

ENGINEERS AUSTRALIA

Western Australia Division



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NOMINATION OF

EAST PERTH POWER STATION

FOR AN

ENGINEERING HERITAGE NATIONAL MARKER (EHNM)



PREPARED BY ENGINEERING HERITAGE WESTERN AUSTRALIA

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Cover image: Aerial view of East Perth Power Station circa 2000 courtesy of DevelopmentWA.
<https://developmentwa.com.au/projects/residential/east-perth-power-station/overview>

1. **GENERAL**

Name of Item:	East Perth Power Station
Description of Item:	Early example of a coal fired power station based on turboalternators arranged in the independent unit principle.
Engineering Heritage theme(s):	Electric Power Generation
State/Territory Heritage listing:	Western Australia
Type of heritage:	Immovable Tangible
Relevant Dates:	'A' Station (Units 1-5): Construction started 1914; First unit in service 1916; Last unit (5) started service 1927; Last unit retired 1955. 'B' Station (Unit 6): Construction Started 1935/36, In service 1938; Retired 1981. 40/50 Hz frequency changer: Construction Started 1950, In service 1951. 'C' Station (unit 7): Construction Started 1954, In service 1956; Retired 1981.
Location:	Summers Street, East Perth
Coordinates (if known)	31°56'46"S, 115°52'49"E
Local Government Area:	City of Vincent
Owner:	DevelopmentWA. Government of Western Australia
Marker Type sought:	Engineering Heritage National Marker

2. **SUMMARY**

The thermal electric power generation plant to be found at East Perth Power Station is unique within Australia and a rarity around the globe.

Because of its numerous engineering features still in their original locations it deserves a prominent place amongst the coal fired power stations of Australia.

Some of the key features are listed below.

- The power station marked the first entry of a State Government¹ in Australia to undertake responsibility for an electricity supply servicing the public as well as state government organs.
- It was the first coal fired power station in Australia based on turboalternators arranged in the independent unit principle, developed by the world renowned power station expert of the early 20th century, Mr Charles Merz.
- It still houses the largest 40/50 Hz frequency changer in Australia.
- It is one of a small number of existing decommissioned power stations in Australia with a State Heritage Registration of the complete power station building.
- It is the only decommissioned Power Station in Australia which houses turboalternators dating from earlier than the 1950's.
- The power station building has been maintained in good condition and provides a fine example of Georgian industrial architecture.

¹ The ACT's Kingston Power Station was the first to provide this service but it was owned by the Federal Government. It commenced commercial operations in August 1915.

3. HISTORICAL BACKGROUND

Electric power stations emerged as an essential component of industrialised societies in the late 19th century. They revolutionized manufacturing, transport, lighting and many other facets of life.

The Direct Current (DC) technology available at the beginning constrained the delivery of power such that in central city areas, power houses needed to be relatively closely spaced to avoid excessive voltage drop at the load centers.

The critical development in overcoming this constraint was the introduction of Alternating Current (AC) power. Inspired by the genius of Nicola Tesla and commercialized by George Westinghouse, AC was to become the preferred form of power generation. This was only after long and intense competition between proponents of the newer AC and the proponents of the older DC systems.

Another invention that was to underpin the superiority of AC was the transformer. Invented by Hungarian electrical engineer Bláthy in 1884, the transformer overcame the unavoidable voltage drop problem encountered when distributing DC power.

Whilst the battle raged between the two types of electric current, a less conspicuous revolution was taking place. The type of engine needed for the conversion of the energy stored in steam into mechanical rotation was changing. Initially, steam power stations employed slow speed reciprocating engines for this conversion. The steam turbine invented by British engineer, C. A. Parsons, was first used commercially to generate AC power in North East England in 1890. The combined turbine and AC generator was named a 'turboalternator' and by 1910 was established as the dominant type of engine for electric power generation.

A less conspicuous revolution accompanied the flourishing turboalternator technology. In 1914 Charles Merz's first power station employing turboalternators laid out on the independent unit principle commenced operation at Newcastle-upon-Tyne, England.

Under the independent unit principle, the aim is to maximise the use of auxiliary plant items dedicated to a given turboalternator and to minimise the number of plant items servicing groups of turboalternators. Each turboalternator and its dedicated auxiliary plant forms one "unit." Once running normally, electrical power for each unit is provided by a "Unit Auxiliary transformer" and "Unit switchboard." The provision of "Station" transformers and Station switchboards for use during outages of the Unit electrical supply system provides an alternative to the Unit supplies. This power station design principle improves operation, maintenance and fault finding resulting in greatly increased reliability. It was quickly adopted throughout the world and remains the universally adopted pattern of design.

East Perth Power Station provides an intact example of one of the earliest power stations constructed along these lines.

4. DESCRIPTION

East Perth power station is unique among national and international power stations as it stands on a floating concrete raft set on top of approximately 1,300 Jarrah piles. Jarrah, or *Eucalyptus marginata*, is a hardwood that occurs naturally only in the south-western forests of Western Australia. It is renowned for its strength and durability.

The original power station building was built in the Georgian architectural style, characterised by symmetry, classic proportions, and simple elegance. This was economically achieved at East Perth by constructing a steel framed building with an expended metal mesh covering. The concrete render applied to all external surfaces gave the impression of a commanding stone or brick edifice. The building is well exhibited on the cover and in Figure 17 on page 37.

The subsequent 'B' station development replicated the same style as shown in Figure 25 on page 43 and Figure 26 on page 43. The 'C' station development required no significant external building work.

To facilitate a planned frequency conversion from 40 Hz current to 50 Hz current, a frequency changer was commissioned at the power station in 1951. It consisted of two synchronous machines, each with a capacity of 25 MW making it the largest pair of electric motors in the southern hemisphere.

No other power station in Australia houses a comparable range of power generation plant. At the time of writing the following items of major plant remain inside the power station building:

- 'A' station: 40 cycles per second (Hz) 7.5 MW turboalternator
- 'A' station: two 40 cycles per second (Hz) 12.5 turboalternator
- 'B' station: a single 25 Megawatt 40 Hz turboalternator
- 'C' station: a single 30 Megawatt 50 Hz turboalternator
- The 40 Hz/50 Hz 25 Megawatt frequency converter &
- A long row of 2 inch thick polished slate switch boards dating from 1916.

5. OWNER'S LETTER OF SUPPORT
TO BE ADDED

6. **SIGNIFICANCE**

East Perth Power Station was the first power station in an Australian State capital city established to provide power for use by Government instrumentalities and the general public.

It also provides a unique example of an early thermal power station laid out in the enduring 'independent unit principle.'

Its place in the chronology of early Australian coal fired power stations is exhibited in Table 1 below.

Table 1: Early Australian Thermal Power Stations

Location	First Year of Power Station Operation	First Year of Turboalternator Operation	Last Year of Power Station Operation
Richmond, Melbourne	1891	1905 (Note 1)	1982 (Note 2)
Ultimo, Sydney	1899	1905 (Note 1)	1963
Grenfell, Adelaide	1901	1914 (Note 1)	1925
Balmain, Sydney	1909	1913 (Note 1)	1998 (Note 3)
Kingston, Canberra	1915	1927 (Note 1)	1957
East Perth, Perth	1916	1916	1981 (Note 4)
White Bay, Sydney	1917	1917 (Note 1)	1958 (Note 5)
Newport, Melbourne	1918	1918	NA (Note 6)
Note 1: Turboalternator installed but without adoption of the independent unit principle. Note 2: All original machinery was decommissioned by 1930. Note 3: All original low pressure steam machinery was decommissioned by 1970. Note 4: The original 'A' Station was decommissioned in 1959. Note 5: The first stage of the station was decommissioned in 1944. Note 6: Newport's gas fired thermal generation, 'D' Station, commenced operation circa 1980 and remains in service at the time of writing. The de-commissioning date of the original 'A' Station is unknown.			

Australian State Heritage Registered Thermal Power Stations are listed in Table 2 below. The table provides original details of ownership and the purposes for which the stations were built.

Table 2: Australian State Heritage Register Information

Location	Heritage Registered	Significance
Richmond, Melbourne	State Register 1988	Privately owned power station. The remnant turbine hall has been converted to office space. No existent machinery at the site.
Ultimo, Sydney	State Register 2020	Government owned power station erected for supplying traction power to tramways. Now houses Sydney's Powerhouse Museum. No existent machinery at the site.
Grenfell Street, Adelaide	State Register 1985	Privately owned power station. The building now houses the Tandanya National Aboriginal Cultural Institute. No existent machinery at the site.
Balmain, Sydney	State Register 2003	Privately owned power station. No existent machinery at the site which is now occupied by residential properties.
Kingston, Canberra	ACT Register 2000	The nation's first Government owned power station to directly supply electricity to the general public. No existent machinery at the site which is now occupied by the Canberra Glassworks.
East Perth, Perth	State Register 2005	The nation's first State Government owned power station providing power for both Government and public consumption. Turboalternators dating from 1922, 1927, 1938 & 1956, unique frequency changer, cellular switchgear and original power station buildings.
White Bay, Sydney	State Register 1999	Government owned power station erected for supplying traction power to Sydney's railways and tramways. Remediation and conservation work has been completed at the site which houses a Parsons 50 MW turboalternator dating from the 1950's, a 1949 control room and original power station buildings.

6.1 Historical and Social Significance

(a) Importance in the course, or pattern, of the region's history

At the start of the 20th century the Perth region was dependent on several unreliable electric power stations for power, tramways and lighting.

The largest of the power stations belonged to private companies, the Perth Gas Company and the Perth Electric Tramways. These stations, and their associated power distribution systems, had been starved of investment for several years in anticipation of buyouts by either local or state governments.

In December of 1912, the Western Australian Government entered a verbal agreement with the City of Perth promising to build a new power station from which it would deliver electric power to the city for resale to all consumers within a 5 mile radius of the GPO. This new power station would also generate power for the tramways which were soon to be under the control of the state government.

East Perth was an ideal location for the new station. The selected site was close to a railway for coal deliveries from Collie and the Swan River for cooling water. Coal and water would be needed in great amounts to meet the needs of the proposed power station.

Civil works commenced in 1914. Thereafter, progress was slow because the hostilities in Europe disrupted deliveries of electrical and mechanical plant.

The first export of power was in 1916. Until the commissioning of the South Fremantle power station in 1951, East Perth Power Station was the primary source of electric power for Perth, Fremantle, Midland Junction and environs.

(b) Strong or special association with the life or works of a person, or group of persons, of importance in a region's history

East Perth Power Station featured prominently in the lives of the Aboriginals and migrants who made East Perth their home principally due to this being an inner city location with affordable accommodation.

For adult males, shoveling coal at the power station was one of the main casual work activities available in the area. One activity was emptying the railway wagons in which coal was delivered to the power station as described under heading 6.2(c) 2 below. Another shoveling operation, was keeping the chain bucket coal elevator free from fouling on the ever growing mound of coal that formed from coal spilling from the buckets. This task was carried out in a pit beneath the elevator where the thick black dust limited vision to one metre or less.

In the years after World War II, the work force engaged in this casual unskilled labour was swelled by arrivals of migrants from Europe, in particular, the southern and eastern parts.

For the younger folk of the area, the power station provided a far more pleasant experience. Cooling water from the station's condensers was piped into the Swan River where children could jump in and be carried downstream in a pleasant current of warm water.

William Henry Taylor:

From the time of his arrival in 1914 until his retirement in 1948, the name of William Henry Taylor was synonymous with East Perth Power Station. Previously the deputy General Manager of the Walthamstow Electric Supply and Tramways company, he had the type of experience that would be needed to guide the development of the new power station, the tramways and all other aspects of the electricity supply undertaking. Recommended for the post by Merz & McLellan, he was subsequently appointed to the role of General Manager, Western Australian Government Electricity Supply and Tramways.

Given Western Australia's extreme isolation from the national and international centers of engineering excellence Taylor was the ideal candidate for this role.

Taylor was a polymath whose abilities spanned all the technical disciplines required for the thermal generation of electric power. These extended beyond electrical and mechanical engineering that would be expected in such a role to encompass geology, chemistry, thermodynamics, metallurgy and economics.

His business acumen was demonstrated by his ability to run the undertaking despite a large percentage of the station's output being sold to the Perth City Council at less than the cost of generation.

With great exertions to educate to the hierarchy of the WAGR he was able to secure the investments in generating plant that enabled the power station to keep up with rising demand throughout the years of the WAGR's responsibility for the power station.

It was common knowledge amongst senior staff at the power station that the removal of his name was removed from the power station's commemorative plaque as a deliberate act of professional jealousy by one of his successors. The plaque, shown in Figure 52 on page 68, clearly shows the area from which the wording was etched out.

(c) Potential to yield information that will contribute to an understanding of the region's history

At the time of its construction, the Power Station was just one of a plethora of industries in the locality.

When it closed in 1981, it was one of the few remaining industries in the area. At the time of writing it is the only surviving example, all other examples having been demolished or completely obscured under subsequent development.

The East Perth Power Station building stands as a monument to the suburb's vibrant industrial past upon which much of the growth of Perth, and in turn the State of Western Australia, depended.

Existent 'A' and 'B' station turboalternators are shown in Figure 47 on page 63.

The existing 'C' station turboalternator is shown in Figure 48 on page 64 and Figure 49 on page 65.

6.2 Engineering and Technical Significance

(a) Creative and Technical Achievement

The East Perth Power Station building consisted of matching boiler house and turbine hall, producing a beautiful combination of form and function.

For economy and strength, the building is steel framed but for aesthetics it had a concrete facing applied over expanded metal mesh.

Cathedral-like in its size and elegant in its geometry, the edifice presents magnificent views from the Swan River and the Windan Bridge (parallel to the alignment of the former 'Bunbury' Railway Bridge).

The fine lines and symmetry which characterise its outward appearance serve as symbols of the method, order and logic that are the hallmarks of the machinery within.

(b) Demonstrating the principal characteristics of an aspect of the development of engineering practice

1. Independent Unit principle

The Independent Unit Principle was invented by Charles Merz, an electrical engineer from North East England considered to be one of the world's most influential people in power station design. This principle divides generating plant into distinct and separate systems, each of which can be run entirely independently of the others. Thus, a failure in one generating unit is confined to that unit, leaving the remaining units unaffected. This improves the overall reliability of the power station.

This principle has been standard design practice for thermal power stations throughout the 20th century and into the 21st century.

2. Merz Price Differential Protection

Developed in 1904, this protection was applied to all of the alternators installed at the power station. Up to present times, it remains one of the most common types of protection applied to both synchronous machines (e.g. turboalternators) and substation busbars.

The major benefits of this type of protection are:

- Its speed of operation and
- Its ability to protect precisely defined zones while being immune to faults outside of the protected zone.

3. Condenser Technology

The first three turboalternators in 'A' station relied on costly multi-stage air pumps to draw and maintain the condenser vacuum needed for normal turbine operation. Because the air pumps were powered by electric motors, any black starts incurred an extra 20 minute delay to bypass the air pumps.

Turboalternators 4 and 5 were supplied with steam jet ejectors which relied on the Venturi effect to draw the condenser vacuum. These did not need manual air vent valve operation making for much faster black starting times.

The station provides an excellent record on the progression of condensing turbine technology.

4. Power Station Control

Early images of the turbine hall such as Figure 12 on page 33 and Figure 13 on page 34 show the power station controller's desk. It occupied a small space between the row of turboalternators and the station's 6,000 V switchboard that occupied the eastern wall of the turbine hall.

The use of communication technology was demonstrated by the following installations:

- the mechanical 'ship's telegraphs linking the controller's desk and each pair of boilers. These allowed the power station controller to communicate steam requirements to the boiler crews in the same way in which the officers on the bridge of an ocean liner of the day would have done.
- telephone lines between the controller's desk and the unit attendants' stations located at each of the condensers beneath the turbine house floor.

Synchronisation was another key duty of the power station controllers. To run an alternator in parallel with other alternators requires that phase and frequency be in synchronism prior to connecting the incoming alternator.

The invention of an analogue measuring instrument referred to as a synchroscope eliminated earlier crude synchronising methods by providing clear indications of voltage and differential frequency. Guided by the synchroscope display, an operator could select appropriate 'raise' or 'lower' commands and finally close the circuit breaker on an incoming alternator to provide a 'bumpless' transition. For the sake of visibility at long range, synchroscopes were usually quite large.

East Perth's turbine Hall was equipped with a pair of ornate synchroscopes suspended overhead in front of the row of high voltage switch panels. As exhibited in Figure 5 on page 29 one was the north and the other one south of the control desk so that operators had a clear view of the instrument no matter which circuit breaker panel they were preparing to switch.

The principle of operation of the synchroscope has not changed in over a century of power station operations.

In 1928, as part of the ultimate development of 'A' Station, the control of the power station was relocated from the turbine hall floor to a dedicated control room. An image of this room dated 1938 showing the synchroscope that replaced the original pair forms Figure 27 on page 44.

5. High Voltage Switchgear

Power stations require high voltage (HV) switchgear to control the flow of electrical power in a safe and orderly manner. In East Perth's 'A' and 'B' Stations this consisted of a long row of 2 inch thick polished slate switch panels formed into a 6,000 Volt switchboard that lined the eastern wall of the turbine hall.

In essence the function of the switchboard was to collect the output of the turboalternators and distribute it to the following locations:

- The underground cable system that supplied the local area at 6,000 V
- The step up transformers supplying the 20,000 Volt overhead lines that supplied the outlying areas
- The rotary converters supplying the tramways &
- The Station transformers that supplied the various power station loads.

The station's 6,000 Volt switchboard was constructed in the 'cellular' pattern. This entailed the physical separation of circuit components onto four separate floors commencing at a base level and working up as follows:

- Base level: cable terminations, circuit earthing switch and disconnect switch
- Level 1: circuit breaker
- Level 2: a pair of busbar selector switches
- Top level: a pair of duplicate busbars which ran the entire length of the switchboard.

This structure can vaguely be discerned in the yellow highlighted segment of Figure 35 on page 51. The operationally accessible slate panel is shown highlighted in blue and the circuit breaker's remote operator handle indicated by the violet arrow.

The 'cellular' pattern was rendered obsolete by the advent of metalclad switchgear, such as the type installed at the power station in 1922 for service in the 20,000 Volt supply network.

A recent image showing the slate switch panels forms Figure 41 on page 57.

(c) Uncommon or rare aspects of the development of engineering practice

1. Merz Hunter cable ring main protection

In addition to overload protection, the 6,000 V feeder cables supplying the city ring main cable system were protected by the Merz Hunter split conductor protection system. The term 'split conductor' stems from the requisite cable construction of 2 conductors per phase (making six conductors in total for a three phase system.) This type of protection was invented by P. V. Hunter in 1911.

Unlike Merz Price protection which is in wide and continuing use throughout the electric power industry, Merz Hunter protection proved unsuccessful. Its basic premise of operation was that on any one of the three phases supplying power, the current would be shared equally by that phase's two conductors. In practice, this was rarely the case and unbalance from faults or any unusually large currents caused nuisance tripping and unnecessary disconnection of customers.

2. Manual Coal Handling

At the start of its operational life while under the administration of the Western Australian Government Railways (WAGR) the expectation was that coal handling would be entirely mechanized without the need for any manual handling. Bottom dump rail wagons were provided by the WAGR for transporting coal to the power station siding where it was dumped into larger hoppers below the tracks.

At a time which has not been documented, probably around the time of the formation of the State Electricity Commission on 30 June 1946, the WAGR decided to recall these wagons for exclusive WAGR use. Thereafter, coal was delivered in wooden sided rail trucks fitted with side opening gates. A certain amount of coal would empty under gravity but most of it needed to be manually shoveled from the wagons into the bunkers below. This required a team of five men, sometimes more, with four shoveling and the remainder resting. Any more than five was considered a bonus as it afforded more rest time for the workers.

This practice persisted until 1955 when a powered rail truck tippler was commissioned. Figure 32 on page 49 shows a coal train with one of its coal trucks being emptied by the tippler.

Manual intervention was also required inside the boiler house. Above each of the boilers was a coal bunker capable of storing up to 50 tons of coal. Coal was fed through a chute at the bottom of the bunker onto a chain grate or retort stoker for combustion inside the boiler. A bunker attendant was employed to monitor the level of coal in each bunker. Sometimes coal adhering to the sides of a bunker interrupted the flow to the boilers and the practice was to jump into the bunker to loosen the stuck coal. On one night shift in 1929, casual labourer Harold Scott was working alone as a bunker attendant. During the next day shift a blockage was reported in the No 7 bunker. On investigation, Harold's body was found in the bunker suffocated under 35 tons of coal.

In response, management instituted a policy whereby a minimum of two workers would have to be in attendance if anyone entered a coal bunker.

The location of the bunkers within the original boiler house building are marked in red highlight in Figure 35 on page 51.

(d) Yielding new or further substantial scientific and/or archaeological information; and/or is an important benchmark or reference site or type

The major plant items remaining inside the power station building are discussed below.

1. 40 Hz 7.5 MW Turbo-Alternator Set No. 4.

This Parsons set commenced operation in 1922. It had two advantages over the original Willans & Robinson sets. It used more accurate fully enclosed oil relay governors and steam ejectors which enabled the condenser vacuum to be maintained in the absence of electricity supplies.

The set is visible in Figure 16 on page 37 and Figure 45 on page 61 and in the background of Figure 12 on page 33.

2. 40 Hz 12.5 MW Turbo-Alternator Set No. 5.

This Parsons set commenced operation in 1928. Within this turbine steam was expanded in two stages, that is in a high pressure and a low pressure cylinder. This was more efficient than the existing turbines which had only one cylinder each. This set was the last to be installed in 'A' station.

After the final expansion of its boiler house, the 'A' station comprised:

- 10 boilers rated in aggregate at 290,000 pounds of steam per hour at an outlet pressure of 210 PSI, and
- 5 turboalternators with a combined rated output of 32 MW.

The set is visible in the background in Figure 21 on page 41.

3. 40 Hz 25 MW Turbo Alternator Set No. 6

This set, another Parsons machine, was the one and only 'B' station turboalternator. It was in operation from 1938 to 1981.

The set is visible in the background in Figure 28 on page 45.

4. 40 Hz/50 Hz Frequency Changer

In 1944, a decision was made to abandon the power station's 40 Hertz system in favour of a 50 Hertz system.

To enable compatibility between the new and old frequencies, a frequency changer was ordered for East Perth. Commencing operation in 1951, it consisted essentially of two large synchronous machines capable of the following tasks:-

- 1) converting 50 Hertz current to 40 Hertz,
- 2) converting 40 Hertz current to 50 Hertz, and
- 3) correcting power factor (a key parameter in the efficient transmission of AC power.)

5. 50 Hz 30 MW Turbo Alternator Set No. 7

This Parsons machine was the one and only 'C' station turboalternator. It was in operation from 1956 to 1981.

The set is visible in the background in Figure 28 on page 45 and in its present condition in Figure 34 on page 50.

7. SUMMARY STATEMENT OF SIGNIFICANCE

East Perth Power Station is recognised as one of the oldest and best preserved examples of an Australian power station built to provide electricity for tramway traction, general power applications and lighting. Surviving machinery still occupying original locations within the power house include:

- 7.5 MW 40 Hz Turbo-Alternator Set No. 4 (1922) [visible in the background in Figure 12]
- 12.5 MW 40 Hz Turbo-Alternator Set No. 5 (1928)
- 25 MW 40 Hz Turbo-Alternator Set No. 6 (1938)
- 31.25 MVA (25 MW) 40/50 Hz Frequency Converter (1951)
- 30 MW 50 Hz Turbo-Alternator Set No. 7 (1956).

In addition to the above, there is an abundance of surviving mechanical and electrical auxiliary plant items on site.

As identified in Table 2 on page 9, no other steam powered electric generation site in Australia has anywhere near the range of machinery that is still in place inside the East Perth Power Station.

The power station needs to be nationally recognised as a forerunner of the coal fired power stations that were to follow in Australia. It also deserves recognition for the significant contributions it has made to the State of Western Australia and to the people who have lived near it or relied on it for their livelihood.

The plant and machinery remaining at the site are key components of an early coal fired power station built on the independent unit principle. With appropriate interpretation, the site can afford future generations with the understanding of how the burning of fossil fuels, the raising of steam and the conversion to electricity was achieved.

8. HISTORY

THE ORIGINS OF THE POWER STATION

In late 1912 there was a diversity of power stations in the Midland/Perth/Fremantle area with most stations operating independently and producing different types of current at different voltages. Some were owned by local government, some by state government and others by private industries. At that time, only local government was generating power for sale to the public.

The Western Australian Government would be taking ownership of the Perth Electric Tramways on 1 July 1913. It was clear that it was to inherit a run-down power station of inadequate capacity for proper running of the system. In a similar set of circumstances, the Perth City Council had acquired several power stations after completing its purchase of the Perth Gas Company on 14th February 1912.

Both organisations had separately sort expert opinions on how to provide a suitable future electric power supply. In December 1912, in a submission to the State Government the engineering consultants, Merz & McLellan, recommended that a new power station be built to serve the tramway network and to supply current to the Perth City Council. In subsequent policy discussions, it was agreed that the Council would have the right to on-sell power to any consumers located within a 5 mile radius of the Perth GPO and the State Government the right to supply consumers beyond a 5 mile radius.

The Western Australian Government who would own and operate the power station chose to site it at East Perth.

INITIAL CONSTRUCTION

During the initial discussions with Merz & McLellan it was agreed that the new power station would generate at fifty Hertz (Hz). For reasons that have never been made clear, when the specifications for the station were written forty Hertz plant was stipulated.

The successful tenderers for the main items of power plant were:-

- Babcock and Wilcox for the power station building, boilers, pipework and overhead crane. The crane still exists and is shown in Figure 50 and Figure 51.
- Willans and Robinson for the turbo-alternators, condensers, air pumps, circulation water pumps and air exhausters .
- Allegemeine Electricitats Gesellschaft (A.E.G.) for the transformers, motors and 20,000 V switchgear. With the onset of the 1914-1918 , tenders were recalled with the successful tenderer being British Westinghouse. An image of the 20,000 V switchgear installed in 1922 is shown in Figure 19 and the associated remote control panels in Figure 20.
- Callenders Cable and Construction Company for the supply and jointing of cables.
- British Westinghouse for the two 750 kilowatt rotary converters shown in Figure 8 on page 31.
These converters took the AC current and converted it to 600 V DC for tramways use. They allowed for the retirement of the old tramways power station in January 1917.

Work on the site for the new power station commenced in September of 1913 and by April of 1914 more than 1300 jarrah piles had been driven. [see Figure 1]

In May of 1914, the erection of the steel frame of the power station building commenced under the supervision of William Henry Taylor. [see Figure 2 to Figure 4] Taylor was the former Deputy Electrical and Tramways Engineer to Walthamstow Council in England.

The steam turbines, each rated at 4 MW (4,000 kilowatts) were built by Willans and Robinson of Rugby, England. Brown Boveri of Switzerland built the alternators. They each had a continuous rating of 4,412 kilovolt-amperes (kVA) and a half hour rating of 5,300 kVA. These ratings were adequate for 4 MW at 0.9 power factor continuous output or 4 MW at 0.75 power factor for 30 minutes.

The nameplate of TA3 is exhibited in Figure 7.

The initial development of the 'A' station turbine hall is shown in Figure 5.

‘A’ STATION

The first commercial generation took place on 3rd December 1916.

Coal consumption at 'A' station was in the order of four pounds of Collie coal for each kilowatt-hour of electricity produced. The older stations that it replaced used approximately thirteen pounds of the same type of coal for the same output. This improvement in efficiency resulted from improved coal burning techniques; the use of turbines which could convert energy more efficiently than reciprocating engines; and from raising the steam to greater temperatures and pressures, which enabled a greater percentage of its stored energy to be converted to useful work.

In 1922, the original 20,000 V switchgear contract was completed by Metropolitan Vickers, the company which took over British Westinghouse. At the time, their high voltage switchgear was considered superior to all others in the electrical world. Rather than requiring a built structure four stories in height, a single switch was less than 8 feet high with a width of not more than 4 feet. These dimensions permitted the installation of a suite of 8 switches in the inconspicuous fibro-cement shed shown in Figure 9. This switchgear formed a key part of the supply network to the more remote load centers such as Midland and Fremantle. Note that the 6,000 V switchgear installed within the power station building was not part of this contract and was supplied at the same time as the power generation plant.

In 1924 Western Australia's first electric train went into service. A Metropolitan Vickers electric locomotive was commissioned to fetch coal from the adjoining railway yards and take away ash-filled rail wagons. It replaced steam locomotives which attracted costly demurrage charges. Power for the new locomotive was derived from the 600 volt Tramways switchboard. It remained in service until 1969. After retirement, it was taken to the Australian Railways Historical Society's Museum, at Bassendean, Western Australia where it remains displayed today.

At the height of its development, the 'A' station power output averaged 1 kilowatt hour for 3 pounds of coal.

By early 1959 'A' station had retired.

‘B’ STATION

The 'B' station consisted of three boilers (11, 12 and 13) and one turbo-alternator, installed between 1935 and 1938, plus an additional boiler (14) commissioned in 1955. The thermal efficiency of 'B' station was nearly 3 times that of 'A' station. This improvement was mainly achieved by burning pulverized coal, which enabled steam to be raised to a temperature of 815 degrees Fahrenheit and a pressure of 625 pounds per square inch.

C A Parsons supplied the 25 MW, number 6, turbo-alternator. It was the last forty Hertz set to be installed at East Perth. The 'B' station boilers, supplied by International Combustion Limited, were each rated to evaporate 125,000 pounds of water per hour. An image of this set forms Figure 28.

Pulverized coal was produced by two Lopulco coal mills per boiler. Each mill could reduce eight tons of lump coal per hour. Each boiler was fitted with a Lodge Cottrell electrostatic precipitator to clean the flue gases of fly ash.

By 1941, the overall station power output averaged 1 kilowatt hour for 2.02 pounds of coal.

In 1955 the fitting of oil burners to the 'B' station boilers allowed firing on either coal or oil. Oil firing did not occur at significant levels until the 1960's when oil prices were in parity with coal prices.

THE FREQUENCY CHANGER

When the new turboalternators for South Fremantle were ordered from Metropolitan Vickers the contract included the supply of a frequency changer for East Perth. This machine converted power from 40 Hz to 50 Hz and vice versa. It was required as part of a frequency conversion of the entire metropolitan electric power system to 50 Hz in line with the rest of Australia.

Commencing service in 1951, the frequency changer initially provided the 50 Hz power needed for the commissioning of the new South Fremantle power station. Its ultimate use enabled the continued operation of 'B' Station by converting the 40 Hz output of Unit No 6 to the 50 Hz required for consumer use.

Metropolitan Vickers also supplied 6,300 volt metalclad switchgear for coupling the alternating current machines to their respective bus bars. The frequency changer and its switchgear were housed in a building erected a short distance from the northern end of the turbine hall.

An image of this set forms Figure 30 on page 47 and its associated switchgear forms Figure 31 on page 48.

'C' STATION

The 'C' station consisted of the turbo-alternator shown in Figure 34 on page 50 and boiler No 15 shown in Figure 33 on page 50.

No. 7 turbo-alternator, a Parsons 30 MW set, was commissioned in 1956. The principle difference between it and the existing TA No 6 was its frequency, 50 Hertz. A secondary difference was the voltage at which it generated, 22,000 volts.

With 'C' station came new coal handling equipment including a coal wagon tippler which commenced service in December 1955. This put an end to the manual emptying of coal trucks.

THE RETIREMENT OF THE POWER STATION

From its operational peak in 1951 when 266 GW hour was generated, station generation diminished to as little as 2.1 GW hour in 1974. This could have meant the end of its life but for the oil price shocks of 1973 and 1974.

By the end of 1974 the power station's coal handling, processing and firing plant was fully operational and between then and its retirement in December of 1981 a further 1,039 GW hour was generated.

After retirement, the station remained connected to the power grid so that the frequency changer could be on immediate standby to stabilize system voltage.

It was not until the late 1980's/early 1990's that the last of the infrastructure required for power system operations was finally decommissioned thereby removing all dependence on East Perth Power Station.

Note that none of the power station's boilers are existent at the time of writing. Since the closure of the power station spending on maintenance has been minimal.

The site is now administered by the Western Australian Government department, DevelopmentWA, which is engaged in repurposing the site which includes the power station building and several nearby service buildings that formed part of the power station.

9. HISTORICAL GALLERY



Figure 1: East Perth Power Station Ground Works circa 1914 [Plate 3]

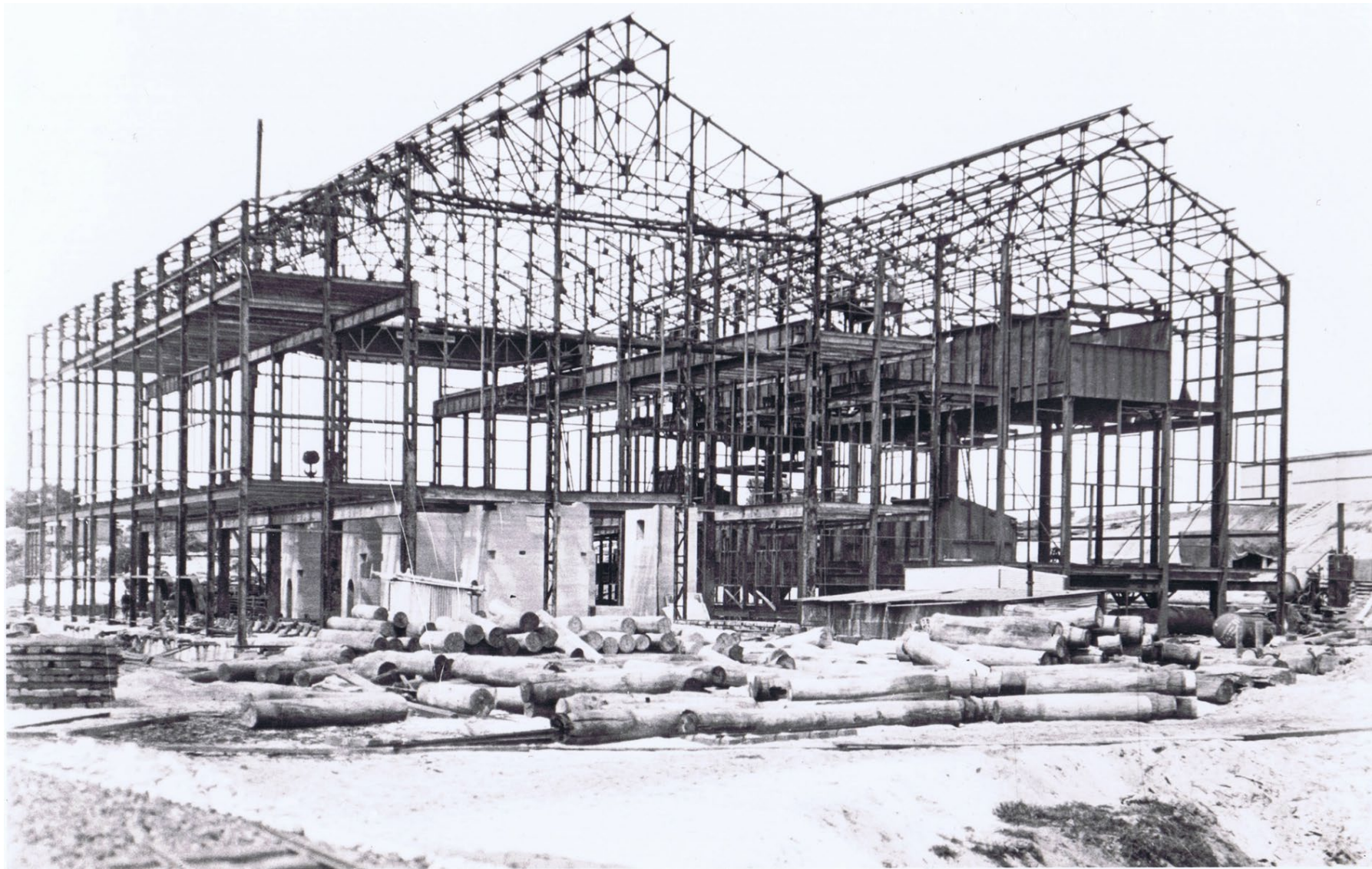


Figure 2: East Perth Power Station at completion of Building Framework [Plate 4]

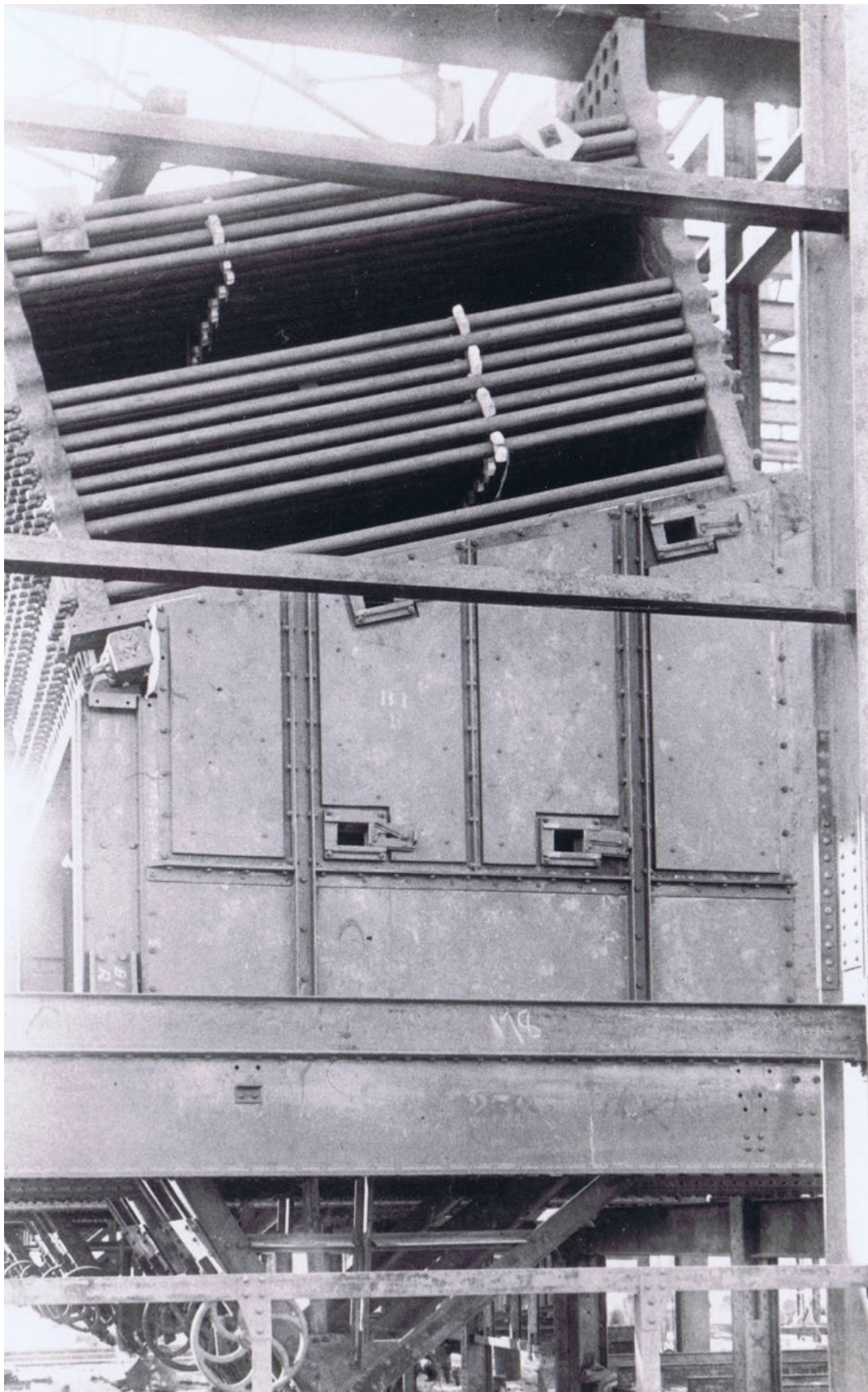


Figure 3: 'A' Station Boiler during Construction [Plate 6]

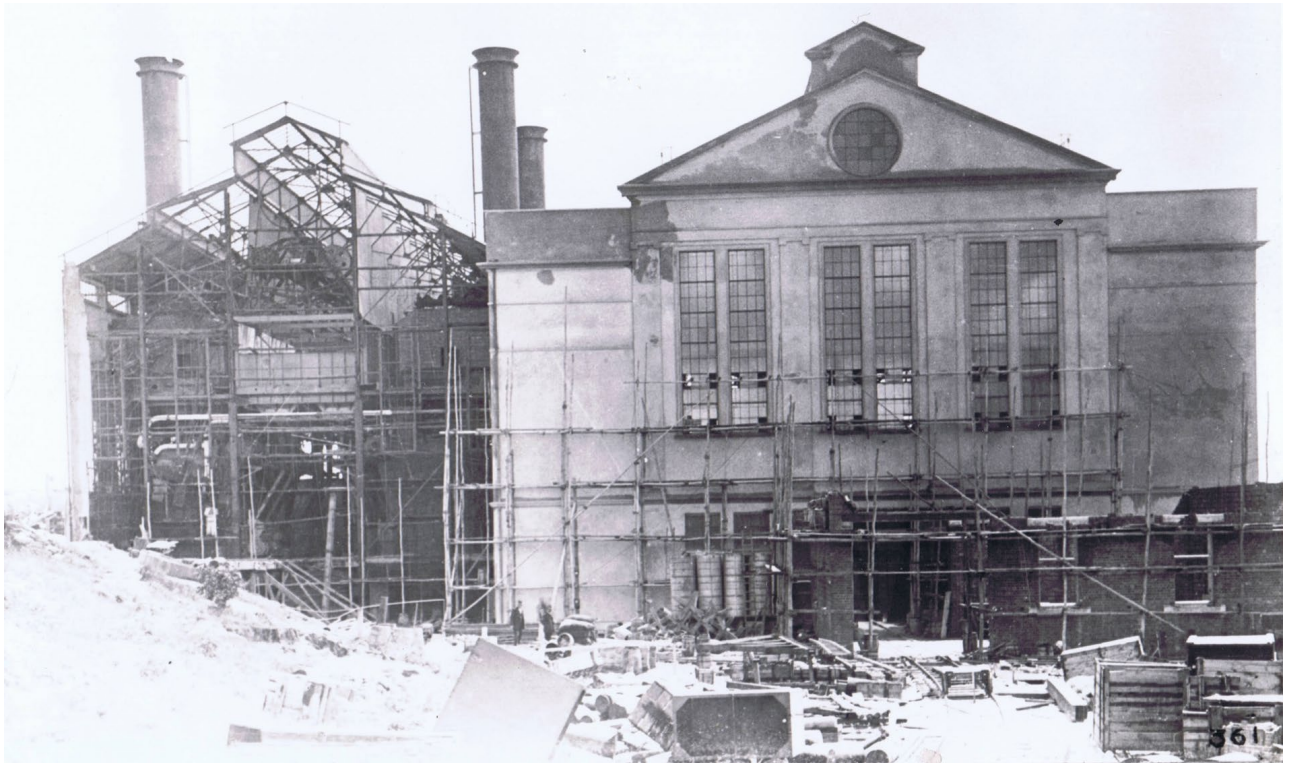


Figure 4: Southern End of Power Station Building during Construction [Plate 7]

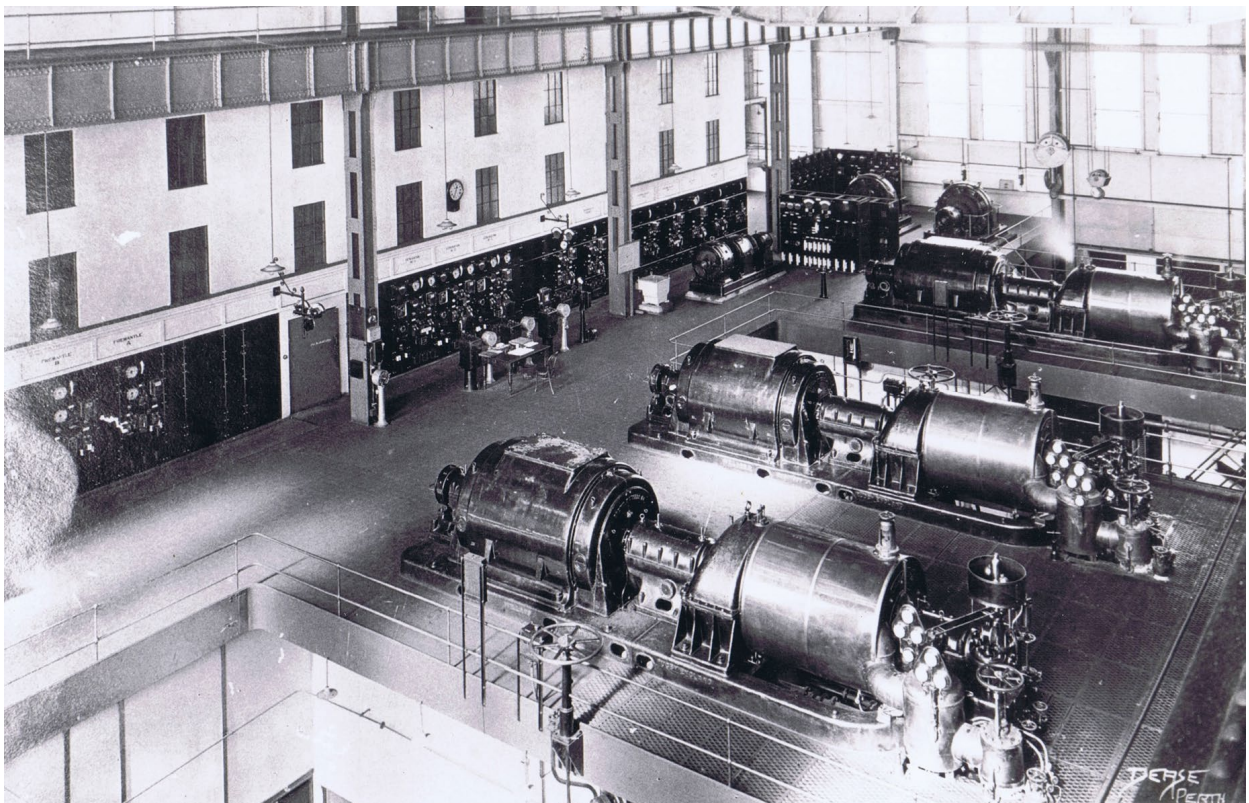


Figure 5: Turbine Hall showing Units 1,2 and 3 in the foreground and the pair of 750 kW Rotary Converters in the background [Plate 8]

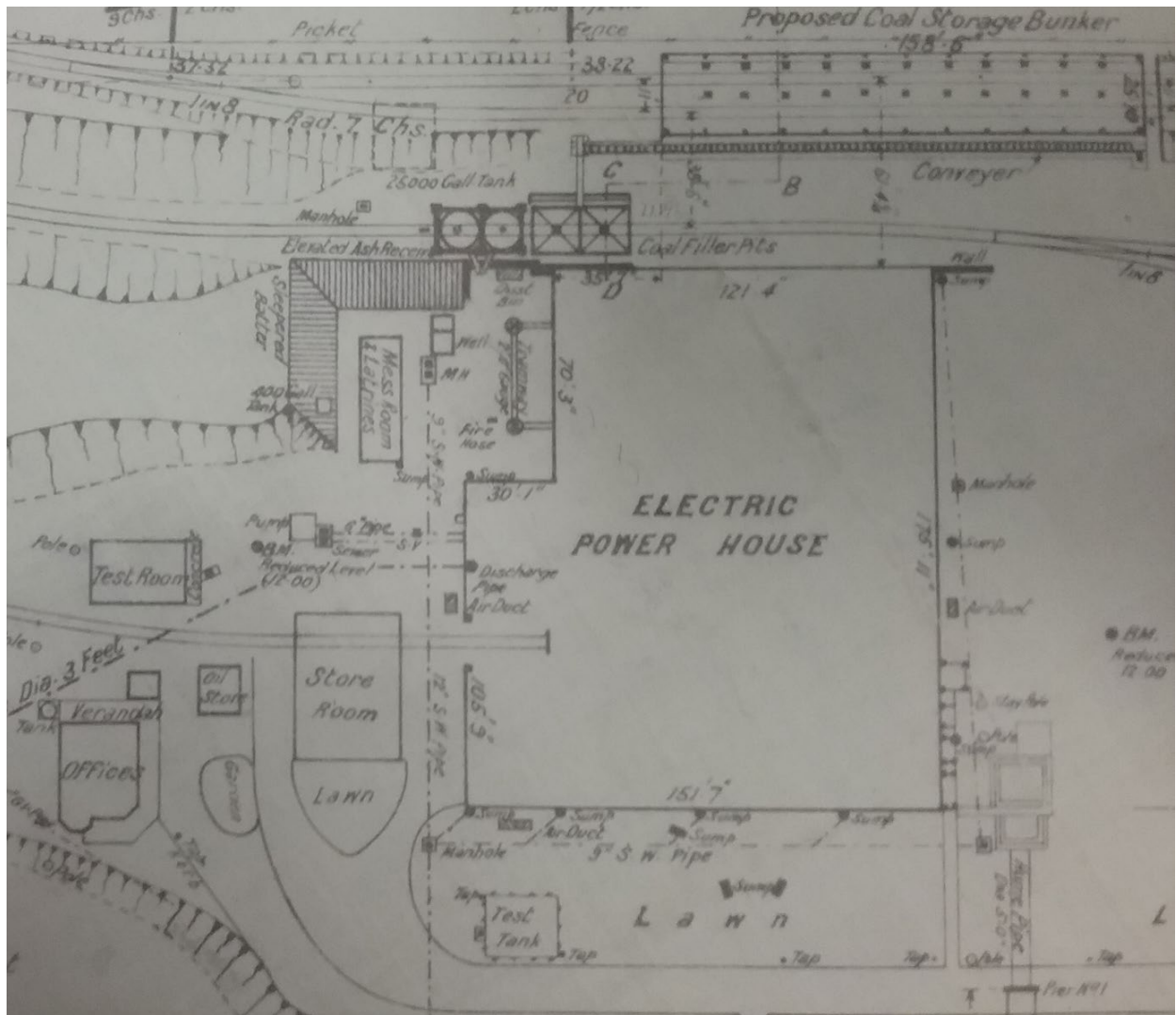


Figure 6: Plan view of Proposed Coal Bunkers, 1922 [20201017_121312.jpg]

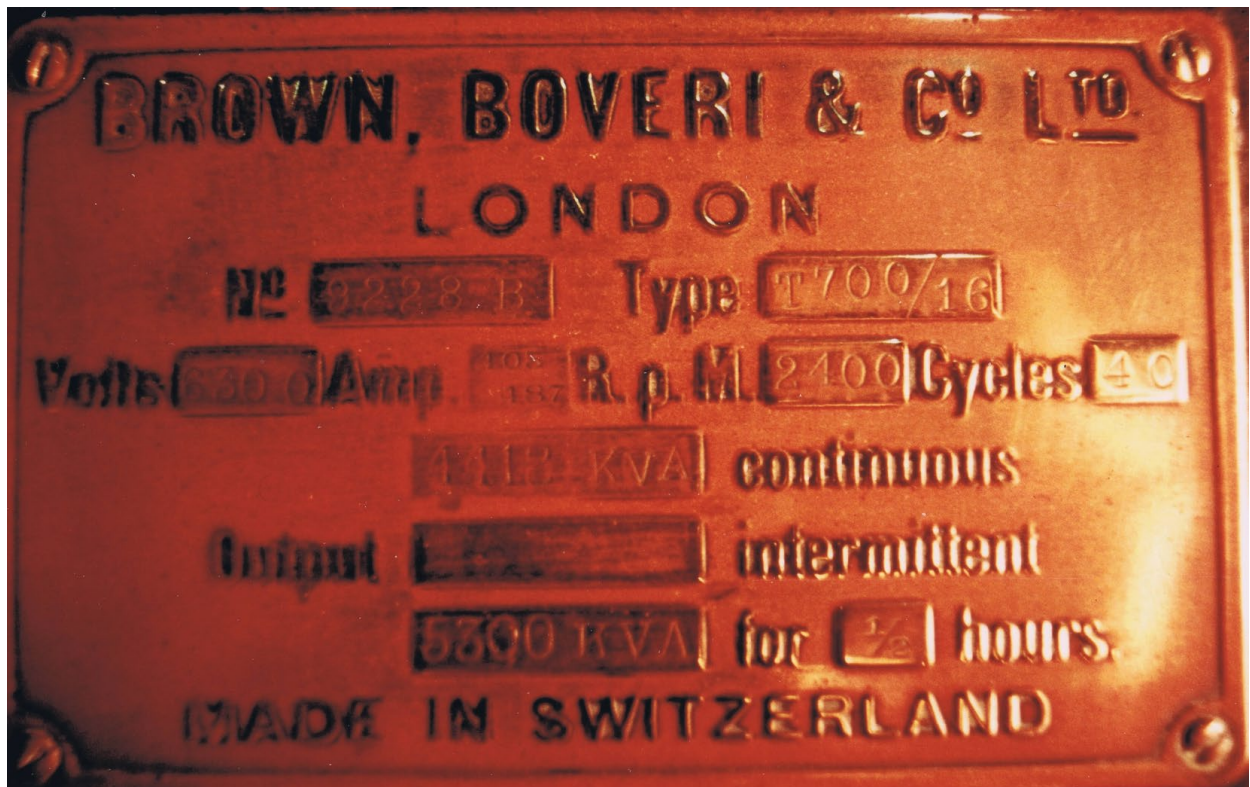


Figure 7: Unit 3 Alternator Nameplate [Plate 11]

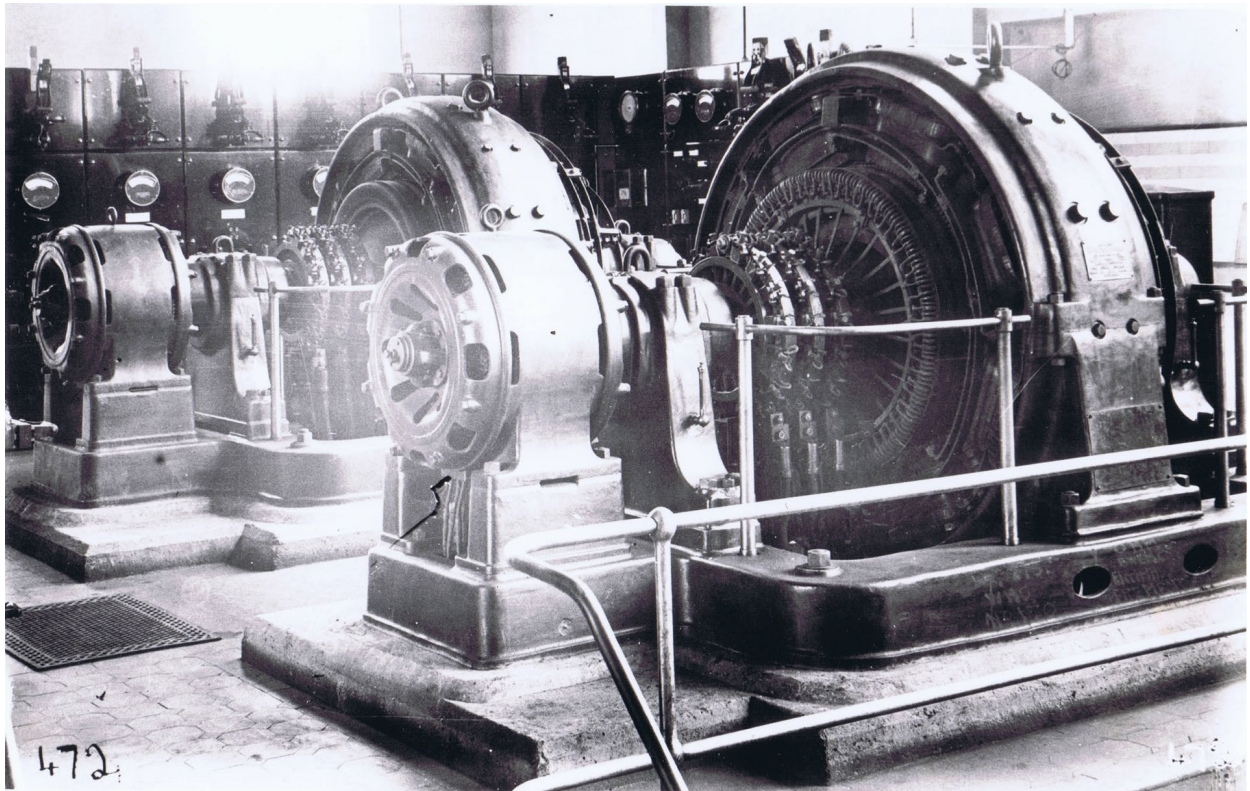


Figure 8: 2 x 750 kW Rotary Converters for Tramway Power



Figure 9: Step Up Transformer House – Reyrolle Switch House – Turbine Hall [BA2850 album 01]



Figure 10: Northern end of Power House [BA2850 album 02]



Figure 11: Eastern Wall of the Power House looking north [BA2850 album 03]

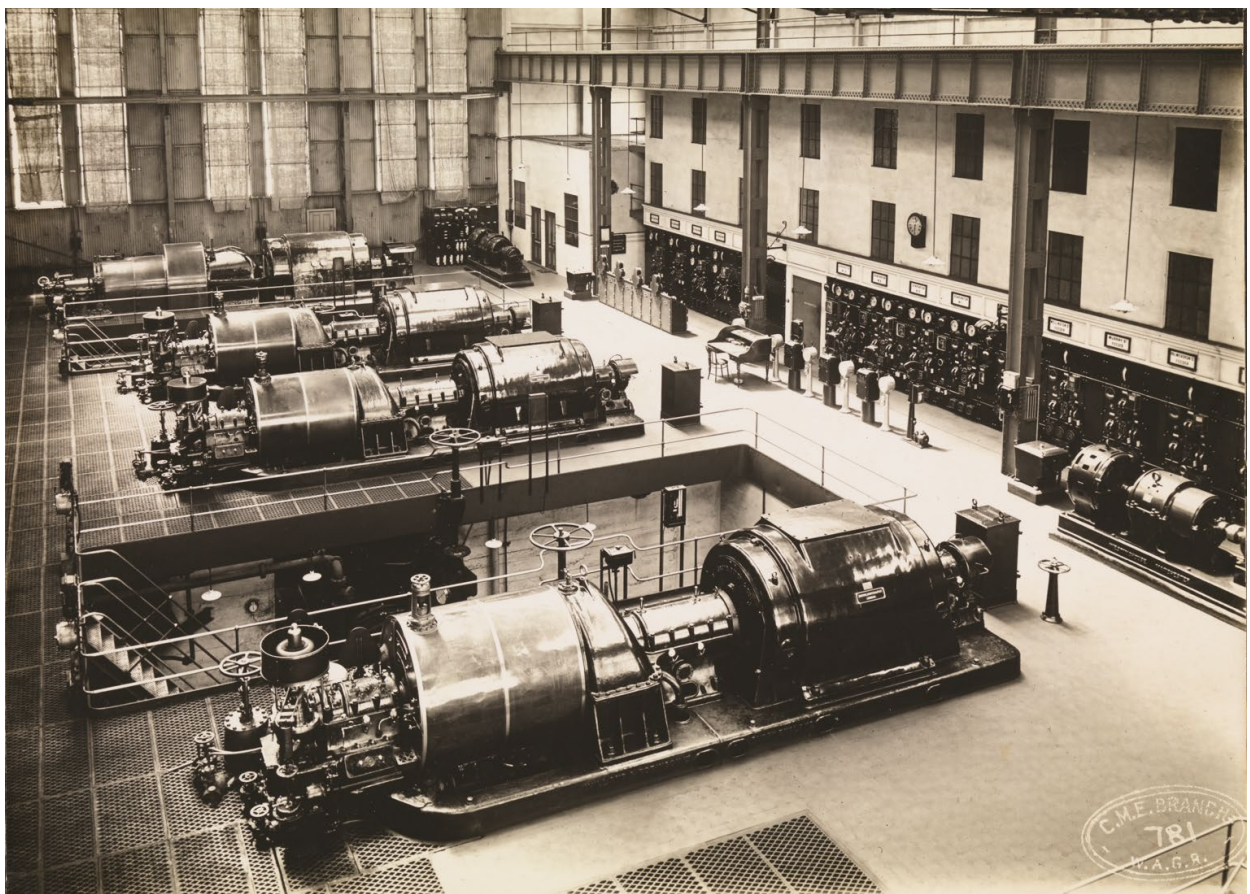


Figure 12: Turbine Hall looking north [BA2850 album 04]

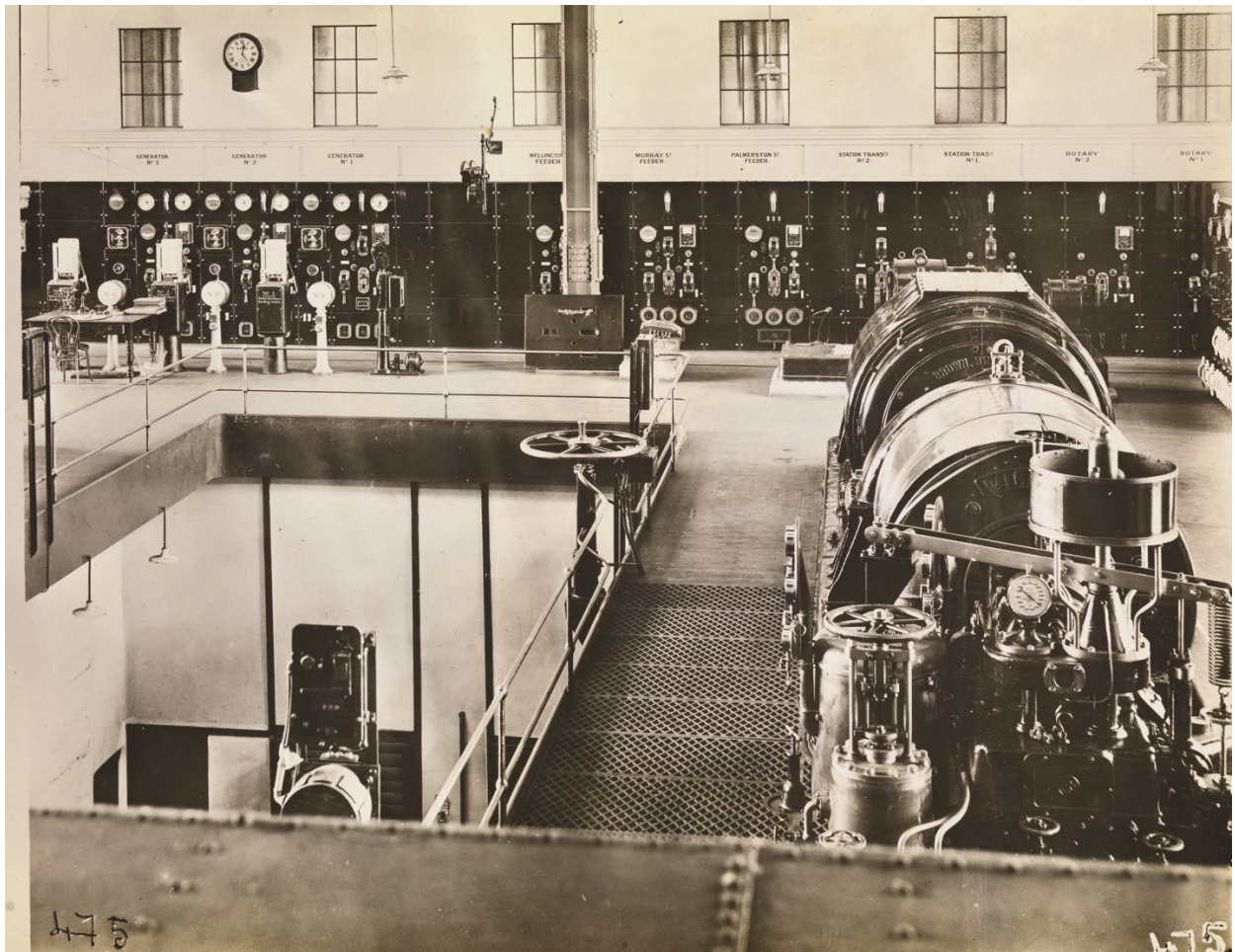


Figure 13: Unit 1 viewed from Steam end [BA2850 album 05]

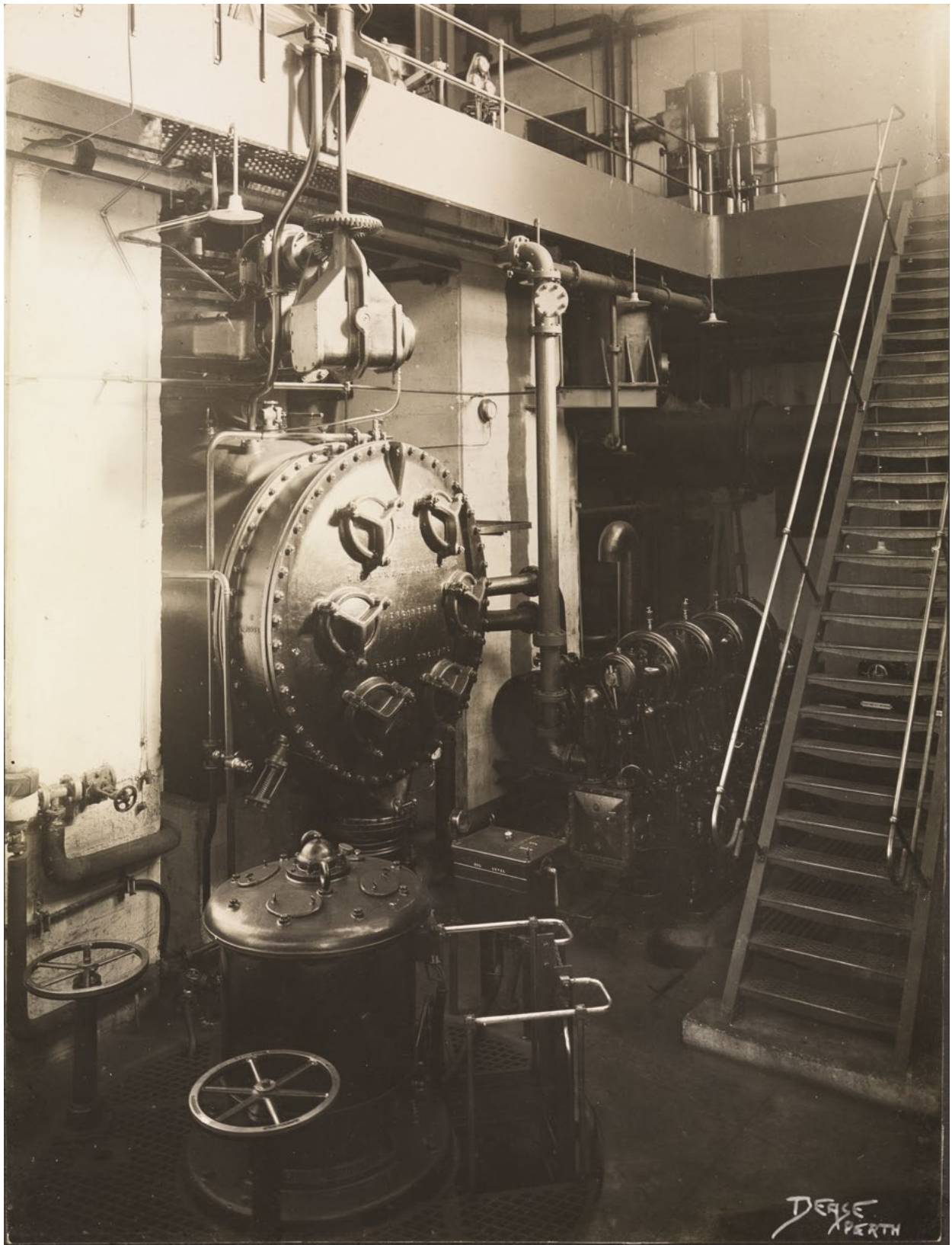


Figure 14: 4 MW Turboalternator Condenser showing Circulating Water Pump and Edwards Air Pump [BQ2850 album 12]

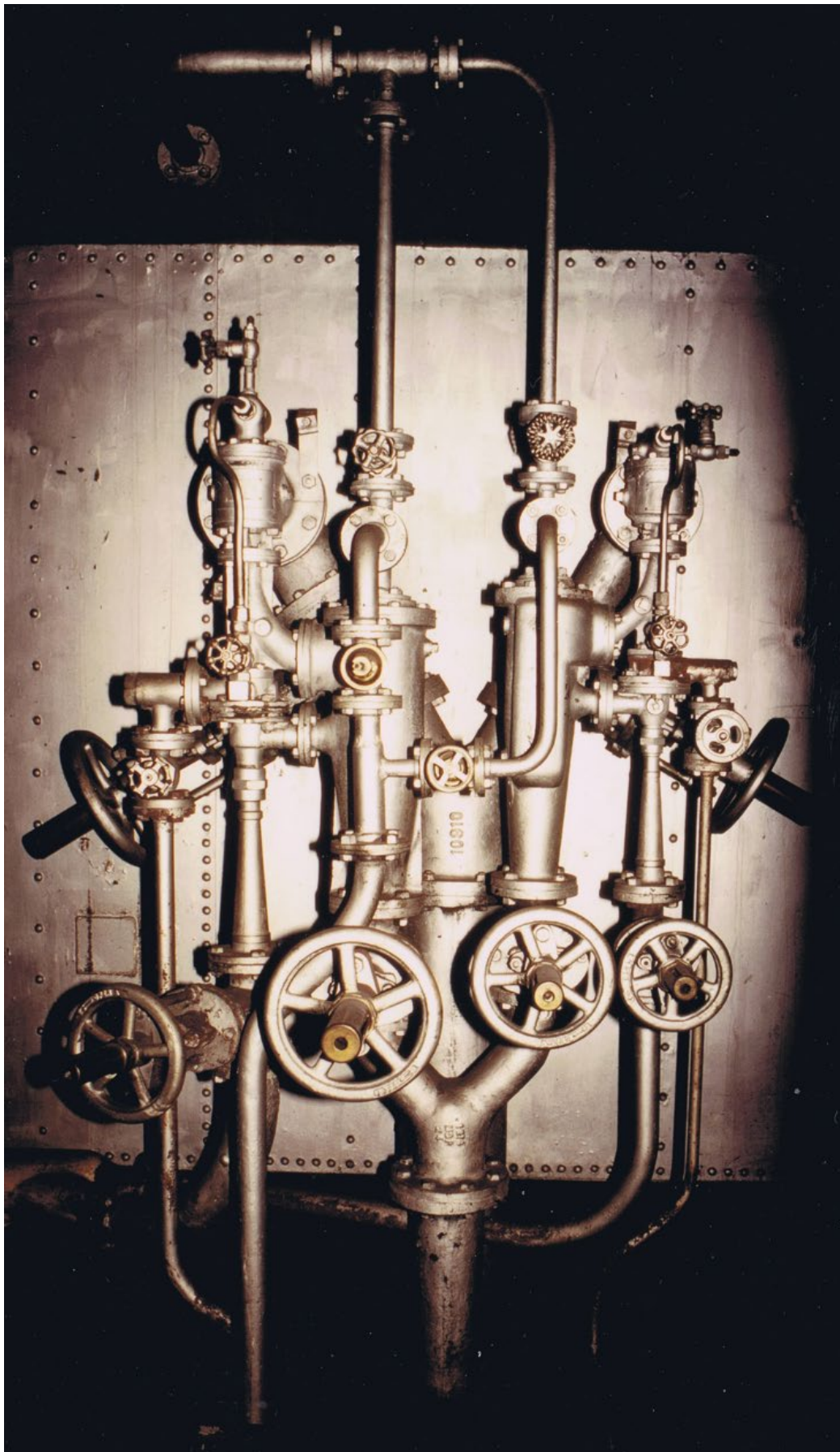


Figure 15: Unit 4 Steam Ejectors [Plate 16]

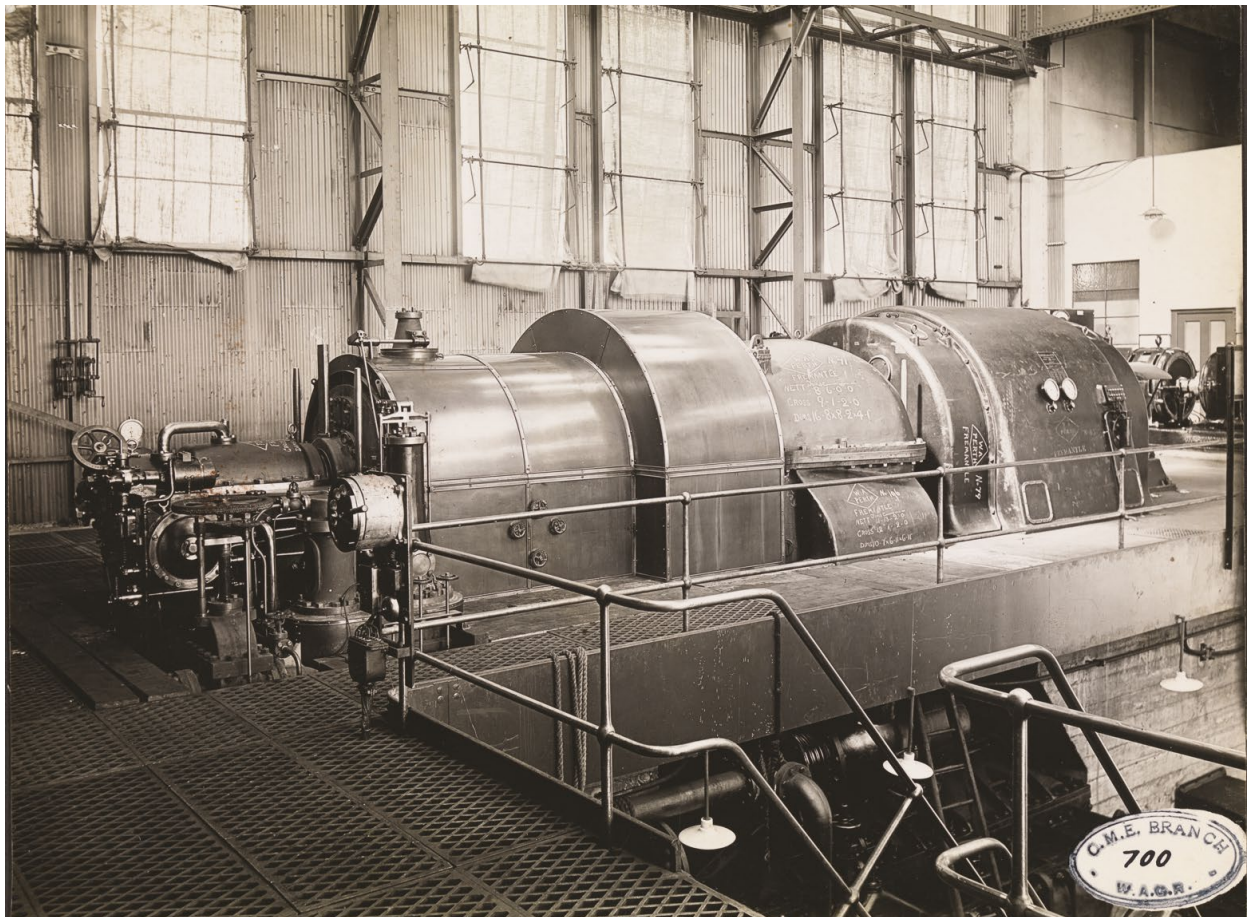


Figure 16: Unit 4 viewed from Steam end [BA2850 album 05]

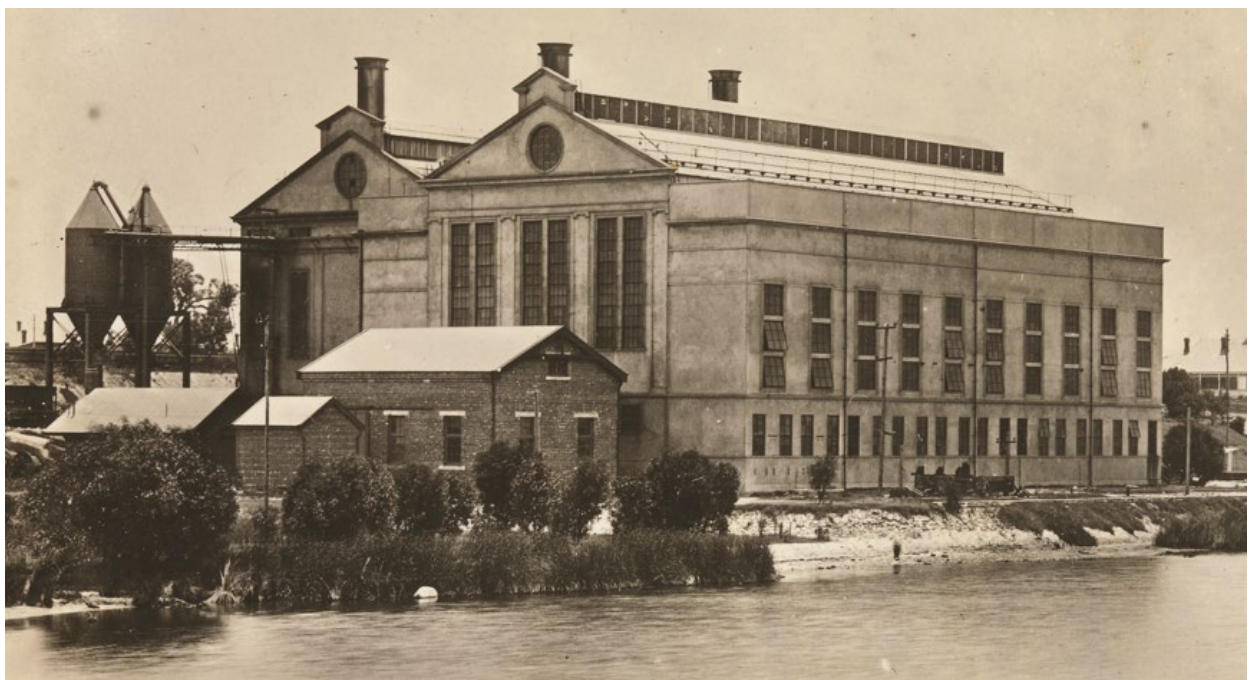


Figure 17 Initial East Perth 'A' Station development 1919 [BA2850 album 12]



Figure 18: 6/20 kV step-up transformer building [BA2580 album 10]

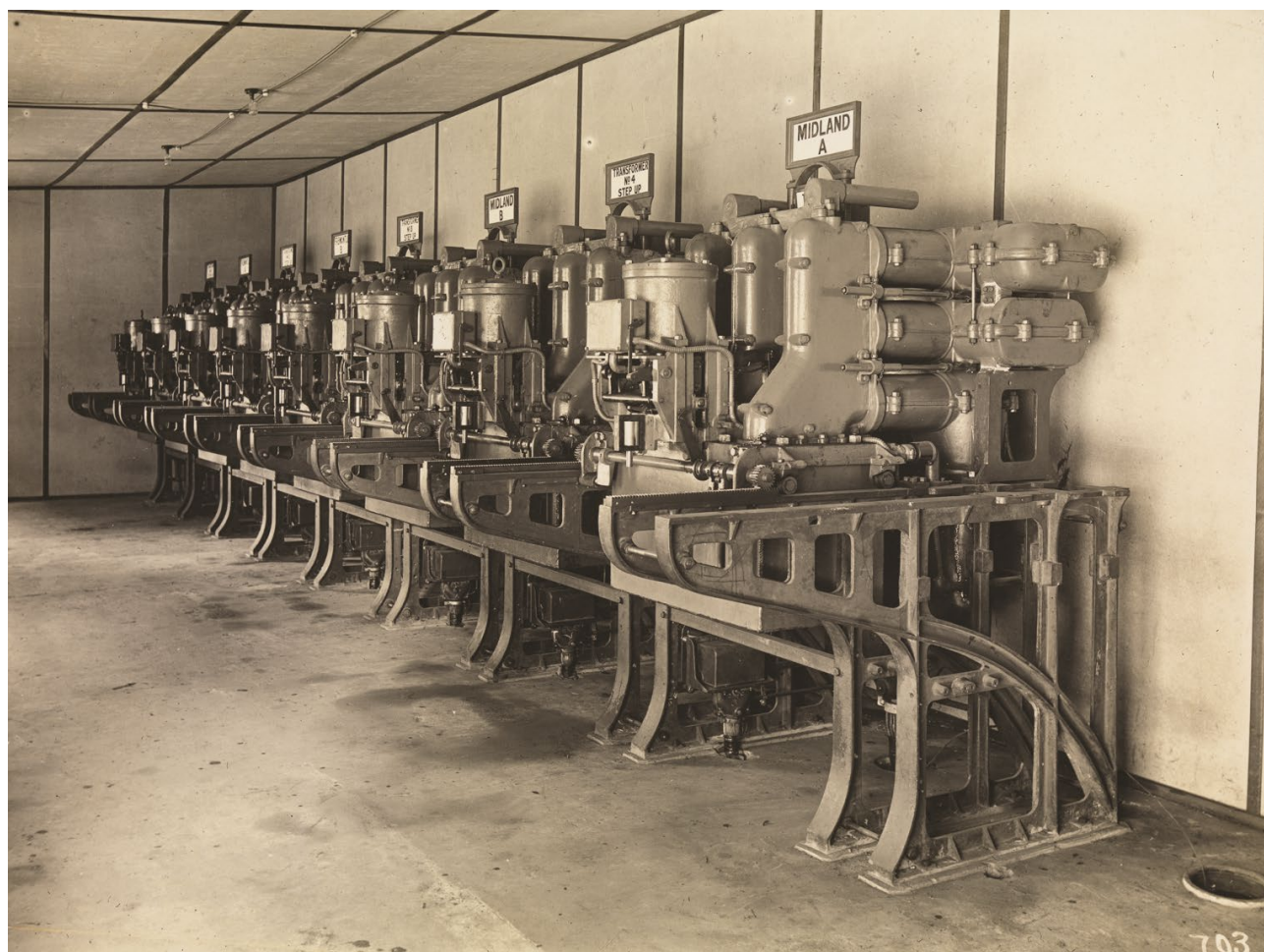


Figure 19: Reyrolle Switchhouse-22 kV OCBs: 4 x 6/20 kV step-up transformer incomers; 2 x Midland 20 kV OHLs & 2 x Fremantle 20 kV OHLs (Installed 1922) [BA2580 album 09]

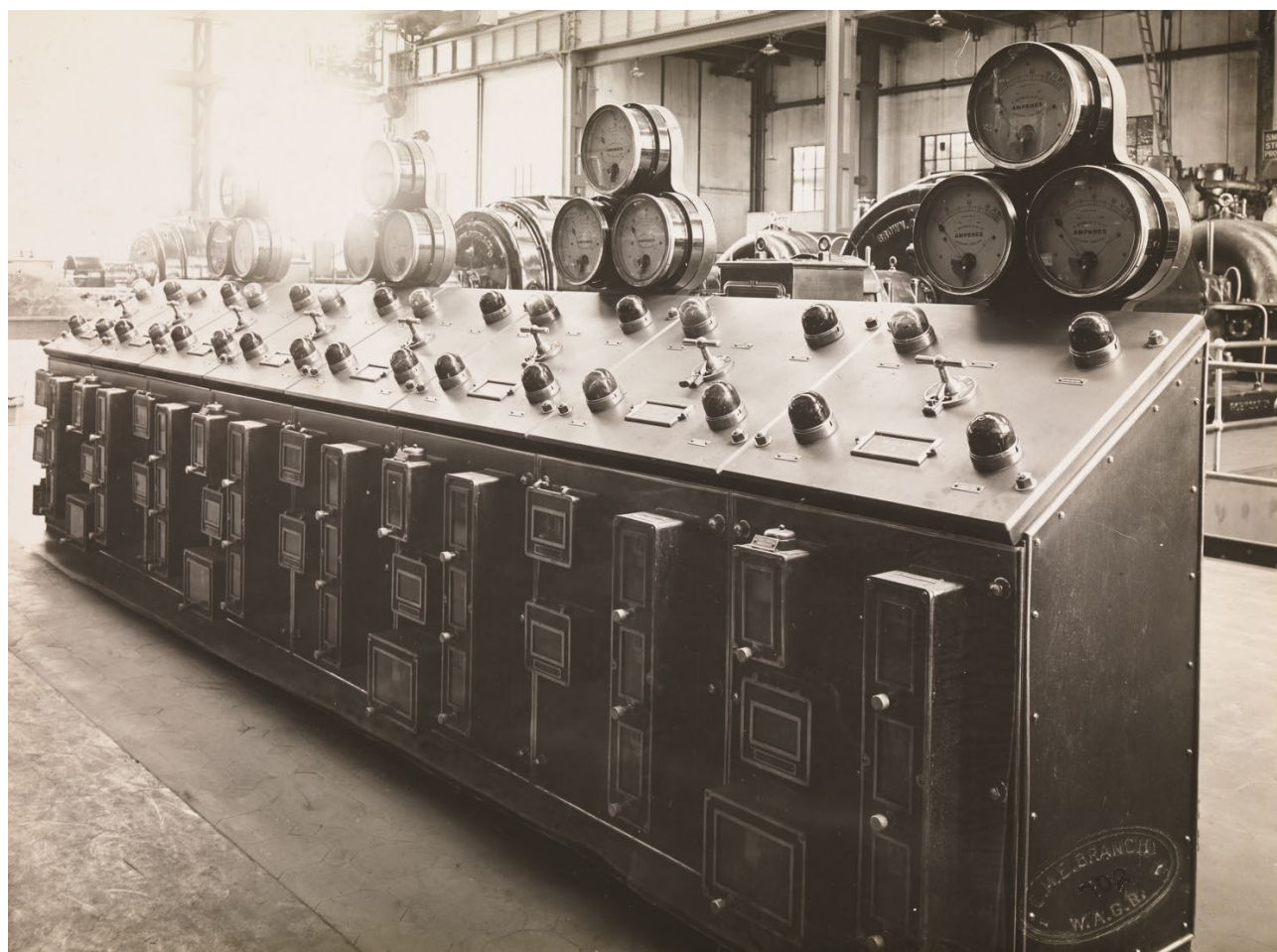


Figure 20: Reyrolle Switchhouse-22 kV OCB Remote Control Panel [BA2580 album 08]

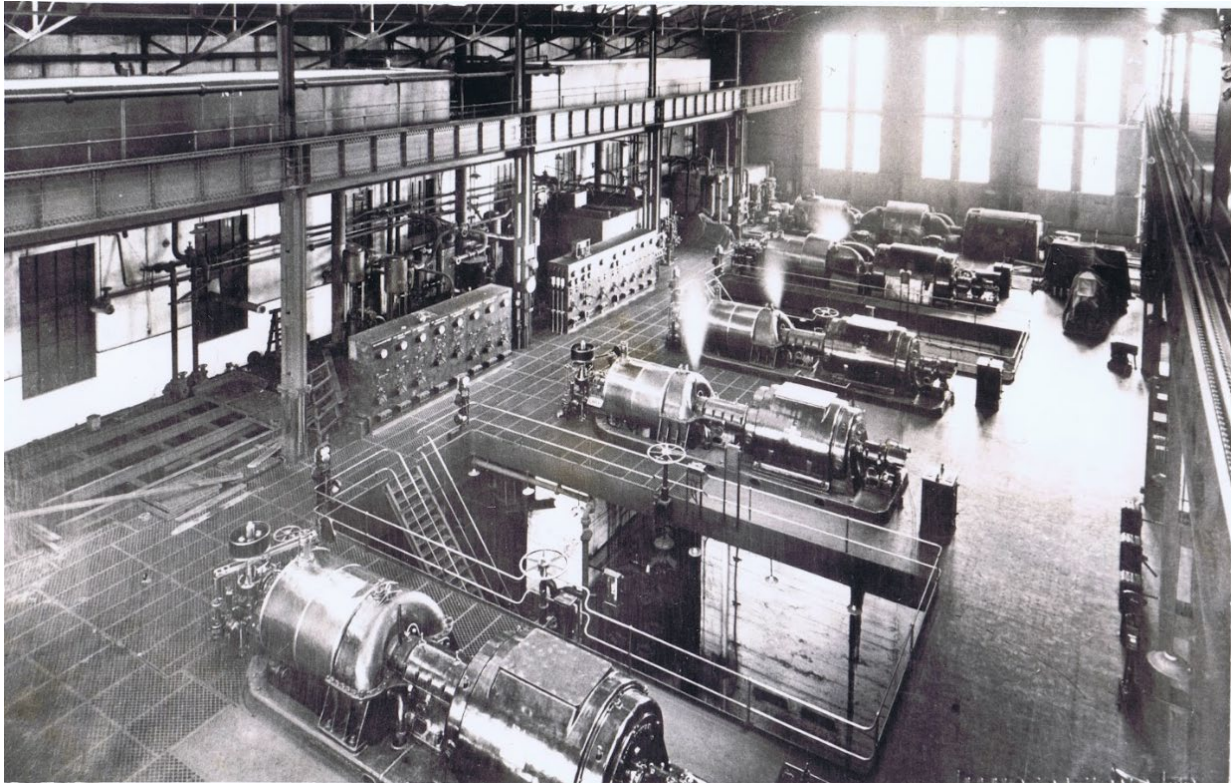


Figure 21: Turbine Hall circa 1928 [Plate 22]



Figure 22: Power Station Building viewed from South East circa 1929 - 1928 [001275d 1928]



Figure 23: 'A' Station viewed from North West circa 1929 [EPPS A Stn 1929]

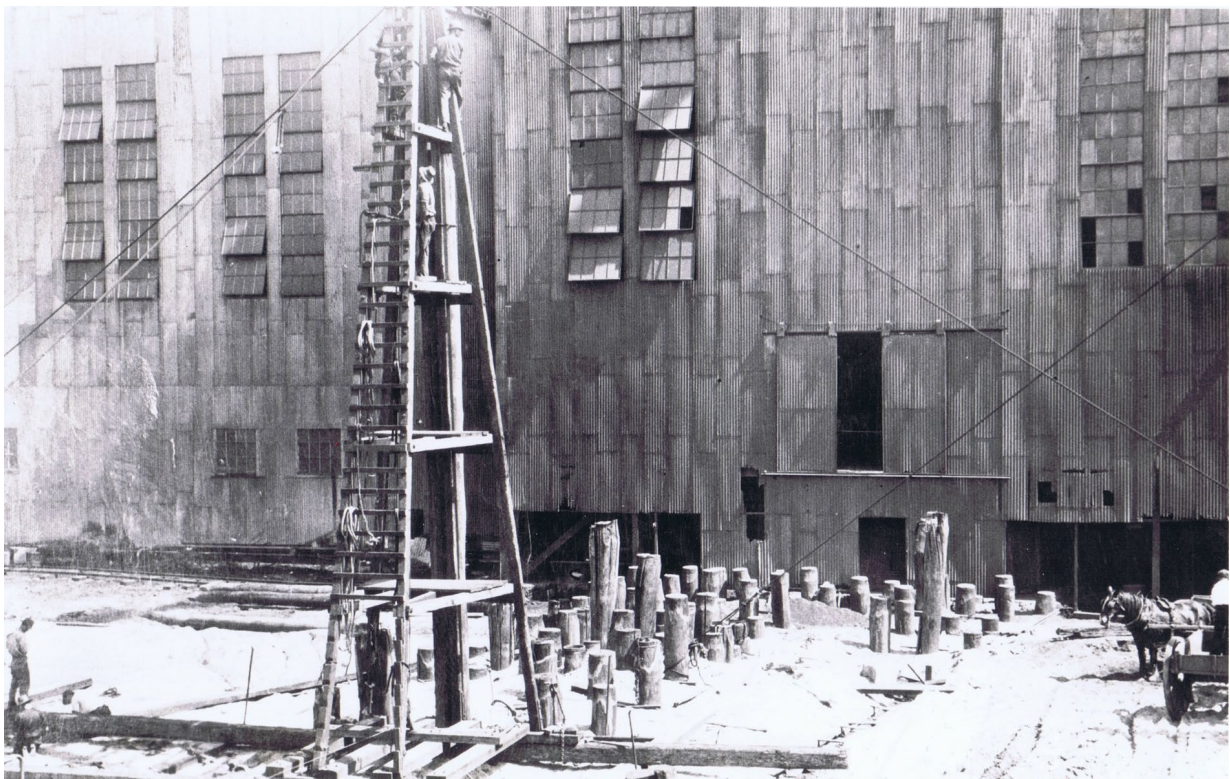


Figure 24: 'B' Station Ground Works [Plate 21]

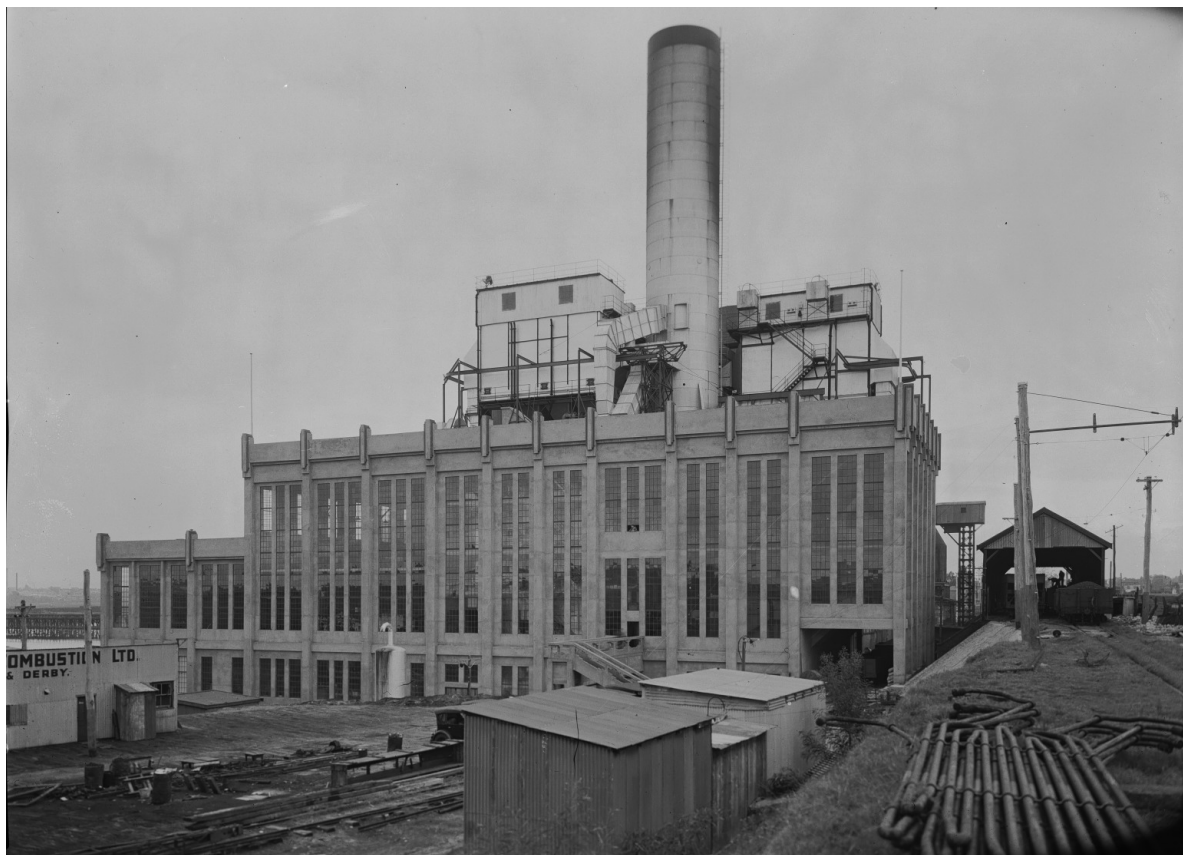


Figure 25:slwa_b2404120_1 B Stn circa 38



Figure 26: East Perth Power Station with only 3 of the 4 'B' Station Boilers installed. Not earlier than 1939. [call no BA575_295]



Figure 27: slwa_b2404120_2 Ctrl Room Aug 1938

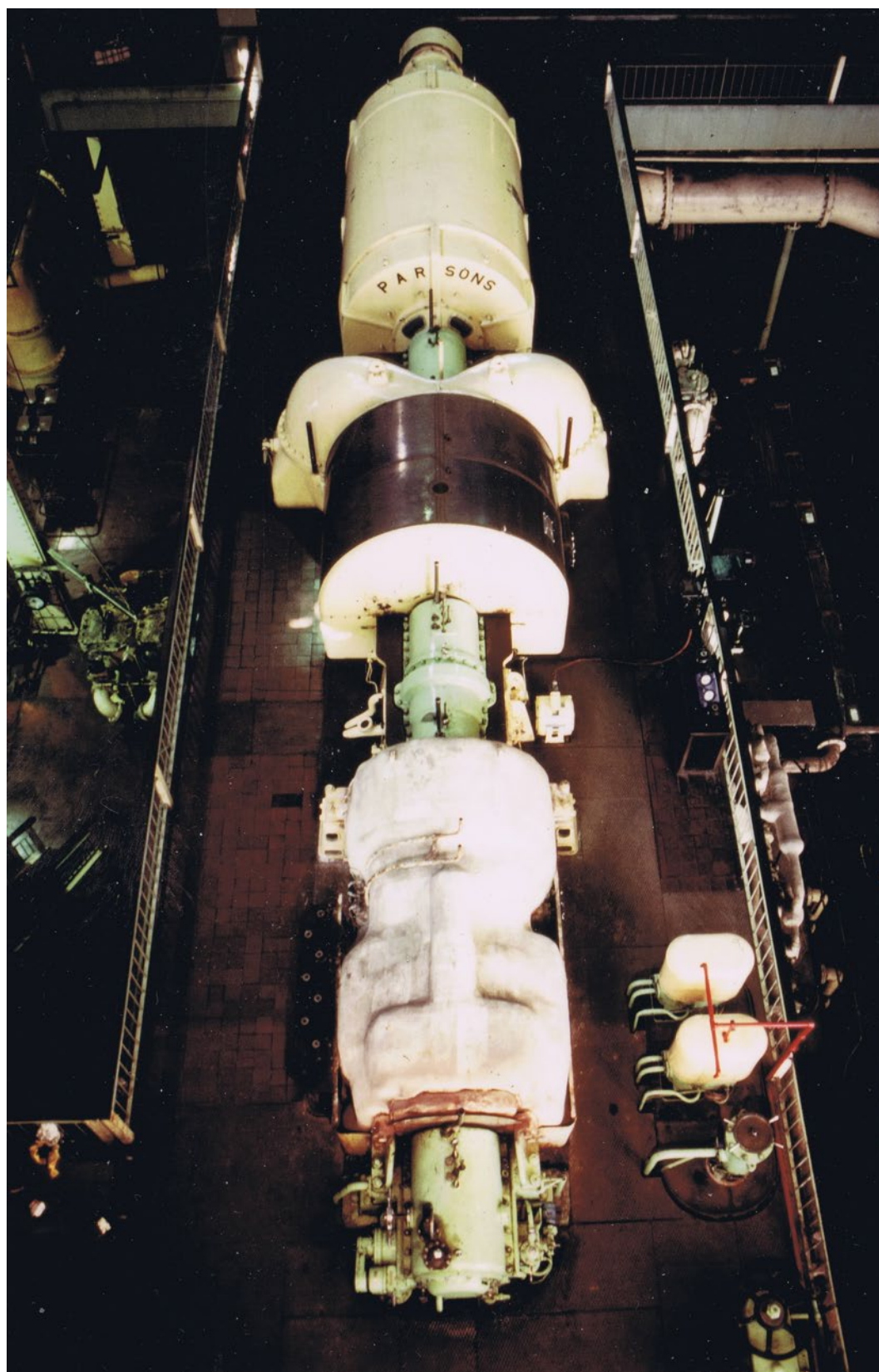


Figure 28: 'B' Station - TA No 6 [Plate 25]



Figure 29: 'B' Station Precipitators viewed from 'C' Station Chimney [Plate 26]

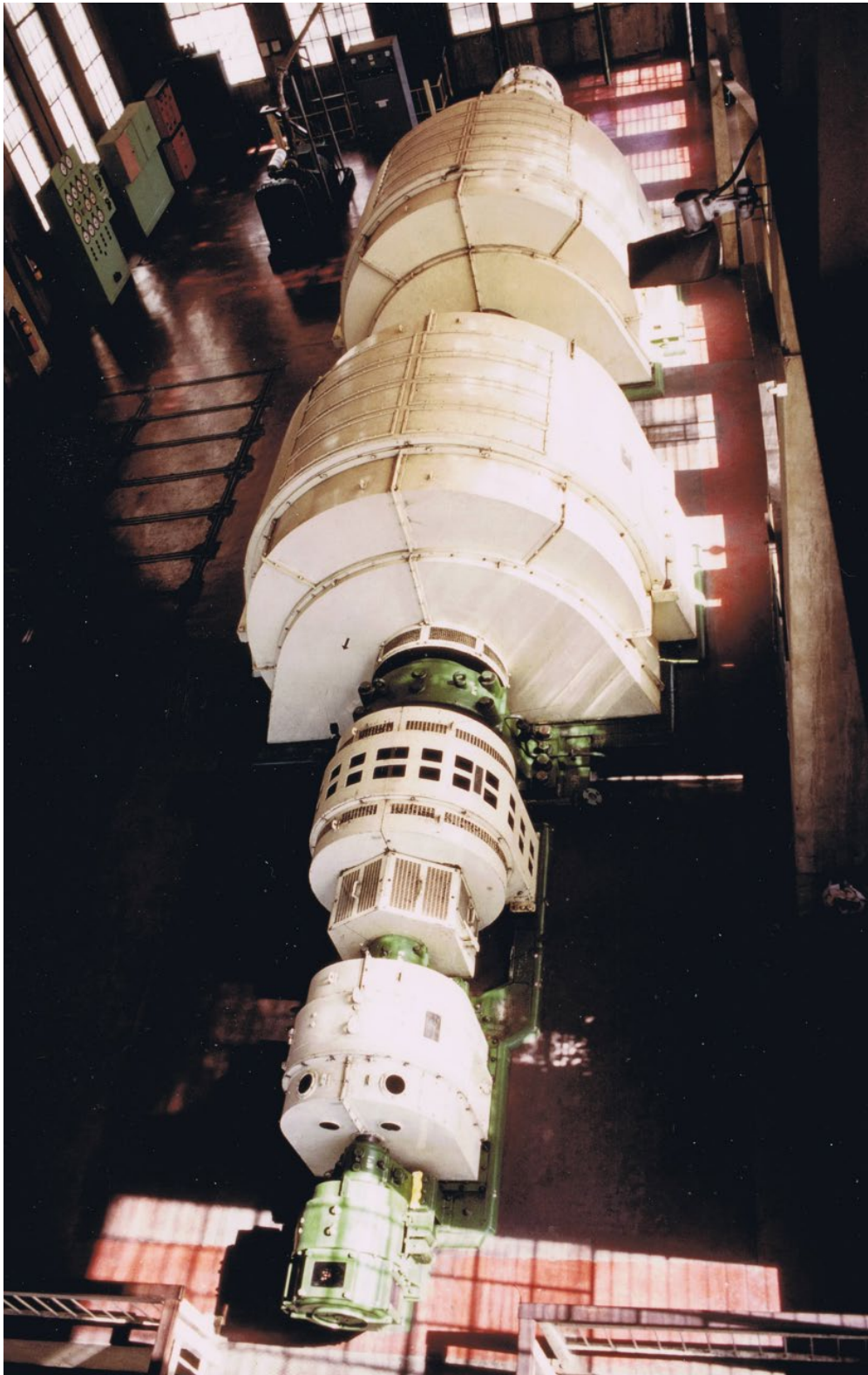


Figure 30: Frequency Changer [Plate 27]

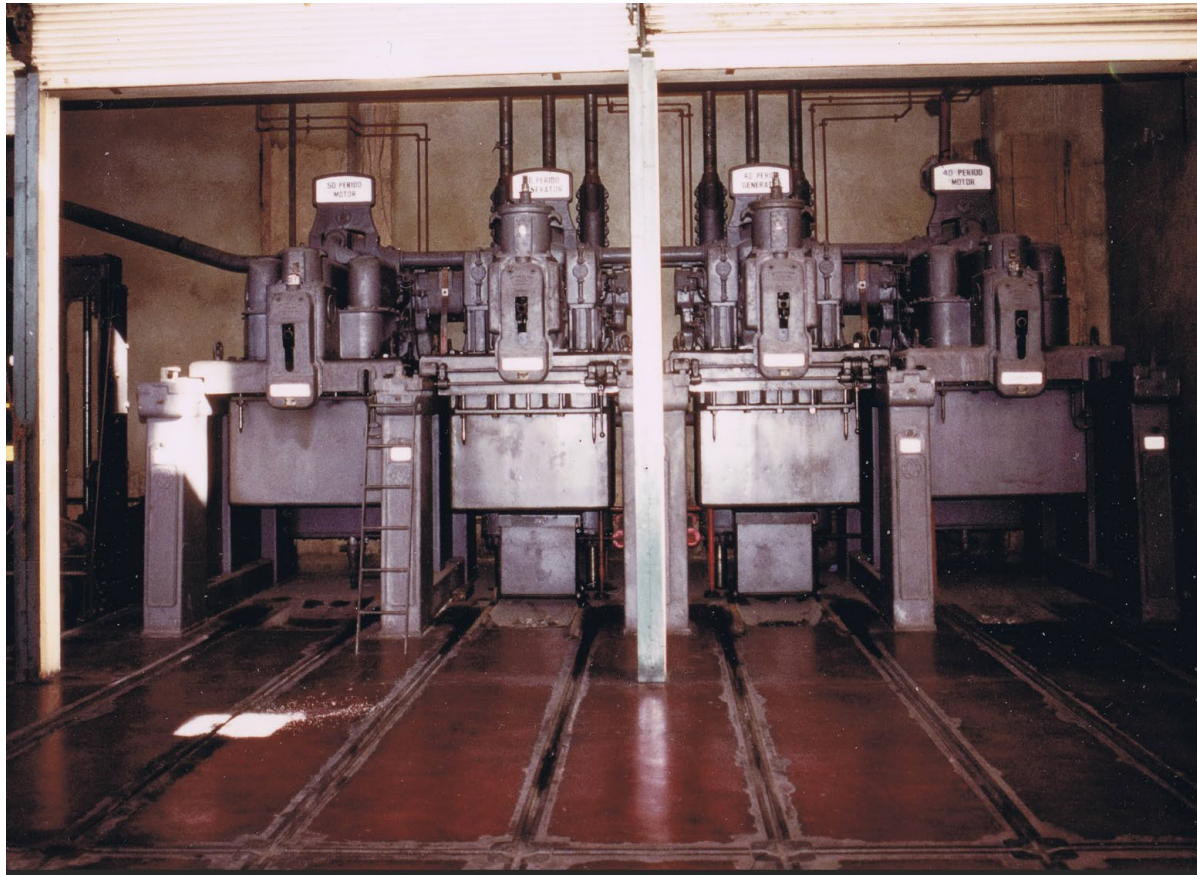


Figure 31: Frequency Changer 6 kV Switchgear [Plate 28]

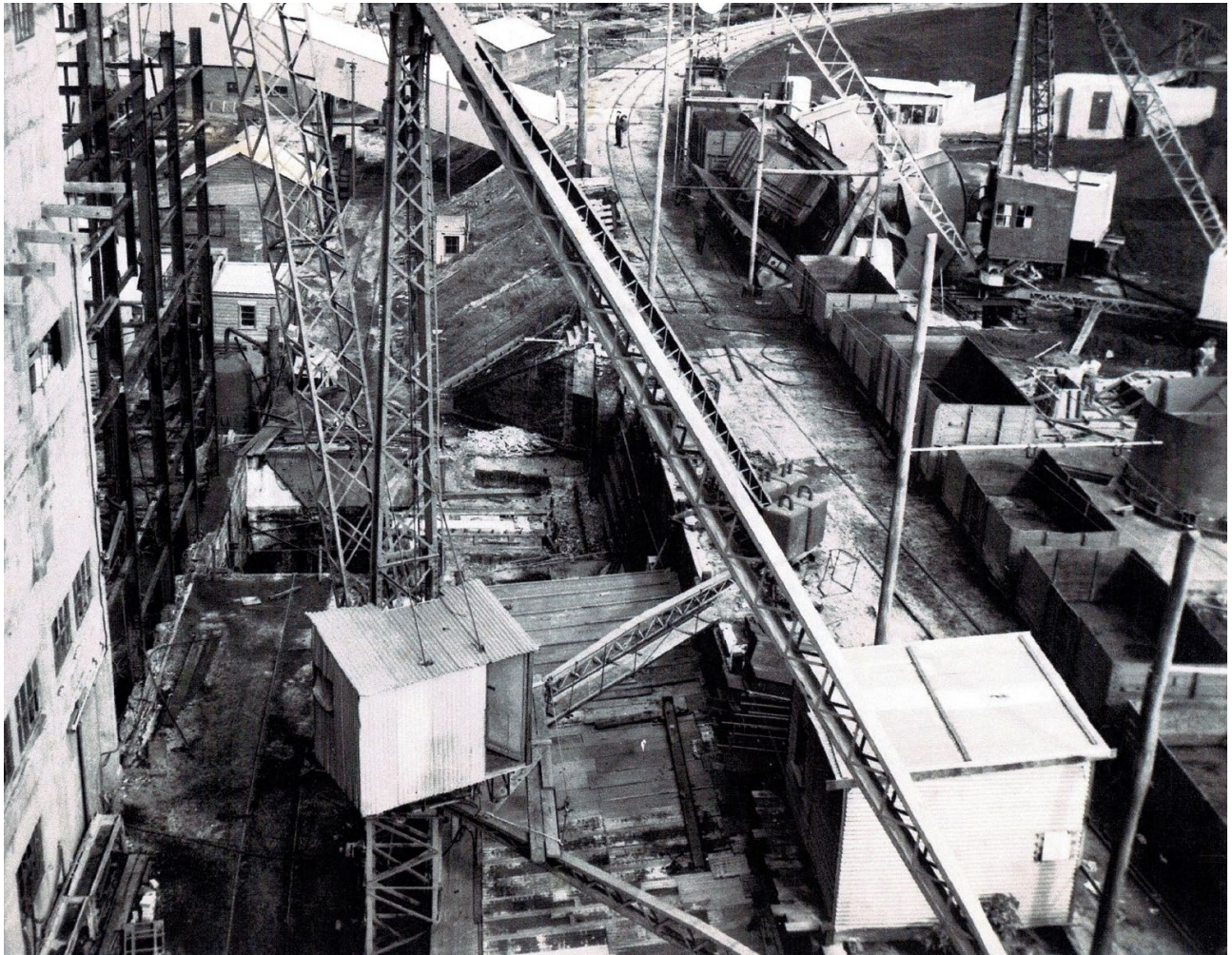


Figure 32: Coal Train being emptied by the Coal Tippler

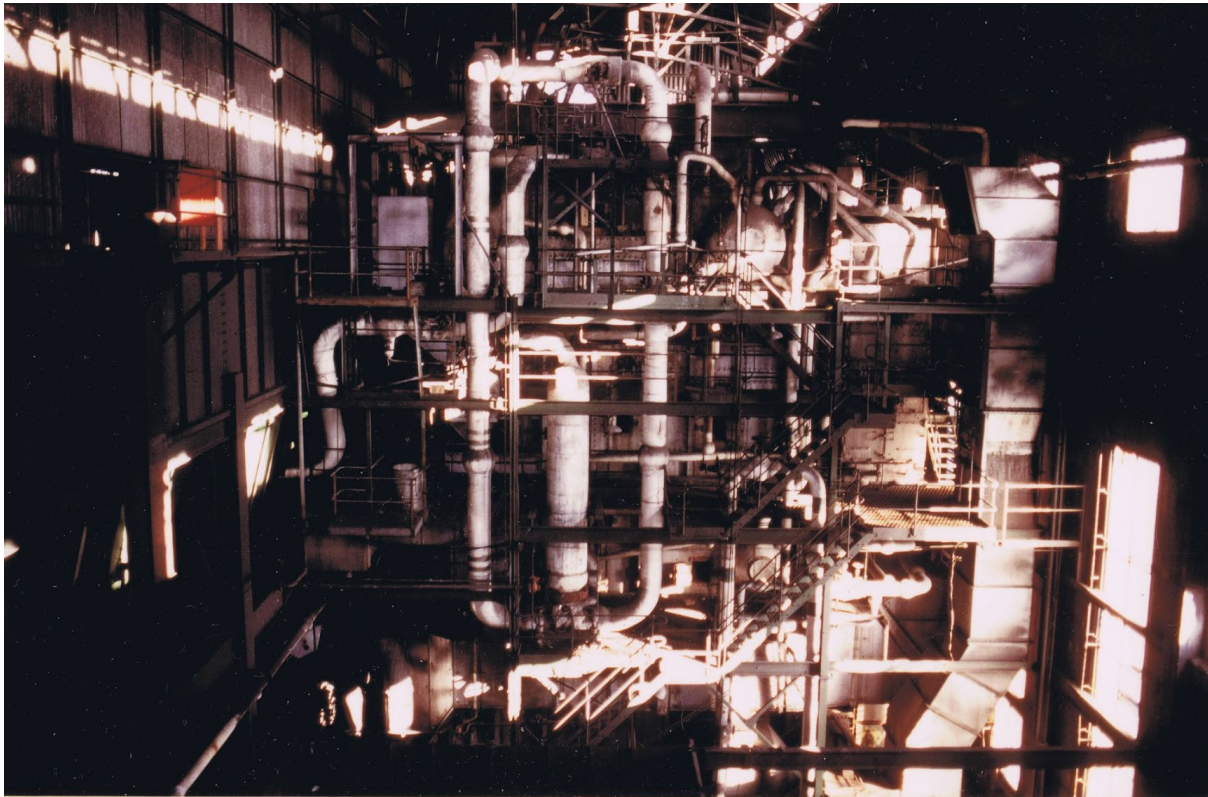


Figure 33: 'C' Station – Boiler 15 [Plate 25]



Figure 34: 'C' Station - TA No 7 [Plate 25]

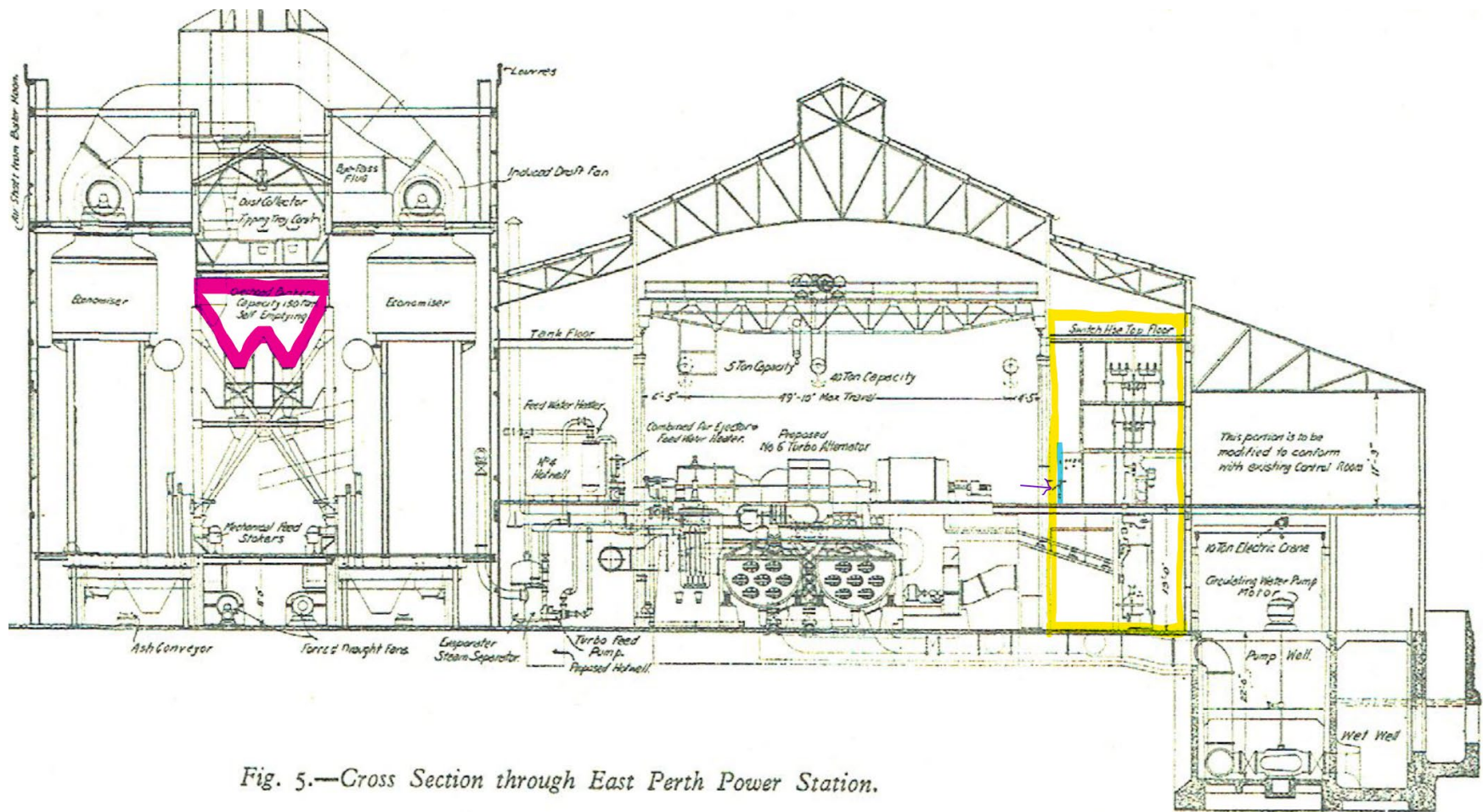


Fig. 5.—Cross Section through East Perth Power Station.

Figure 35: Power Station cross section with side elevation of 6,000 V switchgear cell highlighted

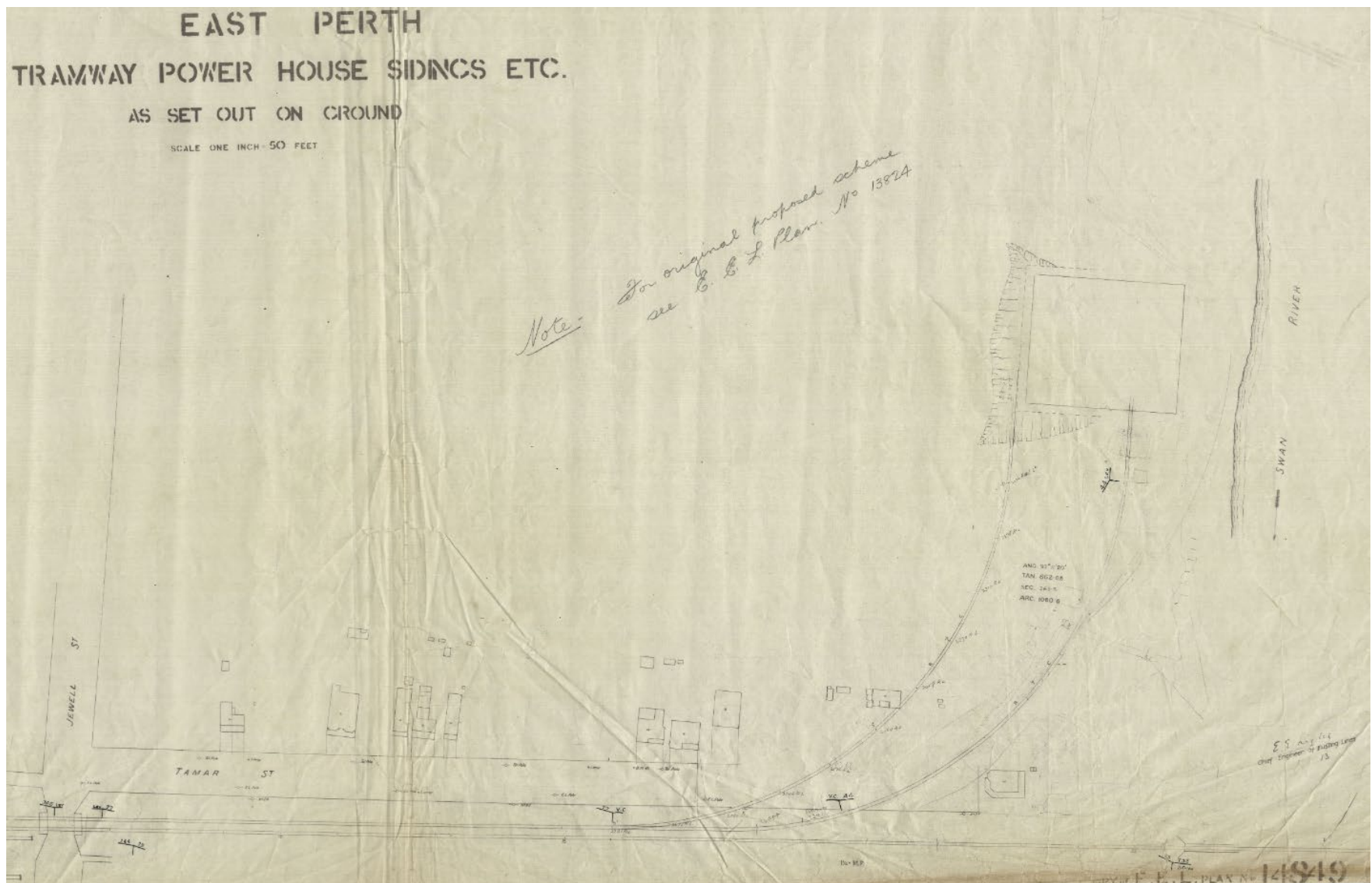


Figure 36 Plan View Drawing of Railway Lines-November 1913

New Power House Area.

Water Supply.

* Proposed Trench to open up Seepage Supply marked A-B.

Proposed 4" G.W.I. Pipe Line to take Water to tank for Loca purposes marked B-C

4" settling tank for Power House . B-D

Scale 1 in = 50 Ft.

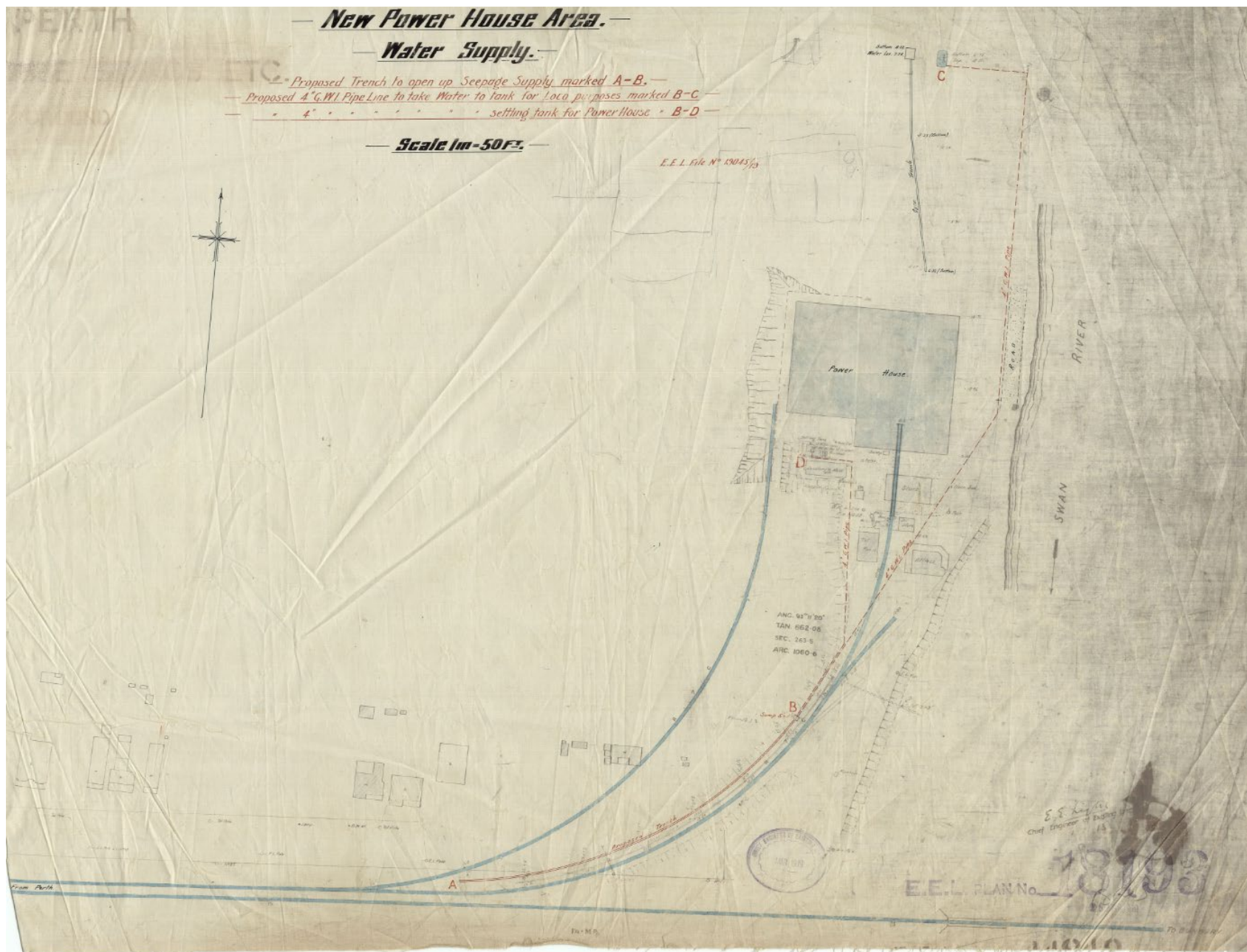


Figure 37: Power House Water Supply Modifications Mar 1919

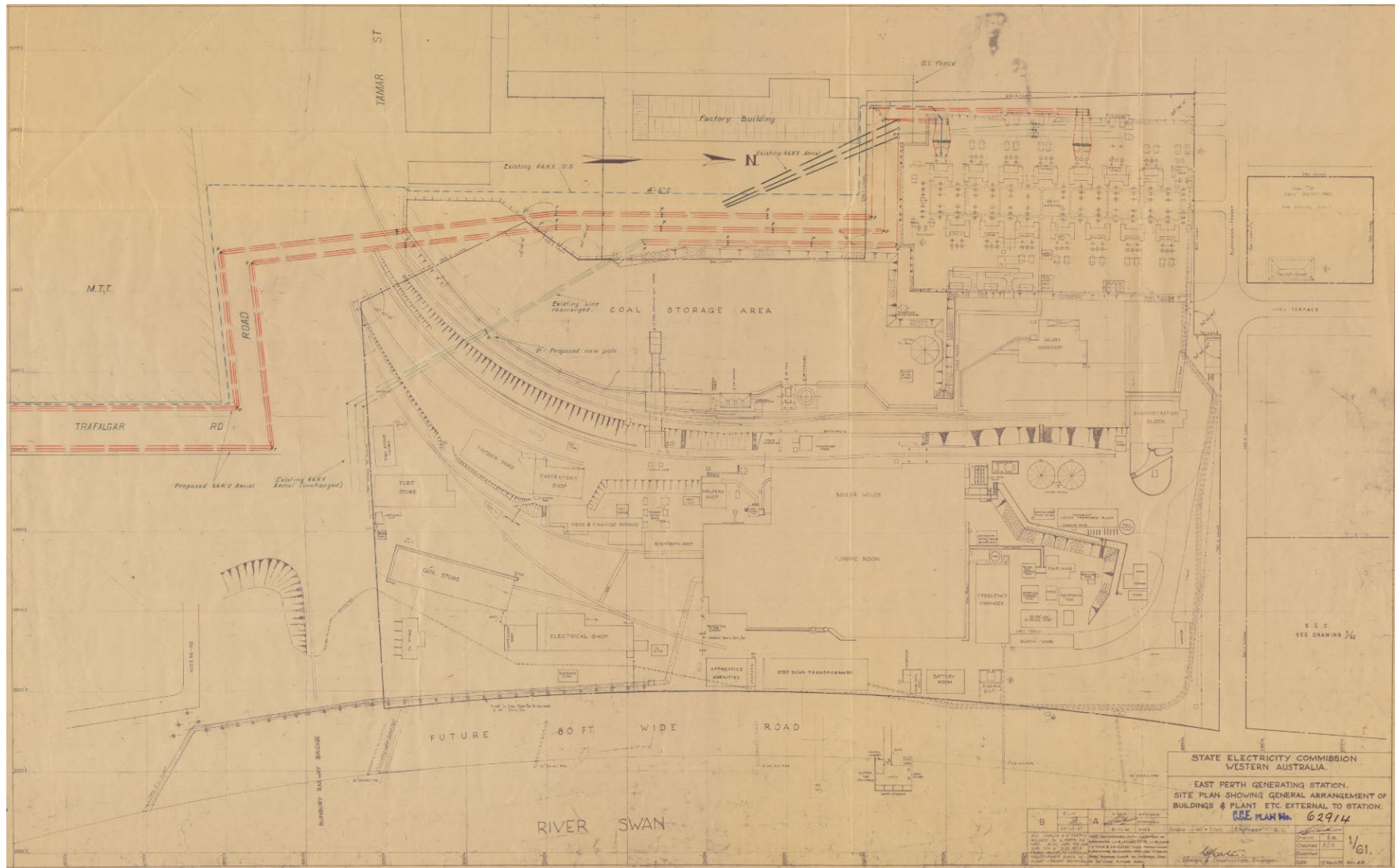


Figure 38: Plan View Drawing of Site-October 1967

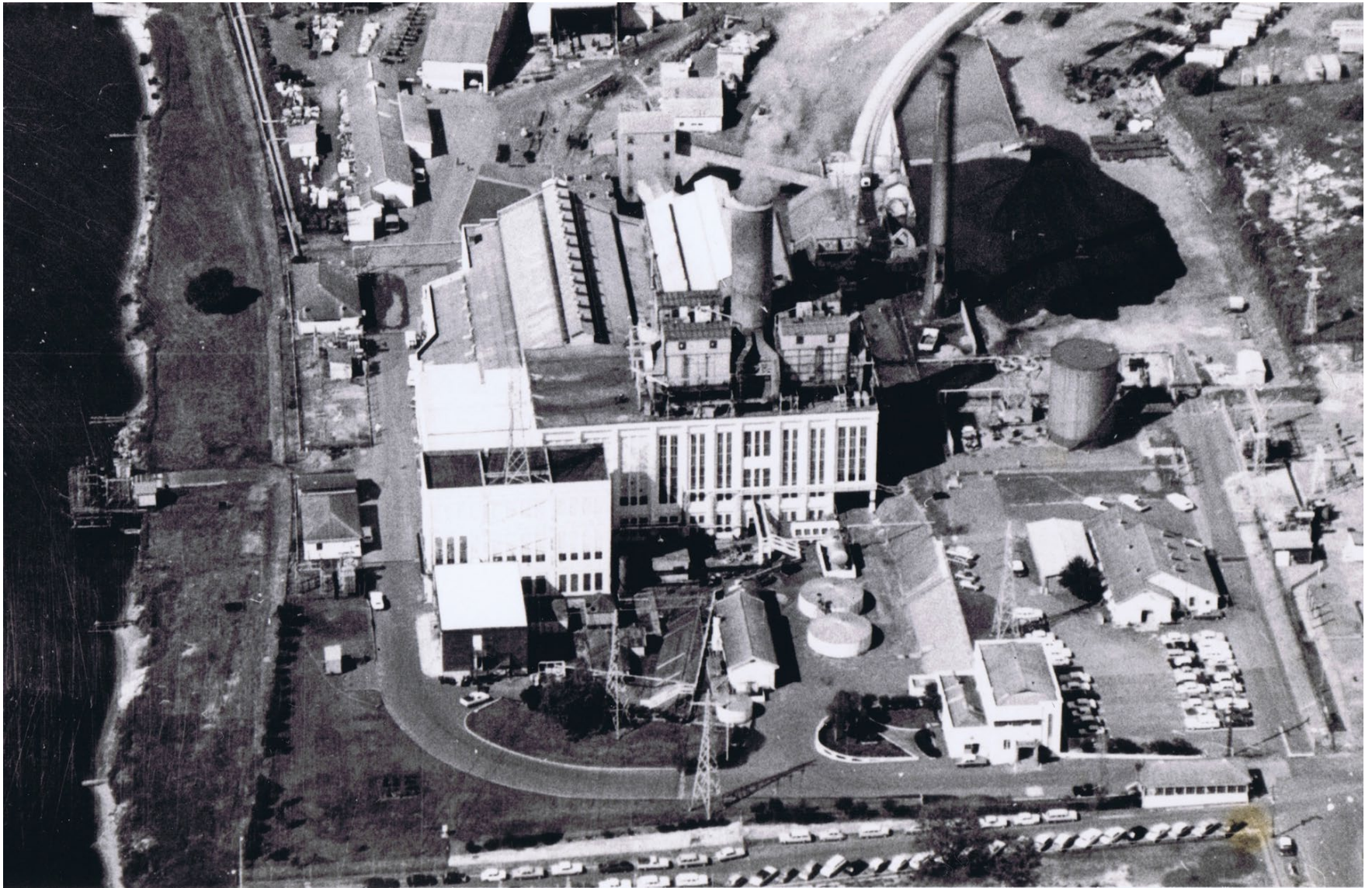


Figure 39: East Perth Power Station around the time of its Ultimate Development [Peak of Dev]



Figure 40: East Perth Power Station around the time of its Ultimate Development [Birds eye view]

10.COMTEMPORARY GALLERY



Figure 41: Original Slate Switch Boards form 1916

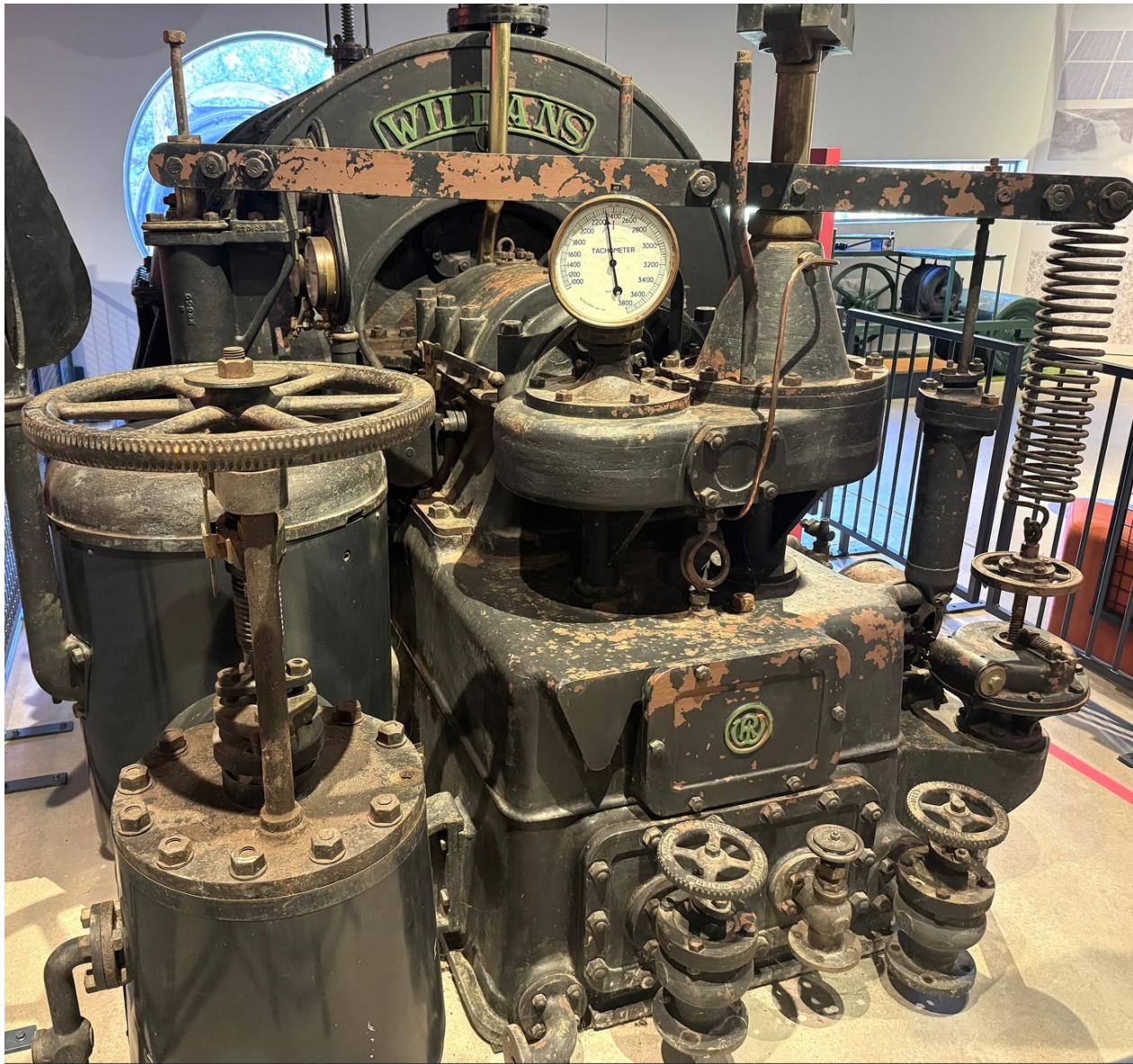


Figure 42: TA No 3 - Turbine End (Preserved at Manjimup Electricity Museum)



Figure 43: TA No 3 - Alternator (Preserved at Manjimup Electricity Museum)



Figure 44: SEC No 1 Electric Locomotive (Preserved by Rail Heritage WA)



Figure 45: Turboalternator No 5



Figure 46: Condenser of Turboalternator No 5 viewed from beneath TA No 6



Figure 47: : Turboalternators Nos 4, 5 and 6



Figure 48: Turboalternator No 7 and associated 22, 000 V Switchgear



Figure 49: Turboalternator No 7



Figure 50: 40 Ton Gantry Main & 5 Ton Auxiliary Crane



Figure 51: Gantry Crane Lifting Trolley

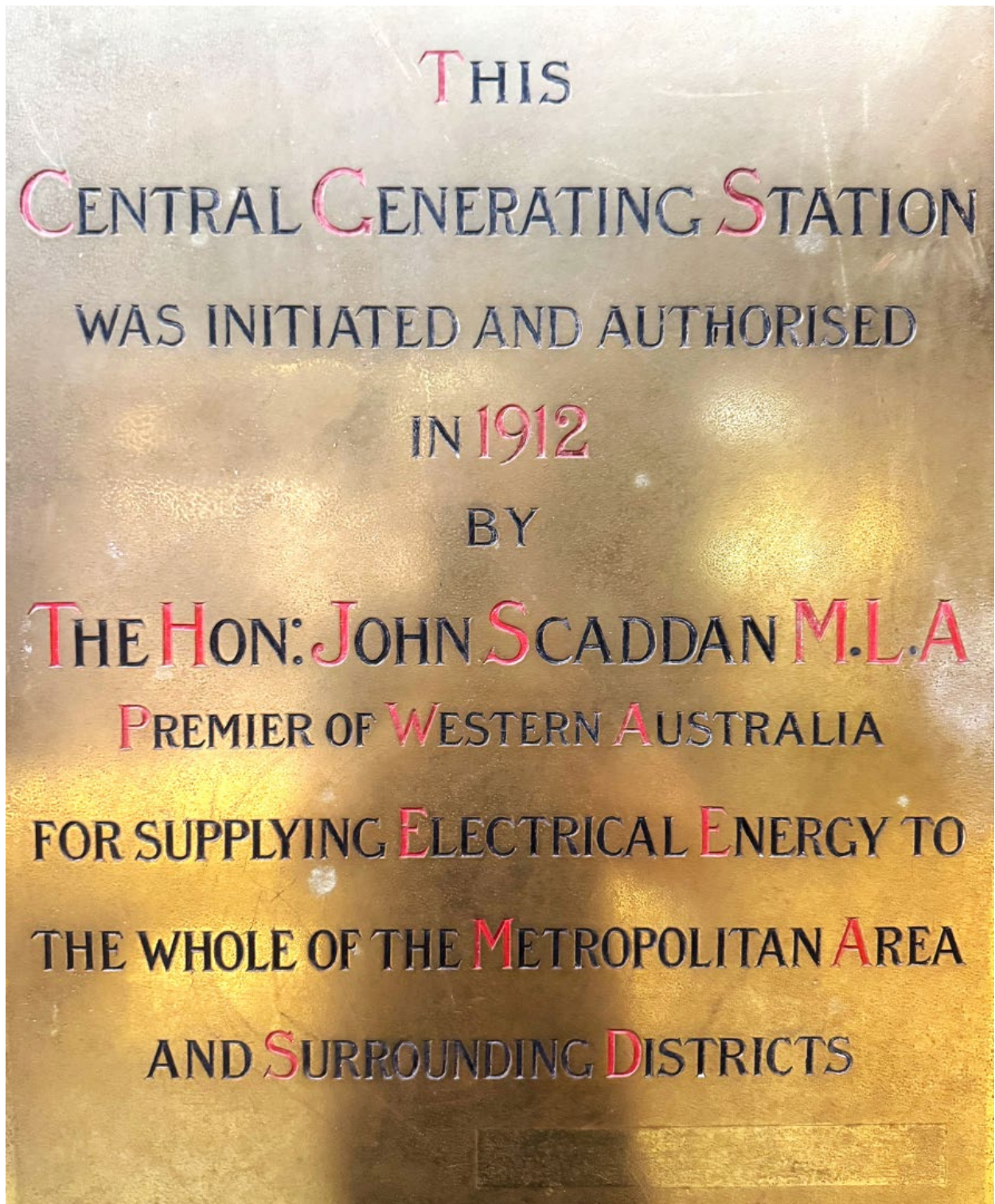


Figure 52: Power Station Commemoration Plaque (Preserved at Manjimup Electricity Museum)

11. LOCATION MAP



Figure 53: <https://earth.google.com/web/@-31.95040427,115.86554423,16.31183892a,6030.68897569d,35y,0h,0t,0r/data=MikKJwolCiExRVpITHp2QIU0cXI3X2hDWjJ0U3BHZZiNbxZsZzc3X3ggAToDCgEw>

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State Energy Commission of W.A. Annual Reports

West Australian Newspapers of 07-05-14
West Australian Newspapers of 11-12-16
West Australian Newspapers of 14-12-16

Perth City Council - Lighting Accountants Instructions 737/1916
Perth City Council - Lighting Committee Minutes 27-2-12 to 27-11-17
Interviews with former S.E.C. employees who held positions at East Perth Power Station:

Mr E Plues, from 1940 Distribution Engineer with the WAGES and
from 1956 Approvals and Testing Engineer with the SEC,

Mr S Clarke, Charge Engineer

Mr K Nicholas, Station Engineer at the time of closure

Mr M Shean, Power Production Engineer

Mr Ron Buller, Unit Attendant.

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