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FERRANTI'S DEPTFORD POWER STATION

This supplement is extracted extensively from a pamphlet published by the CEGB in 1986 entitled ***"Cradle of Power – The Story of Deptford Power Stations" and written by Rob Cochrane****. The pamphlet came to light recently, when historical material was rescued by Roger Hughes and John Gale from The Electricity Association's offices at Millbank prior to their closing down.*

Deptford has had many associations with the sea and port facilities over the years. The Romans had built defences there. In Norman times it had become Depeford from the deep water, where the Ravensbourn flowed into the Thames: a feature which was to lead to it becoming known all over the world as a major shipbuilding centre. When Chatham was a dreary marsh and Portsmouth a fishing village, Deptford, cradle of the British Navy, was sending out ships to harry the Spaniards and the Frenchman. That first Royal Dockyard was founded by Henry VIII, while a hundred years later Tsar Peter the Great worked there, as an artisan to learn the shipbuilding skills which helped him create the Russian navy.

Trinity House Corporation, responsible for Britain's pilotage and lighthouses, has been associated with Deptford since its foundation. The powerful and wealthy East India Company had a major base and built many of its ships there. As the railways developed, Deptford was the first place to be connected to London.

Soon Deptford was to see the start of another development, which would make possible so many of the technological achievements of the 20th Century through the large-scale generation of electricity and its high voltage transmission over great distances inaugurated in the Deptford power station scheme. It's difficult to realise fully the immensity of the step forward at that time, and to appreciate the vision of the man responsible - Sebastian de Ferranti - not to mention his courage in confronting the beliefs of eminent men of science. The industrial revolution had transformed manufacturing processes, transport was horse-drawn and the motor car was only just being invented. For most people, lighting was provided by candles or paraffin lamps. Although the use of gas was increasing in towns, the 'bats-wing' burners gave only a poor light.

Electric lighting was in its infancy. Michael Faraday's discovery of electro-magnetic induction in 1831 had opened the way to converting mechanical power into electricity, and within thirty years small generators were being used in lighthouses. By 1878 the Sheffield Football Association had staged an evening match under electric lights - with players' errors being blamed on the intensity of the illumination. The Gaiety Theatre was using some electric lighting, and the next year saw the start of the famous Blackpool illuminations. But until that time lighting had been produced by the arcing of electricity between two carbon rods, with an intensity and glare, which made it quite unsuitable for normal domestic use. The effect of the electric lighting at the Gaiety had been described as 'half a dozen harvest moons shining at once in the Strand', while a committee appointed by a gas company reassured share-holders by reporting 'We are quite satisfied that the electric light can never be applied indoors without the production of an offensive smell, which undoubtedly causes headaches, and in its naked state it can never be used in rooms of even a large size without damage to sight'.

The breakthrough came with Joseph Swan's invention of the incandescent lamp, matched in the United States by an almost simultaneous invention by Thomas Edison. An installation in the new Savoy Theatre, opened in 1880 by Richard D'Oyly Carte for the Gilbert and Sullivan Operas, was claimed by that impresario to be 'the first time it has been attempted to light any public building entirely by electricity'. A year later the House of Commons was similarly lit, but electric lighting was still something of a status symbol for businesses and individuals, with small experimental local stations being set up in the West End and the wealthier residential districts.

It was in 1883 that Sir Coutts Lindsay made up his mind to light his Grosvenor Gallery in New Bond Street with 'the new smokeless electricity'. A neighbour to whom he mentioned the idea promptly said 'Put down twice the necessary machinery and produce twice the current you need, and let me have what you can spare'. Soon others were making similar requests and the original installation in an outbuilding became quite inadequate to meet all requirements. Sir

Coutts decided to build a permanent generating station in a specially constructed basement under the Gallery. Three steam engines drove a pair of Siemens alternators - the largest yet built by that pioneer electrical company - the current being transmitted to other premises by overhead cables supported from poles on the housetops. However, the system installed at that time proved so difficult to work that he invited a 21-year-old engineer named Ferranti to take charge of the generating station: a step which was to have momentous consequences.

Man of Vision

Sebastian Ziani de Ferranti was already a remarkable young man ; not altogether surprising considering the family from which he came. Two of his ancestors had been elected Doges of Venice during the 12th Century, and later members of his family had held important positions in the Italian city-states of the Middle Ages. His grandfather was a musician of distinction - a friend of Paganini and Rossini. His father had become famous as a portrait photographer, while his mother was a highly accomplished musician who, until the death of her first husband, had toured all the European capitals with him giving recitals. Yet from a very early age, Sebastian's whole interest was focused on engineering and scientific matters.

When he entered St Augustine's Roman Catholic College at Ramsgate, he was lucky in having as headmaster a man of great insight. Sebastian's schoolwork showed anything but promise, yet Abbot Regan recognised his developing qualities. 'That he was an original genius soon became perceptible... he forced us to let him have full scope for his ingenuity, and we willingly assigned him a room, where all by himself, he could work at practical problems, exercising his budding genius.'

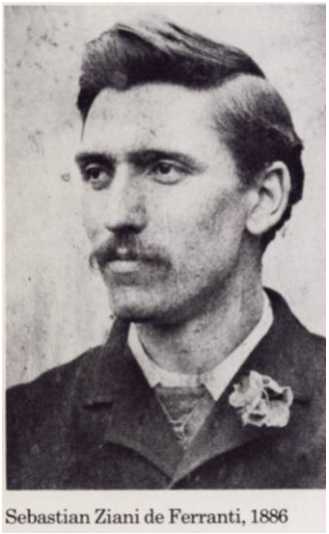
Sebastian Ziani de Ferranti, 1886

Fig.1 Sebastian Z. de Ferranti

Within a month of leaving St Augustine's at seventeen, he had sold a dynamo he had made for £5 l0s 0d and soon got employment with Siemens, being sent around the country to supervise the installation of electric lighting plants. By eighteen he had set up his own company in collaboration with Alfred Thompson, an engineer, and Francis Ince, a lawyer greatly interested in scientific developments; and that same year of 1882 saw another remarkable achievement. He invented an alternator with a revolutionary type of zig-zag armature, which far outstripped anything else on the market at that time; only to find that another machine with many identical features had just been developed by Sir William Thomson (later Lord Kelvin). Agreement was reached under which the machine marketed was known as the Thomson-Ferranti alternator, with Sir William receiving a royalty on all sales.

It created a sensation in the technical and public press. 'This machine, with its novel zig-zag armature and vastly greater efficiency than any existing alternator, gives five times as much output as any other machine of equal size.' By the end of 1883, Ferranti was in business on his own account manufacturing alternators, arc lamps, meters and other electrical equipment of his own invention.

When he accepted Sir Coutts Lindsay's invitation to become Engineer of the Grosvenor Gallery generating station, he immediately set about drastic changes. The system was converted to run 'in parallel' instead of 'in series'; switchgear of his own design was erected, and soon the Siemens machines were replaced by Ferranti alternators. The electric supply given was so much in demand that, within three years, his remodelled overhead network was supplying premises in 100 miles of streets in an area from Regent's Park to the Thames and from Knightsbridge to the Law Courts at the border of the City of London. As the journal *Industries* reported, 'This central station has, in the fullest sense of the term, been a pioneer in public supply of electricity, and is at present the largest station in England'.

That early achievement was impressive enough in the light of developments in this country, where the use of electricity was lagging far behind the United States and some European countries. Here the industry was little more than a collection of huts and basements with clanking reciprocating steam engines supplying lamps within a relatively small radius. Even a 'big' station would generate no more than 800 kilowatts - enough to light 26,000 lamps of that period; but the level of illumination they gave was poor, and the most that could be said was that it was better than anything else then available. But already a major challenge was on its way.

In 1886 Welsbach had invented the incandescent gas mantle, increasing the efficiency of gas lighting. Gas had already been a much cheaper means of lighting than electricity, and was being made even more economic by gas companies shutting down local gasworks in favour of much bigger plants situated in places like Rotherhithe.

The Grand Design

Ferranti didn't hesitate to use the gas industry's example in support of his own vision. In place of a proliferation of little electric light works serving local communities he envisaged a big power station capable of supplying London with electricity on a really large scale, built by the Thames where unlimited cooling water was available and where land and the sea-borne supplies of coal would be cheap. 'The business of distributing electrical energy must be done on a large scale to be commercial, and to attain this we must supply a large area ... and we must do this from a site not in the congested heart of a big city but from a position best suited by its natural advantages to the carrying on of such an undertaking.'

The scheme he planned was on a scale undreamed of in this or any other country. It says much for the acumen and financial courage of Sir Coutts Lindsay and his brother Lord Wantage that they formed and were the principal shareholders of the London Electric Supply Corporation Ltd having an authorised capital of £1,000,000, with the intention that LESCo should take over the Grosvenor Gallery station and proceed with the massive new undertaking. And it was decided to build this new station at Deptford on a 3-acre site called The Stowage, which had once housed the store rooms, rigging sheds, mast sheds and sail lofts of the East India Company.

It was an incredible venture for its time. The plant at the Gallery was already considered big, but Ferranti's proposals must have seemed like a leap into the technical unknown. Whereas the largest of the four Gallery engines was 750 hp, the Deptford plant would eventually include four of 10,000 hp each. Instead of the existing four boilers capable of producing 20,000 lbs of steam per hour, the new station would have eighty boilers with a steaming capacity of 1,380,000 lbs per hour - and it was planned to triple even that arrangement. But perhaps the most startling aspect was the proposal to install at Deptford four alternators of 500 tons each, generating at 10,000 volts and more than twelve times the capacity of the Grosvenor Gallery alternators. The completed station would be capable of supplying no less than two million lamps.

Work began in April 1888, and was pushed forward night and day to such effect that by midsummer 1889 the main building had been erected, 24 boilers and two initial 1,250 hp engines had been installed and the alternators were almost ready. Ferranti's part in this almost beggars description. His wife wrote later, 'The first thing I remembered during those first months of married life was Deptford, and again Deptford. We talked Deptford and dreamed Deptford'. On many nights he didn't go to bed at all, staying in a little cottage on site which he used as an office and sometimes spreading his overcoat on the floor and lying down to snatch an hour or two's sleep. The Chairman of LESCo was generous in his praise:' He pledged his reputation, his fortune, his labour - day and night - to achieve the result he promised to the Directors'.

There was no aspect in which he wasn't personally involved. In October 1888 the *Electrical Engineer* quoted him as "The Michelangelo of that installation because from first to last, from foundation to highest turret, the architecture, materials, foundations and machines all were specified or designed by one man, and the credit of that success will have to be given, without detracting one iota in favour of any other person, to Ferranti".

He wasn't without his critics. Eminent men of the day prophesied disaster, particularly in Ferranti's proposed use of the unheard-of electrical pressure of 10,000 volts to transmit the current to central London. That pressure seems very ordinary nowadays, when the British Supergrid operates at 400,000 volts, but at the time it created a sensation. As one writer put it, anything over 2,000 volts was regarded as dangerous and tempting Providence. The heart of the matter was the belief held by many very distinguished engineers that the future of electricity supply lay in direct current low-tension systems, serving local communities. Ferranti was convinced that economic electricity supply depended on the use of alternating current and transformers, which would enable the energy to be transmitted at high voltage over very much greater distances. The 'Battle of the Systems' - AC versus DC - was to rage for years. One of the exponents of the DC system was Thomas Edison, hailed by many as the genius of the age. Even before Sir Coutts Lindsay had started his Grosvenor Gallery station, two of Edison's renowned 'Jumbo Dynamos' (named after a circus elephant) had been installed in the 3,000 light generating station at No.57 Holborn Viaduct; the first central station for private incandescent lighting in the world, which came into operation in January 1882, just a few months before Edison's own famous Pearl Street station in New York. In September 1889 the famous man visited the Deptford power station under construction.

The *Daily News* told how, despite his severe cold, he 'soon appeared to forget his indisposition when he began his inspection of the wonderful machinery, spending a long time minutely examining the immense engines and dynamos'. With his convictions about the immense superiority of low tension systems he was hardly an unbiased observer, and

spoke of the risks of an enormous electrical pressure through a narrow wire compared with 'our New York tension wires which are so safe that even a child may play with them'. But he added 'Oh, it will go!' Others abroad were following the progress of the Deptford Station with great interest. The New York *Electrical World* admitted combined admiration and apprehension about the proposed high tension method of transmission - the project must be either a gigantic success or gigantic failure - but it was unstinting in its appreciation of the concept:
"The reproach which has long existed regarding the backward state of electric lighting in England is at last to be removed. ... There is now in progress in London an installation which is calculated to exceed many times in capacity any other existing light installation in the world .etc".

Fig.2 Deptford Station
Circa 1890's

Mains to Central London

For Ferranti to envisage transmitting current at such a high pressure was one thing; to achieve it proved quite a different matter. The cables originally purchased and laid in the early part of 1889 were a failure. He decided that the only way to get mains capable of transmitting current at 10,000 volts to central London would be to design and manufacture his own; the beginning of the famous Ferranti cables, and another achievement generously applauded in the public press.

Within six months, the *London Daily News* was carrying a story: 'The Ferranti "mains" are believed to be one of the most valuable discoveries yet made in electric lighting. The "main" or cable contains, within the same casing, both the conductor for the "out" current and the conductor for the "return" current; and it may be laid down in the earth without any protection whatever. It consists of two copper tubes, one within the other, separated by an insulating substance; outside the outer tube is another layer of the insulating substance (Mr. Ferranti's invention) and the whole is inserted into a protecting tube of iron. The "mains" thus completed are laid down in lengths of twenty feet each. They now extend from Deptford, through Charing Cross to the distributing station at Maiden Lane. This is the section which will be ready to supply some twenty thousand glow lamps of ten candle power each on the 1st October.' (Ferranti's 'insulating substance' consisted of layers of chemically pure brown paper, saturated with melted earth-wax; the 'protecting tube of iron' was added after the initial design stage.)

That newspaper may have told the story: but it didn't recount the whole story! The power company knew that the cable-laying would involve having to break up some streets, involving all the delays and expense of obtaining statutory powers. To reduce the need for this, agreement was reached with three railway companies by which the mains were to be laid on the surface along railway tracks and across the bridges to the Charing Cross, Cannon Street and Blackfriars stations. A similar agreement with the Metropolitan and District Underground Railway enabled their tunnels to be used to get the cables to the main distribution points.

That was all very well: but the Board of Trade, responsible for ensuring the public safety of electricity supply, was more than sceptical whether Ferranti had provided an effective means of earthing a 10,000 volt current in the event of mishap. He promptly invited them to witness a highly unusual demonstration. Harold Kolle, who had left his previous post of

Electrical Engineer at Eastbourne to join him, volunteered to hold a cold chisel while another assistant drove it through a live main! Both remained completely unscathed. But even though permission to proceed was given, the job of cable laying had its more interesting moments.

At first, the junction between each of the 20 ft cable lengths had been filled with black wax forced in under pressure: until a pump burst and splattered a newly varnished shop-front with wax, and a new jointing method had to be hastily devised. Then there was the time when a navvies foreman decided that a cast-iron pipe they had uncovered must be one of the many London street pipes no longer in use: until they cut into it and a huge jet of water shot high over the neighbouring roofs. Sacks of stones and wheelbarrows hastily piled on top did no good at all, and the deluge continued until an official hastily summoned from the water company could find the valve and turn if off. 'There was a terrible mess - - - - and the most terrible row!'

Yet in spite of everything the cables were laid, and out of 8,000 joints only 15 proved faulty. It was an impressive achievement. Some of those cables were to remain in regular service until 1933, only being replaced then because of the need to provide greater compatibility in the cable system. Under the heading 'Sic Transit! End of the Famous 10,000 volt Ferranti Cables of Glorious Memory' the *Electrical Times* commemorated the forty-five years' history of 'the first paper-insulated concentrics ever made, and the forerunners of those that we know today'. As they said, 'It is a wonderful record'.

Disappointment and Disaster

Yet even while Ferranti had been working on the design of the high voltage cables, a massive blow had been dealt to his plans for a really effective and economical supply of electricity to London from the Deptford station; and ironically, this arose from the commonplace need to lay the low voltage distribution cables in the streets.

LESCo had made a wholesale application for the necessary statutory authority covering streets within the boundaries of 24 local authorities; something quite unprecedented in sheer scale for laying electricity cables, which happened to coincide with a number of smaller applications from other companies. The Board of Trade promptly ordered a local enquiry. For them, this was an opportunity to regulate a whole sphere of operations of electricity supply undertakings by laying down principles under which powers to break up streets would be granted - as well as a chance of examining the whole scope of the revolutionary Deptford proposals.

To Ferranti, the effects of the inquiry under Major Marindin were nothing less than catastrophic. Under pressure of the argument that the concentration of four 10,000 hp units at Deptford would constitute a risk of maintaining a reliable electricity supply, the LESCo Directors agreed to put two of the units in a station to be built elsewhere. Worse, Deptford's proposed area of supply was halved. And, in the area still left, Ferranti could foresee the likely effect of the general principle adopted as a result of the inquiry: that while a local authority might allow two companies to compete within its area, they should not both supply alternating current, a measure tacitly encouraging the further growth of local low-tension stations. As he explained in a letter written some years later:

"Failure to maintain our position at the Government inquiry entirely killed the scheme. Our area was greatly reduced, but worse than this, we had competition from local stations arranged for in every part of our area ... naturally with a new system on the scale we were operating, it was very difficult to compete right away with the small low-tension stations dotted all over our area as, of course, we had great technical difficulties to deal with at the start, and the small low-tension stations had very little new to contend with".

That was still for the future. At the time, in spite of his feelings about the result of the inquiry, Ferranti was keeping up the pressure to bring the station into operation. By November 1889 the first generating unit was brought into service; and although this was only a 1,250 hp machine, it was more than capable of providing all the electricity supplies that would be required until the original mains cables could be replaced by the 10,000 volt cables he had designed. A few months later he was reporting that two of the 10,000 hp engines had been completed in manufacturer's works, the 10,000 volt alternators were in an advanced state and soon the whole of that major generating capacity would be at the company's disposal.

Even those plans were never to be realised, destroyed as the result of one man's simple error. It happened on 15th November 1890, while the engine room machinery at the Grosvenor Gallery was being dismantled and the electricity supply to customers was being provided by incoming supplies from Deptford. An operator at the Gallery was bringing a fresh set of transformers into service when he mishandled a switch and started a 5,000 volt electrical arc. He must have momentarily lost his head; instead of cutting off the current, he allowed the arc to continue, starting a fire which swept

through the whole of the station. It was a major set-back, doubly unfortunate because the extent of the damage was due to a temporary rearrangement of plant while Deptford was taking over responsibility for generation; but worse was to follow.

Everyone rose to the occasion. By a superhuman effort, supplies to customers were restored within a fortnight by repairing some of the less badly damaged transformers and getting hold of some new ones. Then only a week later one of the repaired transformers failed, throwing its electrical load onto the others; and as they were already carrying as much current as they could safely, they burned out one after the other. As the Directors weren't confident that the Deptford station was really ready to carry the full load, they decided to cease all attempts to give any supply until this could be done reliably.

The shut-down lasted three months, and none of that time was wasted. The overhead lines from the Grosvenor Gallery were replaced with 24 cables, while at the same time the 10,000 volt cables from Deptford to central London were completed. But by then the damage was done. Many customers had deserted the company, and the number of lamps connected to the system had dwindled from 38,000 to 9,000. It's not surprising that the LESCo Directors were worried men, finding it difficult to maintain faith in Ferranti's bold concept. The company had lost a lot of money. The hopes of achieving large scale supplies of electricity to London seemed to be vanishing before their eyes, while many of the most eminent men in the field were still insisting that the future of electricity lay with much smaller low-tension stations.

Ferranti had his supporters of his scheme, which history would eventually prove right. It was quite another matter for the Company's Directors in that May of 1891. They could see that the two 400 kilowatt alternators transferred to Deptford from the Grosvenor Gallery were more than sufficient to meet all requirements at that time: and soon the two original 1,250 hp units would be back in service after their alternators had been rewound to raise their voltage to 10,000 volts. What need for the immense 10,000 hp machines originally planned and awaiting installation? The wrath of LESCo Chairman J S Forbes descended on the young engineer: 'Ye're a very clever man, Mr. Ferranti, but I'm thinking ye're sadly lacking in prevision'. The order for the machines was cancelled. For Ferranti, that must have spelt the end of his vision of Deptford as a station capable of meeting much of London's increasing demand for electricity with the economic benefits of large-scale generation. As he was to comment later, 'Not long after these events occurred, all the in-town stations were in such trouble from one cause or another that they were looking for supply from outside. If Deptford had been continued on its right lines, it would have been able to furnish current wholesale for distribution by other companies.' As it was, he left the Company in the August of 1891 to resume his manufacturing career.

However even with Ferranti gone, Deptford was back in service by August 1891. The Company's old customers were returning as fast as they could be reconnected. But by November of that year, the system had collapsed again. They soldiered on for a few more years until in 1900, it was decided to shutdown for 6 months in order to replace both cables and plant. From then on the Deptford Station went from strength to strength, culminating in a further power station being built alongside, called "Deptford West" and being commissioned in 1929. Deptford East as the old station became known was rejuvenated in 1953 when an extension was built to accommodate an HP station, known as Deptford East HP. Generation ceased on site finally in 1983.

Fig.3 Massive Ferranti Alternator