged Life Equipment) demonstrated with 75 and 90 mW units. The project reached the commercial stage in 1968 with a 4 W unit for powering an aircraft ground radio-beacon.
- 1965** **Centre Européen de l'Entreprise Publique ("C.E.E.P.")*, formed in Brussels with the object of representing the interest of the "public" undertakings *vis-à-vis* the Commission of the E.E.C. Membership included electricity supply undertakings.
- 1965** The Electricity Council, on 1 April, established at headquarters the *National Fault and Interruption Reporting Scheme* for the distribution systems of the Area Boards and the two Scottish Boards. The purpose of the scheme was to show those aspects of system planning and construction which offered the greatest prospects of improved performance.

- 1965** **H.V. d.c. transmission.* In the U.S.S.R., the 300-mile link between the Volgograd and Donbas hydro-electric stations, rating 750 MW at 400 kV above and below earth potential, completed in May.
- 1965** *Electricity Supply Industry Training Board ("E.S.I.T.B.")* established on 24 June, under the Industrial Training Act 1964; was concerned with the development of training within the electricity supply industry in Great Britain and, insofar as it generates and distributes electricity, London Transport. (See also under "Training for the future" 1972.)
- 1965** *Resale price of electricity.* On 1 July the electricity boards in England and Wales fixed maximum prices at which electricity might be resold for use in domestic premises, using their powers under Section 29 of the Electricity Act, 1957. Maximum charge per unit was fixed at 0.25d above the final unit rate in each board's domestic tariff, plus a daily charge of not more than 4d.
- 1965** *Status Agreement* for industrial staff in electricity supply, completed in September. Covered a series of major changes in the terms and conditions of employment, negotiated during 1962 and 1965 between the supply industry in Great Britain and five trade unions. Four of the major aspects of the Status Agreement concerned the use of flexibility of work patterns, employee co-operation and movements in hours of work, rates of pay and earnings, and changes in manpower.
- 1965** *Dungeness "B" A.G.R. project.* Publication by the C.E.G.B. in July of two booklets: (i) "Dungeness 'B' Nuclear Power Station" and (ii) "An appraisal of the technical and economic aspects of Dungeness 'B' Nuclear Power Station".
- 1965** *"The National Plan"* Cmnd. 2764, published in September, provided for a growth of 25 per cent in the gross domestic product up to 1970, equivalent to an average annual growth of 3.8 per cent. The Electricity Council's demand forecast for the year 1971-72 was geared to this plan.
- 1965** **World's first 735 kV system*—the 226-mile line carrying 300 MW from the Manicouagan hydro-electric power station to the Poste Lévis substation, Quebec, of the Hydro-Quebec transmission system, commissioned in September.
- 1965** Establishment of *The Electricity Council Research Centre ("E.C.R.C.")* Capenhurst, Cheshire, for research on distribution technology and the utilisation of electricity.
- 1965** National Board for Prices and Incomes ("N.B.P.I.") Report No. 5 *"Remuneration of Administrative and Clerical Staff in the Electricity Supply Industry"*, Cmnd. 2801.
- 1965** Commissioning of the first of 4×100 MW single-stage reversible pump turbines at the *Cruachan pumped storage station* of the North of Scotland H.-E.B., Loch Awe in Argyllshire. It operated under a head of 1,195 ft., at the time of commissioning the highest in the world for this type of plant.
- 1965** White Paper *"Fuel Policy"*, Cmnd. 2798, published in October, set out the principles which should govern a co-ordinated national fuel policy and the machinery and measures whereby the Government proposed to secure and maintain such a policy. Consumer freedom of choice was to be an essential guide to the efficient planning of supplies provided that the prices reflected all relevant costs. Among the recommendations was that the *electricity supply industry should continue to give preferential treatment to coal over other fuels.*

- 1965** *Cooling tower failures.* On 1 November three of the eight cooling towers at the Ferrybridge "C" station collapsed. The C.E.G.B.'s Committee of Inquiry (Chairman: Dr L. Rotherham), which reported in August 1966, found that the failures were primarily caused by a serious under-estimate of wind loading in the design. C.E.G.B. immediately embarked on a programme of tower reinforcement.
- 1965** *The first find of North Sea natural gas* was made in October by B.P. in the West Sole Field about 40 miles off the Humber. The first supplies came ashore at the Easington shore terminal in 1967.
- 1965** *On 9 November the malfunctioning of a relay at Ontario Hydro's Beck No. 2 Hydroelectric plant initiated cascade tripping which led to *supply interruptions in the N.E. U.S.A. and Ontario* from about 5.15 p.m. affecting 30 million people over an area of 80,000 square miles. On the New York system the interruption lasted nearly 14 hours.
- 1965** N.B.P.I. Report No. 7 "*Electricity and Gas Tariffs. London Electricity Board and Scottish, South Western and Wales Gas Boards*", Cmnd. 2862.
- 1965** *275 kV pipe-type compression cable* installed in Dartford road tunnel under the Thames Estuary, to reinforce supplies to South East England: first circuit commissioned in December.
- 1965** *350 MW units* commissioned at the Drakelow "C" L.P. and Blyth "B" stations. The two units at each station are the only ones of this size on the British system. Boiler capacities are 2,350 k lb/h at Blyth "B" and 2,450 k lb/h at Drakelow "C" L.P. Steam conditions at the turbine stop valve are 2,300 lb/sq. in. and 1,050°F. with reheat to 1,050°F.
- 1966** *Electronic turbine governor control*—first practical application on the 300 MW No. 5 set at West Thurrock power station.
- 1966** **950 MW turbo-alternator* unit commissioned at TVA's Bull Run power station.
- 1966** *First 275 kV substation in London*, commissioned at Tottenham.
- 1966** *Linear motors.* Herbert Morris Ltd. developed first commercial model.
- 1966** *Electrolytic sewage treatment.* First commercial installation of new system using electrolysed sea water developed by Constructors John Brown Ltd. in co-operation with The Electricity Council, at La Creux Mahie on the island of Guernsey.
- 1966** *First single stack chimney* with four flues in the one stack for *2,000 MW power station*, completed at Eggborough.
- 1966** *Productivity.* South of Scotland E.B. introduced a series of *yardsticks for the assessment of individual performance*. These controls were later amplified and improved, and the N.B.P.I. in their report No. 42, Cmnd. 3405, 1967—*q.v.*—advocated that the board's practices should be widely adopted.
- 1966** **Sodium conductor cables* under active development for distribution systems in the United States, including a design with polythene insulation for use up to 15 kV.
- 1966** *First high pressure sodium lamps* in Europe used in experimental street-lighting installation.
- 1966** *Superconducting d.c. motor* developed by the International Research and Development Co. for the Ministry of Defence (Navy). Claimed to

be the *first in the world*, this homopolar motor is rated at 50 h.p. (Three years later the company demonstrated a 3,250 h.p. superconducting motor—see under 1969.)

- 1966 **First Target Nuclear Programme* published in accordance with the Euratom Treaty.
- 1966 Commissioning of *Sizewell nuclear station*, on the Suffolk coast. Design output is 580 MW from two 325 MW sets. A feature of the station is that both reactors are housed in the one building.
- 1966 *House service pillars*. South Western E.B. introduced trial installations of pillars providing multi-house service connections on new housing estates, without underground jointing.
- 1966 *Combined neutral and earth (c.n.e.) cables* for p.m.e. distribution systems—introduction of the C.O.N.S.A.C. cable, the first c.n.e. type to be used in commercial quantity.
- 1966 *Battery electric vehicles*. Early in the year, The Electricity Council's demonstration of four battery electric cars, *two* of them conversions made under Council research contract, created wide interest.
- 1966 *The Electricity Council*, on 1 January, took over the responsibility for all national promotional work hitherto carried out by E.D.A. for the Area Boards of England and Wales and the E.D.A. was reconstituted as the *E.D.A. Division* of Council headquarters.
- 1966 *Computer control of group of power stations*. Experimental project to load 31 generating sets in six stations in the South Western Region under way in January.
- 1966 *Prototype fast reactor (P.F.R.)*. Minister of Technology announced on 9 February the Government decision to authorise the construction by the U.K.A.E.A. of a 250 MW (e) P.F.R. on the Dounreay site. Work started mid-year and commissioning was expected in 1973. This intermediate stage between the D.F.R. and large commercial F.B.R.'s had liquid sodium cooling and used mixed oxides of plutonium and uranium as fuel, clad in stainless steel and made up into clusters of thin pins. Steam conditions at the turbine stop valves were 2,300 lb/sq. in. at 955–1,000°F.—a single 300 MW set was used.
- 1966 *"Second Report from the Select Committee on Nationalised Industries—Gas, Electricity and Coal Industries"*, H.C. Paper 77, published in February, enquired into the current problems of the gas, electricity and coal industries. Representatives of the electricity supply industry gave reasons for the short-fall in commissioning of generating plant.
- 1966 *SF₆ circuit breakers*. C.E.G.B.'s first 132 kV unit commissioned at Hall Green, Birmingham, substation in March.
- 1966 Launching of the two new *"roll-on roll-off" vessels* conceived by the C.E.G.B. for carrying heavy electrical and other plant for new power stations under construction. These ships, named *"MV Aberthaw Fisher"* and *"MV Kingsnorth Fisher"* were the *first of their type in the world*.
- 1966 *Ripple control of consumers' appliances*. Midlands E.B. commissioned

a pilot scheme at the Feckenham 275/66 kV grid supply point. Water heating of some 400 customers was controlled by a 300 Hz signal injected into the system.

- 1966** *Semi-automatic control of set start-up, loading, and shutdown* introduced in June as a normal routine for the first time in the U.K. at the Kincardine H.P. station of the South of Scotland E.B., when the station was transferred from base load operation to two-shift working.
- 1966** *"The Prospects for Alternative Methods of Generation of Electric Power: A Comprehensive Review"* by F. H. S. Brown. Paper to World Power Conference, Tokyo, published in the Proceedings, 1966, Vol. III, p. 1441 etc.
- 1966** *O.E.E.C. published *"Energy Policy—Problems and Objectives"* a report by their Energy Committee on the energy situation of member countries grouped in three regions, North America, Western Europe and Japan.
- 1966** *"Report on visit to the United States and British Columbia"* by R. F. Richardson and P. A. Lingard, published in September. The purpose of the visit was to assess the impact of natural gas on electricity growth, particularly in the domestic sector.
- 1966** *First International Conference on Clean Air*, in London, in October.
- 1966** Establishment of the *Power Engineering Research Steering Committee* to develop and co-ordinate collaboration in research. The committee included representatives of The Electricity Council and electricity boards and senior executives of electrical manufacturers, cable-makers and boiler-makers.
- 1966** *Live line working:*
First U.K. scheme for 275 kV demonstrated by the South of Scotland E.B. on the Clyde's Mill-Stratheven line, in October.
**"Bare-hand"* technique for 500 kV demonstrated by the Hydro-Electric Power Commission of Ontario, in November.
- 1966** *"Power Supply for 1970"* by E. S. Booth. Chairman's Address to I.E.E. Power Division on 26 October (published in *"Proceedings I.E.E."*, Vol. 114, No. 1 January 1967, p. 89 etc.).
- 1966** **La Rance Tidal Power Scheme*, France, commissioned. Final capacity 240 MW from twenty-four bulb turbo-generators each of 10 MW. Generated at peak times practically independent of the state of the tide.
- 1966** *The Electricity Council* granted a patent, in December (applied for in February 1964), for a *thermal storage heater* incorporating an air/water heat exchanger suitable for use with hot-water central-heating systems—called *"Centralec"*.
- 1966** *First 500 MW unit* commissioned in December—at Ferrybridge "C" station, Yorks. The 2,000 MW station was completed in 1968. Each of the four 500 MW sets was steamed from a 3,450 k lb/h boiler, with steam conditions at the turbine stop valve, 2,300 lb/sq. in. at 1,050°F. with reheat to 1,050°F. Plant programmes included 49 of these standard units in 14 new stations.
- 1967** *Electricity in mining.* N.C.B. commissioned the R.O.L.F. (remotely

operated longwall face) automatic control system at Bevercotes colliery, Notts—the *first colliery planned for a complete and integrated system of mining*.

- 1967** *A.C.E. trailers.* Commissioning of the first trailer equipped with *air cushion equipment*, based on the hovercraft principle, conceived by the C.E.G.B. for the transport of heavy indivisible loads, such as transformers.
- 1967** *Lighting*—introduction of the *high pressure sodium lamp*, in the City of London.
- 1967** *Natural gas firing.* A 65 MW unit at *Hams Hall "C"* station was converted, as an experiment, to dual coal/natural gas firing. The full conversion of the six 65 MW units was completed in 1971. In 1972 conversion was completed at a second station, West Thurrock, 1,300 MW.
- 1967** Opening of The Electricity Council's *Electro-Agriculture Centre* at a permanent site of the Royal Show at Stoneleigh, Warwicks; and *Electric Garden* at the Gardening Centre, Syon Park, Middlesex.
- 1967** *Aluminium wiring in use* in pilot scheme by the Midlands E.B.
- 1967** *First supercritical unit* on the British public supply system went into service at the Drakelow "C" H.P. station. A 2,500 k lb/h Babcock and Wilcox boiler, developed from the Benson once-through boiler, steamed an English Electric 375 MW set. Stop-valve steam conditions were 3,500 lb/sq. in. 1,100/1,000°F.
- 1967** C.E.G.B. *bulk supply tariff—new structure* introduced on 1 April with running rates based on the running costs of power stations at the margin instead of on average running costs; and two capacity charges, one related to basic system capacity costs, the other to the cost of plant used during peak periods only.
- 1967** Commissioning of the first of four 300 MW units at the *Cockenzie* station, of the South of Scotland E.B., on the Forth Estuary. The set was steamed from a 2,050 k lb/h boiler. Turbine stop valve conditions were 2,350 lb/sq. in. at 1,050°F. with reheat to 1,050°F. A leading station in *automatic control*—with control equipment applied to each turbine, to control the preparation of auxiliary plant and the operation of the turbines through all stages of running-up to full power, and in the reverse order for plant shut-down.
- 1967** N.B.P.I. Report No. 36 "*Productivity Agreements*", Cmnd. 3311. Included the electricity supply industry's "Status Agreement".
- 1967** *Support for coal*—Minister of Power announced in the House on 18 July that the supply industry had been asked to increase their coal burn by up to 6 million tons a year in the period to March 1971. Additional costs, resulting from reduced oil burn, would be met from public funds. This was given effect under Section 6 of the *Coal Industry Act 1967*, although such additional costs as those incurred in holding excess coal stocks, and deferring conversions to oil firing, were not reimbursable. Assistance of this kind had already been given to the coal industry for over two years, the costs being borne by electricity consumers.
- 1967** N.B.P.I. Report No. 42 "*Pay of Electricity Supply Workers*", Cmnd. 3405.
- 1967** *District Heating Association* formed in October.

- 1967** *"Report from the Select Committee on Science and Technology—UK Nuclear Reactor Programme"*, H.C. Paper 381, included the recommendation that the consortium system of tendering for nuclear power stations should be phased out as existing contracts were completed; and that a single Government body should be set up to deal with all aspects of nuclear energy policy.
- 1967** *Aluminium smelters.* Board of Trade invited proposals from aluminium companies for the establishment of aluminium reduction plants in development areas. The Government announced special arrangements concerning electricity supplies on 4 October. These, with a description of the projects and details of Government financial support were set out in the White Paper *"Industrial Investment. The Production of Primary Aluminium"*, Cmnd. 3819, November 1968. Three projects were agreed—(i) An Alcan plant of 120,000 tons ultimate capacity at Lynemouth, Northumberland, with electricity to be provided from a new coal-fired station owned by Alcan, and coal supplied by the N.C.B. under a long-term contract; (ii) a British Aluminium Co. plant of 100,000 tons initial capacity at Invergordon, in Ross and Cromarty, supplied with electricity by the N.S.H.-E.B.; and (iii) a plant of 100,000 tons initial capacity at Holyhead operated by Anglesey Aluminium Metal (jointly owned by—Rio Tinto-Zinc, B.I.C.C., American Kaiser Aluminium and Chemical) and supplied by the C.E.G.B. The three plants were planned for commissioning in 1971.
- 1967** White Paper *"Nationalised Industries: a Review of Economic and Financial Objectives"*, Cmnd. 3437, published in November. Reviewed the main considerations which should apply to investment and pricing policies and laid down the principle that *investment appraisal should be based on the use of a test discount rate*. The Government decided that a test discount rate of 8 per cent was a reasonable figure under the circumstances then obtaining. In August 1969, the rate was raised—except for steel—to 10 per cent.
- 1967** White Paper *"Fuel Policy"*, Cmnd. 3438 published in November, stated the Government's policy for the primary fuels with special reference to the new sources available—natural gas and nuclear power. The policy aimed to make possible a national supply of energy at the lowest total cost to the community having regard to a whole range of relevant considerations—economic and social—and to national and regional economic policies. Government accepted as in the national interest the *rapid introduction of nuclear power and North Sea gas* and that *support be given to the coal industry* to lessen the social consequences of the inevitable contraction of that industry.
- 1967** *Live-line working.* C.E.G.B. demonstrated, a "bare-hand" technique for changing spacers on live 400 kV quadruple conductors—believed to be a "first" in Europe. The linesman wore a conducting suit ("Faraday cage") connected to the high voltage line.
- 1967** *Oldbury nuclear station* on the Severn Estuary entered service in December. Design output was 600 MW from two 313 MW sets. This was the first British station with *concrete pressure vessels*, and the first of any power station with a computerised alarm analyser with a cathode-ray-tube display.
- 1968** *First 2,000 MW steam stations* to be completed—Moss Landing station of Pacific Gas and Electric Co., and C.E.G.B.'s Ferrybridge "C" and West Burton stations.
- 1968** *Gas and Electricity Act 1968* enabled the supply industry to borrow on overseas capital markets. In 1969 The Electricity Council and the South of Scotland E.B. floated loans on the German market.

- 1968 *1,100 MW single-shaft turbo-alternators—the *largest single-shaft machines yet to be built in Britain*, ordered from A.E.I. by Consolidated Edison of New York; and from English Electric by Detroit Edison for the Enrico Fermi B.W.R. station and Southern California Edison for the San-Onofre P.W.R. station. The New York station was abandoned for environmental reasons.
- 1968 "*Optimal Pricing and Investment in Electricity*. An Essay in Applied Welfare Economics" by R. Turvey, published by Allen and Unwin.
- 1968 "*Consumer Consultative Machinery in the Nationalised Industries*", a Consumer Council Study, published by H.M.S.O. Covers electricity, gas, solid fuel and public transport.
- 1968 "*Royalties on Nuclear Stations*"—Report from the Committee of Public Accounts, published as H.C. Papers Nos. 156–1, 233–1 and 314. Criticised an arrangement between Treasury, C.E.G.B. and U.K.A.E.A. which related to the royalties being paid to the Exchequer for nuclear electricity to cover the cost of developing the reactor system.
- 1968 *Reorganisation of Area Boards*. Several boards were streamlining their organisation by reducing the number of Areas and/or Districts.
- 1968 Reconstitution of the E.D.A. Division as the *Marketing Department of The Electricity Council*.
- 1968 **Douglas Point 208 MW nuclear station* of Ontario Hydro commissioned—the first full-scale prototype of the C.A.N.D.U. system.
- 1968 *First three 230 MW units commissioned at the Gordon M. Shrum hydro station of the *Peace River Project* in British Columbia. Final capacity was planned at 2,270 MW.
- 1968 U.K.A.E.A.'s prototype *steam generating heavy water reactor (S.G.H.W.R.)* at Winfrith reached full power of 100 MW (e) in January.
- 1968 *Siting of nuclear power stations*. Minister of Power announced in the House of Commons on 6 February a modification to nuclear siting policy. On the advice of the Nuclear Safety Advisory Committee, the safety of a gas-cooled reactor in a prestressed concrete pressure vessel was such that it *may be located much nearer built-up areas than so far permitted*. Previous policy was that nuclear stations should be located on remote sites.
- 1968 **High-voltage single-phase distribution for new housing developments* introduced by the Electricity Supply Board, *Ireland*. The 10 kV system was similar to American U.R.D. practice.
- 1968 *Distribution system for trainees*. East Midlands E.B. brought into use a complete 11 kV/433 V distribution system with five substations at the Board's new Operational Training School, at Ashover.
- 1968 *First commercial zinc/air primary battery* announced by Energy Conversion.
- 1968 *Zinc smelter*—claimed to be *world's largest*, and first metallurgical plant with on-line computer control, load 16 MW, built for the Imperial Smelting Corporation (N.S.C.) Ltd. at Avonmouth, officially opened in May.
- 1968 *First 132 kV vacuum circuit breakers* installed by C.E.G.B. at West Ham sub-station.

- 1968** *"Hoverkiln" for ceramic manufacture*—air cushion conveying in new kiln invented by Shelley Furnaces of Stoke-on-Trent. Two types available—electric or gas heated.
- 1968** *First industrial total energy gas turbine scheme* in the U.K.—installed at Esso's Milford Haven refinery. Supplied 10 MW of electricity and hot exhaust gas for industrial processes.
- 1968** *"The 1966 Sample Survey of Domestic Consumers"*, Utilisation Research Report No. 75, published by The Electricity Council.
- 1968** **600 MW single-shaft turbo-alternator set* commissioned at the Porcheville "B" station of E. de F.
- 1968** World Power Conference changed its name to the *World Energy Conference*, after revising its Objects and Constitution to embrace all forms of energy. Meetings would be held at intervals of three years, instead of two years as hitherto. A Survey of World Energy Resources would be published at intervals of six years.
- 1968** N.B.P.I. Report No. 59. *"The Bulk Supply Tariff of the Central Electricity Generating Board"*, Cmnd. 3575.
- 1968** A *22,000 h.p. motor* went into service in the Powerformer plant at the Esso refinery, Fawley, in May—claimed to be the *world's largest direct-on-line started induction motor*. The motor operated at 11 kV.
- 1968** *"Report from the Select Committee on Nationalised Industries—Ministerial Control of the Nationalised Industries"*—Vol. I, Report and Proceedings, Vol. II Minutes of Evidence and Vol. III Appendices and Index, H.C. Paper 371. The committee enquired into the relationship between the nationalised industries, Government departments and Parliament. They recommended the establishment of a single Ministry of Nationalised Industries to deal with these industries as a whole in matters concerning their efficiency, and also that greater managerial freedom should be given to the boards of these industries.
- 1968** *"Report from the Select Committee on Nationalised Industries—Exploitation of North Sea Gas"*, H.C. Paper 372, concluded that the exploitation of natural gas as planned must be accepted as a fully justifiable capital investment.
- 1968** N.B.P.I. Report No. 79. *"Electricity Supply Industry. National Guidelines covering Productivity Agreements"*, Cmnd. 3726.
- 1968** **Submarine cable links*. The d.c. submarine cable between the mainland of *British Columbia and Vancouver Island* rated at 312 MW and operating at 130 kV was commissioned. Ultimately it operated at ± 260 kV to provide 624 MW. This link comprised 33 km of submarine cable and 41 km of overhead line. (Two circuits, at 138 kV a.c. total capacity 250 MW, were installed in 1956 and 1958.)
- 1968** Monopolies Commission Second Report on the *Supply of electric lamps* published December.
- 1968** **"First guidelines for a Community energy policy"* presented by the E.E.C. Commission in December to the Council of Ministers; considered by the Council on 13 November 1969; and two regulations adopted by the Council on 31 January 1972—*q.v.*
- 1968–70** *Centralec* off-peak small-bore system of central heating—field trials carried out on E.C.R.C. developed prototype units.

- 1969** *400 kV cable*—commissioning of the two 3½ mile cable circuits laid in the disused Woodhead-Dunford Bridge railway tunnel under the Pennines, linking Thorpe Marsh power station with South Lancashire.
- 1969** *Sodium cables*—Eastern E.B. carrying out field trials.
- 1969** *First 275 kV sulphur hexafluoride (SF₆) circuit breaker to be made in the U.K. entered service.*
- 1969** *Remote control in primary distribution sub-stations.* Eastern E.B. drew up plans for equipping the 425 primary sub-stations in its area during the next three years with alarm signalling, state of plant indicators, and remote voltage control.
- 1969** The first large “all-electric” *Integrated Environmental Design (“I.E.D.”)* building with heat recovery air conditioning—North Eastern E.B.’s Testing and Research Building, Wallsend, opened in September; and Merseyside and North Wales E.B.’s head office building, Chester.
- 1969** *“The future of the Heavy Electrical Plant Industry”*—Report by G. B. Richardson, B.E.A.M.A. Publication No. 232. Suggested that competitive tendering was inappropriate to the special circumstances of the heavy electrical plant market and could prove disastrous for the future of the industry. Trading agreements were the best way of balancing the interests of manufacturers of heavy plant and their supply industry customers.
- 1969** **1,150 MW cross-compound unit* commissioned at the Paradise station of T.V.A. Steam conditions were 3,500 lb/sq. in. at 1,000/1,000°F. from an 8,000 k lb/h boiler.
- 1969** Opening of The Electricity Council’s *Electric Catering Centre*, in St. Martins Lane, London, as a national centre providing a wide range of equipment, planning advice and demonstrations of new techniques.
- 1969** *Live line working.* C.E.G.B. demonstrated “bare-hand” working at 400 kV and “hot stick” working at 132 kV.
- 1969** Monopolies Commission. *Recommended Resale Prices*—Report on the general effect on the public interest of the practice of recommending or otherwise suggesting prices to be charged in the resale of goods.
- 1969** N.B.P.I. Report No. 102 *“Gas Prices (Second Report)”*, Cmnd. 3924. The Board’s study included *joint meter reading*, collection and billing for gas and electricity. The Electricity Council and the London and Yorkshire E.B.s assisted in this part of the inquiry.
- 1969** White Paper *“Report of the Committee of Enquiry into Delays in Commissioning C.E.G.B. Power Stations”*, Cmnd. 3960. The committee, under the chairmanship of *Sir Alan Wilson*, reached the general conclusion that strong remedial actions had been taken and new methods introduced which should in the future avoid many of the causes of delay which had dominated the situation for the last ten years. The effectiveness of management and the productivity of labour on some sites remained “distressingly low”.
- 1969** *Day/night (White Meter) tariffs* providing cheap night units usually between 11 p.m. and 7 a.m., generally introduced from 1 April in England and Wales and south of Scotland. They were introduced by the

North of Scotland H.-E.B. on 1 April 1970. These tariffs had no restrictions as to the type of apparatus which could be supplied and did not necessarily require separate circuits as was the case with off-peak tariffs.

- 1969** *Transmission Lines.* On 1 April the *financial responsibility* for almost all transmission plant operating at 132 kV and below was transferred to *Area Boards*.
- 1969** "*M.H.D. Electrical Power Generation*"—report issued by the International M.H.D. Liaison Group of E.N.E.A. and the I.A.E.A., concluded that the latest evidence from international research suggested that M.H.D. generators would be cheaper and more efficient than turbo-generators, and that development should continue into base-load M.H.D. generating plant, both nuclear-powered and fossil-fuelled.
- 1969** Official opening, in May, of the new extension to The Electricity Council's *Appliance Testing Laboratories ("A.T.L.")* enabling more emphasis to be placed on performance testing.
- 1969** White Paper "*Ministerial Control of the Nationalised Industries*" Cmnd. 4027, gave the Government's reaction to the "Report from the Select Committee on Nationalised Industries—Ministerial Control". The Government did not accept the proposal for a Ministry of Nationalised Industries.
- 1969** **First Congrès International des Réseaux Electriques de Distribution ("C.I.R.E.D.")* held in Liège during July, under the aegis of the Association des Ingénieurs Sortis de l'Institut Electrotechnique Montefiore.
- 1969** The Ministry of Power was absorbed into a new Government department, the *Ministry of Technology*.
- 1969** *The colour code* used for wires in the mains leads of appliances was changed to green and yellow stripes for the earth wire, brown for the live wire and blue for the neutral by SI No. 310.
- 1969** *Proposal for the reorganisation of the electricity supply industry in England and Wales.* On the 18 July, in the House of Commons, the Minister of Power announced that he proposed "to reconstitute The Electricity Council and rename it the Electricity Authority with new powers to plan and control the policy of the industry as a whole". The boards would remain statutory bodies responsible for the generation, transmission, distribution and supply of electricity, but would discharge these duties within the framework of broad policy for the industry as a whole, which would be settled by the Electricity Authority. The legislation to give effect to these proposals was embodied in the *Electricity Bill* 9 March 1970—q.v.
- 1969** "*Twenty Years of Electricity Distribution under Public Control*"—paper providing a broad survey and appraisal of progress in the public distribution of electricity since nationalisation, presented to the I.E.E. by D. P. Sayers and E. Hill, published in "Proceedings I.E.E." Vol. 116, 1969, pp. 1527 etc.
- 1969** *Superconducting d.c. motor.* International Research and Development Co. demonstrated their 3,250 h.p. variable-speed superconducting homopolar motor in November, at Newcastle—the *largest superconducting machine* yet built. The machine underwent extensive industrial trials at the *Fawley power station*, where it was used temporarily to drive one of the cooling water pumps.
- 1969** *Fawley oil-fired station* commissioned. Its *control system* was among

the most advanced in the world. Each of the four 500 MW units had computer control capable of taking the set from hot conditions to a selected load target, without intervention of the operator, taking corrective action if a fault occurred, and shutting down if necessary. Temperatures, pressures, flows and actions taken were displayed on a cathode ray tube.

- 1970** The Electricity Council set up an *Overseas Consultancy Service* to act as a focal point for enquiries from home and overseas government departments and other organisations, such as consulting engineers and overseas utilities, who needed specialist technical advice or practical assistance which the industry could provide.
- 1970** Opening of The Electricity Council's *Air Conditioning Advisory Bureau* in Northumberland Avenue, London, for national promotion of air conditioning in commercial and industrial premises.
- 1970** *The Electricity (Overhead Lines) Regulations 1970* (S.I. 1970 No. 1355), to come into force on 1 October 1971 replacing Overhead Line Regulations 1947 made by the Electricity Commissioners. They imposed a more flexible system of control on design and erection of new overhead lines and stricter requirements in respect of safety.
- 1970** **Fuel Cells*—"1970 Final Report Project Fuel Cell" (U.S. Government Printing Office: 1970 0-405-586). Gave results of research in the development of a commercial fuel-cell power generating system using coal as a fuel, undertaken for the U.S. Department of the Interior. Recommended further research aimed at establishing commercial feasibility.
- 1970** *Main gas-turbine stations*—C.E.G.B. applied for consent to build a gas-turbine peak-load plant of 150 MW on the Watford power station site. This was granted in July 1971. By the end of 1972 applications had been made to build on twelve sites totalling 2,550 MW; the first commissioned at Leicester in 1976 and used industrial-type machines instead of aircraft-type gas turbines.
- 1970** E.C.A., N.E.C.T.A. and N.F.E.A. were re-organised to form a single Association, again known as the *Electrical Contractors' Association* ("E.C.A."). It embodied the major aims and objects of all three former Associations.
- 1970** *C.N.E. cable for p.m.e. networks*. First installation of cable to Specification TRYDAN by the South Wales E.B.
- 1970** *Central Service Units* (C.S.U.). The Eastern E.B. set up, at Norwich, the first of two C.S.U.s to rationalise storage and transport of a wide variety of domestic appliances and contracting and engineering materials. In the second C.S.U., commissioned in 1973, the storage and retrieval of appliances was controlled by computer.
- 1970** *Glossop Automatic Switching Programme* ("G.A.S.P."). To provide an increased supply to an industrial consumer in Glossop, the North Western E.B. developed a switching arrangement such that if overload conditions arose, the firm's supply was automatically transferred to whichever more lightly loaded circuits were available.
- 1970** "*The 1969 Domestic Lighting Survey*", Utilisation Research Report No. 99, published by The Electricity Council.
- 1970** *Nuclear Reactor Development*. The Department of Trade and Industry launched a review to test development programmes against national requirements. Two working parties were set up with members drawn

from D.T.I., U.K.A.E.A. and the generation boards. They reported in 1972. (See Future Nuclear Strategy under 1972.)

- 1970** **Pumped storage.* T.V.A.'s Raccoon Mountain project reported as being under construction. Will have four 325 MW reversible pump/turbines with water cooling of both stator and rotor windings—the *world's largest pump/turbine units planned to date*. First units will commission in 1978.
- 1970** *Longannet power station*, Fife, of the South of Scotland E.B. started up in January. Its four 600 MW sets and 4,000 k lb/h boilers were the largest on the British system. The cross-compound units had turbine stop valve steam conditions 2,350 lb/sq. in. at 1,050°F. with reheat to 1,050°F. A unique feature was the fuel supply arrangement—the output from a complex of four collieries was despatched to the station stock-yard along a computer-controlled underground conveyor system of some 5½ miles, with automatic blending to ensure consistent ash content.
- 1970** *Support for coal*—Minister of Technology announced in the House of Commons on 6 February that as coal was no longer in excess supply the use of additional coal by the supply industry would not be necessary after 31 March.
- 1970** *Electricity Bill* published 9 March. Based on the proposals for the re-organisation of the supply industry in England and Wales announced by the Minister of Power on 18 July 1969—*q.v.*—the Bill was given a Second Reading in the House of Commons on 6 April 1970 and was being considered by a Committee of the House when Parliament was dissolved in May 1970. The Bill accordingly *lapsed*.
- 1970** *"Report from the Select Committee on Science and Technology—Generating Plant Breakdowns: Winter 1969—70"*. H.C. Paper 223, published April, concluded that, for conventional plant, without prejudging the reason for the stator failures, the evidence pointed in the case of other faults to a basic failure of engineering design: further, that the prospects for restoring nuclear reactors to full power did not appear good (they had been operating at less than full power because of corrosion problems).
- 1970** N.B.P.I. Report No. 153 *"Coal Prices (Second Report)"*, Cmnd. 4455, recommended increases of 15 to 16 per cent in the price of coking coal; but no immediate rise in the price of general purpose coal, used mainly by the C.E.G.B. and industry.
- 1970** *Supply industry dispute.* "Report of a Court of Inquiry under Professor A. D. Campbell, M.A., into a Dispute between the Parties represented on the National Joint Board for the Electricity Supply Industry", Cmnd. 4410, made recommendations concerning *restoration of differentials* with industrial staff.
- 1970** North Western E.B.'s *Daniel Training Centre*, Chorley, started operating in September. Designed to house training courses for the whole range of the Board's employees, this Centre was an example of I.E.D. which also contributed to the Board's promotions.
- 1970** Under reorganisation of Government departments the Ministry of Technology, whose responsibilities included fuel and power, became part of the new *Department of Trade and Industry*.
- 1970** *First commercial deposits of North Sea oil* discovered by B.P. in November in the Forties Field.

- 1970** *"The next 25 Years in the Electricity Supply Industry"* by Sir Stanley Brown. Lecture to the I.E.E.T.E. on 16 November, published in the "I.E.E.T.E. Journal", January 1971, p. 17 etc.
- 1970** Anglesey Aluminium Metal's *new smelter at Holyhead* started up in December. C.E.G.B. supplied electricity under special terms based on generation employing the latest technology and the cost of associated transmission reinforcement.
- 1970** *Grid control.* With the commissioning in December 1970 of the new National Control Centre, the changeover to three-tier operation—District, Area and National Controls—was completed.
- 1970** First of four 500 MW units commissioned in December at the *Kingsnorth power station*, in Kent—the first station designed from the outset for *dual coal/oil firing*. Each unit was computer-controlled with automatic start-up of individual auxiliaries and pulverised fuel mill, and automatic loading of the turbo-alternator from half load, with automatic control of fuel supply etc. The number 3 set was the terminal of a 640 MW d.c. cable link to Willesden and Beddington which was commissioned in 1974.
- 1971** *Re-organisation of the C.E.G.B.*—the internal organisation was completely revised from 1 January. A high degree of delegated authority was given to the five Regions and construction and design work was transferred to two new Divisions, the Generation Development and Construction Division, and Transmission Development and Construction Division.
- 1971** *U.H.V. transmission research* started at C.E.R.L., following the completion of a *1500 kV outdoor test site*.
- 1971** Formation of the *Electrical, Electronic and Allied Industries Europe Committee* ("E.E.A.I.E.") to study the problems to which U.K. membership of the European Communities would give rise, and to see in what way the members of the associations could best be helped.
- 1971** *Atomic Energy Authority Act 1971* provided for the transfer to a new company, *British Nuclear Fuels Ltd.* ("B.N.F.L."), formed in February, of the nuclear fuel cycle business of the Production Group of the U.K.A.E.A., including the Calder Hall and Chapelcross nuclear stations. The company started independent activity on 1 April 1971. The Act also established the *Radiochemical Centre Ltd.*
- 1971** *Centralec* off-peak small-bore system of central heating—general marketing stage reached.
- 1971** **World's first solid-state electricity meter* announced by Landis and Gyr Co.—a three-phase instrument for measuring bulk supplies.
- 1971** *Report of a Court of Inquiry into a dispute between the parties represented on the National Joint Industrial Council for the Electricity Supply Industry.* Chairman: The Rt. Hon. Lord Wilberforce. Cmnd. 4594, published February. Following a breakdown of negotiations in the N.J.I.C. in December 1970, industrial action had been taken by the unions concerned leading to a major disruption in electricity supplies and the Government declared a State of Emergency. Following publication of the Court's report, negotiations with the unions were re-opened and a settlement was reached in March 1971.
- 1971** *"Whither Nuclear Power?"* by E. S. Booth. Annual Lecture to the I.E.E. Power Division, 24 March 1971, published in the "Proceedings I.E.E.", Vol. 118, 1971, p. 1215 etc.

- 1971** *Uranium enrichment by gas centrifuges—URENCO—CENTEC*, an Anglo-German–Dutch uranium enrichment company, was formed to carry out projects to develop and exploit centrifuge processes.
- 1971** N.B.P.I. Report No. 153 (Supp. No. 1) "*Coal Prices (Second Report—Supp. No. 1)*", Cmnd. 4455–1, found that domestic coal users subsidised industrial consumers and that the steel and *electricity generating industries* were the *major beneficiaries* of the N.C.B.'s pricing policies.
- 1971** British Aluminium's *new smelter at Invergordon* started up in May. Special power cost arrangements with the N.S.H.–E.B. were based on generation at the Hunterston "B" nuclear station expected to commission in 1973, and the cost of appurtenant transmission reinforcement.
- 1971** "*Report of the Select Committee on Nationalised Industries—Relations with the Public*", H.C. Paper 514. Among the recommendations, which mainly concerned the role and working of the consultative bodies, was that studies should be continued to bring down the costs of reading electricity meters from a central point to an acceptable level.
- 1971** *Battery electric vehicles*. To obtain more extensive experience of these vehicles under everyday operating conditions, *The Electricity Council* announced the industry's intention to purchase 80 electric cars and light vans. Most of these were the *Enfield 8000 Electric City Car*.
- 1971** *First computerised central appliance store* commissioned at the South-Eastern E.B.'s Central Warehouse at Tunbridge Wells.
- 1971** *Completion of the first nuclear programme* with the commissioning of the last of the "Magnox" stations in November. The *Wylfa* station, Anglesey, had a design output of 1,180 MW from four 335 MW sets. The central computer station control and data processing system was in the van of developments in this field.
- 1971** *Formation, in December, of a new company *Euro-H.K.G.* from the C.E.G.B., E.deF., two West German undertakings, and the German consortium Hochttemperatur Kernkraftwerk. The company's object was to pool experience on the design and operation of *high temperature gas-cooled reactors*.
- 1972** **Superconducting generator*. Westinghouse Electric Corporation of the U.S.A. announced a 5 MW a.c. generator described as the "world's most powerful superconducting machine".
- 1972** *132 kV overhead line crossing*—Scotland's longest span, 4,574 ft., across Loch Long completed by North of Scotland H.–E.B.
- 1972** *District heating scheme*. London E.B. announced their plans for a scheme to be incorporated in the London Borough of Southwark's strategic plan for the development of the area south of the Thames between Waterloo Bridge and Tower Bridge. The scheme would provide for a total energy requirement of 200 MW, of which 100 MW would be supplied in the form of heat.
- 1972** **Fast breeder reactor*—Russian 350 MW *prototype fast reactor* at Shevchenko, part of a desalination project, achieved criticality. A *commercial fast reactor* of 600 MW (e) capacity was due to commission in 1979 at the *Beloyarskaya* nuclear complex in the Urals.
- 1972** "*Connection charges for Electricity and Gas*", Cmnd. 5036, report by the Monopolies Commission, stated principles which the commission considered should govern the level and character of connection charges, and made recommendations for the introduction of standard charges.

- 1972** *Coal miners' strike.* Following a work-to-rule during the preceding October, a strike began on 4 January and ended on 28 February. The supply industry operated *rota disconnections* from 11 February to 1 March, but voltage reductions were necessary from the end of January. The strike was settled following the report of the *Wilberforce Committee* (Cmnd. 4903).
- 1972** *Pumped-storage*—C.E.G.B. applied for and was granted consent to promote a Private Bill to authorise the construction of a 1,400 MW pumped-storage station at *Dinorwic*, near Llanberis, Caernarvonshire.
- 1972** A *pilot gas-centrifuge system* was commissioned by British Nuclear Fuels Ltd. at Capenhurst as part of Britain's contribution to the British–Dutch–West German joint development of centrifuges.
- 1972** **World's largest generating unit* completed at the Cumberland station of T.V.A.—a 1,300 MW cross-compound unit with steam conditions 3,500 lb/sq. in. at 1,100/1,000°F.
- 1972** *Commissioning of the *Pickering C.A.N.D.U. nuclear station* of Ontario Hydro. When the last of four 540 MW (e) units entered service in 1973 it became the *world's largest nuclear station*: C. A. Parsons supplied the sets.
- 1972** *First of eleven 475 MW units commissioned at the *Churchill Falls* project in Labrador, some 1,100 km north-east of Montreal—it was completed in 1975. Transmission connection to the Hydro-Quebec system 200 km away was at 735 kV.
- 1972** *E.E.C. Commission's proposals of January for a *Community Energy Policy to 1985*. In order to reduce their dependence on oil, the Commission wanted more use of natural gas, solid fuel and nuclear power, increasing the share of each by one third. In this way reliance on oil would be cut from 60 per cent to 50 per cent of the total by 1985.
- 1972** *E.E.C.'s "*First guidelines for a Community energy policy*". On 31 January, the Council of Ministers adopted *two regulations* proposed to them by the Commission, which stipulated that the latter was to be informed of: (i) investment projects of Community interest in the oil, natural gas and electricity sectors; and (ii) imports of hydro-carbon fuels.
- 1972** "*Training for the Future. A Plan for Discussion*", a consultative document published by the Department of Employment, outlining a major reorganisation of industrial training envisaged by the Government. (In consequence, The Electricity Council, with the support of the trade unions, requested the Secretary of State for Employment to consider the dissolution of the *E.S.I.T.B.* and its replacement by a strengthened Education and Training Committee of the N.J.A.C.)
- 1972** Alcan *aluminium smelter at Lynemouth* started producing metal in March. Electricity was provided from private generation, the power station having three 130 MW coal-fired units.
- 1972** **H.V. d.c. transmission.* 900 kV d.c. line operative—the 895 km line from Manitoba Hydro's Kettle Rapids hydro-electric stations to Winnipeg energised on 20 June. At 450 kV above and below earth potential, *the highest voltage d.c. transmission in North America*.
- 1972** *New 132 kV link to Isle of Wight* completed in July—the first large 132 kV cable contract undertaken by the Southern E.B. since they took over responsibility for the 132 kV system in their area.

- 1972** *Low profile sub-station*—commissioning in August of the Mark II 400 kV sub-station at Wymondley, Herts. which used much less solid structures than the standard, with overall height reduced from 72 ft. to 53 ft.
- 1972** *Future nuclear strategy.* Following a report of a departmental committee of the D.T.I. (Chairman: *F. R. P. Vinter*), the Secretary of State for Trade and Industry announced in August that the first full-scale order for a *sodium-cooled fast reactor* was likely to be placed in the latter part of the 1970s and that from the mid-1980s a major part of nuclear orders would be for this type of station.
During the next eighteen months the programme would comprise study of a specific design for the S.G.H.W.R. system; possible improvement to the A.G.R. system; international collaboration in the development of the H.T.R.; and safety of light-water reactors (L.W.R.). In addition the Secretary of State proposed to set up a nuclear power board to advise the government on nuclear reactor policy.
- 1972** *First 400 kV line in Scotland*, from Hunterston to Neilston, became live in August.
- 1972** *E.E.C.'s *Second Target Nuclear Programme* published in October. Covering the period 1975–1985, the programme set a target of a nuclear capacity of at least 100,000 MW(e) in service in the six original Community countries by 1985. This would represent 33 per cent of their total electricity output and 10 per cent of their total primary energy needs.
- 1972** *Electricity in sewage treatment*—Europe's first high oxidation plant dealing with sewage disposal, officially opened in October at Pirbright, Surrey, for Guildford R.D.C.
- 1972** *Battery electric vehicles.* In November, E.C.R.C. demonstrated a *sodium sulphur battery* vehicle. The battery, of capacity 30 kWh based on the well-tried laboratory cells, was demonstrated in a Bedford 18 cwt delivery van which should have 100 km range with virtually normal payload.
- 1972** *Reorganisation of the gas industry.* Gas Act 1972 provided for the reconstitution of the Gas Council as the British Gas Corporation, the dissolution of the Area Gas Boards and the transfer of their responsibilities to the new Corporation. The vesting date was 1 January 1973.
- 1972** *Support for coal*—On the 11th December 1972 the Secretary of State for Trade and Industry announced in the House of Commons a programme of financial support for the coal industry aimed at ensuring the preservation of a viable coal industry in a situation of possible world energy shortage and uncertainty about future world fuel prices.
- 1973** *Coal Industry Act*—included provision for payment of grants to cover extra coal burnt by the supply industry, but payable to the N.C.B. instead of to the generation boards.
- 1973** **EHT transmission*—a project for an experimental half-mile of 2,300 kV transmission line, substation and voltage regulating equipment, at Indiana & Michigan Electric Co's Dumont station near Lakeville, Indiana was announced.
- 1973** *Electrical and Electronic Retailers Association* formed in February.
- 1973** *Pumped storage.* C.E.G.B. announced in March that an extra £5.25 million was to be spent on environmental measures around the 1,500 MW Dinorwic pumped storage scheme, mostly for the undergrounding of cables. The North Wales Hydro-electric Act authorising the scheme received the Royal Assent in December.

- 1973** *National Nuclear Corporation*—Government announced the formation of this new nuclear design and construction company, the shares of which were to be divided between G.E.C. 50%, other engineering firms 35%, and the Government 15%.
- 1973** **E.E.C. energy policy*. Memorandum "Guidelines and Priority Activities under the Community Energy Policy", submitted by the Commission of the European Communities to the Council of Ministers on 19 April, proposed the strengthening of co-operation between the Community and other energy-importing countries, the establishment of relations of trust with the energy-exporting countries and better organisation of the Community's petroleum market. It was discussed by the Council of Ministers in May.
- 1973** *American Electric Power commissioned a *1,300 MW single-shaft Brown Boveri set* at the *John E. Amos station*.
- 1973** *33 kV submarine cable linking* the island of Stronsay to the mainland was energised in June. This 12 km long cable was the longest continuous h.v. distribution cable in British waters.
- 1973** "*Trident*" design temporary *132 kV single-circuit wood pole line* constructed by South Western E.B. based on existing 33 kV line practice. Merseyside and North Wales E.B. developed the concept to a new permanent "*Trident II*" in 1975, a low profile amenity design based on wood poles of 12 m average height.
- 1973** *Remote meter reading* was unlikely to be economic in Britain for many years, according to a report by Atkins Planning, "*Domestic Meter Reading*", pub. by Dept. of Trade and Industry.
- 1973** *General Atomic Company* formed in June by Shell and Gulf Oil to develop and market Gulf's high temperature reactor (H.T.R.)
- 1973** *Work started on Hydro-Quebec's *James Bay hydro-electric complex* on La Grande River. The four stations will have a total capacity of 10,340 MW and the first, LG2, with a capacity of 5,328 MW from sixteen 333 MW sets, was expected to commission during 1980 to 1982.
- 1973** "Second Report from the Select Committee on Science and Technology —*Nuclear Power Policy*", H.C. Paper 350, (Minutes of Evidence etc, H.C. Paper 117). Recommended that the proposed G.E.C. shareholding in the new single nuclear design and construction company should be cut from 50 per cent to 30 per cent or less and that the Government's holding should be raised from 15 to at least 30 per cent. Also recommended that the major U.K. nuclear research and development effort should be on the H.T.R. and that there could well be little point in continuing work on the S.G.H.W.R.
- 1973** **Fast nuclear reactors*. The French Phenix 250 MW (e) fast reactor achieved criticality in August. It reached full power in March 1974.
- 1973** *Nuclear Power Advisory Board* held its first meeting under the chairmanship of the Secretary of State for Trade and Industry. The Board, which was given wide terms of reference to advise Government on future power policy, included the chairmen of the C.E.G.B, the Electricity Council, and the South of Scotland E.B. among its members.
- 1973** "*Distribution of Electricity*" by A. G. Milne, Inaugural Address by the President of the I.E.E., published in "*Proceedings I.E.E.*", Vol. 121, No. 1, January 1974, p. 1 etc., outlined the latest practices in U.K. distribution engineering.

- 1973** *Crude Oil Prices*—on 16 October Arab governments announced from Kuwait very large price increases—in the ensuing months prices more than quadrupled.
- 1973** *Fuel Emergency—Oil Supplies*—on 17 October Arab governments announced the use of the oil weapon in the war with Israel—there were production cuts and embargos on some countries. *Pay Claims*—On 1 November the E.P.E.A. started a ban on out-of-hours working which continued until 7 January 1974. The N.U.M. banned overtime from 12 November, and from 10 February to 10 March 1974 were on strike. A.S.L.E.F. engine drivers supported the miners by a 'non-co-operation' campaign beginning 12 December 1973 and lasting until the end of January. A *State of Emergency* was declared on 13 November and lasted until 10 March 1974. *The Fuel and Electricity (Control) Act 1973* made Orders restricting lighting and heating; a three-day working week for industry was introduced on 17 December and lasted until 7 March. Offices and shops were only permitted to use electricity on either mornings or afternoons. *Voltage reductions* were in force on 12 November and from 26 November to mid-December due to plant shortages caused by the E.P.E.A. action, and from mid-December to 16 January to conserve fuel stocks, and from 12 February to 10 March 1974 because of the coal strike. *Load disconnections* were necessary on only two occasions. During the emergency, coal-fired plant was run on "thermal efficiency merit order". A ban on television after 10.30 p.m. was relaxed for the General Election on 28 February 1974. A Labour Government was formed on 4 March and on 6 March the N.U.M. accepted a £100 million pay settlement. By 24 March all the emergency S.I.s had been revoked.
- 1973** *The 1972 Sample Survey of Domestic Consumers*, Load and Market Research Report No. 119, was published by the Electricity Council.
- 1973** *Eurodif* consortium was established to build a uranium enrichment plant using gaseous diffusion methods at Tricastin in France, of nine million separative work units annual capacity, for commissioning in 1978–79. When Iran joined the consortium in 1975 the national shares were France 43%, Italy 25%, Belgium and Spain 11% each, and Iran 10%.
- 1973** *On-line computer control of a distribution network*. Midlands E.B. commissioned on-line computer control equipment in the Summer Lane control centre of the Birmingham Area—for the remote control of the more important sub-stations and the presentation of the system diagram and supporting information on electronic displays.
- 1973** White Paper, "*Nuclear Power Policy: Government Observations on the Second Report from the Select Committee on Science and Technology*", H.C. Paper 350, Session 1972–73", Cmnd. 5499. The Government defended its choice of G.E.C. as the major shareholder in the National Nuclear Corporation with a 50 per cent holding.
- 1973** **Pumped storage*. First of four 73 MW reversible units commissioned at the *Turlough Hill* station of the Electricity Supply Board, Ireland.
- 1974** *Department of Energy* established to take over all responsibilities for energy previously exercised by the Department of Trade and Industry.
- 1974** *Electrical Research Association* set up as a limited company independent of Government on 1 January.
- 1974** *National Power Company*, the operating arm of the National Nuclear Corporation, took over responsibility for completing the A.G.R. programme.

- 1974** *"First Report from the Select Committee on Nationalised Industries—Capital Investment Procedures"*, H.C. Paper 65. Recommended that the electricity supply industry should adopt corporate planning and that urgent consideration should be given to whether the present structure of the industry was conducive to effective and continuous corporate planning. As a matter of urgency there should be a detailed study of the role of the nationalised industries in the economy and the ways in which they should be controlled.
- 1974** *Safety of L.W.R. pressure vessels*—In a memorandum to the Select Committee on Science and Technology dated 22 January, Sir Alan Cottrell, Chief Scientific Adviser to the Cabinet Office, pointed out that the security of a L.W.R. vessel against fracture depended on the maintenance of rigorous manufacturing and quality control standards and regular crack-detection tests on the vessel during service. The possible growth of small cracks in highly stressed regions and the effect of thermal shock from emergency cooling water in a loss-of-coolant incident needed further scientific examination.
- 1974** *Statutory Corporations (Financial Provisions) Act* made provision for compensating certain statutory corporations in respect of financial loss due to compliance with the national policy relating to limitation of prices. The Act also empowered the supply industry to borrow in Sterling from the Commission of the European Communities or from the European Investment Bank.
- 1974** *"First Report from the Select Committee on Science and Technology—the Choice of a Reactor System"*, H.C. Paper 73 i–vii, 145. The view of the Committee was that until the H.T.R. and F.B.R. were available on a commercial basis, one of the proven British nuclear technologies should be used—they noted the enthusiasm of the South of Scotland E.B. for the S.G.H.W.R.
- 1974** *750 kV oil-filled underground cable*. Pirelli announced a cable design capable of operating between 750 kV and 1,100 kV.
- 1974** *Energy Technology Support Unit* set up by the Department of Energy at the U.K.A.E.A's Harwell research laboratories to assess the need for further research into non-nuclear forms of energy.
- 1974** *"Plan for Coal"*—the N.C.B. recommended planning for a demand estimate of 150 million tons of coal in 1985, and capital investment of £600 million to provide 42 million tons of new capacity to replace depletion. Output per man shift was expected to rise by four per cent per annum. Suggested research projects included fluidised bed combustion and the production of gas and oil from coal.
- 1974** **Energy storage by compressed air*. Nordwest Deutscher Kraftwerke announced a 290 MW gas turbine plant with associated compressed air storage, due to commission in 1977.
- 1974** *Commonwealth Edison Co. commissioned two *single-shaft sets of 1,100 MW and 1,040 MW capacity* respectively at the *Zion P.W.R. nuclear station*.
- 1974** **Consolidated Edison Co.* announced in April that for the first time since 1885 they would not be paying a quarterly dividend to their shareholders.
- 1974** *London to Glasgow railway electrification* inaugurated in May. The Royal Scot created a record for the run of 4h 58 min.
- 1974** *Fuel cost adjustment* was applied for the first time to domestic and other quarterly-billed customers from 1 May.

- 1974** *"Towards a new energy policy strategy for the European Communities"* Document R/1472/74 published by the European Communities Commission, recommended that by the year 2000 nuclear energy should provide at least 50 per cent of the Community's energy requirements. The Select Committee of the House of Lords on the European Communities (H.L. Paper 114) considered the nuclear target too optimistic, and the Secretary of State for Energy said in the House on 11 February 1975 that it was unrealistically high.
- 1974** *Chloride Silent Power Ltd* established as a joint undertaking by the Chloride Group Ltd and the Electricity Council to develop and commercially exploit the sodium sulphur battery for traction purposes.
- 1974** The *first 660 MW unit commissioned*—at the Drax coal-fired station in the West Riding of Yorkshire. The original intention was to use super-critical pressures, but in 1966 it was decided to employ subcritical steam conditions similar to those of the 500 MW units namely, 158.58 bars at 565°C (T.S.V.) with re-heat to 565°C, steamed from a 561 kg/s boiler.
- 1974** *Advisory Council on Energy Conservation* established (Chmn. Prof. Sir William Hawthorne) to advise and assist the Secretary of State for Energy in carrying out his duty of promoting economy and efficiency in the use of energy, in particular by identifying areas for improvement and methods of conservation.
- 1974** White Paper *"Nuclear Reactor Systems for Electricity Generation"*, Cmnd. 5695—set out the Government's nuclear policy that the S.G.H.W.R. should be selected for future nuclear station orders. Reactor units of 600–660 MW would make up an initial programme of not more than 4,000 MW over the four years to 1978, for commissioning after 1981.
- 1974** A White Paper *"United Kingdom Offshore Oil and Gas Policy"*, Cmnd. 5696 foreshadowed the establishment of a British National Oil Corporation and extended Government control over offshore operations.
- 1974** *"Domestic Tariffs Experiment"*, Load & Market Research Report No. 121, published by the Electricity Council, gave the results of an experiment into novel structures of domestic electricity pricing. Seasonal and seasonal time-of-day tariffs seemed promising in terms of customer response, but metering costs were a major problem.
- 1974** An Electricity Council *demand profile recorder of advanced design* was developed in collaboration with Normalair-Garrett Ltd. to monitor customers' demand patterns.
- 1974** A *fish hatchery* was established by the White Fish Authority using warm water from Hunterston "A" power station, to investigate the possibilities of commercial fish farming.
- 1974** The Electricity Council submitted memoranda to the Energy Resources Sub-Committee of the Select Committee on Science and Technology on the *pricing policy of the electricity supply industry* (included in H.C. Paper 127–I) and on *inverted tariffs* and the *price elasticity of electrical demand* (included in H.C. Paper 127–II).
- 1974** *Coal industry examination*—endorsed the N.C.B.'s "Plan for Coal" (q.v) following tripartite discussions between the N.C.B., the Government and the unions. Anticipated that electricity supply would have coal-burning plant needing 100 million tons a year by 1985.
- 1974** *"Energy and the Environment"*, published by the R.S.A.—a report by a working party (Chmn. Lord Nathan) set up jointly by the Committee for

- Environmental Considerations (the forum for the main conservation and amenity bodies in Britain), the R.S.A. and the Institute of Fuel. Recommended the establishment of an Energy Commission to plan energy programmes, the discouragement of open competition between energy suppliers, and an independent body to consider possibilities of small-scale decentralised generation making use of reject heat.
- 1974** *"The Increased Cost of Energy—Implications for UK Industry"*, National Economic Development Office, estimated the effect on the U.K. economy of the sharp increase in the price of energy between the middle of 1973 and early 1974.
- 1974** *"Energy Conservation: A Study by the Central Policy Review Staff"* (Chmn. Lord Rothschild) made recommendations which included the consideration of wave power as a possible source of electricity generation.
- 1974** *Domestic off-peak tariffs*—on 29 July the Secretary of State for Energy announced that the percentage relationship between quarterly off-peak and standard electricity rates was to be restored from 1 August to that which existed in March before the introduction of fuel cost adjustment to domestic tariffs.
- 1974** *A direct current link of 640 MW capacity from Kingsnorth to Willesden* operating at ± 266 kV was completed by the C.E.G.B., the first in the world to integrate short-distance d.c. transmission with a closely interconnected a.c. system in an urban area.
- 1974** White Paper *"Choice of Thermal Reactor System. Report of the Nuclear Power Advisory Board"*, Cmnd. 5731, published in September, set out the Board's earlier advice to the Government that the choice of a thermal reactor system for the UK should be either P.W.R. or S.G.H.W.R. They had been unable to reach a unanimous recommendation on which would be the most suitable.
- 1974** **U.S. Atomic Energy Commission* was dissolved in October. Its research and development function was transferred to a new Energy Research and Development Administration (ERDA).
- 1974** *"Energy Conversion to Electricity"*—paper presented by D. Clark to the Royal Society and published in their Philosophical Transactions, Ref. A.276, p. 559 etc. (1974). Looked at the scope for innovation in the technology of conversion of fossil fuels to electricity.
- 1974** *Foyers pumped-storage station* on Loch Ness commissioned with two 150 MW reversible pump turbines, part of the North of Scotland Hydro-Electric Board's Great Glen Group of stations under remote control from Fort Augustus.
- 1974** *"Cable Practice in Electricity Board Distribution Networks: 132 kV and Below"*—review paper by A. Ross to the I.E.E. published in the "Proceedings I.E.E.," Vol. 121, No. 11R, November 1974, p. 1307 etc.
- 1974** *Advisory Committee on the Safety on Household Electrical Equipment* set up by the Secretary of State for Prices and Consumer Protection to advise on the administrative guidance to be provided concerning the proposed Electrical Equipment (Safety) Regulations. (q.v.)
- 1974** *"Electricity in Agriculture"*—a review paper by R. A. Bayetto, H. Paterson, and P. O. Wakeford to the I.E.E., published in the "Proceedings I.E.E.," Vol. 121, No. 11R, November 1974, p. 1244 etc.
- 1974** **International Energy Agency* (I.E.A.) established by O.E.C.D. to imple-

ment the International Energy Program for developing a common level of emergency self-sufficiency in oil supplies and to reduce dependence on imported oil. Its establishment was noted in a White Paper "*Agreement on an International Energy Program*", Cmnd. 5826, which set out the I.E.A.'s programme. The Agreement was signed by the U.K. on 18 November.

- 1974 *Cross-Channel cable extension*—joint C.E.G.B./E.D.F. investigations into a proposed reinforcement of the link with France indicated that a new 2,000 MW h.v.d.c. link could produce significant economic savings in the early 1980's.
- 1974 In his November budget the Chancellor of the Exchequer stated his objective to *eliminate subsidies to the use of energy* through artificial prices for the products of nationalised industries.
- 1974 *Thermal insulation standards for new buildings* were increased under "The Building (Second Amendment) Regulations 1974" S.I. No. 1944, which came into operation on 31 January 1975. (Later incorporated in "The Building Regulations 1976", S.I. No. 1676)
- 1974 *Energy conservation—The Electricity (Advertising Lighting) (Control) Order 1974*, S.I. 1974, No. 2159, prohibited the daylight use of electricity for advertising purposes (later repealed under the Energy Act 1976); *The Fuel and Electricity (Heating) (Control) Order 1974*, S.I. 1974, No. 2160, prohibited the use of fuel or electricity to heat premises above a temperature of 68°F (20°C). They came into operation on 13 January 1975.
- 1975 "*Save-It*" campaign—the biggest and most concentrated publicity exercise ever undertaken by the Government was launched by the Secretary of State for Energy on 20 January to bring home to consumers the need to save energy and to explain how it could be done.
- 1975 *National Consumer Council* established, as foreshadowed in the White Paper "National Consumers' Agency", Cmnd. 5726, Sept. 1974, a non-statutory body to represent the consumer's view to central and local government.
- 1975 *Joint reading of electricity and gas meters*—the Under-Secretary of State for Energy said in the House on 20 January that consideration of this question had revealed that any saving would be very marginal if anything at all.
- 1975 *The 250 MW Prototype Fast Reactor* (P.F.R.) at Dounreay began supplying electricity to the grid. The liquid-sodium-cooled station's fuel charge amounted to 900 kg P_uO₂ and 3,000 kg UO₂.
- 1975 *Consultative councils*—From 1 February the responsibility for appointing the chairman and members of the consumer councils for the coal, gas, electricity and transport industries and the Post Office was transferred to the Secretary of State for Prices and Consumer Protection.
- 1975 North of Scotland Hydro-Electric Board put in hand design studies for a pumped storage station at *Craigroyston* on Loch Lomond of up to 3,200 MW capacity.
- 1975 Electricity Boards adopted a voluntary *Code of Principles* aimed at providing prompt and efficient *appliance servicing* within about three days at a reasonable cost, with an associated complaints procedure operating through electricity consultative councils, and provision for arbitration.

- 1975** *Domestic off-peak tariffs*—on 25 March the Secretary of State for Energy announced the phasing out of the concession on the price of off-peak electricity introduced on 1 August 1974. (*q.v.*)
- 1975** *Higher electricity prices*—during the year domestic tariffs were increased by 40 per cent including fuel cost adjustment and there were large increases in other tariffs in a move towards economic pricing after a period of price restraint.
- 1975** **Uranium Enrichment Corporation* of South Africa (U.C.O.R.) began to operate their pilot plant based on what was claimed to be a unique process for uranium enrichment.
- 1975** *"Electricity and Heat Production: Energy Efficiency Versus Cost Efficiency"*—paper by P. A. Lingard to the District Heating Association on 13 May considered the economics of district heating schemes supplied from steam power stations.
- 1975** *North Sea Oil*—on 18 June Hamilton Brothers group delivered *Britain's first offshore oil* from the Argyll field, ferried by the Liberian tanker Theogennitor to British Petroleum's Isle of Grain refinery. In October the first oil from B.P.'s Forties field was piped to Cruden Bay near Peterhead, then on to the Grangemouth Refinery; and the Phillips group piped the first supplies from Norway's Ekofisk field to Seal Sands, Teesside.
- 1975** *The Uranium Institute* was established in London by international uranium producers to act as their trade association.
- 1975** *Effect of V.A.T. change on selected domestic appliances*—the Domestic Appliances Working Group of the Electrical Engineering Economic Development Committee estimated that the increase in V.A.T. from 8 per cent to 25 per cent would reduce sales of the most important electrical appliances by up to 20 per cent.
- 1975** *"The Electrical Equipment (Safety) Regulations 1975"*, S.I. No. 1366, made under the Consumer Protection Act 1961, laid down compulsory comprehensive safety criteria for all equipment designed and suitable for domestic use and offered for sale in G.B. They came into force on 1 April 1976.
- 1975** *Advisory Council on Energy Conservation* reported to the Secretary of State for Energy (Energy Paper No. 3, pub. Dept. of Energy). Among its recommendations were—energy prices should reflect the full cost of production, any strongly promotional element in pricing should be eliminated, the Electricity Council and Scottish electricity boards should be encouraged to take positive roles in developing combined heat and power schemes.
- 1975** *Statutory Corporations (Financial Provisions) Act*—made provisions for compensating certain nationalised industries for their losses due to price restraint in the years 1974–75 and 1975–76. The Act also transferred financial responsibility for the electricity consultative councils to the Secretary of State for Prices and Consumer Protection as from 1 October.
- 1975** *"Overhead—Line Practice"*—review paper by E. H. Cox published in "Proceedings I.E.E.", Vol. 122, No. 10R, October 1975, p. 1009 etc. covering overhead-line developments in the U.K. since 1882.
- 1975** *"Development, Design and Use of Ripple Control"* review paper by W. L. Kidd published in "Proceedings I.E.E.", Vol. 122, No. 10R, October 1975, p. 993 etc. covering the history of ripple control developments.

- 1975** "First Report from the Select Committee on Science and Technology—*Energy Conservation*", H.C. Paper 487, (and H.C. Papers 127 i–ii, 155 and 156 i–iv.) called for a Government energy conservation policy that would reduce U.K. energy consumption by 15 per cent within two or three years.
- 1976** *White Paper "The Structure of the Electricity Supply Industry in England and Wales—Report of the Committee of Inquiry"*, Cmnd. 6388, published January. The Committee was set up by the Secretary of State for Energy in December 1974, with Lord Plowden as Chairman. Their main recommendation was that the supply industry in England and Wales should be unified, with a new single statutory body, the Central Electricity Board, to take over the responsibilities of the Electricity Council, the C.E.G.B. and the area boards. The Secretary of State for Energy announced in February that the report provided an opportunity for all concerned to have the widest possible discussion on the shape of the industry.
- 1976** The OECD's *Dragon experimental high temperature reactor* (H.T.R.) project at Winfrith terminated on 31 March.
- 1976** Results of a *feasibility study of district heating* for a re-development area around the old Pinkston Power Station, Glasgow, made by the South of Scotland E.B. in collaboration with Kennedy and Donkin Associates, showed that the district heating consumer would have to pay more for his heat than for alternative forms, and if electricity were produced in conjunction with the district heating scheme it would be more expensive than that generated by conventional methods.
- 1976** *British Electricity International Limited*, a wholly-owned subsidiary of the Electricity Council, was established on 15 April to strengthen the overseas consultancy services of the U.K. electricity supply industry.
- 1976** "*Solar Energy: A U.K. Assessment*"—paper presented at the Royal Institution by the U.K. Section of the International Solar Energy Society (Chmn. J. K. Page) stated that, in the long term, solar energy could supply 10 to 20 per cent of U.K. energy requirements.
- 1976** *Electricity and gas showrooms*—Secretary of State for Energy announced that the Government had accepted the advice of the electricity and gas industries that their showrooms should not be merged; and advice from consumers' representatives that when one industry closed an uneconomic showroom the possibility of providing a service through the showrooms of the other industry should be considered.
- 1976** "*Nuclear Power and the Environment*", Sixth Report of the Royal Commission on Environmental Pollution (Chmn. Sir Brian Flowers), Cmnd. 6618, considered that the Government's nuclear power proposals carried unjustifiable risks to the public, the F.B.R. should be delayed as long as possible on environmental grounds, but the fusion reactor would involve much less hazard from radiation.
- 1976** "*Energy R. & D. in the U.K.: a discussion document*" based on studies carried out for the Advisory Council on Research and Development for Fuel and Power (A.C.O.R.D.) (Chmn. Dr. W. Marshall) estimated the expected gap between energy demand and home supplies of fossil fuels by the turn of the century according to various criteria.
- 1976** "Fourth Report from the Select Committee on Nationalised Industries—*Gas and Electricity Prices*", H.C. Paper 353. Recommended inter alia the abandonment of fuel cost adjustment in domestic tariffs, and that the Department of the Environment should give guidance on the running costs of heating systems and other appliances.

- 1976** *First National Energy Conference*—Held on 22 June, a one-day conference organised by the Secretary of State for Energy to encourage and stimulate discussion amongst a wide range of interests and to draw on their advice in preparing a national energy policy. The Electricity Council's paper "Flexibility in Long-Term Energy Policy" called for a reduction in government direct intervention in energy decision making, and ground rules set by Government as a framework for flexible planning. The Secretary of State announced in the House on 19 July that the energy forum had indicated a need for a more permanent body to consider energy policy and that he was considering what form this body should take.
- 1976** *National Joint Co-ordinating Council (Great Britain), for the Electricity Supply Industry in Great Britain, (N.J.C.C. (G.B.))* was established on an interim basis in place of the two existing National Joint Advisory Councils (one for England and Wales and one for Scotland), to consider matters of importance or of common interest to the whole industry, including negotiations where it would advise on general matters which affected more than one of the existing negotiating machineries.
- 1976** White Paper "*Energy Conservation. The Government's Reply to the First Report from the Select Committee on Science and Technology, Session 1974-75*", Cmnd. 6565. The Government did not accept that energy tariffs were promotional nor that the large consumption of gas and electricity was synonymous with wasteful consumption. Stated inter alia that inverted tariffs would tend to encourage multi-fuel use which was inefficient in natural resource terms, and would also have an adverse impact on energy-intensive firms, and in the domestic sector would have adverse social consequences for low-income consumers with unavoidable large energy requirements.
- 1976** *National Nuclear Corporation*—U.K.A.E.A. increased its shareholding from 15 per cent to 35 per cent by acquiring shares from G.E.C., whose holding was reduced to 30 per cent. The remaining 35 per cent was held by British Nuclear Holdings, a consortium of industrial companies. G.E.C. would continue to exercise a supervisory role in support of the N.N.C.'s operating company, the Nuclear Power Company.
- 1976** *Low income groups and fuel bills*—
Supplementary benefit claimants and fuel disconnections. Arrangements were agreed between the Electricity Council and Department of Health and Social Security which would enable the Supplementary Benefits Commission to make payments direct to electricity boards by means of regular deductions from supplementary benefits in order to help to avoid disconnections through non-payment of bills.
"Energy Tariffs and the Poor"—a report by a Government inter-departmental group of officials appointed to review the scope for helping low-income consumers concluded that possibilities such as concessionary tariffs were not a satisfactory way of helping low-income groups with their fuel bills.
"Fuel Debts and the Poor"—Poverty Pamphlet No. 24 from the Child Poverty Action Group recommended that Supplementary Benefits should include increased fuel allowances, there should be a much wider choice of payment methods to help households to budget weekly, the fuel advisory service should offer free advice on comparative fuel and appliance costs, arrears in fuel bills might be paid back at an agreed weekly sum.
Token operated pre-payment meters—the Electricity Council commenced two-year trials using standard pre-payment meters adapted for operation by plastic tokens.
Tariff structures and pricing policies of electricity and gas—"Third Report from the Select Committee on Nationalised Industries". H.C. Paper 352. Recommended that coin meters should be more readily

available, that pay-as-you-burn schemes should be encouraged, and that local authorities should allow council tenants to pay fuel bills with the rent.

"Review of Payment and Collection Methods for Gas and Electricity Bills" (Chmn. Mr G. Oakes) This informal review body's principal recommendation was that the electricity and gas industries should no longer disconnect supplies to domestic customers for non-payment of bills but should rely, instead, on other means of recovering debts.

An electricity discount scheme was announced in November under which the Government would pay 25% of the electricity bills for householders on Supplementary Benefit or Family Income Supplement in respect of meter readings made in February, March or April 1977.

A code of practice for payment of domestic electricity and gas bills was agreed by the electricity and gas industries which provided reasonable procedures for the settlement of bills in cases of hardship.

1976 *S.G.H.W.R.*—on 22 July the Government announced that the commissioning of the first Sizewell reactor would be delayed until August 1985 as part of measures to reduce the public sector's claims on the nation's resources.

—In a memorandum to the Secretary of State for Energy (*"Thermal Reactor Review"*, 23 July) and evidence to the Select Committee on Science and Technology (13 October) the South of Scotland E.B. stated that the S.G.H.W.R. represented a viable reactor choice with good operational flexibility and ease of repair.

—In a memorandum to the Secretary of State for Energy (*"Reactor Policy"*, 26 July) the U.K.A.E.A. recommended that the S.G.H.W.R. programme should be replaced by A.G.R.s or P.W.R.s.

—On 22 October the Secretary of State for Energy announced his support for a new assessment of reactor designs to be carried out by the Nuclear Power Company.

—*"First Report from the Select Committee on Science and Technology—The S.G.H.W.R. Programme"*, H.C. Paper 89 (1977) recommended inter alia that the S.G.H.W.R. programme should only be cancelled if it were more expensive than other types of reactor designed to the same safety standards, if other types had significantly greater export potential, and if the construction of alternative reactors could begin in early 1979, the date scheduled for Sizewell "B" and Torness S.G.H.W.R.s.

1976 *"The Electricity Supply Industry—Yesterday, Today and Tomorrow"*—by E. S. Booth. Inaugural Address of the President of the I.E.E. published in *"Proceedings I.E.E."*, Vol. 124, No. 1, January 1977.

1976 *"An Assessment of the Integrity of P.W.R. Pressure Vessels"*, report of a study group headed by Dr. Walter Marshall, Deputy Chairman of the U.K.A.E.A., which considered the question of the possibility of P.W.R. pressure vessel failure. Recommended that the Nuclear Inspector could now be satisfied about the safety of such vessels built in Britain.

1976 *Selby coal-mine project* inaugurated—the first completely new coalfield for 70 years. It would provide 10 million tons a year at a capital cost of £400 million.

1976 *Accelerated ordering of power stations.* According to a report by the Heavy Electrical Machinery Working Group of the Electrical Engineering Industry E.D.C. the ordering of a 2,000 MW fossil-fuel-fired station in 1977, some four years before required, could yield net savings if inflation offset interest charges. But the C.E.G.B. indicated that advanced ordering would result in substantially higher costs although a better case could be made for nuclear plant.

- 1976** *Electricity (Financial Provisions) (Scotland) Act 1976* included provisions to compensate the North of Scotland Hydro-Electric Board for the deficits incurred in supplying British Aluminium Company's smelter at Invergordon due to the late commissioning of Hunterston "B" A.G.R. station.
- 1976** **Coredif*, a new consortium to build a gaseous diffusion plant to produce enriched uranium was provisionally established. Shares were split between Eurodif (*q.v.*) 51%, France 29% and Iran 20%. About 10 million separative work units annual capacity was envisaged, with the first commissioning expected for 1983–85.
- 1976** *C.E.G.B.* Headquarters Research Department was re-designated a *Research Division* and the title Controller of Research changed to Director-General, Research Division.
- 1976** Accelerated *power station closure programme*—the C.E.G.B. closed down 23 stations and partly closed 18 on 25 October involving 2,884 MW of plant. A second tranche, implemented in March 1977, involved closing six further stations and partially closing two, totalling 649 MW.
- 1976** *First A.G.R. nuclear stations* commissioned—Hinkley Point "B" near Bridgwater, Somerset and Hunterston "B" near Largs, Strathclyde. The CO₂ gas-cooled graphite-moderated two-reactor stations, with one 660 MW set per reactor, employed slightly enriched uranium in the form of ceramic UO₂ canned in stainless steel.
- 1976** *At *Ontario Hydro's Bruce nuclear station* the first of four 750 MW(e) C.A.N.D.U. reactor units entered service. The 800 MW set, one of four to be supplied by C. A. Parsons, was the largest so far built in Britain. The station will also supply steam for a heavy water plant built alongside with an annual output of 800 tons.
- 1976** "*Consumers and the Nationalised Industries*"—a report of the National Consumer Council to the Secretary of State for Prices and Consumer Protection, which for the electricity supply industry recommended that the existing area electricity consultative councils and their district committees should be abolished and that in their place there should be a National Electricity Consumer's Council and 12 "regional presences", each consisting of a secretariat working under the National Council's control and the regional member of that Council.
- 1976** "*Energy Act 1976*"—contained powers for the control of fuel and electricity and for conservation measures. It replaced the Fuel and Electricity (Control) Act 1973 (*q.v.*) passed during the 1973–1974 fuel emergency, parts of which were renewed annually by Order.
- 1976** "*A Study of UK Nationalised Industries: Their Role in the Economy and Control in the Future*"—a report to the Government from the National Economic Development Office which concluded that the system of control and government relationships with the nationalised industries was highly unsatisfactory and in need of radical change. Recommended that for each major nationalised industry there should be a Policy Council to agree corporate objectives and strategies, establish performance criteria and monitor performance; and a Corporate Board which would manage the corporation within the framework agreed by the Policy Council.
- 1976** **International Electro-technical Commission* (I.E.C.) completed their draft technical specification for a 16 A. plug and socket intended for world-wide acceptance.
- 1976** *The Brown's Ferry, Alabama, B.W.R. Station of T.V.A. became the

world's largest nuclear station with the commissioning of the third 1,067 MW unit.

1976

"The Future of the United Kingdom Power Plant Manufacturing Industry: A Report by the Central Policy Review Staff" (Chmn. Sir Kenneth Berrill) suggested possible measures for action which included the rationalisation of the power plant manufacturing industry through mergers, bringing forward one power station order, a Government commitment to a firm and steady order programme, and the ordering of a prototype 1300 MW unit.

1976

New appointments in electricity supply were announced by the Secretary of State for Energy :

Mr. F. L. Tombs, Chairman of the South of Scotland E.B., to succeed Sir Peter Menzies as Chairman of the Electricity Council with effect from 1 April 1977 ;

Mr. G. England, Chairman of the South Western E.B. to succeed Sir Arthur Hawkins as Chairman of the C.E.G.B. from 1 July 1977 ;

Mr. A. W. Bunch, Chairman of the Southern E.B. became Deputy Chairman of the Electricity Council on 1 December 1976.

Select List of References on the History of Electricity Supply in Great Britain

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1958/59—

Central Electricity Generating Board

1958/59—

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Sir (J) Ambrose Fleming
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Note

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EB : Electricity Board
esi : electricity supply industry
ps : power station(s)

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