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VICTORIA.

REPORT

ON THE

COAL WINNING OPERATIONS

OF THE

STATE ELECTRICITY COMMISSION

AT

YALLOURN,

BY J. KLITZING, DIRECTOR OF THE ILSE BERGBAU A.G., GERMANY.

PRESENTED TO BOTH HOUSES OF PARLIAMENT BY HIS EXCELLENCY'S COMMAND.

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Yallourn,
21st April, 1926.

Sir John Monash, G.C.M.G., K.C.B.,
Chairman,
State Electricity Commission of Victoria,
Melbourne.

DEAR SIR,

I have pleasure in handing you herewith my Report on the technical and economic exploitation of the brown coal deposits at Yallourn, in the State of Victoria.

I take this opportunity of expressing my special thanks for the honour you have done me in commissioning me to undertake this important work, and to say that its execution was a source of much pleasure to me. It has been particularly a pleasure, because I had not previously had the opportunity of inspecting, studying, and preparing a project for so rich a coal deposit as the State of Victoria possesses at Yallourn ; rich not only in the magnitude of its coal resources, but also in the extreme uniformity of its disposition—an asset of vital importance from the point of view of mining economy. The moisture of the coal itself is not the serious factor which is here generally attributed to it. Furthermore, it can be reduced by suitable measures, to which I have devoted special consideration. I have no doubt as to the success of such measures.

Wherever possible I have in my work drawn comparisons with the modest brown coal deposits found in Europe and their economic influence on mining, and the points in favour of the Yallourn Coal-field are clearly illustrated by the resulting figures. In the following pages I have taken the liberty of making further comparisons which did not come within the scope of my project, but which may be of interest.

I may at this point, perhaps, be permitted to congratulate the State of Victoria in possessing men who have realized the great economical importance of its coal resources, and who, in spite of many difficulties, have pursued the policy of utilizing these valuable resources for the benefit of their country, and their efforts will assuredly be crowned with success.

The earlier developments of the Marga Works, which came under my direction, may be of interest in this connexion.

In comparison with Yallourn, the Marga coal deposits are very modest indeed, and, in addition, lie in decidedly swampy locality, through which runs a subterranean stream. Many mining experts publicly declared that mining here was an impossibility, and that Marga would never produce a single briquette. Nevertheless, with the aid of all the latest perfections of mining technique, and a huge pumping plant, the scheme was put in hand, and carried through. To-day Marga is one of the largest brown coal works in the world, and, in addition to raw coal and power, 3,300 tons of briquettes are produced per day (Yallourn only produces 350 tons per day).

At Marga 130 cb. m. (29,000 gallons) of water used to be pumped per minute, and to-day 70 to 80 cb. m. per minute are still pumped. All this, of course, meant heavy working costs, which could only be covered by large production, and so, with the opening up of the mine, a briquette factory, equipped with 40 presses, was immediately erected (Yallourn has five presses).

In comparison with the above quantities, the water flowing in the coal at Yallourn is negligible, the water actually pumped per minute being only a few gallons.

The coal deposit at Marga, as stated previously, is a very modest one, as the following figures will demonstrate.

The Marga mine has 30 m. (100 feet) overburden on a coal seam of only 10 m. (33 feet) depth, whereas Yallourn has only 10 m. (33 feet) overburden covering 50 m. (165 feet) coal. The effect of these considerations is that at Marga 3 cb. m. (3·9 cubic yards) overburden rest on every ton of coal, while at Yallourn only one-fifth cb. m. ($\frac{1}{4}$ cubic yard) of overburden lies on 1 ton of coal, i.e., only one-fifteenth as much as at Marga. That such conditions must have a favorable effect on the working costs at Yallourn will be obvious. Applying these figures to one year's operation, the result is that, with a daily output of 10,000 tons of coal in each mine, at Marga 10,000,000 cb. m. (13,000,000 cubic yards) of overburden have to be excavated and removed, and at Yallourn only 0·7 million cb. m (0·9 million cubic yards) per annum.

This comparison clearly shows that considerably more equipment is required at the Marga Mine in order to remove these enormous quantities, and more labour, as well as a larger staff of engineers, is necessary for operation, maintenance, and supervision. A comparative statement relative to the above will be found in my report (page 22).

Nevertheless, Marga operates on a profitable basis, a fact attributable only to the continued application of the latest advancements in mining technique. Recent years particularly have brought considerable progress in the development of large electric dredgers for coal and overburden, and through the introduction of locomotive transport and the use of special machines for mechanically dumping large quantities. Thus, hand labour has been entirely superseded.

These improvements, and the latest achievements in mining technique, have been carefully considered in relation to and adapted to your undertaking in such a manner that, should my project be approved of, I am convinced that my proposals will yield favorable results.

It must be pointed out, however, that a deposit such as exists at Yallourn calls for rich harvesting—in other words, it demands large production. Small outputs require small uneconomical machines and equipment, and the same personnel as would be wanted for large machines. Thus the larger the production the cheaper the working costs, and I consider that *each* working face at Yallourn should produce 10,000 tons per day. A market will not be wanting since large outputs will decrease working costs, and brown coal, whether in the form of briquettes or power, will then compete with black coal, which at present is still being imported in large quantities. Your statistics show that, apart from black coal for locomotives, you still have a possible market for over 1,000,000 tons of briquettes per annum. Furthermore, 330,000 tons per annum of expensive firewood can be replaced by briquettes. The wood so released would be available for other purposes. There is, therefore, a possible market of 1·3 to 1·4 million tons of briquettes per annum. The local briquettes are of excellent quality, and as they have the same calorific value as the European briquettes, are equally as good as these. When compared as to ash content, the Yallourn briquette, which has several per cent. less ash, is admittedly superior.

A similar growth in production is possible in the case of power where brown coal should supersede the use of black coal in power stations burning the latter at present. In Germany large power stations have been erected on a brown coal basis in the centre of black coal districts.

It is, of course, of utmost importance that every citizen of this State should support the undertaking over the costly period of development by at once making use of brown coal, whether in the home or in the factory, whether in the form of briquettes or power. He thus also helps himself, since by a greater demand he helps to raise production, and

Increased Production Means Reduction in Price.

That at present briquettes are comparatively expensive is not surprising—with a daily production of only 350 tons it could not be otherwise. In considering an enlargement of the briquette factory, however, it is essential to fully utilize the progress made in this industry, i.e., the installation of a boiler plant with high-pressure boilers, and, incidentally, low steam-drying pressure. By this means even greater quantities of surplus electrical energy are won than at present, which, apart from amortization of the machines, cost almost nothing.

The above statement can best be illustrated by a concrete example.

At one of our older works called Anna-Mathilde, until 1923 only 1,100 kw. surplus energy was produced with a daily production of 930 tons of briquettes, with a boiler pressure of 12 at. (180 lb. per square inch) and a drier pressure of 3·6 at. (54 lb. per square inch). After the plant had been equipped with boilers at 34 at. (510 lb. per square inch) pressure and turbines were installed, the surplus energy to-day amounts to 2,800 kw., and will soon be increased to 3,500 kw., with almost the same coal consumption.

The removal of dust developed during manufacture by electrical precipitation is another important improvement in the briquette industry. See article in the *V.D.I. Journal* by Director F. Fischer, of the Ilse Mine.

For years experiments in this direction have been carried out at Marga, and to-day the process has been perfected to such an extent that precipitation plants are being definitely installed throughout. Thus at Marga four of the drier stacks have been remodelled so far without interrupting operations, and the remainder will be reconstructed one by one. Other works are also installing these plants in Middle Germany and in the Rhineland.

Electrical precipitation of dust is important, in so far as the coal dust which is liberated in the revolving drier drums during the process of drying the raw coal is recovered by high tension direct current in a *dry state*. This coal dust may be burnt under boilers as pulverized fuel, or it can be returned to the process of manufacture for briquetting. Up to the present this coal dust, which had already been dried down from 65 per cent. to 15 per cent. moisture, has been caught by fine sprays. The muddy water was either filtered, the residual coal sludge being burnt under boilers as far as possible, or it was allowed to run to waste.

The quantity of coal dust caught by the wet method of extraction is approximately 5 per cent. of the total briquette production, while 2 per cent. escape to atmosphere, representing a total loss of 7 per cent. On a daily briquette production of 350 tons per day this means an annual loss of 350 × 300 = 105,000 tons at 7 per cent. = 7,350 tons; or, expressed in money value, assuming a ton of coal dust at 10s., equals £3,680 per annum. With the proposed enlargement of the factory, the amount would be increased to £10,500 per annum.

The installation of an electrical precipitation plant would well pay for itself, and I would recommend you to consider this question and, perhaps, to send an engineer to Germany to study the electrical precipitation of dust.

I may, therefore, assume with safety that with a reduction in the cost of coal, followed by a corresponding decrease in the production cost of briquettes and power, other coal and power consuming industries will develop and contribute towards the prosperity of the country, e.g., the local production of aluminium which, as your statistics show, is imported in large quantities (about 1,000 tons per annum) into Victoria, may be taken up.

The above observations illustrate the far-reaching importance of brown coal to the State of Victoria and its inhabitants, and that the State Electricity Commission is deserving of the utmost support.

I am,

Yours faithfully,

J. KLITZING.

COAL REQUIREMENTS.

The following are the estimated coal requirements on which the project is based :—

1926—(*a*)	First half	3,700 tons per day
(*b*)	Second half	4,200 tons per day
1927—(*a*)	First half	5,000 tons per day
(*b*)	Second half	5,700 tons per day
1928—(*a*)	First half	5,700 tons per day
(*b*)	Second half	6,000 tons per day
1929—(*a*)	First half	6,000 tons per day
(*b*)	Second half	8,000 tons per day

From 1926 to the first half of 1929 increase in requirements through the Power Station.
From the second half of 1929 increase in requirements through extension to the Briquette Factory.

COAL WINNING OPERATION.

1. ARRANGEMENT OF THE MAIN WORKING BENCH AND HAULAGE THEREFROM.

1. The fundamental principle to be aimed at, in order to cheapen and simplify the operation of coal winning, lies in placing the whole of the operations, both coal winning and transport, for both Power Station and Briquette Factory upon a single main working bench. Upon this bench all the coal winning and transport appliances can be made to operate in unison with and for each other ; the whole operations are thereby concentrated and supervision becomes effective. By thus collecting all coal-winning machinery on a single bench, only a single transport system is required which, however, must therefore be of a very reliable character. Most reliable machinery for the transportation of coal in large quantities is fortunately available. By the creation on the other hand of separate transport systems from different working benches, the capital cost, as well as operating costs, are increased, without increasing the safety of coal transport, since the operation of several transport appliances complicates working, and thus has a detrimental influence on safety.

2. As a safe means for the haulage of large quantities, locomotive traction, associated with what is known as an inclined steep haulage, has proved thoroughly successful ; the latter, at the same time, serves to overcome considerable differences in height by the shortest route. An inclined steep haulage operates in the same way as a skip hoist in deep shafts, with the difference that in the case of the former the hoisting is not on the perpendicular, but on a sloping plane. In going up-hill a powerfully sprung dummy truck places itself behind the loaded train, pushing it up-hill, while the empty train descends of its own accord behind the twin dummy truck. The couplings of the coal trucks and locomotive are not brought into operation at all and, therefore, no interruption through breakages of these couplings need be feared, nor do any delays occur through the coupling and uncoupling of haulage ropes or chains which would be required in any other form of haulage.

3. It is worth noting that with such inclined steep haulage, the dead weight of the ascending train is balanced by that of the descending empty train, and the useful load alone must be hauled up. The original mode of operation on steep haulages was to couple and uncouple the locomotives. This can now be eliminated as well. The locomotive ascending, as well as the one descending, is left coupled to the train, and both will perform work while so moving. Thus, the tractive efforts of both engines is availed of, and the steep haulage hoisting engine can thereby be reduced in size. In eliminating the process of coupling and uncoupling in the open cut and at the top of the incline much time is saved, thereby increasing the output of the haulage appliance, since the time for each working cycle is thereby shortened. This is a recent amended patent of the Buckau Company, which firm specializes in these inclined steep haulages. Similar Buckau steep haulages have been operating for a number of years and have worked very satisfactorily in the Lausitz, in the Rhineland, and at the State Ambr Works at Palmnicken. The capacity of a single such steep haulage is 12,000 tons per diem. Thereby 12,000 tons per day are dumped into the bunker by *one man per shift*, and, in addition, he has time to supervise operations at the bunker and keep in telephone communication with the open cut.

4. To use locomotive traction, without steep haulage, in order to overcome great heights (such as are met with in brown coal open cuts having deep coal deposits) and for the transportation of large outputs would mean, in the first place, to employ the locomotive as a hoisting machine ; secondly, on the downward journey a large amount of valuable potential energy would be completely lost through the braking action of the locomotive.

5. Ropeways do not, it is true, possess certain of the disadvantages of direct locomotive haulage. They are, however, quite unsuitable as a means of transporting large quantities, and their use has been abandoned in all cases where outputs have been materially increased. They have also been done away with wherever by locomotive haulage transport costs can be lowered.

(*a*) Thus, for example, at the Marga Mine the chain haulage (equivalent to the Yallourn ropeways) was displaced by locomotive haulage, as the latter ensured larger capacities and cheaper working costs. This resulted in a saving of 100 men per day. In the same way, haulage by locomotive has been introduced throughout the Rhineland for the purpose of increasing haulage capacities as well as for lessening working costs. In one case five existing chain haulages were replaced by one inclined steep haulage ; even in mines with small productions a change to locomotive haulage was effected with advantage, for example, at the Plessa Coal Mines, with an output of only 2,000 to 3,000 tons per day. In this case locomotive haulage is operating to a considerable distance from the open cut, and on normal grades without a steep haulage incline.

(*b*) Transport by means of rope or chain haulage is not only limited in capacity (about 4,000 tons per day), but is more expensive in comparison with locomotive haulage. Only to re-load coal from a shovel to ropeway trucks, seven men (i.e., men on loader) are required. These are dispensed with in the case of transportation by locomotive. Further, the rope haulage can overcome gradients of only 1 : 17, whereas steep haulages can have grades of 1 : 6, and if necessary, 1 : 5. Hence, to overcome the difference in height between the mine and surface level (40 : 45 m.) the ropeway will require a distance of 17 × 40 = 680 m., or 45 × 17 = 765 m. length, respectively. Locomotive transport with steep haulage will require a length of only 6 × 40 = 240 m., or 6 × 45 = 270 m. Thus, for the ropeway, lines almost three times as long as are required for the locomotive transport with steep haulage must be constructed, maintained, and supervised. The liability to interruptions in ropeway operations caused by rope breakages and material damage resulting therefrom must not be disregarded.

(*c*) A further disadvantage of rope haulage is that the working tracks, i.e., those running under the loader, must be continuously shifted by hand or rebuilt.

6. It would be equally disadvantageous at Yallourn to endeavour to operate without a steep haulage, in other words, to use the locomotives alone as hoisting machines. The maximum gradient in the latter case would be 1 : 60, which means that to overcome the difference in height of 40 to 45 m., a length of track 40 × 60 = 2,400 m., or 45 × 60 = 2,700 m. (1·7 miles), respectively, would have to be constructed and maintained. Expressed in other words, this means that for the transport to surface level alone, ten times the length of track would have to be constructed and maintained, and the total output of the mine would have to be transported many times further than in the case of inclined steep haulage. If the height of the bunker (9 m. = 30 feet) is also taken into consideration, the length of track on grade required for locomotive transport without steep haulage would be (35 m. + 10 m. overburden + 9 m. height of bunker = 54 m.), 54 × 60 = 3,240 m., representing an additional length of 3,240 − (54 × 6) = 2,900 m. (1·8 miles) approximately. Apart from the cost of a double track 2,900 m. long and its maintenance charges (construction and material per km. double track = £7,550), and apart from the fact that, in consequence of the longer track, more trains are required (two trains with locomotives and trucks per 10,000 tons per day), and apart from the fact that a locomotive is an inefficient hoisting machine, the whole output of the mine must be carried 2·9 km. (1·8 miles) further than necessary. With an annual production of 3,000,000 tons of coal, the working costs would be increased by 3,000,000 × 2·9 km. = 8·7 million ton-km., which, at 0·5d. operating costs per ton-km., is equivalent to £18,000 more per year. Under local conditions a ton-km. would cost about 1·0d., that is £36,000 per year. I find, therefore, that if the cost of the steep haulage is covered by the saving in track material, there still remains the saving of the above £36,000 per year working costs. From the above considerations it will be seen that, in the transport cost, inclined steep haulage with locomotive transport is a technical and economical necessity.

7. I shall now return to the consideration of operating the mine from a single main working bench. Reckoned from the bottom of the coal, this bench must be so high that the bottom can be reached with an excavating machine without re-loading or re-handling. Since deep dredgers are now built to operate to a depth of 25 m. (82 feet), the main working bench will be 25 m. above the deepest point of the first mine area to be exploited. This gives the so-called 35 m. bench (= 115 feet below top of coal) as the main working bench of the mine, i.e., at the reduced level known and figured on plans as Minus 5.

This arrangement also fulfils the second requirement, which is, that a scraper-dredger has sufficient range in height that it can economically operate on and remove the whole of the coal lying above the Minus 5 level, which is to be the main working bench.

2. COLLECTING POINT OF THE COAL IN THE MINE.

8. The point at which the coal will be collected for transportation to the bunker must at the same time be the pivot point of the working faces of the dredger. The first mine field to be exploited contains over 100,000,000 tons of coal. The point at which this quantity and further quantities to be mined in the future are to be collected for further transport should lie as close to the point of consumption as possible.

9. In the case under review, there are two places of consumption—

(*a*) The Power Station—a large and growing consumer.

(*b*) The Briquette Factory; it must be remembered here that the factory is situate 30 m. (100 feet) higher than the Power Station.

Since, firstly, the Briquette Factory is 30 m. higher than the Power Station, and, secondly, that the Power Station will probably continue to be the larger consumer in the future, I propose to place the point of collection near the Power Station, and provide the Briquette Factory with an independent point of collection only when the requirements of that factory exceed 4,000 tons per day, i.e., *after* the first enlargement of the factory at present in contemplation. To give the Briquette Factory a separate point of collection with a bunker and inclined steep haulage of its own at the present juncture would, with the relatively small present requirements of 1,600 tons per day, be economically unsound. The same observation would apply to the Power Station, if its present-day moderate requirements were not likely to be increased.

10. My proposal is, therefore, in the first place, and until the total output of coal exceeds 8,000 to 10,000 tons per day, to provide a common bunker and steep haulage for both plants, and, later, when the output exceeds this figure, to leave the proposed present bunker and steep haulage for the use of the Power Station only, and then to give the Briquette Factory a separate bunker with a steep haulage, or, alternatively, a belt conveyor.

The point of collecting the coal for the Briquette Factory can, when this later development is reached, be located at the most favorable point for that destination, just as is now being proposed for the common collecting point for both Power Station and Briquette Factory.

11. From the above it follows that the collecting point for the coal, and also the pivot point for the working faces in the coal workings, must be a point near the Power Station. At the same time, the existing ropeway to the Briquette Factory can be used to good effect to supply it with coal until its requirements exceed 4,000 tons a day (see Sketch 1). I have also taken into consideration the modernizing of the Old Brown Coal Mine, which will be treated separately. The problem of later giving the Briquette Factory an independent source of supply has been kept in view in my proposed arrangement of the coal faces. This aspect of my solution will be further dealt with under the heading of " Position of Working Faces."

3. PROPOSED EXTENSION TO OPEN CUT.

12. From the above considerations the locations of the bunker for the Power Station and for the first pivot and point of collection have been established.

13. (*a*) The existing open cut is favorably located so far as the Power Station is concerned, but not so the inclined ropeway at present leading from it. The latter leads to the screening plant, which I propose is to be definitely eliminated, and *would* be eliminated, in any case, when winning coal with bucket dredgers. Nor has the screening-house a favorable connexion with the Power Station. It is neither economical nor is it sufficiently large for requirements above 4,000 tons per day.

(*b*) Further, the face on the north side of the present open cut is endangered by the possibility of landslips, symptoms of which are observable at the present time. This danger would become more serious as the cut increased in depth.

(*c*) The present development also has the disadvantage of being one-sided, that is, it is capable of being developed only on the south side on a single face, since the northern face is bounded by the spoil dump, the railways, and the river. The lay-out of a second face, which would become necessary for an output over 8,000 to 10,000 tons per day, can only be solved by a new cut.

14. The conclusion from these considerations is that the position of the proposed extension to the new open cut should be such that the connexion to the Power Station is the most favorable one possible, and so that the workings could be carried out on two faces simultaneously if desired, thereby making it possible to increase the output from the cut to 16,000 or 20,000 tons per day without any special additional equipment. The proposed lay-out of the extension possesses all these advantages. This position has, in addition, other points in its favour.

15. (*a*) By working on two coal faces (on both sides of the open cut), even with the present moderate prospective requirements of 8,000 tons a day, the coal faces will be exposed for a longer period to air-drying. The full effects of this advantage are more specifically dealt with under the heading of "Air-drying." If a face of 1,200 m. is chosen, and the slope of the coal face is 55 degrees, we have an area of coal face exposed of 72,000 sq. m. on each face. With an output of 8,000 tons per day 11·1 c.m.($4\frac{3}{8}$ inches) would be cut away from this face each day. If the second face be worked as well, the thickness of coal removed from each face per day would be decreased by one-half. Consequently, the effect of air-drying would be so much greater.

A 1 per cent. decrease in moisture in the coal through air-drying on a production of 8,000 tons per day is equivalent to an evaporation of 80 tons of water. To evaporate this water would require about 320 tons of coal per day. Assuming the cost of coal at 2s. per ton, the reduction of 1 per cent. in moisture is equivalent to a saving of £32 per day. This amount would cover interest and depreciation on two additional bucket dredgers, which could be utilized alternatively with those on the first face without increasing operating costs, since both machines would employ the same personnel, i.e., no additional personnel would be required. These additional machines would be required in any case later on when the output from the mine is increased.

(*b*) The location of the proposed extension to the new open cut lends itself particularly to the beneficial effect of sun-drying. (See Sketch 1.)

The drainage of coal in general, and of air-drying in particular, will be discussed in a later section.

16. (*a*) A further advantage of the proposed cut lies in the fact that, by opening it up in a westerly direction, opportunity is provided in the vicinity of the Briquette Factory for the future second point of collection previously mentioned; by placing the first pivot point at point A, the end of the working bench commences to move westward from point B. In this way a face is exposed which can be made to take a ramp leading to the Briquette Factory, and, at the same time, the position for the pivot point B intended for the Briquette Factory is developed without any extra cost. Here, then, a separate steep haulage can in future be installed without difficulty, and at no great expense.

(*b*) The development of both coal-working faces is assured for over twenty years by the lay-out of the cut which I propose. A further development of faces after that time is allowed for as well.

(*c*) The recommended development has further the great advantage that the surface of the overburden, as well as that of the top and bottom surfaces of the coal are admirably flat, i.e., horizontal, and even; that, further, the proportion of overburden to coal is equally favorable, having, according to the cross sections shown on Drawing No. 393/6, a ratio of 1 to 5.

(*d*) The cross sections on these drawings show that this area contains alone a coal supply of 85,000,000 tons, the winning of which can be performed under the most favorable circumstances, i.e., with low operating costs. The same can be said of the overburden, owing to its uniform and level disposition. The possibility also presents itself of linking up the dredger tracks on face A with those of B, either by joining the excavator tracks themselves, or by a special track. Herein lies a reciprocal reserve both of coal and machinery, and the additional advantage of being able to utilize either face exclusively for Briquette Factory or Power Station respectively.

(*e*) A further advantage of the proposed development is that the worked-out area between the two faces will become available for the dumping of overburden. If the workings were one-sided, the unused face would have to be covered with spoil, which, at a later date, would require to be cleared away again at great expense.

4. THE DRAINAGE OF THE COAL BY DEEP DRAINAGE AND AIR-DRYING.

17. The present very systematically executed attempt to drain the coal by means of deep drainage tunnels has proved without a doubt that it is ineffective at the present juncture, and that the cost bears no satisfactory relation to the result achieved. The samples taken up to date have shown that the coal in the drainage drives has still the same moisture content as the coal in the open cut, although the deep drainage system has been in existence for two to three years and has had time to be effective.

18. The small quantities of water collected in the drives are, in greater part, surface waters, which flow down the two shafts, and partly water dripping from particularly damp spots in the coal, which I believe to result from surface waters.

19. In this connexion I am of opinion that with further extension of the open cut the drainage may improve, i.e., pressure may develop in the coal, which will assist in pressing the water out of the coal. As soon as the action of pressure is observed another trial with deep drainage is to be recommended. I would also put forward the suggestion to endeavour at some later date to produce pressure in the coal by explosion, then to carefully observe the results, and draw up a comparison of costs between the quantity of water recovered and the expenditure involved.

I shall be pleased to be of assistance to you in any future experiments of this nature.

20. One thing, however, can and must be done more carefully, in my opinion, and that is the exclusion of all running surface waters, be they factory waste, rain water, or leakage from fire hoses.

21. Notwithstanding its present moisture content, the coal is still capable of absorbing moisture. I had an opportunity of observing this after rain. The rain water collected in depressions and troughs formed on the coal surface, and was gradually absorbed by the coal.

Certain portions of the coal seam took up water more readily, which could be very clearly seen by the damp spots on the coal faces.

22. Especially is loose damp coal capable of absorbing water. This fact is well illustrated by the results of the moisture determinations made on the fine coal dump at the Briquette Factory.

One cannot regard this case as one of air-drying at all, but of continued moistening of loose coal by rain. The coal entirely absorbed the rain water, which gradually found its way to the deeper strata. This is demonstrated by the fact that where air-drying can have no effect, the percentage of moisture increases with the depth.

The results were—

From 0 to 1 foot coal content—60·92 per cent. water.
From 1 to 2 feet coal content—63·83 per cent. water.
From 2 to 6 feet coal content—64·87 per cent. water.
From 6 to 9 feet coal content—65·47 per cent. water.
From 9 to 15 feet coal content—65·83 per cent. water.

Nevertheless, the effect of air-drying is noticeable near the top, which effect, however, will be annulled by rain since the coal here is loosely dumped, and therefore very hygroscopic.

23. This same phenomenon may be observed with the shovel. When digging, a large pile of fine coal is always lying in front of the shovel, which, being loose and constantly shovelled up, easily absorbs rain water.

In order to maintain the coal supply this loose water-soaked mass of coal must, of necessity, be recovered as well.

This constitutes one serious disadvantage of shovel operation.

24. The bucket dredger operates in a different manner. To begin with, it is continually digging on a solid and compact face of coal. On rainy days, when the deep dredger is used for coal winning, the water-laden loose coal at the bottom of the face can be left lying there until it dries.

25. It can therefore be concluded with safety that even on rainy days the coal mined by the bucket dredger will be drier than that won by the shovel.

26. That air-drying is effective has been conclusively proved by the experiments already carried out at Yallourn (see air-drying results).

27. The drying effect naturally decreases with increasing depth, but near the surface the action of the atmosphere is appreciable, and this advantage can only be fully utilized by the bucket dredger and not at all by the shovel. The latter is always digging on a fresh moist face, while the remaining dried coal surfaces on the whole front remain untouched.

28. The advantages of drying by atmospheric exposure can be increased by decreasing to a minimum the thickness of coal taken off by the bucket dredger each day. This can be realized by long and high working faces.

With a working face of 1,200 m. (4,000 feet) at an angle of 55 degrees and a daily output from one face of 8,000 tons, the cut taken off, when the total depth of face is 50 m., will be an average of 11·1 c.m. (4$\frac{3}{8}$ inches).

According to the experiments made, which completely realize my expectations, favorable air-drying results should be realized at this small depth. Such realizations can be satisfactorily enhanced by employing duplicate dredger plant on the second coal face, and taking only 4,000 tons of coal from each face daily. Under such an arrangement the average daily cut to be taken off would be about 6 c.m. (2$\frac{3}{8}$ inches).

29. Increased drying effect may also result from using specially constructed teeth on the scraper and deep dredger. The teeth, by cutting grooves into the coal, will help to augment the coal surface exposed.

30. I therefore reach the conclusion that in the drier season of the year the coal will, in my opinion, decrease in moisture to 62 per cent., while on rainy days the coal from the bucket dredger will still be somewhat drier than from the shovel.

31. Disregarding the latter possibility, and assuming that no rain falls for 200 days in the year (see Rain Tables), and that air-drying will account for a decrease to 62 per cent. moisture, then on a daily output of 8,000 tons, this represents an improvement of 8,000 tons $\times$ 200 = 1·6 million tons of coal dried from 65 per cent. to 62 per cent., or equivalent to an evaporation of 48,000 tons of water. The evaporation by the atmosphere of this quantity of water would represent—

in the Briquette Factory a saving of 1,140 tons coal per day;
in the Power Station a saving of 920 tons coal per day.

With coal at 2s. per ton, the operation costs of—

Briquette Factory would be reduced by £114 per day;
Power Station would be reduced by £92 per day.

Such an amount will cover interest and depreciation to an extent of roundly £30,000 per annum, upon a sum much more than sufficient to provide machinery for the second coal-working face.

32. The operating costs are not increased through the second face since the same dredger and train crews can be temporarily transferred to it during the time that the first face is at rest. I would propose to operate one face on day shift, and the other on afternoon shift, during which time the face not being worked will be subjected to the most favorable conditions for air-drying. For the present, I would entirely avoid the night shift for coal-winning operations, firstly, because it represents an extra charge on wages, and, secondly, because the effect of drying by atmosphere will be relatively smaller.

33. It must, however, not be forgotten that air-drying can be made to become effective only gradually with the development of coal faces through the use of bucket and scraper dredgers.

34. Unfortunately, not sufficient attention has been paid so far to the stripping of overburden for coal reserves. More extensive areas of coal should certainly have been brought into existence.

This project, namely, the uncovering of coal, cannot be too assiduously pushed ahead, for the early lifting off from the coal surface of the overburden blanket brings about an aeration and drying of the coal so uncovered.

35. It may be said in reply that rain will continually moisten the coal again. That is true, but so also is the coal kept damp by the superimposed overburden blanket, which absorbs much moisture and passes it on to the coal. However, as previously pointed out, the coal does not immediately absorb all the rain. After rain one can readily observe pools of water on the coal which are only very gradually absorbed. This fact can be taken advantage of by cutting trenches on the coal surface in order that stormwater, particularly during heavy and short downpours in summer months, can be quickly led away to the pumps. The disadvantages of rain are minimized by this means, and air-drying of the exposed coal surfaces will meet with success.

In the same manner the overburden, which should be removed well ahead, must be drained with the aid of trenches.

36. This work, and the study of all details relative to the artificial moisture of the coal, must be carefully observed. It is a function of the coal-winning operations, and I believe that if an engineer were to study this phase thoroughly, and carefully supervise these works, it would be of great advantage to the whole undertaking. He must always bear in mind what great significance lies in the reduction of coal moisture by merely 1 per cent.

5. BUCKET OR SHOVEL EXCAVATION.

37. From the foregoing section the superiority, with special reference to better air-drying of the bucket dredger over the shovel, has been shown. I shall also make a critical comparison between the economy of both types of excavators. For this purpose the following table, which has been drawn up from working figures, will be used. For purposes of comparison, a bucket dredger, such as I propose for your conditions, has been chosen, with a practical output of 5,000 tons in two shifts, as against your "Ruston" shovel.

There is no material difference between the maintenance and repair charges for both types of excavators :—

1. Type of excavator	Ruston shovel	Bucket dredger
2. Practical output per hour	250 tons	310 tons
3. Capital cost, including erection	£59,370	£30,000
4. Capital cost per 1,000,000 tons annually	£49,500	£20,250
5. Interest per 100,000 tons at 8 per cent.	£396	£162
6. Labour required per shift	10 men	4 men
7. Wages required per shift	£8	£3 4s.
8. Wages per 100,000 tons	£400	£128
9. Total interest and wages per 100,000 tons	£796	£290
10. Saving in working costs for interest and wages per 100,000 tons		£506

(*a*) This statement shows the economic advantage of the bucket dredger over the shovel.

(*b*) Further, the bucket dredger supplies a more uniform coal than the shovel, which tears off very large pieces which hinder transport unless a breaker is used ; and this, in turn, increases the cost of coal winning and demands an extra handling of the coal.

In a more extensive test over a lengthy period, which I made in Germany, the texture of the coal was—

	(*a*) With the shovel in per cent. and without breaker.	(*b*) With the bucket dredger in per cent.
Under $\frac{1}{4}$ inch	37	17
Between $\frac{1}{4}$ inch–$2\frac{3}{8}$ inch	38	23
Between $2\frac{3}{8}$ inches–4 inches	8	21
Over 4 inches	17	39

(*c*) In the case of the bucket dredger it is quite a feasible proposition to build a breaker into the hopper, i.e., at a point where the coal must pass in any case, and, therefore, where neither re-loading nor special supervision is required.

(*d*) A further advantage of the bucket dredger lies in its greater safety in operation, while, in the case of the shovel, interruptions may easily occur through trouble to tracks (e.g., in excavating the trunks of trees or by carelessness of the personnel during shifting operations, &c.). It has often happened that shovels have capsized.

(*e*) The work of men engaged under and near the shovel is unpleasant, and always dangerous owing to falling lumps of coal.

(*f*) Fatal accidents are not unusual in this connexion.

(*g*) Another point meriting consideration is that a number of men are continually engaged under the loader to remove the spillage.

(*h*) Not least in importance is the fact that the output per man is increased by the bucket dredger. The shovel driver can dig a large or a small number of buckets, and can do so in a skilled or a clumsy manner ; on the other hand, the bucket dredger works almost automatically and continually maintains the required output.

(*i*) There is one point which I would not like to omit mentioning ; on each working face, one dredger can be worked with a flat slope for sunny days and the other with a steep slope for rainy days, which would help to drain the rain off.

38. These considerations demonstrate the great superiority of the bucket dredger over the shovel, which may be shortly summarized as follows :—

Bucket Dredger.	Shovel.
Good air-drying of the coal	None
Greater economy than	In the case of the shovel.
More uniform coal texture than	,, ,,
More suitable texture than	,, ,,
Safer in operation than	,, ,,
Safer with regard to accidents than	,, ,,
Shifting of tracks simple, being done by machine	Changing of the tracks by hand.

All these advantages caused us in Europe to replace shovel by bucket excavation years ago.

6. LOCATION OF THE BUNKER WITH REGARD TO COAL SUPPLY FROM THE OLD OPEN CUT.

39. It would not be right, in my opinion, to omit modernizing and thus improving the working of the old brown coal mine in connexion with the new project; since, first of all, according to the present state of coal-winning operations in the new mine, the old mine will have to supply coal for the Power Station for at least two years from now. Secondly, there exists in the future a market for raw coal. Finally, the possibility of using old mine coal for the purpose of gasification and, incidentally, recovery of by-products, must be remembered.

The possibility of modernizing the old mine has been taken into consideration in locating the bunker, and will be referred to later.

40. (*a*) The projected bunker can be supplied from the new open cut by means of the inclined steep haulage on the shortest possible route leading out of the mine, and can at the same time be supplied from the old open cut by means of a railway line rising on a grade of 1 : 60.

(*b*) Here a special hauling device is unnecessary, for the height to be overcome is only 9 m. (30 feet), and there is a length of haul of 2 km. ($1\frac{1}{4}$ miles), which will rise on a grade of 1 to 60 to the top of the bunker. Thus there is no necessity, artificially, to increase the length of haulage.

(*c*) The bunker itself will have a capacity of 1,500 tons. The Telpher plant and storage pile, which I consider necessary for local conditions ruling at present, are increased in capacity by the said 1,500 tons, while the further possibility remains of drawing on the bunker for Briquette Factory requirements.

41. The fundamental idea governing the choice of the bunker location and its arrangement was to leave the Telpher plant and storage pile intact.

42. Division walls may be fitted in the bunker and the several sections may be filled as desired with coal either from the new or old open cut. It is therefore possible to supply—

(*a*) old open-cut coal to the Power Station,
(*b*) new open-cut coal to the Power Station;

also, if necessary—

(*c*) old open-cut coal to the Briquette Factory,
(*d*) new open-cut coal to the Briquette Factory;

and, additionally—

(*e*) old open-cut coal for raw coal sales,
(*f*) new open-cut coal for raw coal sales.

43. The device for delivering coal from the bunker itself is quite a simple one, and necessitates only one man on every shift for supervision. This method of discharging coal was first made use of by the Ilse Bergbau A.G. on the Marga Mine. This project was prepared and carried out in collaboration with the Buckau Engineering Company, of Magdeburg. The plant is simple in construction, as is also the method of working, and it is at the same time so reliable in operation that individual works in Germany subsequently installed our coal-feeding device on their bunkers.

I would not like to omit mentioning that as a result of this coal-feeding device the bunker equipment can be made remarkably simple and effective even when handling unbroken coal.

44. The old method of emptying bunkers was the provision of separate discharge doors to every bunker pocket. This had the great disadvantage that the coal settled solidly in the separate pockets, leaving a vertical shaft-like opening, which could be loosened only by expensive and dangerous hand work.

45. The proposed bunker is provided merely with two inclined side walls which at the bottom form a longitudinal slit, which extends the whole length of the bunker and is always open. (See Sketch 3.) The coal passes unrestricted through this wide slit and settles, at its natural angle of repose, on a table which is placed under it. An automatic tipping truck, with revolving feeders, travels to and fro along the table and removes the desired quantity of coal. By adjusting the speed of the feeder any desired quantity of coal can be taken from either side of the bunker table. The quantity can be regulated so accurately that, for example, a thin fine stream or strongly flowing coal can be maintained at will. The output of such a single mechanical feeder is 5,000 to 6,000 tons daily. This output can be increased to twice this amount by using a second feeder on the other side of the bunker.

The automatic feeder pushes the coal on to a conveyor belt situated between it and the table, there being two such belt conveyors, one on each side of the table. The feeder is automatically reversed at the end of its run along the bunker.

The reversing gear can be adjusted so as to operate at any desired part of the bunker and therefore the coal can be loaded on to either belt conveyor from any particular division in the bunker.

I may recommend the inspection of a similar plant at the Marga Mine by the engineers of the Electric Supply and Briquetting Departments. I understand that Mr. Bridge, Engineer in charge Coal Supply, inspected the plant at Marga soon after it was put into operation.

On account of the continual movement to and fro of the feeder, the coal in the bunker is always in motion, and sticking has never, up to the present, occurred.

I have assumed the slope of the bunker side walls at 60 degrees (Marga has 58 degrees slope). However, I would recommend that a working test be made to verify whether 60 degrees is sufficient. For this experiment a section of the bunker should be erected temporarily in wood, having side walls at 60 degrees and a table below it, all to full size. When feeding coal into this bunker section and on removing it from the table below, observations must be made to see whether the coal passes smoothly through the bunker. The bunker face should be suitably lined with sheet metal. If the test shows that 60 degrees is sufficient, this slope may be adhered to.

46. With regard to the transport of coal from the bunker, I suggest that the northern belt conveyor should supply the Power Station and the southern one the Briquette Factory. As the Briquette Factory will not yet fully utilize this conveyor, it may be used at the same time as a raw coal loading conveyor. If the raw coal sales increase much more than at present—e.g., if they increase to over 1,000 tons per diem—a separate conveyor must be installed. At present this would be absolutely unnecessary.

Both bunker discharging conveyors can be made to deliver to crushers. In any case room has been left for that purpose, so that crushed coal can be supplied to the Power Station, Briquette Factory, and raw coal loading plant, as required.

The coal for the Power Station is to pass over an ascending conveyor belt for the boiler bunkers, so that for every boiler bunker the required quantity of coal can be tripped off as required.

It is also possible to draw off any desired quantity of coal from the conveyor at any desired point of the storage pile. The Telpher plant will continue to supply coal to the boiler house from the storage pile whenever necessary.

The briquette coal conveyor will, on the other hand, convey the coal to automatic loader (already existing in screening house), which is to be set up near the bunker. This loader will load trucks on No. 4 ropeway (leading to the Briquette Factory), which will have to be extended towards the proposed bunker.

The alterations to the ropeway tracks are not important, and the existing ropeway plant, which is capable of handling up to 4,000 tons, though inefficient in many respects, can be still utilized to advantage.

47. To install a new belt conveyor to the Briquette Factory from the bunker at the present time would be too costly, and would not pay interest on the transport of 4,000 tons per diem, much less would locomotive haulage pay. The latter would be more expensive still and less economical, on account of the altitude of the Briquette Factory, as well as on account of the structural work necessary over the congested area near the Power Station.

7. EXTENSION OF THE BRIQUETTE FACTORY AND POWER STATION IN RELATION TO COAL SUPPLY.

48. As previously mentioned, the No. 4 ropeway is capable of handling outputs up to 4,000 tons. When requirements above that amount have been reached it will then be time to supply the Briquette Factory with a separate coal-working face and separate transport system *in the vicinity of the Briquette Factory.*

49. The time will then have been reached when the Power Station will take over exclusively the steep haulage and bunker which it had used in common with the Briquette Factory up till then, since extensions to the Power Station will by then have also eventuated.

50. The re-arrangement of coal supply to the Briquette Factory, referred to above, will then be the subject of a special project. It must, however, be considered in the present development of the mine. The probable future extensions to the Power Station of a second and third boiler-house must also be considered in the present scheme. The proposed coal supply to these is shown in the drawings I am handing to you with this Report. These drawings also show that room has been left for possible telpher plants and storage piles for both new boiler-houses.

As previously mentioned, one inclined steep haulage has a capacity of 12,000 tons per day, and a single bunker can deal with 10,000 tons per day. These outputs will be entirely set aside for the requirements of the Power Station as soon as the Briquette Factory receives a separate coal supply. If the date of the Power Station extension does not coincide with that of the Briquette Factory, that is, if the Power Station is enlarged sooner, then the Briquette Factory should receive an independent coal supply earlier.

In the meantime, the Coal Supply Department should accumulate liquid reserves saved from operation expenses to be used for the second steep haulage to the Briquette Factory, and for the second coal-working face. A special item is charged against operating costs in the cost sheets appended.

B.—OVERBURDEN OPERATION.

1. EXISTING MODE OF OPERATION.

51. Reference has already been made, under section 4—" The Drainage of the Coal by Deep Drainage and Air-drying "—to the removal of overburden so as to create coal reserves. The stripping of overburden has, however, the further advantage of ensuring safety in operation. One can go further, and in favorable years create a secret reserve for the whole undertaking, which may be drawn on when necessity arises. In other words, overburden operations may be suspended temporarily if required. This necessity may arise in times of labour shortage, or whenever men are urgently required in the mine for track construction, &c.

It may also become necessary to set up the dredger machinery, and with it the transport system, temporarily at some other point on overburden removal.

To meet all such eventualities it is of extreme importance to carry the overburden operations well ahead of actual requirements. This can easily be done, as the overburden conditions in relation to the coal are *exceptionally favorable* at Yallourn.

52. (*a*) The present overburden plant and equipment is not suitable for this work. Its capacity is too small and operation too costly.

There exist at present for overburden removal—

(1) The 3½-yd. shovel, with a capacity of 700 cb. m. (900 cubic yards) per eight-hour shift.

(2) The 2½-yd. shovel, with a capacity of 460 cb. m. (600 cubic yards) per eight-hour shift.

(3) The new drag line, capacity 460 cb. m. (600 cubic yards) per eight-hour shift.

Under the *most favorable* circumstances these machines would have a total capacity of approximately 1,600 cb. m. (2,100 cubic yards) per eight-hour shift, or in two shifts 3,200 cb. m. (4,200 cubic yards). In the present state of operations, however, the output would fall short of this figure by a long way. At the present time the 3½-yd. shovel is operating with very small outputs.

In the last month it removed only 25,000 cb. m. (33,000 cubic yards approximately), or with a ratio of overburden to coal of 1 to 4·5, only 112,500 tons were uncovered.

This is far too little for a new open cut undertaking, where a great deal of coal has to be left in place for batters, ramps for ropeway, &c., nor would it be sufficient to remove 3,000 cb. m. (4,000 cubic yards) per day in the initial stages, for it would take too long to attain the advantages accruing from coal reserves.

(*b*) In addition, many small machines are expensive to operate, since every shovel or dredger must have the same crew whether it digs 400 or 700, or, as I wish to propose, 2,500 cb. m. per shift. It is quite feasible to reach this latter figure with a single bucket dredger; on the contrary, a large bucket dredger with a capacity of 2,500 cb. m. (3,300 cubic yards approximately) in eight hours will require less men than any one of the present shovels. Then, in the case of shovel operation, the reconstruction of tracks is a constant source of trouble. It has to be done by hand. In the case of the bucket dredger, a machine does this work—a track-shifting machine of a kind which is used in Germany by the hundreds.

(*c*) The costs per cb. m. of overburden at the present time are extremely high, but I shall come to speak of this later, under " Overburden Costs."

It must not be overlooked that the overburden-stacking plant used hitherto cannot be employed for the proposed extension of the open cut, as it would merely dump the spoil to one side of the cut, and this dump would have to be rehandled when the second coal face came to be put into operation.

2. PROPOSED OVERBURDEN OPERATION.

53. Although only relatively small quantities of overburden have to be dealt with, since one ton of coal is equivalent to $\frac{1}{4}$ to $\frac{1}{5}$ cb. m. overburden, overburden operations must nevertheless be conducted as cheaply as possible. Every fraction of a penny per cb.m. or per ton of coal mounts up at the end of the year to a large figure wherever large quantities have to be transported.

54. It must be taken for granted that the coal winning operations should create a substantial coal reserve out of overburden operating costs, and this charge is provided for under operating costs by taking the ratio of overburden to coal as 1 to 4 (actually it is 1 to 5).

55. In considering the question of the removal of overburden from the coal, not only should coal reserves be considered, but also the exposure of the coal surface. In my opinion, there should be at least 200 meters (650 feet) at the outer end of the coal face between the overburden and coal faces, if all advantages to be gained are availed of.

56. Assuming bucket dredger operations to start on overburden from 1st July, 1927, and that overburden precedes the coal by 200 meters after three years, then sufficient overburden must be removed in these years to uncover the following amounts of coal :—

(*a*) For Actual Requirements—

1927—2nd half, 5,700 tons per day	= 0·9	million tons per annum.
1928—1st half, 5,700 tons per day	= 0·9	,, ,,
1928—2nd half, 6,000 tons per day	= 1·00	,, ,,
1929—1st half, 6,000 tons per day	= 1·00	,, ,,
1929—2nd half, 8,000 tons per day	= 1·25	,, ,,
1930—1st half (assumed), 10,000 tons per day	= 1·5	,, ,,
Total approximately	= 6·55	,, ,,

(*b*) For Coal Reserves—

$\frac{200 \times 1,200}{2} \times 50$	= 6·0	,, ,,
Total approximately	=12·6	,, ,,

Say 13,000,000 tons.

57. Assuming an actual ratio of overburden to coal of 1 to 4·5 owing to losses through batters, ramps, &c., the following amount of overburden must be shifted in three years :—

$$\frac{13,000,000}{4 \cdot 5} = 2 \cdot 89, \text{ say, } 2 \cdot 9 \text{ million cb. m. (3·8 million cubic yards.).}$$

Therefore in one year— $\frac{2 \cdot 9}{3}$ = approximately 1,000,000 cb. m. of overburden, or in 250 working days (50 days are deducted on which there is possibly no output due to rain) $\frac{1,000,000}{250}$ = 4,000 cb. m. (5,250 cubic yards) of overburden must be shifted per day.

58. These 4,000 cb. m. must actually be removed every day, and in order to be on the safe side, I recommend the purchase of a bucket dredger with an actual output of 5,000 cb. m. (6,500 cubic yards) in sixteen hours, including all stoppages.

The bucket dredger will be required to continue taking 4,000 cb. m. per day after the termination of the three years, in order to create a still larger reserve, so as to meet further increased demands on the coal supply.

However, I do not wish to lay plans beyond this time, as I do not yet know the extent of the coal requirements. It may perhaps be advisable, when that juncture arrives, to provide another similar overburden dredger on the second coal face.

59. The overburden area which is actually being worked must also be protected from storm waters or other surface waters.

I therefore recommend that a deep trench be cut with embankment on one side from the Briquette Factory ridge to the Morwell River, in order to protect the first mine field. For such work, a shovel or drag line could be used to advantage, either of which would cut about 100 feet of trench with embankment per 8 hours.

The cost of such work must be included under operating costs.

3. ARRANGEMENT OF OVERBURDEN WORKING FACES.

60. Obviously the lay-out of the overburden working faces must correspond with those for coal winning. Having regard to the existing overburden conditions, I desire to recommend a provisional scheme designed to uncover as quickly as possible the coal immediately required, and shall enter into this project in more detail hereunder.

The period necessary to develop the new operations will be specially treated in this section.

61. Not only for coal winning, but also for overburden as well, it is essential to find the shortest route over which to transport the overburden mass to the dumps. Unfortunately, we are somewhat hampered by the existing workings, but a way can be found by bridging over or by embankments across the present open cut after the coal winning from the new working face has been developed. Hence, I prefer not to fix definitely final arrangement of the tracks at present.

4. OVERBURDEN DUMPS AND THEIR ARRANGEMENT.

62. The proposed dumping area is well adapted for this purpose ; it does not interfere with coal winning for the next twenty years, and so soon as there is a possibility of dumping in the worked-out portion of the open cut, that possibility should be utilized.

This will be the case when the coal deep dredger has cleared a width of 150 m. at the extreme end of the fan-shaped sector, i.e., when about 20,000,000 tons of coal have been removed from the new face—or in about six years.

Until then the overburden must be carried to the special dumps as proposed, and dumped to an extent of altogether about 6,000,000 cb. m. In the initial stages Marga had to carry about 15,000,000 cb. m. to special dumps before it could dump into its own worked-out open cut.

63. As a result of this the overburden costs in the first six years will be relatively higher than afterwards. However, after dumping in the open cut becomes possible, the position becomes most favorable, having regard to the small quantity of overburden to be so dumped in relation to the depth of the coal deposit. The cost per cb. m. of overburden will then fall to about 4·4d. per cb. m.

These favorable conditions should be fully utilized, and I shall prepare, later, a special project for same.

64. Dumping overburden as practised at the present time is extremely expensive, and is partly responsible for the high overburden costs ruling at present. In recent years machines have been devised (called " Spreaders ") which minimize this work of hand dumping. I therefore propose that such a machine be procured.

Three months' hand dumping, however, will be necessary before the spreader can start work in order to raise the dump to the requisite height.

Both of these phases will be taken into consideration in the cost estimate for overburden operations.

65. It may be taken for granted that steam dredgers and steam locomotives operate less economically in large scale mining operations than electrically equipped machines.

66. It may also be assumed that a 90 cm. rail gauge, which has been found in Germany to be the most suitable, will also be the best for your conditions.

5. PERIOD OF DEVELOPMENT OF THE OPEN CUT.

67. Existing operations and full delivery of coal to meet requirements will not be interfered with in any way by the development of the proposed extensions.

The plan does not involve any interference. On the contrary, I aim to maintain existing conditions as far as possible and to improve same by supplying coal under the extended scheme at the earliest possible moment.

68. The proposed extension to the open cut will, as already mentioned, be 1,200 m. long. In order to reach the main working bench (at 35 m.), I propose to procure the deep dredger first, which is to operate later on the main working bench, where it will dig to the bottom of the coal. This dredger will temporarily work upon the top surface of the coal as soon as the overburden dredger has advanced its cutting sufficiently far.

That will be possible immediately a coal area 50 m. wide and 1,200 m. long has been uncovered.

69. Assuming that overburden will be at 1 : 1 slope, this means the quantity of overburden to be moved will be—

$$\frac{(10 + 50 + 10) + 50}{2} \times 10 \times 1{,}200 = 720{,}000 \text{ cb. m.},$$

or with the daily output of 4,000 cb. m., the time taken will be 180 working days, i.e., eight months. In the interests of the present state of operations, I prefer to shorten this time. This can be done, firstly, by placing the pivot point of the overburden dredger on point B and by turning about this point until the cut is 50 m. at the widest or northern end and 400 m. in length. The coal down-dredger can thus commence operations four months after overburden removal commences. If the latter cutting to a depth of 20 m. is set to produce 4,000 tons immediately, then overburden removal will always be in the lead as the overburden dredger, which (digging only 10 m. deep) will remove 4,000 cb. m. per day, will uncover double the surface required for a daily production of 4,000 tons of coal. If, as soon as the deep dredger is set to work on the coal, the pivot point of the overburden dredger is transferred to point A, then the cut will very soon attain its whole length of 1,200 m. and—without interfering with the working of the coal dredger—the coal-working face will be correspondingly lengthened to 1,200 m. At the same time the 7·7 cb. m. " Ruston " shovel will follow the coal deep-dredger on the 35 m. working bench in order to prepare that bench as the *main working bench,* but the shovel will no longer discharge to the loader but, as in the case of the deep dredger, will deliver coal directly to the 20-ton coal trucks, and will, therefore, be in a position immediately to take over the production of 4,000 tons per day (on two shifts).

The capacity of the shovel will probably be higher when operating without the loader.

70. The inclined steep haulage, as well as locomotive, transport system must, therefore, be ready to operate by the 1st November, 1927. The 7·7 cb. m. " Ruston " shovel will then deliver its coal to the inclined steep haulage from the 35 m. working bench, while the deep dredger, as mentioned above, will at first deliver its coal from the top surface of the coal to the steep haulage. Both machines will thus take up the whole supply with safety under the new scheme at cheaper costs. On this date the whole bunker arrangement, as well as the conveyors to the Power Station and to the ropeway reloading station, must be complete. All this work can be carried out without interrupting present operations.

71. As soon as the electric shovel has excavated the cut 50 m. in width on the 35 m. bench, the scraper-dredger can start working—that will be the case (assuming the shovel to dig only 3,000 tons per day) after—

$$\frac{1{,}200 \text{ x } 50 \text{ x } 15}{3{,}000} = 300 \text{ days},$$

i.e., after one year. By this time, therefore, the erection of the scraper-dredger must have been completed. To be on the safe side, I estimate the time taken for delivery and erection at eighteen months, therefore the scraper-dredger must be ordered by the 1st May, 1927.

72. The scraper dredger will take over the coal supply so as to release the deep dredger working from the coal surface in order that the latter may be moved down to the 35 m. bench—its final position. I estimate that four to eight weeks will be needed to run the dredger down into the open cut, for which purpose the existing ramp can be utilized. The dredger will not require to be dismantled, but the bucket ladder should be detached. The cost of this will be considered in the costs schedules. Care must be taken to leave a bench on the new east working face for the future scraper dredger on the east face (15 m. is sufficient, but about 25 m. must be left at the place of erection).

73. On the 1st January, 1929, therefore, the equipment of one face must be complete for the coal as well as for the overburden. The cost estimate No. II. has been drawn up for these conditions.

74. Since the 7·7 cb. m. " Ruston " shovel is to be utilized under the new scheme as a separate coal-winning machine, care must be taken to leave a coal-working face above the 35 m. level on the east side of the new extension.

If, in the meantime, digging on one face with bucket dredgers only confirms the expectation of drier coal, the time would then come to put on two deep dredgers to work on the east face—not on account of extra output,—but solely on account of more extensive drying.

75. Should this be done, I would recommend that the coal deep-dredger, which is destined for the east face, be first made to work on the overburden east face until sufficient coal is exposed, and that meanwhile the scraper dredger on the east face be the only dredger employed on coal winning. Later, this second deep dredger can be taken from the overburden to assist it on coal. The following dates would, therefore, suggest themselves :—

(1) Second deep dredger to be ordered in time to start on overburden as early as the end of 1928, i.e., to be ordered on the 1st July, 1927.

(2) Second scraper dredger to be ordered in time to start on 1st January, 1929, i.e., to be ordered on the 1st July, 1928. If the second extension to the Briquette Factory (i.e., beyond present contemplated extension) may be reckoned with, in 1930 the erection of the steep haulage for it will have to be complete by the time the second extension to the factory is finished.

With regard to this phase a special project will be prepared in good time, to be governed by conditions ruling at the time.

76. The points mentioned above may be traced schematically on Sketch No. 2. The following table sets out the coal-winning operations for the ensuing years :—

(1) *November*, 1927—

Taking over of the whole supply under the new scheme—

(*a*) The deep dredger on the top of the coal surface	5,000 tons in two shifts.
(*b*) The 7·7 cb. m. "Ruston" shovel on the 35 m. level	4,000 tons in two shifts.
Total maximum	9,000 tons per day.
Requirements are	5,700 tons per day.

Plant reserve, therefore, exceeds 60 per cent.

(2) 1*st January*, 1929—

The following machines commence to operate :—

(*a*) The scraper dredger, with	5,000 tons in two shifts.
(*b*) The deep dredger, with	5,000 tons in two shifts.
(*c*) Reserve : 7·7 cb. m. shovel, with ..	4,000 tons in two shifts.
Total maximum	14,000 tons in two shifts.
Requirements for the second half of 1929 are	8,000 tons per day.

Plant reserve, therefore, exceeds 60 per cent.

77. The possible coal supply, and thus the reserve, can be considerably increased by also equipping the east face ; in special circumstances it can also be increased, if desired, by 30 per cent. by working a third shift.

With such reserves operations may be considered secure.

78. These considerations, however, elucidate clearly the fact that in order to meet the proposed requirements the existing lay-out is not conceived on sufficiently broad lines, nor is the existing plant capable of dealing with them.

79. Nevertheless the equipment required at Yallourn to handle 10,000 tons of coal per diem is comparatively small, and a comparison with Marga will show what a favorable influence the nature and magnitude of the coal deposits at Yallourn have on coal-winning operations. The comparison is made on a basis of 10,000 tons of coal per day.

COMPARATIVE STATEMENT FOR PLANT AND EQUIPMENT REQUIRED TO HANDLE 10,000 TONS PER DAY.

(1) Overburden at Yallourn.	(2) Overburden at Marga.
10 m. (30 feet) overburden.	30 m. (100 feet) overburden.
1. 1 bucket dredger	4 bucket dredgers of same size.
2. 4 complete transport trains, i.e., five locomotives	15 trains, i.e., twenty locomotives of same size.
125 overburden trucks	425 overburden trucks.
3. 1 track-shifting machine	5 track-shifting machines.
4. 1 dredger track, 1,200 m. (4,000 feet) long	Dredger tracks 4,000 m. (13,000 feet) long.
5. Transport tracks, 5 km. (3 miles) ..	45 km. (28 miles).
6. 1 converter	4 converters.
7. 1 overburden spreader	Slush dumps.

COAL WINNING.

Coal depth : 50 m. (165 feet).	7–10 m. (23–33 feet).
1. 1 coal deep dredger	2 coal deep dredgers.
2. 1 scraper dredger	2 small levelling dredgers.
3. 4 coal trains	6 coal trains.
Five locomotives, 25 trucks	Nine locomotives (i.e., comparatively more locomotives, as a result of long grades) 40 trucks.
4. Dredger truck, 1,200 m. (4,000 feet) ..	2,500 m. (8,200 feet).
5. 1 mercury rectifier	1 mercury rectifier.
6. 1 track-shifting machine	3 track-shifting machines.
7. 1 inclined steep haulage	In consequence of the great distance between mine and factory, Marga has a track rising on a continuous grade, and, in addition, over 2·5 km. (1½ miles) double track.
8. 1 bunker	2 bunkers.
9. About 100 m. (330 feet) overhead railway	700 m. (2,300 feet) overhead railway.
10. Belt conveyors, &c.	The same.
11. 1–7·7 cb. m. "Ruston " shovel ..	3 small shovels for sundry work.
12. Yallourn—Mine water pumping: Unimportant	1 mine water pumping plant of 4,000 h.p. at present pumping 70 cb. m. (15,500 gallons) of water per minute.

This comparison alone clearly brings out the importance of the coal deposits at Yallourn, and if, therefore, the proposed programme is now carried out without delay, this undertaking will represent an important economical factor in the State of Victoria.

80. The very much higher wages in this country are frequently referred to. In this connexion a comparison is of special interest. At Marga, with our modest coal deposits, and, consequently, with the larger number of machines on overburden and coal, we require 800 men for 10,000 tons per day, including workshops personnel, which latter has to be very much larger at Marga than at Yallourn, while at Yallourn 250 men only will be required (including workshops) to deal with 9,000 to 10,000 tons per day.

The latter point is brought out in a summary of working costs.

81. My main aim has been directed towards replacing hand labour by the very much cheaper mechanical operations. Moreover, local workmen are more adapted to the use of machines. As driver or attendant on a machine, the men's work is subordinate to that of the machine, and he consequently feels himself improved in his status as well as his responsibility.

82. On the other hand, it is possible, under abnormal circumstances, to maintain the supply of coal to the Power Station with only a few hands. Partly for the latter reason, I have regarded the retention of the Telpher Plant as desirable ; in fact, I have enlarged the coal reserves by the added capacity of the bunker. Such a provision is imperative, as the Power Station is called upon to maintain supply to the metropolis, with its public utilities, such as railways, hospitals, &c.

83. It must never for a moment be forgotten that even in operations on a large scale every penny must be reckoned with, beginning with every drop of lubricating oil ; because a saving of only one-tenth of a penny per ton amounts in a year, on a production of 3,000,000 tons of coal, to £1,250.

84. The necessity for economy in costs must not only be obvious to the Works Manager, but he must also impart it to his entire staff. Then the success of an undertaking so rich in valuable coal reserves will be assured, and will contribute to the wealth and prosperity of the State of Victoria.

With the expression of this guiding principle I beg to submit this Report, in which I have endeavoured to embody my best efforts.

Good Luck to Yallourn!

Yallourn,
20th April, 1926.

(Sgd.) J. KLITZING.

C. TIME SCHEDULE FOR PLANT AND MACHINERY AND ESTIMATE OF COST FOR SAME.

A. MINE.

(1,000 V.D.C.) (Track 90 cm. Gauge.)

Description of Plant.	Date of Taking Over.	Proposed Date of Ordering.	Remarks.	Cost.		Cost to be carried to— Cost Estimate I.	Cost Estimate II.
				£		£	
1. One coal deep dredger for actual output of 5,000 tons in two shifts (fifteen hours' working time), 25 m. vertical cutting depth with levelling piece	1st Nov., 1927	1st June, 1926	Cost of dredger, inclusive of packing, freight, duty, and erection	32,500	I.	2,500	..
2. One scraper dredger, with same capacity as Item 1, having vertical cutting height of 35 m.	1st Nov., 1928	1st Mar., 1927	Cost of dredger, inclusive of packing, freight, duty, and erection	35,000	II.	..	35,000
3. Four complete coal trains and one spare train, each consisting of five trucks— Five electric locomotives, each 440 h.p. Twenty-five coal trucks of 20 tons net capacity each	1st Nov., 1927	1st July, 1926	Five locos. at £7,800 = £39,000; 25 trucks at £1,000 = £25,000	64,000	I.	64,000	..
4. Dredger tracks— (a) 1,200 m. (4,000 ft.) for deep dredger	1st Nov., 1927	1st July, 1926	Each dredger track including 100 lb. excavator-rails, transport tracks, sleepers, electric equipment, switches, complete—£18,375	18,375	I.	18,375	..
(b) 1,200 m. (4,000 ft.) for scraper dredger	1st Nov., 1928	1st July, 1927		18,375	II.	..	18,375
5. One mercury rectifier plant 1,200 kva.	1st Nov., 1927	1st July, 1926	Each mercury rectifier, £10,750	12,250	I.	12,250	..
One mercury rectifier plant 1,200 kva. (in same building)	1st Nov., 1928	1st July, 1927	Two-thirds building cost £15,000	10,750	II.	..	10,750
6. One inclined haulage plant, grade 1 : 6, capacity 120 tons, 500 tons per hour	1st Nov., 1927	1st July, 1926	Mechanical equipment = £25,000; Buildings £5,000	30,000	I.	30,000	..
7. One bunker of 1,500 tons capacity with mechanical equipment	1st Nov., 1927	1st July, 1926	Completely equipped throughout	20,400	I.	20,400	..
8. One ramp for inclined haulage ..	1st Nov., 1927	1st Aug., 1926	Excavators, tracks, and electrical equipment	20,250	I.	20,250	..
9. Belt conveyors, complete with steel structure, from breakers for boiler-house and Briquette Factory	1st Nov., 1927	1st Aug., 1926	Completely equipped ..	7,500	I.	7,500	..
10. Other electric plant, wiring, &c. ..	1st Nov., 1927	1st Aug., 1926	.. ..	5,000	I.	5,000	..
11. One track shifting machine ..	1st Nov., 1927	1st Aug., 1926	.. ..	3,000	I.	3,000	..
12. All trestle work with tracks complete, leading to and from bunker	1st Nov., 1927	1st Aug., 1926	.. ..	10,000	I.	10,000	..
13. Reconstruction of track for coal deep-dredger, including dismantling	1st Jan., 1929	See report ..	.. .. ..	500	II.	..	500
14. Transfer of coal deep-dredger to main working bench	1st Jan., 1929	See report ..	.. ..	600	II.	..	600
15. Alterations to No. 4 ropeway to connect to 1,500-ton bunker	1st Nov., 1927	See report ..	.. ..	500	I.	500	..
				289,000	..	223,775	65,225

D. TIME SCHEDULE FOR PLANT AND MACHINERY AND ESTIMATE OF COST FOR SAME.

B. OVERBURDEN.

(1,000 V.D.C.) (Track 90 cm. Gauge.)

Description of Plant.	Date of taking over.	Proposed Date of Ordering.	Remarks.	Cost.
				£
1. One overburden deep dredger having actual output of 5,000 cb. m. (6,500 cubic yards) in two shifts —(15 working hours) 12 m. vertical cutting depth	1st July, 1927	Immediately	Cost of dredger, including packing, freight, duty and erection	31,000
2. One overburden spreader of same capacity as under No. 1	1st Oct., 1927	1st July, 1926	.. ..	22,500
3. Four complete overburden trains and one spare train, each consisting of 1 loco. and 25 trucks— 5 locos. each 440 h.p. 125 overburden trucks, each 5 cb. m. capacity	1st July, 1927	1st June, 1926	5 locomotives, each £7,800—£39,000 125 trucks, each £200—£25,000	64,000
4. One track shifting machine ..	1st July, 1927	1st July, 1926	Could be done without, in which case machine required for mine must be available 1st July, 1927	3,000
5. 5 km. (3 miles) dump tracks with electrical equipment	1st July, 1927	1st Oct., 1926	Inclusive of rails, sleepers, electrical equipment and construction	20,180
6. One dredger track, 1,200 m. long (4,000 feet)	1st July, 1927	1st Oct., 1926	Same as under Mine ..	18,375
7. One mercury rectifier plant 1,200 kva.	1st July, 1927	1st July, 1926	Rectifier, £10,750 .. .. Portion of building, £750 ..	11,500
8. One repair shop in corrugated iron, for electrical locomotives and trucks, with two pits for locomotives 1 pit for coal trucks 6 pits for overburden trucks including all workshop equipment	1st July, 1927	1st Nov., 1926	.. ..	12, 500
9. Other electrical plant and wiring ..	1st July, 1927	1st Nov., 1926	.. ..	5,000
10. Tracks for overburden spreader ..	1st Nov., 1927	1st Nov., 1926	.. ..	9,000
			Total	£197,055
			Say	£200,000

E. SCHEDULE OF LABOUR AND SUPERVISION—A. MINE.

LABOUR REQUIRED FOR AN OUTPUT OF 5-6,000 TONS PER SHIFT FOR TWO SHIFTS—10-12,000 TONS.

1. OPERATION.

Plant (where employed).	Labour.	Rate. s. d.	Wages. s. d.	Supervision. s. d.	Total Wages. s. d.
1. Labour Supervision on inclined steep haulage	1 shift boss	20 0	...	20 0	20 0
2. Scraper dredger	1 dredger driver	23 8	23 8	..	23 8
	1 chute attendant	18 0	18 0	..	18 0
	1 greaser	17 0	17 0	..	17 0
3. Deep dredger	1 dredger driver	23 8	23 8	..	23 8
	1 chute attendant	18 0	18 0	..	18 0
	1 greaser	17 0	17 0	..	17 0
4. Coal trains ..	4 locomotive drivers	19 0	76 0	..	76 0
5. Inclined steep haulage	1 signalman	18 0	18 0	..	18 0
	2 pointmen	17 0	34 0	..	34 0
	1 engine-driver	23 8	23 8	..	23 8
	1 hoist attendant	18 0	18 0	..	18 0
6. Bunker ..	1 attendant at top	18 0	18 0	..	18 0
	1 conveyor attendant at bottom	18 0	18 0	..	18 0
	1 breaker attendant	18 0	18 0	..	18 0
7. Briquette loading and Transportation	2 men on loader				
	1 at ..	17 0	35 0	..	35 0
	1 at ..	18 0			
	1 ropeway plant attendant at Briquette Factory	16 6	16 6	..	16 6
8. Labour supervision for bunker and breaker	1 shift boss	20 0	..	20 0	..
9. Wire rope attendant	2 greasers	17 0	34 0	..	34 0
10. One tally Clerk	1 tally clerk	16 0	16 0	..	16 0
	26 men for day shift	..	442 6	40 0	482 6
	26 men for afternoon shift	..	442 6	40 0	482 6
For two shifts—Total	52 men—Total for (a)		885 0	80 0	965 0

2. MAINTENANCE AND REPAIRS.

Plant.	Labour.	Rate. s. d.	Wages. s. d.	Supervision. s. d.	Total Wages. s. d.
1. Labour supervision	1 shift boss ..	20 0	..	20 0	20 0
2. For the track shifting machine	1 leading L.H.	20 8	20 8	..	20 8
3. For the dredger tracks	5 labourers ..	16 0	80 0	..	80 0
	5 labourers ..	16 0	80 0	..	80 0
4. Trenches ..	3 labourers ..	16 0	48 0	..	48 0
5. Spare loco. and track shifter	1 loco. driver	19 0	19 0	..	19 0
6. Spare crew for dredger or shovel	1 shovel driver	23 8	23 8	..	23 8
	1 plant attendant	18 0	18 0	..	18 0
	1 greaser ..	17 0	17 0	..	17 0
7. Miscellaneous	2 firemen ..	16 0	32 0	..	32 0
	5 pump men	17 0	85 0	..	85 0
	6 fitters, smiths, &c.	20 8	124 0	..	124 0
Total ..	32 men Total for (b)	..	547 4	20 0	567 4
Total of (a)..	52 men ..		885 0	80 0	965 0
Total of (b)..	32 men ..	..	547 4	20 0	567 4
Grand Total	84 men ..	..	1432 4	100 0	1532 4

In the case where No. 4 ropeway is required to operate on the 3rd shift, the following additional men will be required:—

	Rate. s. d.	Wages. s. d.	Supervision. s. d.	Total Wages. s. d.
1 conveyor attendant ..	18 0	18 0	..	18 0
1 breaker attendant	18 0	18 0	..	18 0
2 men at the loader	17 0	35 0	..	35 0
	18 0			
1 ropeway attendant at Briquette Factory ..	16 6	16 6	..	16 6
2 greasers	17 0	34 0	..	34 0
1 shift boss	20 0	..	20 0	20 0
8 men Total	..	121 6	20 0	141 6

(F.)

SCHEDULE OF LABOUR AND SUPERVISION.

B.—OVERBURDEN.—Labour required for Operation and Maintenance on a daily output of 5,000 cb.m. (6,500 c. yards) in two shifts.

Plant.	Labour.	Rate.	Wages.	Supervision.	Total Wages.
		s. d.	s. d.	s. d.	s. d.
1. On the dredger	1 dredger driver	23 8	23 8	..	23 8
	1 chute attendant	18 0	18 0	..	18 0
	1 greaser ..	17 0	17 0	..	17 0
2. Train crews ..	4 loco. drivers	19 0	76 0	..	76 0
3. Cleaning tracks	2 labourers	16 0	32 0	..	32 0
4. Greasing trucks	1 labourer ..	16 0	16 0	..	16 0
5. General transport and track-shifting loco.	1 loco. driver	19 0	19 0	..	19 0
	1 labourer ..	16 0	16 0	..	16 0
6. Dump gang No. 1	1 shift boss	20 0	..	20 0	20 0
	15 labourers	17 0	255 0	..	255 0
Dump gang No. 2	1 shift boss	20 0	..	20 0	20 0
	8 labourers	17 0	136 0	..	136 0
7. Pointmen ..	2 labourers	16 0	32 0	..	32 0
8. Greasing trucks	1 labourer ..	16 0	16 0	..	16 0
9. General work	6 labourers ..	16 0	96 0	..	96 0
10. Office ..	1 tally clerk	16 0	16 0	..	16 0
For day shift ..	47 men ..	..	768 8	40 0	808 8
For afternoon shift	47 men ..	..	768 8	40 0	808 8
Total ..	94 men ..	..	1537 4	80 0	1617 4
11. Maintenance on dredger tracks	1 shift boss	20 0	..	20 0	20 0
	8 labourers ..	16 0	128 0	..	128 0
12. General maintenance gang	6 fitters, electricians, &c.	20 8	124 0	..	124 0
	15 men Total	..	252 0	20 0	272 0
(a) Grand Total	109 men ..	..	1789 4	100 0	1889 4

	s. d.
NOTE.—At commencement of bucket-dredging, 1st July, 1927, dump tipping done by hand, from the 1st October, 1927, overburden-spreader will commence operating, when labour on overburden workings will be reduced by twenty men at 16s. ..	320 0
Then, 89 men will cost	1569 4

STATEMENT OF COSTS PER CUBIC M.—OVERBURDEN.

1. MAINTENANCE, REPAIRS, AND STORES.

Description of Charges.	Cost per cb. m.	Remarks.
	d.	
1. Maintenance of dredger, including wages and materials	0·855	Costs charges included here are exceptionally high. In a well-organized undertaking considerable saving should be effected here
2. Maintenance and repair of tracks and overhead wiring	0·648	
3. Lubricants	0·288	
4. Maintenance and repair of spreader (wages and materials)	0·468	
5. Repairs to trucks and locos.	0·732	
6. Power..	0·600	
	3·591	rounded off: 3·6d. per cb. m.

2. WAGES AND LABOUR SUPERVISION.

Taking into consideration the loss of output on rainy days, the following cost estimate is made, on the assumption of output of 4,000 cb. m. for 250 days, equals 1,000,000 cb. m. Wages, however, are included for the full 300 days.

(a) Wages in the first 3 months = 1,889s. 4d. × 75 = 14,175s.
(b) Wages in the last 9 months = 1,569s. 4d. × 225 = 353,115s.

Rounded off .. .. = £24,750

In the first year the wages costs will be for 4,000 × 250 = 1,000,000 cb. m. overburden per annum, equals 5·94d. per cb. m.

In the second year and later wages costs will be—

$$\frac{1{,}570 \times 300}{1{,}000{,}000} = 5{\cdot}66\text{d. per cb. m.}$$

3. CAPITAL CHARGE AND DEPRECIATION.

Total costs of machinery, plant and building for overburden .. .. = £200,000

Interest at 5·25 per cent.
Depreciation at 4·63 per cent. (over 15 years).

Total .. 9·88 per cent., say, 10 per cent. on capital .. = £20,000

Or per cb. m. of overburden on 1,000 000 cb. m. per annum .. .. = 4·8d.

Total of Costs—

1. 3·6d. per cb. m.
2. 5·94d. per cb. m.
3. 4·8d. per cb. m.

14·34d. per cb. m., say, 14·4d. per cb. m.

With a ratio of 1 : 4 cost per ton of coal for overburden, = 3·6d. per ton.

(G.)

GENERAL STATEMENT OF COSTS PER TON OF COAL DELIVERED.

(a) To power station delivered on to the power station conveyor.

(b) To briquette factory delivered to the No. 4 ropeway hopper at briquette factory.

Statement of costs are made separately for production of 5,700 tons per day under cost statement No. 1; 8,000 tons per day under cost statement No. 2.

A. *Mine Wages*—

965/- plus 567/4 plus 141/6—1,675/- (rounded off)

Cost Statement 1—

For 5,700 tons, 3·54d. per ton.

Cost Statement 2—

For 8,000 tons, 2·52d. per ton.

B. *Capital Charges*—

For Interest and Depreciation 5¼ per cent. plus 4·63 per cent. equals 9·88 per cent., say 10 per cent.

Cost Statement 1—

For 5,700 tons = £223,775 at 10 per cent. equals

$$\frac{£223,775}{5,700 \times 300} = 3·15\text{d. per ton.}$$

Cost Statement 2—

For 8,000 tons = £289,000 at 10 per cent. equals

$$\frac{£289,000}{8,000 \times 300} = 2·9\text{d. per ton.}$$

C. *Maintenance and Repair*—

(1) Maintenance of dredgers (wages and materials) ..	= 0·636d. per ton
(2) Maintenance and repair of tracks and overhead wiring	= 0·468d. per ton
(3) Lubrication ..	= 0·216d. per ton
(4) Maintenance of inclined steep haulage	= 0·180d. per ton
(5) Repairs to trucks and locomotives	= 0·480d. per ton
(6) Power	= 0·600d. per ton
(7) Upkeep of bunker and conveyors	= 0·276d. per ton
Total	2·86d. per ton

D. *Portion of Overburden Charge*—

From Statement "G" the cost of overburden per ton of coal is.. .. .. 3·6d. per ton

OPERATION COSTS.

	Cost Statement 1 for 5,700 tons.	Cost Statement 2 for 8,000 tons.
	d.	d.
A. Mine Wages	3·54	2·52
B. Capital Charges	3·15	2·90
C. Maintenance and Repair of Mine	2·86	2·86
D. Portion of Overburden Charge	3·60	3·60
E. Charge for plant account (second face)	..	1·20
Total of Items A. to E. ..	13·15	13·08
Rounded off	13·2	13·1
F. *General*—		
(a) Administration (Yallourn and H.O.) ..	1·68	1·20
(b) Stores, stables, telephones, Workers' Compensation, sanitation	0·34	0·24
(c) Deep drainage ..	0·40	0·28
	2·42	1·7
Total of Items A. to F. ..	15·62	14·82
	s. d.	s. d.
Cost per ton on Coal Delivered ..	1 3·62	1 2·82

APPENDIX.

In order to complete this project, the following special plans and general lay-outs will be prepared and forwarded as early as possible :—

1. Arrangement and location of the possible future inclined steep haulage from the open cut to the Briquette Factory.
2. Final location of tracks to the workshops and dumps.
3. General arrangement of the locomotive, overburden truck and coal truck workshops.
4. Lay-out of the dump when operating with the spreader.
5. Detailed description of the development of the 1st and 2nd pivot points of the overburden operations to ensure an early uncovering of accessible coal.
6. Description of the removal of the coal deep dredger from the top of the coal to the main working bench (35 m. level).
7. Schedule showing all essential spare parts for dredgers, locomotives, overburden and coal trucks which must be ordered at the same time as these.
8. Detailed drawing of bunker and bunker equipment.
9. Drawings of dredger and transport track equipment.

STATEMENT OF MACHINERY PROPOSED TO BE ORDERED IN GERMANY.

A. *Mine.*

	Cost Statement.	Price f.o.b. German port. £
1. One coal deep dredger for actual output of 5,000 tons in two shifts (15 hours working time), 25 m. vertical cutting depth with levelling piece	I. ..	16,500
2. One scraper dredger with same capacity as item 1, having vertical cutting height of 35 m.	II. ..	19,300
3. Five electric locos., each 440 h.p.	I. ..	20,000
4. One inclined haulage plant, grade 1 to 6, capacity 120 tons, 500 tons per hour	I. ..	12,500
5. One track shifting machine	I. ..	1,250
Total for Cost Statement No. I.		50,250
Total for Cost Statement No. II.		19,300
Grand Total		69,550

B. *Overburden.*

1. One overburden deep dredger having actual output of 5,000 cb. m. (6,500 cubic yards) in two shifts (15 working hours), 12 m. vertical cutting depth ..	16,000
2. One overburden spreader of same capacity as under No. 1	11,500
3. Five electric locos., each 440 h.p.	20,000
4. One track shifting machine	1,250
	48,750

Total for Mine	£69,550
Total for Overburden	48,750
Grand Total	£118,300

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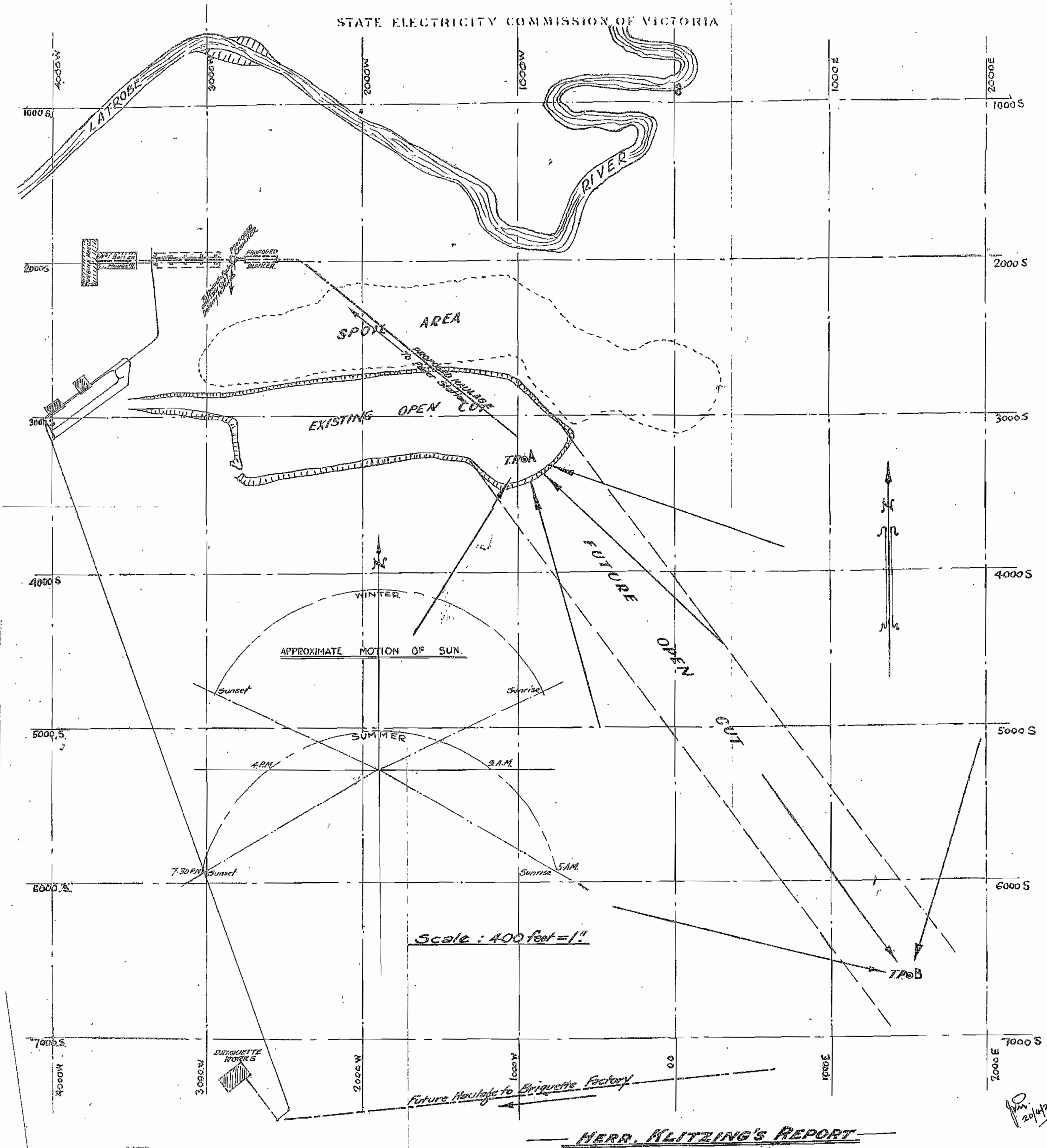
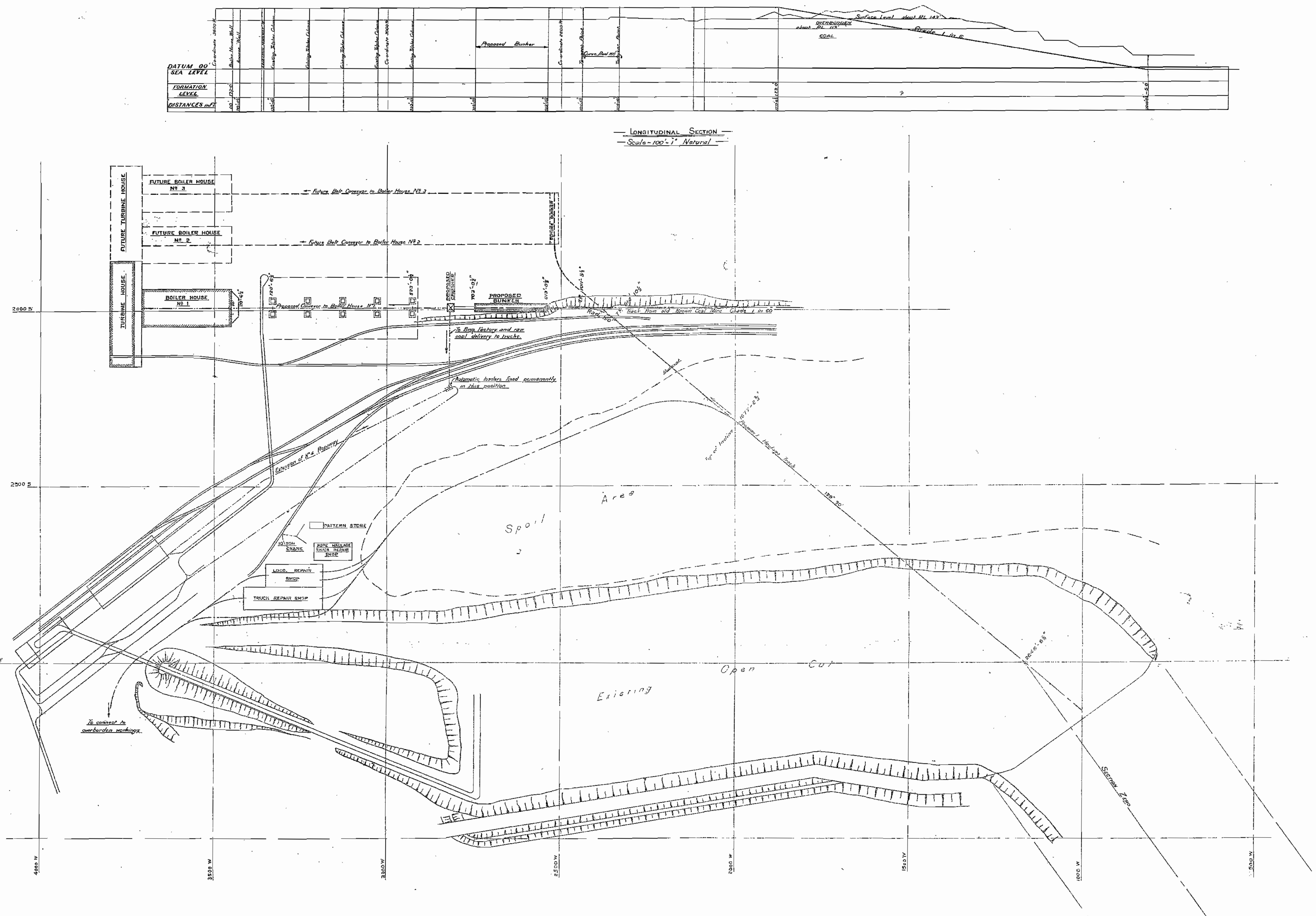


HERR. KLITZING'S REPORT
SKETCH No. I.

C.S. 918.

STATE ELECTRICITY COMMISSION OF VICTORIA



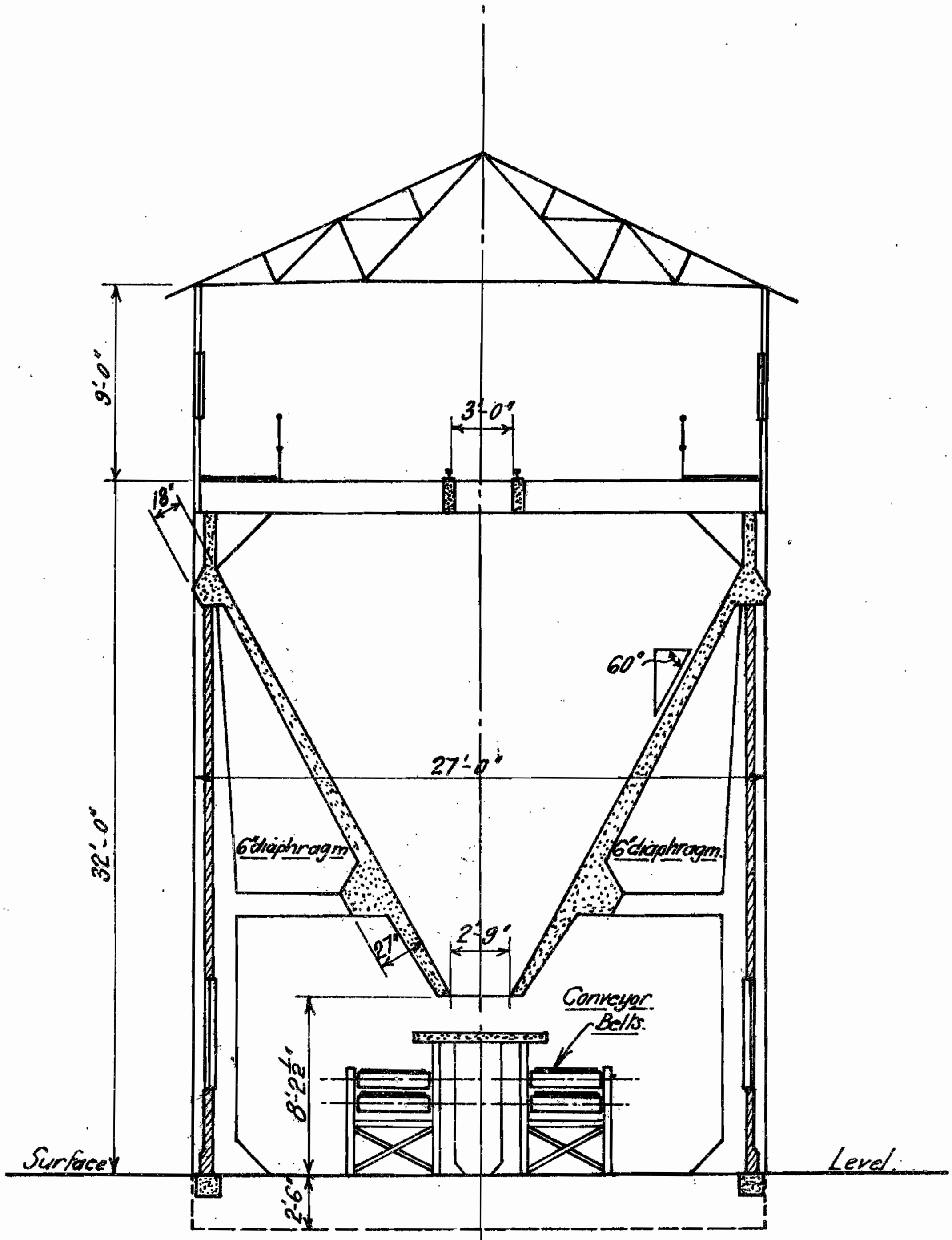
GENERAL ARRANGEMENT OF PROPOSED INCLINED HAULAGE AND BUNKERS (HERR KLITZING'S REPORT)

Sketch 2

Scale - 200' - 1"

Drawn By	C.H.
Traced By	J.R.C.
Checked	
Chief Draftsman	20-4-26
Section Nº OM 1	Drawing Nº OM 1371

STATE ELECTRICITY COMMISSION OF VICTORIA
AUSTRALIA



SKETCH No. 3.

YALLOURN POWER STATION CROSS SECTION OF PROPOSED BUNKER	Drawn by H.R.W. Traced by Checked Chief Draftsman 23-4-26	
Scale : 1/8" = 1'-0"	SECTION NO	DRAWING NO CS 927.

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