GOVERMENT OF INDIA

MINISTRY OF RAILWAYS

FUEL ECONOMY

ON

INDIAN RAILWAYS

REPORT

OF

THE RAILWAY FUEL ECONOMY ENQUIRY

COMMITTEE

1953

VOLUME-II

VOLUME II—APPENDICES

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APPENDIX A

COPY OF RAILWAY BOARD'S LETTER NO. E51CO1/11/3, DATED THE 27TH OCTOBER, 1951, AS CORRECTED BY LETTER NO. E51CO1/11/3, DATED 25TH FEBRURAY, 1952, ADDRESSED TO THE DEPUTY CHIEF ACCOUNTS OFFICER, EASTERN PUNJAB RAILWAY, DELHI.

SUBJECT.—*Fuel Economy Committee.*

The sanction of the President is accorded to the appointment of a Committee to examine and report on the various aspects of the efficient utilisation of coal on Railways for a period of four months from the date the Committee begins to function.

2. The following are the personnel of the Committee :—

(*i*) Shri D. C. Driver, President, Coal Consumers Association of India, Calcutta. *Chairman*

(*ii*) Shri R. A. Massey, Member, Parliament. *Member*

(*iii*) Shri A. B. Guha, Chief Mining Engineer, (Railway Board), Calcutta. *Member*

(*iv*) Dr. J. W. Whitaker, Director, Fuel Research Institute, P. O. Jealgora (Manbhum District). *Member*

(*v*) Shri M. V. Kamlani, Research Officer, Mechanical (Loco), Central Standards, Office for Railways, New Delhi. *Member—Secretary*

3. The terms of reference are as follows :—

" To examine the supply, consumption, and reserve stock of coal on Railways and to make recommendations for economy in expenditure on coal used as fuel ".

This will leave the Committee discretion to include all aspects of the use of coal on Railways in their examination.

COPY OF RAILWAY BOARD'S LETTER NO. E51CO1/11/3 DATED 23RD MAY, 1952 TO THE F. A. & C. A. O. NORTHERN RAILWAY AND OTHERS.

SUBJECT.—*Fuel Economy Committee.*

The President is pleased to approve of the action of the Chairman of the Fuel Economy Committee in having co-opted Shri I. S. Malik, Deputy Coal Commissioner (Distribution) or an alternative officer of the Coal Commissioner's Distribution Organisation when Shri Malik was not available as a Member at the Committee's meetings so far held and to similar action being taken in future. The officer so co-opted shall draw T. A. for his attendance at the meetings under the rules applicable to him in his own Department.

COPY OF LETTER NO. E51CO1/11/3, DATED 19TH JUNE, 1952 FROM THE MINISTRY OF RAILWAYS (RAILWAY BOARD) TO THE F. A. & C. A. O., NORTHERN RAILWAY AND OTHERS.

SUBJECT.—*Fuel Economy Committee*

The sanction of the President is accorded to the Chairman of the Fuel Economy Committee co-opting Mr. P. L. Verma, Traction Superintendent, Central Railway, as a member at the Committee's meetings. Mr. Verma will undertake this work in addition to his duties. He will while so employed draw T. A. under the rules applicable to him.

COPY OF RAILWAY BOARD'S LETTER NO. E51CO1/11/3, DATED 21ST OCTOBER, 1952 TO THE FINANCIAL ADVISER AND CHIEF ACCOUNTS OFFICER, NORTHERN RAILWAY AND OTHERS.

SUBJECT.—*Fuel Economy Enquiry Committee*

The sanction of the President is communicated to :

(*i*) a further extension upto 31st January 1953 of the duration of the Fuel Economy Enquiry Committee last extended in Board's letter of even number dated 12th July, 1952 ;

(*ii*) a further extension upto 31st January 1953 of the duration of the gazetted and non-gazetted posts sanctioned for the committee on the same terms and conditions laid down in Board's letters of even number dated 27th October 1951, 17th December 1951 and 17th January 1952.

(*iii*) Shri A. B. Guha till lately C. M. E., Railway Board, and now Secretary, Coal Board, continuing to be an Official Member of the Committee ; and

(*iv*) the appointment of Shri L. S. Corbett Chief Mining Engineer, Railway Board as an official member of the Committee. Shri Corbett will be eligible for T. A. and travel facilities as for other official members.

APPENDIX I

CHAPTER I

QUESTIONNAIRES

SECTION I.

1·1—Loco Coal Programme

1·2—Control of Quality.

PROCUREMENT/SUPPLY

1·1—Loco Coal Programme.

The coal production during the war was stepped up by giving mining leases freely. As a result of this a very large number of small collieries with an output in the range of 500 to 1000 tons per month came into being which continue to operate to this day.

The situation before the war was that a few collieries, outside the railway owned ones, were called upon to supply coal to railways under contract conditions which guaranteed quality in supplies and also gave rise to no problem regarding stacking requirements in sheds. Today the position is that as many as 500 collieries with an output of not less than 750 tons per month are placed on the loco coal programme. The present arrangement is even slightly better than what it used to be about an year ago when the collieries on the loco coal programme numbered about 746, the qualifying output for a loco coal order being as low as 500 tons per month.

Reports coming in from majority of railways indicate that individual railways are receiving coals not only from a large number of collieries but the collieries supplying coals keep on changing so much so that coals from numerous collieries are required to be given separate stacking space in sheds.

Thus the stacking problem arises from the necessity of stacking coals separately gradewise and collierywise as mixtures are known to give combustion trouble. Even if it were granted that the necessary stacking space could be made available in each shed, the real disadvantage would lie in the large spread of this stacking area which should not only make it difficult for proper control being exercised over theft and pilferage but should generally result in increased expenditure on loading, stacking and re-loading operations.

(1) **Will the Railways furnish information on the present position regarding the coal supplies made to them with particular reference to the following points :—**

(*i*) **Number of collieries that have supplied coal month by month to each single shed over the Financial Year ending March 1951.**

(*ii*) **Collieries by names against which there have so far been no complaints made by the Railways concerned. In other words, collieries that have given satisfaction.**

(*iii*) **Collieries by names which the individual Railways consider have frequently failed to supply coals correct to specifications. In other words, collieries against whom the Railways have a strong case in the matter of excessive amount of slack, dust, and shaly matter in coals they have supplied.**

(*iv*) **Collieries by names which the individual Railways would strongly recommend for inclusion in their coal supplies in due regard to the leads of these collieries from the consuming points on their lines;**

Note.—The above information should be furnished separately for collieries raising caking and non-caking coals.

1·2—Control of Quality

A high percentage of small, dust and shale in steam coal supplied to railways has now become a common feature so much so the railways are finding it difficult to report on all cases of complaints against inferior supplies and the Chief Mining Engineer has not been able to take effective action against defaulting collieries.

There is an arrangement already in existence according to which the collieries against whom more than 3 complaints are lodged by any one railway will be penalised by withholding loco coal orders from them for periods depending upon the nature of the complaints. This arrangement has not proved helpful as it has introduced a rather slow process in correcting the present unhappy situation and ensuring quality in supplies.

The deterioration in quality could be checked if the Coal Commissioner possessed strong enough an organisation to properly inspect and check the coal loadings in respect of the large number of collieries placed on the loco coal programme. There is a proposal to reduce the number of collieries on the loco coal programme to within a 100 by raising the qualifying output of the collieries for loco coal orders to 1000 tons per month, so that the Coal Commissioner's inspection organisation can be adequately strengthened to cope with the situation without much delay. This proposal presupposes the continuation of the Coal Commissioner's control over production and distribution and leaves little choice to the railways in the matter of individual collieries from which they would like to receive their coal supplies regularly.

The reduction of the number of collieries on loco coal orders would not of course be a complete solution in itself but it would be a step in the right direction. The issue has, however, become a controversial one already as the coal trade has strongly opposed the move in this direction on the plea that the smaller collieries will die out if loco coal orders are denied to them. Whatever be the pros and cons of this proposal, there is no denying the fact that the railways must be given immediate relief in the matter of handling coals from a large number of collieries in individual sheds, if they are to exercise proper control over coal consumption in loco motives and over wastages in transit as well as during the handling operations in sheds.

(1) Will the Railways and Coal Commissioner's Inspection Organisation indicate as to what measures have so far been adopted to exercise satisfactory control over quality of coals supplied to Railways and the success achieved with such measures.

(2) Suggestions may be offered as to how the Inspection on the Coal Commissioner's side and the functioning of the Fuel Control Organisations on Railways could be improved to ensure quality in Railway Coals.

(3) Will the Railways please furnish information in respect of the screening tests and chemical analyses made on coals at individual sheds or other receiving points giving particulars on the following lines :—

(*i*) The number of wagons subjected to screening and analytical tests separately and also the total number of wagons received at individual sheds or other receiving points with the names of the collieries whose wagons are subjected to tests.

(*ii*) The percentages of "small and dust" and of shale obtained in the coal wagons jected to screening test.

(*iii*) The Moisture and ash of the coals analysed (that is of the coals in the wagons subjected to analytical tests) as against the specified ash and moisture of the consignments.

Note.—The above information may please be furnished separately for each month of the Financial year ending March, 1951.

(4) Will the Coal Commissioner's Organisation give information regarding the number of Loco Coal Wagons which have been subjected to test checks and the nu mber rejected as a result of such tests in each month of the Financial Year ending March 1951, giving reasons for rejection in each case and the name of the Colliery concerned ?

(5) Will the Railways and the Coal Commissioner's Organisation describe the methods they employ for drawing samples from coal stacks and also from wagons ?

(6) What are the methods employed by the Railways and the Coal Commissioner's Organisation in analysing coal samples and how far do these methods conform to the British Standard methods or the methods employed by the Fuel Research Institute ?

(7) Ash in the Indian Coals is largely mixed o r inter grown with Coals. Hand Picking (a human factor) has been relied upon to do the cleaning. Will the Railways and the Coal Commissioner's Organisation suggest other means of beneficiating (cleaning) coal so as to ensure consistent quality in the grades of Coals supplied to Railways ?

(8) Will the Coal Grading Board please submit a statement giving colliery-wise the names of the seams and the dates on which "Analysis Checks" were made on them ?

(9) Will the Coal Grading Board please furnish information relating to the seams that have been up-graded or down-graded as a result of the periodic analyses carried out on these seams ?

Note.—The information relating to questions 8 and 9 should cover the entire period from the inception of the coal grading scheme to date.

(10) Will the Coal Commissioner state at what periodic intervals are the analyses carried out on individual seams in order to maintain a check on the gradings ?

(11) Will the Coal Commissioner state when the analysis checks were last made on each individual seam bearing its present grading ?

(12) Prior to the war for many years tenders used to be called by the Chief Mining Engineer, Railway Board, against coal requirements of State Railways which were communicated to him by the Railway Board from period toperiod. These tenders were scrutinised by the Chief Mining Engineer and his recommendations were generally accepted by the Ministry of Railways. For placing orders on the individual collieries his advice was often sought by Company Railway as well. In this manner the Railways were able to obtain expert advice of the Chief Mining Engineer and his technical staff in regard to the collieries which were in a position to ensure proper supplies. With the advent of the Coal Control Order (*i.e.*, since 1944) this system has been discontinued and as long as the Coal Control is in force it is difficult to go back to it. Will the Railways indicate whether they will prefer to select their coals in consultation with the Chief Mining Engineer as they used to do in the past ?

APPENDIX I—(*contd.*)

SECTION 2.

DISTRIBUTION

2·1—Rationalisation of Coal Distribution.

2·2—Coal Movements.

2·3—Production of Coal and Transport Arrangements.

2·1—Rationalisation of Coal Distribution.

The statement given below gives an idea of the proportions in which the different railways now receive their coal supplies from the Bengal, Bihar and the outlying coal fields.

COAL COMMISSIONER'S MONTHLY COAL ALLOTMENTS TO RAILWAYS, (APRIL—JUNE 1951),

Railway	Bengal and Bihar %	Pench and Chanda %	C. I. C. %	Singareni %	Orissa %	Assam %	Total (Tons)
E. I.	100	..	..	..	..	..	202,000
B. N.	60·5	5·5	27·0	..	7·0	..	123,000
G. I. P.	53·6	33·8	12·6	..	..	..	135,000
B. B. & C. I.	69·1	3·4	27·5	..	..	..	87,000
E. P.	100	..	..	..	..	..	47,000
M. S. M.—Rail	..	..	25·2	11·1	18·4	..	31,000
Sea	45·	..	..	..	..	..	..
S. I.—Rail	..	..	..	..	..	..	43,000
Sea	100	..	..	..	..	..	..
N. S.	..	6·0	..	94·0	..	..	25,000
Assam	55·0	..	..	..	..	45·0	34,000
O. T.	100	..	..	..	..	..	51,000
My. S.	..	..	..	100	..	..	10,000
Bk. S.	100	..	..	..	..	..	5,000
J.	100	..	..	..	..	..	7,000
Saurashtra—Rail	30·3	19·4	7·7	..	..	..	26,000
Sea	42·6						

The cost per ton of a particular grade of coal, including freight charges, at a consuming point on a railway and the consumption of this grade of coal in lbs./1000 gross ton miles on a given service should together determine the costs in "Rs. As. Ps." per unit of traffic (1,000 G. T. M.). The distribution of the locomotive coal orders over the different collieries for any one railway should be such as will reduce the cost ("Rs. As. Ps.") per unit of traffic to the very minimum. Thus the general trend in rational distribution of locomotive coal orders would be to supply coals to any one railway from the nearer collieries.

(1) Will the Railways examine the performances of the coals they have received from the nearer and distant collieries, from the point of view of overall costs ("Rs. As. Ps.") per unit of traffic costs produced, and indicate as to what coals from the nearer collieries they have found satisfactory for Loco Power purposes and would prove economical if supplies of these coals were arranged in preference to supplies of better grades of coal from relatively distant collieries.

(2) The cost of coal per ton inclusive of freight in the case of Railways receiving all their coal supplies by rail route have ranged from Rs. 22 to Rs. 31 per ton and in the case of Railways receiving their supplies partly by rail and partly by sea, from Rs. 48 to Rs. 62 per ton. In a rational distribution the cost of coal per ton inclusive of freight should not exceed, say, Rs. 35 per ton. What difficulties are being experienced in making coal supplies to Railways all by rail route, in a manner as to reduce the leads from the collieries to the receiving points on Railways to the minimum praticable.

2·2—Coal Movements.

It is generally accepted that movement of coal in regular train loads does lead to an appreciable saving in transit time and thereby result in increased wagon availability on account of quicker turn round of wagons. To fully appreciate the above proposition, it is necessary to study the working of coal loads from the railway sidings at collieries (leading points) to the junction yards (colliery base stations) situated within the mining

areas, marshalling of the loads in the junction yards so that as far as possible full train loads are moved from colliery base stations to the various destinations with little further marshalling *en route*.

(1) Will the Railways operating in coal fields and the Coal Commissioner's Organisation please submit notes describing in detail the systems adopted by them for distributing Loco coal orders over the various collieries in due regard to the desirability of moving coal in full train loads from the colliery areas to destinations?

(2) Are any labels of different colours or of distinctive markings employed for indicating the routes that the individual coal wagons are to follow so that advantage of such distinctive markings or colour indications could be taken in adopting marshalling orders for coal loads at base stations such as will avoid further marshalling at other junction *en route* ?

(3) Will the colliery base stations furnish examples of the different marshalling orders that have been adopted in forming coal trains for different destinations with a view to minimising marshalling work at junction points *en route*? The examples quoted may please be illustrated by actual records of the coal train compositions maintained at colliery base stations for a fortnight or a month during the busiest period of coal traffic.

(4) It is believed that previously certain Railways have on occasions worked to a system of running special block rakes for loco coal movements. Will the Railways furnish details of such a system and indicate whether it is possible to reintroduce it (as a special case) on sections where coal movements are now very much restricted? If otherwise the reasons against the adoption of such a system may please be stated.

(5) Will the Railways submit statistics month by month for the financial year ending March, 1951, giving tonnages of coal loads received in and moved out of the junction yards located over the different sections of their lines (a) as full train loads (b) as train loads combining coal with other goods ?

(6) Will the Railways operating coal traffic and the Coal Commissioner's organisation state the difficulties they experience with the present arrangements in obtaining quicker movements of coal wagons (a) within the colliery base stations and (b) at combining points on railways and suggest remedies to overcome these difficulties ?

(7) Will the Railways submit statistics month by month for the financial year ending March, 1951, giving the total number of coal wagons received in each traffic yard for unloading the tatal number of wagon hours spent by these wagons before being released to traffic as empties, also the total number of wagon hours spent on account of the delays and "to and fro movements " between yards and unloading points ?

(8) Are the coal wagons booked from the colliery base stations only to main receiving points on Railways or direct to individual sheds and other consuming points? Full details of the existing arrangements may please be furnished.

(9) What sort of control is exercised over the movement of coal wagons between the colliery base stations and their destinations on railways in order to avoid concession at different junctions ? Is there any system whereby the authorities at receiving points are informed of the full movements of the coal wagons so that if the wagons are not received at destinations in accordance to schedules repeat orders for the same supplies of coals and diversions of coal loads *en route* are avoided?

(10) Will the Railways please submit statistics month by month for the financial year ending March, 1951 the number of coal wagons received at each consuming point, (running giving shed, pumping station, power house, etc.) and the total number of wagon hours (or wagon days) spent in the entire routing of (a) receiving wagons within the premises, (b) unloading and clearing them out of the premises ?

2. **3—Production of Coal and Transport Arrangements :—**

The supply of Coal to consumers can be affected by the following known factors :—

(*i*) Shortage in production *i.e.*, demands from consumers are greater than the actual raisings.

(*ii*) Shortage in wagons for coal traffic.

(*iii*) Limited yard or siding capacities for marshalling coal loads to form trains for different destinations.

(*iv*) Limited capacities for transhipment of coal at " break off gauge " junction.

(*v*) Limited line capacities for traffic.

The total demands, allocations and despatches in respect of the railways and other industries as recorded for the year 1950 are given in the table below :—

	Demands (tons)	Allocations (tons)	Despatches (tons)
Railways	11,338,164	11,218,746	100,30,438
Industries	23,404,262	23,151,142	18,584,952
TOTAL . .	34,742,426	34,369,888	28,615,390

APPENDIX I—(*contd.*)

It will be seen that the despatches are short of the demands by about 18%. The allocations being based on production estimates show that the production of coal in the country is not behind the actual demands. The causes of restricted coal supplies are to be traced to transport difficulties.

(1) Will the Railways please give clear indications of the causes coming under (ii), (iii), (iv) and (v) above and those others arising from local conditions that have restricted coal movements on their lines ? A detailed account may please be given of the factors that have been mainly responsible for restrictions on coal movements.

(2) Suggestions may please be made for increasing yard line capacities and eliminating partially or fully the bottlenecks on different sections of each railway system. These suggestions may include requirements of the particular types of locomotives for increasing train loads to maximum permissible limits of siding capacities and may indicate possibilities of raising goods speeds.

SECTION 3

COAL STOCKS ON RAILWAYS AND COAL DUMPS.

3.1—Coal Stocks on Railways.

3.2—Coal Dumps.

3.1—Coal Stocks on Railways.

The advantages of maintaining coal stocks at consuming points on railways are :—

(*i*) reliability of supplies ; and

(ii) utilisation of coals in accordance with their suitability.

The disadvantages are :—

(*a*) Losses by way of breakage etc.

(*b*) Additional costs of handling, that is, loading, stacking and re-loading charges.

(*c*) Losses by pilferage.

(*d*) Spontaneous combustion.

Thus the coal stocks should not be too large to result in unduly heavy losses of coal nor too small to adversely affect reliability of supplies and thereby efficient utilisation.

2. The optimum coal stock for any consuming point depends upon the time the coal takes to move from the colliery to the consuming point, i.e., upon transit time. Here, again, there is an average value for the transit time and there are fluctuations over this average value. These fluctuations arise from the uncertain traffic conditions, caused by line breaches due to floods and heavy monsoons, unexpected engineering restrictions, train accidents, labour troubles and layout or equipment difficulties at coal transhipment junctions etc., etc. Thus the longer the lead of a consuming point from the colliery and the greater the number of junction points on the rail routes the more the fluctuations in transit time.

3. The Indian Railway Fuel Committee has accepted for the basis of determining optimum stocks for individual railways the following two factors:—

(*a*) minimum (danger point) stocks, as given by 10 days consumption ; and

(*b*) additional stocks proportional to effective transit days, effective transit days here being given by the product of the average transit time and a co-efficient ranging from unity upwards.

4. Where a consuming point is close to the source of coal supply, fluctuations in transit time are the minimum and the co-efficient to be used for calculating effective transit time is unity. Where a consuming point is very distant from the source of coal supply, the co-efficient to be applied against heavy fluctuations in transit time is 2·5. The Railways that do not fall on the two extreme limits, will adopt a transit time co-efficient between 1 and 2·5.

5. On the basis of the formula recommended by the Indian Railway Fuel Committee (which covers the upper and the lower limits on the transit time co-efficient) railways have recommended optimum coal stocks for their individual systems. On this basis the total ground stocks that all Indian Railways will maintain works out to 24 days consumption, as against the earlier basis of overall stocks amounting to 16·7 days' consumption. The Indian Railway Fuel Committee's recommendation, therefore, involves locking up of larger capital in ground stocks on railways.

Will Railways please state whether the recommendations regarding optimum ground stocks they made at the 4th meeting of Indian Railway Fuel Committee (on the basis of the existing arrangements for distribution of loco coal supplies) should stand or be modified ?

3.2—Coal Dumps.

One way of reducing coal stocks on a railway is to minimise fluctuations in transit time by setting up coal dumps at suitable locations on traffic routes. The idea is to utilise periods of lean traffic (and of better wagon availability) for moving full train loads of coal from collieries to the dumps so that reduced coal despatches from the collieries during the busy traffic periods or on account of traffic dislocations or shortage of wagons could be made up by supplies arranged from the dumps.

2. The idea of establishing coal dumps is not new to railways as wagon supply irregularities and line capacity/junction limitations and other difficulties at break off gauge points (such as Benares Cantt., Agra East Bank etc.) have necessitated the setting up of coal dumps at certain points and experience indicates that coal movements are appreciably improved by this measure.

6. During the last 6 months the Southern Railway and the Saurashtra Railway in the Rajasthan group of metre gauge systems have experienced difficulties in coal supplies due to limitations of line capacities and lack of shipping space for coal moved by sea route. It is possible that the rail route supplies for the two railway systems could be improved by provision of coal dumps at suitable locations in due regard to the bottle necks now obtaiig. Provision of a few dumps may also prove advantageous in the case of coal moved by sea route as these latter dumps should afford increased movement of coal by sea during periods when shipping space is readily available.

4. An important point to consider is that in order to maintain supplies for the Southern and the Saurashtra Railways, it has been necessary to adopt emergency measures such as the giving of preference to the loco coal over merchandise and public coal, the diversion of coal loads from booked destinations to consuming points running short of supplies and even the taking away of public coal for railway use. Provision of coal dumps may indeed eliminate the need for adopting measures which are not in the interest of rail transport.

(1) **Will the Railways and the Coal Commissioner's Organisation describe the working of the existing coal dumps now maintained for railway and public supplies of coal stating their advantages and disadvantages ?**

(2) **If it is considered necessary to provide additional coal dumps particularly to help movement of coal by rail route to the southern railway and to the Rajasthan group of M. G. railways, suggestions may please be offered regarding locations for such dumps, the stacking capacities for the individual dumps and the organisation or agency (governmental or private) that should take over control of the dumps.**

(3) **The coal dumps entail additional loading, stacking and reloading operations. Will the Railways and the Coal Commissioner's Organisation state from experience (or from actual records) costs of coal handling at the existing dumps and at the consuming points on Railways referring the costs to the methods (mechanical or manual) adopted in handling coal? If it is possible to evaluate losses by theft taking place at dumps, at consuming points on Railways and also at pit heads, figures of these losses and the reasons for their occurrence may please be stated.**

(4) **Will the Railways and the Coal Commissioner's Organisation describe the methods they have so far employed in the stacking of coal and the success achieved with such methods in minimising the deterioration of quality and size which now occurs as a result of breakage in handling and spontaneous combustion in stacks. Improvements in the present methods indicated by experience so far gained with Indian coals of coking and non-coking varieties, may please be suggested.**

SECTION 4

FUEL ECONOMY

4.1—Coals suitable for locomotives.

4.2—Fuel losses due to steam leakages.

4.3—Fuel losses due to discharge of carbon and combustible gases (smoke) from the Locomotive Chimney.

4.4—Fuel losses by Pilferage.

4.5—Utilisation of Locomotive Power and Fuel Efficiency.

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4.10—Encouragement to running staff for efficient work.

4.11—Coals outside Bengal and Bihar Coal Fields.

4.12—Alternative Forms of Power.

4.1—Coals Suitable for Locomotives.

On the recommendations of the Indian Railway Fuel Committee, Railways have already undertaken to carry out regular service trials to study the behaviour of the different coals they receive and submit reports separately for coking and non-coking coals on the lines of the proforma given at Appendix II of the 3rd Indian Railway Fuel Committee Report (subsequently revised at the 4th Indian Railway Fuel Committee meeting). Observations on coals tried in locomotive are to relate to features such as " slow or fast burning ", " ash handling easy or laborious ", "consumption—high or low " and " clinkering properties, if any, of individual coals and of mixtures ". The two main purposes to be served by such service trials are :—

(*i*) Coals unsuitable for loco power purposes can be reported to the Coal Commissioner, so that they may be excluded from future loco coal orders ; and

APPENDIX I—*(contd.)*

(*ii*) coals of the same grade which can be used together without having adverse effect on the performance of the locomotive (that is, without giving rise to clinkering troubles and high combustion losses), can be stacked together at sheds, so that sheds may handle a few approved varieties.

(1) Will the Railways compile lists and furnish information on the following lines dividing the information into two separate periods covering the years 1938 to 1944 and 1944 to date?

(*a*) Coals received by each Railway year by year.

(*b*) Coals subjected to trials on locomotives in different services and the number of tests carried out with each coal at different times in each year.

(*c*) Coals subjected to chemical analysis and tests (ash and moisture determination) and the number of analyses made with each coal at different times in each year.

In compiling the lists please give full particulars of the locomotive, the service and the section on which tests were made and also the name of the colliery, the grade and the seam against each coal tested.

(2) Will the Railways furnish particulars regarding (*a*) Coals that have been found suitable and (*b*) Coals that have been found unsuitable on the basis of the service trials carried out with different locomotives and coals during the financial year ending March, 1951? In the case of coals found unsuitable, the Railways may please state whether combustion and clinkering troubles were experienced when the coals were used separately or in mixtures.

(3) Will the Railways furnish data on trials they have carried out with the locomotives "Running Light" and furnish consumption figures for the different types of locomotives in light engine working in terms of lbs. per engine mile ?

4·2—Fuel Losses due to Steam Leakages.

A vital source of fuel loss is connected with steam leakages from locomotives and from steam pipe lines in sheds and power houses. The average loss by way of steam leakage through different orifice openings would be of the magnitude given in the table below :—

Orifice opening	Steam leakage lbs./hour.	Fuel wastage lbs./hour.
1″ dia.	2,850	570
$\frac{3}{4}$″ ,, ...	1,600	320
$\frac{1}{2}$″ ,, ...	700	140
$\frac{1}{4}$″ ,, ...	180	36
$\frac{1}{8}$″ ,, ...	45	9

The above figures indicate that appreciable saving in fuel would result if efforts are directed to eliminate steam leakages, both from the locomotives and from the steam pipe line in sheds and power houses.

(1) What precautions do the shed maintenance staff take to see that locomotives put on line do not suffer from steam leakages at piston glands, pipe joints, steam valves, gauge columns, mountings, boiler tubes, etc. ?

(2) Is there a standard form on which defects regarding steam leakages are recorded, both for the engines coming in for shed services and the engines going out on line ?

(3) Will the Railways submit statistics of the repair bookings regarding steam leakage defects, the common nature of such defects and the time spent in sheds for attending to steam leakage defects as against the time spent on all engine repairs ?

4·3—Fuel Losses due to Discharge of Carbon and Combustible Gases (Smoke) from the Locomotive chimney.

Smoke emanating from the locomotive chimney, either in building up steam in shed or in actual train operation on line, is both a fuel wastage and a public nuisance.

(1) Has any campaign been organised to train the running staff in the correct practices of preparing locomotives in sheds and operating them on line in order to reduce the discharge of smoke from the locomotive chimney to the minimum ?

(2) Have any studies been conducted on the different varieties of Indian Coals (both of coking and non-coking) in respect of the tendency for smoke formation ? Where coals have exhibited this tendency, what measures have been adopted to overcome or reduce it ?

4·4—Fuel Losses by Pilferage.

Coal losses by pilferage occur in (*a*) transit (that is, during coal movements from collieries to destinations) and (*b*) in handling (un-loading, stacking and re-loading work) at consuming points such as, loco sheds, pumping stations, power houses etc. In order that these losses are properly controlled, it is necessary to separate them. This can be done if facilities exist for weighing coal wagons at running sheds and at collieries.

(1) Will the Railways indicate what facilities they have at running sheds or at other receiving points for weighing coal wagons as they are received ?

(2) How many wagons or the total number received at running sheds or other receiving points on Railways are actually weighed ? Figures for the number of wagons weighed and the number received may be furnished for the financial year ending March, 1951.

(3) How many wagons of the total number leaving collieries are subjected to test checks by the Coal Commissioner's Inspection Organisation for weighments shown on the D. A. Notes ? Figures may please by furnished for the financial year ending March, 1951.

(4) Will the Railways and Coal Commissioner's Organisation state what differences have been noticed in the weighments obtained by test checks and the booked weights shown on the D. A. Note giving details of the test checks made and the actual percentage differences recorded where—

(*a*) weighment differences are found to be in favour of the collieries,

(*b*) weighment differences are found to be in favour of the consumers?

NOTE.—The information to be furnished may please by divided under the following headings :—

(*i*) Weighment differences keeping within 5%.

(*ii*) Weighment differences keeping in the range of 5 to 10%.

(*iii*) Weighment differences keeping above 10%.

(5) Where weighbridge facilities are not available have the Railways carried out test checks on volumetric contents of coal in the wagon and calculating the quantity in tons on the basis of bulk densities of the various coals predetermined by practical tests?

What steps have been taken to minimise coal losses by pilferage.

(*a*) in transit,

(*b*) in handling at sheds, or other receiving points ;

and what success has been achieved with the measures adopted?

4·5—Utilisation of Locomotive Power and Fuel Efficiency.

The more intensively a locomotive is used in hauling regular loads, the less time does it spend standing idle in sheds, or on line or on running light and the less coal does it consume in non-productive hours under actual steaming conditions. In other words, a locomotive employed on services, which call for the maximum number of hours being spent in actual haulage of loads against the total number of hours it remains in steam, would return, with other conditions being identical, minimum consumption of coal per unit of traffic produced (lb./thousand gross ton miles). The factors responsible for a high ratio of productive hours to total hours in steam are :—

(*i*) Suitable engine links to keep the engines on line for the longest period in the locomotive work cycle (out from washout/ repair line to service, and back from service to washout repair line in shed) with changes of engine crew restricted to a limited number and with proper facilities provided for engine inspection, lubrication, minor repairs and coaling, at suitable stations on traffic routes and with a reasonable balance of power achieved to reduce engine mileage in light running to the minimum.

(*ii*) Minimum time lost in engine movements from sheds to yards and stations and back from yards and stations to sheds, after completing link services.

(*iii*) Minimum expenditure of time in regular and out-of-course stoppages enroute.

(*iv*) Proper forecast of power requirements, so that engines are not held in sheds " ready in steam " for longer hours than necessary.

(*v*) Minimum expenditure of time on engine movements from inspection pit to washout/repair lines or to lines on which the engines are held ready to leave sheds.

(*vi*) Proper plan for giving loads to locomotives which ensure economic utilisation of power.

For Express and Passenger services the traffic schedules are fixed and printed in advance and loco power can be utilised with minimum fuel loss in idle hours in steam, both in sheds and enroute. As for the goods services, however, their tonnages and timings depend upon the traffic offering from time to time and are subjected to fairly wide fluctuations. Greater care is therefore, necessary in manipulating goods power so that the expenditure of fuel in shed services (" lighting up " or " banking " fire) and in idle engine hours both in sheds and on line (inclusive of light engine running) are reduced to the minimum.

(1) What measures are employed for making close checks on the forecasts of goods loco power and actual traffic demands and also on the variations of the actual train timings from the schedule timings in train services ?

(2) What machinery is employed for establishing cooperation between the traffic and the power staff in conducting train operations so that idle engine hours are reduced to the minimum ?

(3) It is necessary to assess the productive (actual haulage) hours as against the non-productive (idle and light running) hours of each engine in steam so that the causes of fuel wastage arising from non-productive work are properly controlled and fuel losses are reduced to the minimum. Is there a standard form in which (*a*) the time spent by the locomotive in the different phases of the work cycle (out from wash out/repair line to service and back from service to washout/repairs line in shed) and (*b*) the time spent by the locomotive in running light are recorded or such other data is recorded as will give an easy assessment of productive aud non-productive hours of each engine in steam? If so please furnish a copy of such a form with the data filled in to illustrate the use of the form.

APPENDIX I—*(contd.)*

(4) What arrangements exist for carrying out periodic checks on the mechanical condition of the locomotive during its actual operation on line and for recording observations in some standard form which is made over to the shed supervising staff for necessary attention to the locomotive ? A copy of such a standard form may please be supplied with data filled in to illustrate the use of the form.

(5) Give a summary of engine failures arising from mechanical defects, bad coal, negligence of staff and other causes. Statistics are required for the period commencing from 1944 to date.

(6) Will the Railways furnish by division or districts statistics of (*a*) the total gross ton miles handled by the fleet of locomotives in each particular class, section by section, (*b*) the total engine mileages run by the fleet of locomotives in each particular class, section by section and give scheduled loads for each class of locomotives, section by section ?

(7) Are mechanical plants used for handling coal at sheds and/or at railway stations ? If so, reports on the working of these plants may be furnished with particular reference to the following points :—

(*a*) Time saved in coaling operations at loco sheds and also at railway stations for attending to through traffic engines.

(*b*) Relative costs of coal handling by manual labour and by mechanical plants.

(*c*) The degrees of accuracy of the coal measures for issue of coal to engines—

(*i*) By basket loading as manually carried out ;

(*ii*) By bucket/grab crane loading as mechanically carried out.

(*d*) Advantages or otherwise of mechanical loading in securing efficient operation under pooling system.

4·6—Training of Engine Crew

The operation of a locomotive on line calls for skilful handling on the part of the fireman and for a good deal of co-operation between the fireman and the driver in order that—

(*a*) safety valve is prevented from blowing unnecessarily ;

(*b*) fire conditions are maintained satisfactory in spite of fluctuations in loads, engineering restrictions, out-of-course stoppages, etc., and

(*c*) the fire is manipulated so as to suit the quality and the character of coal used and to reduce the grate losses to the minimum.

The engine crew can be made to take interest in the methods of efficient firing, in the proper upkeep of the boiler and the engine, and also in other measures that may be introduced for reducing fuel consumption, (such as feed heating, full-regulator working etc.) when they are trained to follow intelligently the reasons recommending different loco operating practices. Education of the crew, is, therefore, an important step in the fuel economy campaign that may be launched on any railway :

(1) Will Railways please give details of training schemes that have been introduced in order to raise the standards of—

(*a*) The general education,

(*b*) The technical education and practical experience of the engine crew and the maintenance staff ?

(2) Are any examinations (oral or written) and practical tests given to the running staff at regular periods or before they are due promotions or increment ? If so, please furnish statistics of—

(*a*) The total number of staff in each category of engine crew such as drivers, shunters, firemen, etc. and of the maintenance units such as supervisors, fitters, etc. that have appeared for such examinations (*i*) without being put through the training schemes and (*ii*) after being put through the training schemes.

(*b*) The number of staff in each catgory that have passed the examinations and have been given promotions.

(*c*) The number of staff in each category that have failed in examinations.

(*d*) The number of staff that have remained in particular grades for periods longer than three years and have not been promoted either for not appearing or for failing in the examinations.

Statistics are required for the last five years.

(3) Please furnish statistics giving the number of employees in the different categories of the engine crew and maintenance staff that have passed through the training schemes year year for the last 5 years.

(4) What suggestions can be offered for improving the training schemes already in existen

(5) What basis are adopted for recruiting men to the different categories of the engine cr and the maintenance units ? Full details may please be furnished.

4·7—Locomotive Operation under Pooled and Assigned Crew Systems.

It is generally found that maintenance of engine worked under pooling conditions calls for greater attention in sheds than that of engine worked under assigned crew system. As regards inter repairs and POHs (schedule repairs), the issue appears to be somewhat controversial. If the mileage bases were substantially followed and standard mileages were laid down for schedule repairs, then for a given engine mileage the number of engines that would be called in for such repairs should remain unaffected irrespective of whether the engines operate under pooled or under assigned crew system. All that will happen is that a pooled locomotive will go in for inter repairs or for POH at shorter intervals of time and under assigned locomotive at longer intervals. It may, however, be (and conditions of engines have often warranted) that the inter repairs and POHs are somewhat havier in the case of the pooled engines and possibly for this reason the mileages between schedule repairs are actually reduced for these engines. Under the circumstances the total number of engines going in for inter repairs and POHs would be less under the assigned crew working than under pooled working.

The point in favour of pooled working is that the engines are not subjected to frequent boiler cooling which should save the boiler from frequent repetition of alternating stresses and may in consequence save it from expensive repairs. This point, however, has not shown up so pronouncedly in Indian conditions. The general finding is that engines keep in better fettle under assigned crew working. This advntage would be somewhat offset by the following two factors :—

(*a*) larger number of engines are required for operating given traffic, and this results in greater expenditure in terms of interest and depreciation on capital outlay, and

(*b*) more consumption of coal in " lighting up " or " banking " fires as engines will return to sheds frequently to provide rest intervals for the crew in between duty hours.

There is still one clear advantage in favour of the assigned crew working. This advantage lies in larger reserve of power being maintained by individual railway systems which can be utilised more intensively under emergency conditions by changing over to pooled working. Even with a country possessing a high potential for loco building and other heavy industries, a larger reserve of power is an advantage as it will help in utilising the potential Industrial capacity for defence activities, war transport being fully handled by available locomotive power.

(1) Will the Railways offer comments on the pooled and assigned crew working with particular reference to the following factors—

(*a*) Maintenance costs ;

(*b*) Fuel savings ;

(*c*) Reserve power capacity as against interest and depreciation on larger capital outlay ?

(2) Will the Railways submit estimates for the number of different types of locomotives they need for operation under

(*a*) assigned crew system,

(*b*) pooling system

Separate estimates should be given for the existing traffic and the traffic expected after a period of five and ten years.

(3) Have any Railway tried out any system introducing " partial " pooling ? If so, will they please submit detailed reports on the working of " partial" pooling and suggest improvements.

4·8—Fuel Statistics.

Fuel statistics are worked out by Railways from records of fuel issued, consumptions and train loads which are maintained on certain standard forms by fuel sections of the operating departments and statistical sections of the General Managers' Offices with the Railways. The operating departments (in some cases the Statistical Sections) prepare domestic statistics from the shed fuel forms, the driver's tickets and/or the Guard's journals which contain record of coal issues and consumptions and also of the train loads. The Statistical Sections of the General Manager's Offices prepare official statistics for which they use fuel data collected by the operating departments but derive figures for traffic quantities from summaries of goods and merchandise bookings made at the various stations which they receive from time to time. They also use certain co-efficients for converting departmental traffic or any other traffic on railway account into units of revenue traffic.

The domestic statistics are used for checking up the fuel performances of the locomotives of the individual engine crew and of the sheds and the districts as units in day to day service whereas the official statistics are embodied in annual administrative reports of railways to afford a measure of fuel performances of one railway as against the other.

Considerable differences have been noticed in the domestic and the official statistics and enquiries have shown that these differences arise chiefly from the accountal of traffic quantities, the figures for official statistics being collected from the summaries as received from the booking stations which do not as a rule account for all the traffic handled within the particular period for which the statistics are worked out. For any specific periods the domestic statistics would seem to cover traffic quantities more fully than the official statistics and would as such be more reliable for purposes of performance checks. The difficulty today is that the present statistical procedure does not afford a ready means of working out the statistical figures so that they could be immediately applied as checks on fuel performances of locomotives, of engine crew, of sheds and of districts over successive fortnightly intervals.

APPENDIX I—(*contd.*)

The whole statistical procedure (including the various forms laid down for entering up basic data on fuel issues and consumption and on quantities of traffic handled), would need to be standardised so that the sour ces of information for both official and domestic statistics are the same and the method of calculation adopted affords a ready means for working out domestic as well as official statistics, the latter should differ so little from the former that they could be regarded as true final values while the domestic figures are utilised for performance checks only.

(1) **Will the Railways submit the forms they use for recording basic data on fuel and traffic quantities and describe in detail the methods they employ in working out fuel statistics both for domestic and official purposes giving by way of an illustration, an actual calculation of statistical figures from the basic data ?**

(2) **What suggestions can be made regarding the adoption of standard forms so that such standard forms may afford common sources of information on fuel and traffic quantities for deriving both official and domestic statistics ?**

(3) **What changes could be suggested in the methods of calculation in order that a standard procedure could be developed for (*a*) working out domestic statistics within a few days of the closure of the period to be reviewed and (*b*) developing official statistics on the basis of well confirmed data on fuel and traffic quantities ?**

(4) **Is it necessary to have separate domestic and official statistics ? If so, please give reasons ?**

(5) **It is believed that official statistics are generally used for performance comparisons between different Railways in the country as well as between Railways in different countries. How far can the official fuel statistics as prepared by Indian railways be relied upon for affording fair comparison in such cases ?**

4.9—Rationalisation of Service Units.

The statistical figure which expresses the fuel performance of a locomotive in a particular service is given by coal consumption in lbs./1000 gross ton miles. This statistical figure is worked out for the two main service groups, viz :—

(*i*) Passenger and proportion of mixed, and

(*ii*) Goods and proportion of mixed.

The two main service groups, it will be admitted, cover a very wide range of service conditions expressed as they are in terms of load/speed combinations, gradients and curves, traffic requirements as to stoppages, train crossings, shunting operations at stations, departmental duties etc., etc .With the services covering such a wide range of conditions, the statistical figure of fuel performance in lbs./1000 gross ton miles cannot afford a comparison between one Railway and another, without falling into error, as the conditions obtaining in the two service groups may not (in fact, will not) compare closely on the different railway systems.

As we should be able to utilise the statistical figure for comparing fuel performances of different Railways, a better approach to the problem would be to split up the two main service groups into smaller service groups or service units, the service conditions of which should match up closely between one Railway and another. The suggestion is to introduce service units such as " mail and express ", " passenger ", " local "suburban " through goods ", " pick-up goods ", " shunting duties ", "departmental duties ", etc., etc.

Apart from the comparison that the statistical figures derived for these smaller service groups would afford a s between one Railway and another, the other important advantage is that the domestic fuel statistics could be derived easily for the smaller service groups and utilised more effectively for close checks on the fuel performances of locomotives, engine crew, sheds and districts etc. in day to day service.

(1) **Will the Railways offer suggestions regarding the splitting up of the two main service groups into smaller units with a view to obtaining the greatest possible degree of uniformity in the service conditions of the same service units on the different Railway systems ?**

(2) **The following scheme for rationalising service units is submitted —**

(*i*) **" Mail and Express "—Where as a rule lengths of non-stop runs are not less than 25 miles.**

(*ii*) **" Passenger "—Where as a rule lengths of non-stop runs keep within 15 miles and only in a few cases exceed this limit.**

(*iii*) **" Express goods "—Where as a rule lengths of non-stop runs are not less than 20 miles.**

(*iv*) **" Slow Goods "/" Pick up Goods "—Where goods trains drop and pick up wagons frequently on the run.**

(*v*) **Shunting duties—No remarks.**

(*vi*) **Departmental—No remarks.**

(*vii*) **" Light Engine movements "—**

(*a*) **Passenger**
(*b*) **Goods**
(*c*) **Departmental**
} **No remarks.**

Will the Railways offer comments on this scheme and if necessary suggest alternative schemes.

4·10—Encouragement to Running Staff for Efficient Work.

It will indeed be desirable to have some bonus scheme devised so that the human element in services may get sufficient encouragement and put up good performance. There are, certain fundamental difficulties in getting a suitable bonus scheme to operate satisfactorily. Firstly we have yet to evolve a reliable unit of performance which may be used for judging accurately performances of the individual crew. Secondly, engine crews are likely to get " mixed up " with coal clerks in getting their records of coal consumption " cooked up " for a consideration of some sort.

A unit of performance which excludes the varying factors of locomotive operation, is given by the ratio of the actual coal consumption to the 'trip ration' fixed for the 'locomotive service coal' combination. The point is to determine reasonably accurately the actual coal consumption trip by trip and also fix trip rations for known operating conditions (loco-coal-grade-service combinations). The shed problem is accurate calibration of the tender. This would enable the consumption and issue of coal to be correctly assessed trip by trip. Fuel Control Organisations on railways are to establish a routine in regard to the checking up of coal quantities on the tender with the help of calibration markings so that the coal clerk could make correct entries of issues and consumptions for the diffrent train services. It is hoped that within a period of a year we will be able to evolve a procedure ensuring accuracy of coal consumption records.

The second difficulty is that engine crew may work in league with coal clerks and get their records shown up the best. This difficulty should be the strongest point against the introduction of a bonus scheme which may provide for payment of bonuses to individual engine crew for good work done.

An alternative to a bonus scheme is the awarding of prizes to sheds or districts/divisions. Such an arrangement may include special prizes for individual crew and shed repair gangs coming up best both with the winning and losing sides on the lines of sports tournaments. Repairs gangs in sheds should be included in the awards as the fuel efficiency will greatly depend upon the mechanical condition of locomotives apart from what the engine crew may do to save fuel. The awards to the sheds, districts or divisions will be for the concerted effort of the entire operating staff, in sheds, districts or divisions. The prizes to be awarded may be in the form of a shield which will move from shed to shed and from district to district or division to division and cups for individual winners.

The performance of a shed or a district/division can be judged correctly by the unit of performance given as the ratio of the total coal consumption to the aggregate of trip rations in respect of entire services operated by the shed or the district/division. This ratio can be called " Fuel Performance Index ". Once the procedure of evaluating coal issue and consumption and determining trip rations (by practical tests and cross checked by theoretical estimates) is established there will be no disputes on the scores registered by individual sheds, districts or divisions.

There is just one snag in the institution of awards. Fuel Inspectors attached to the sheds, the districts or the divisions would (very naturally) feel inclined to fix more liberal trip rations than they should. This snag can, however, be overcome by having the trip rations fixed for any shed, district or division finally approved by the Senior Fuel Inspectors/Fuel Officers with headquarters who will take an impartial attitude in this type of work.

(1) Will the Railways make suggestions from experience regarding bonus schemes or systems of awarding prizes to operating staff ?

(2) Have any bonus scheme been tried out in workshops and other railway departments ? If so, details of such a scheme may please be furnished, along with comments on the success or failure of the scheme.

4·11—Coals outside Bengal and Bihar Coal Fields.

Coals outside Bengal and Bihar coal fields have not so far been graded. Railways using coals from C. P., C. I. C., Singareni, Talcher and other coal fields outside the Bengal and Bihar group will have collected enough data on the physical and chemical characteristics (generally approximate analyses, coking properties, etc., etc.) of these coals.

Will Railways furnish information on the chemical properties and physical characteristics of the ungraded coals they have used to enable the committee to consider proposals in respect of the regional development of collieries outside the Bengal and Bihar coal fields with the object of rationalising distribution of coal supplies ?

4·12—Alternative Forms of Power.

Steam, diesel mechanical or diesel electric, gas turbine and straight electric locomotives form the four types of power which are now being employed in varying degrees on the railway systems of the world. India has mainly developed steam traction. A few diesel locomotives for shunting duties and some diesel rail-cars have been used on Indian Railways. As long as diesel oil cannot be synthetically produced from coal in sufficiently large quantities, as not only to meet the railway requirements but also the requirements of other important national undertakings, diesel power may not become popular in India. Oil burning gas turbine has been brought into rail transport only recently. Coal burning gas turbine locomotive is still in the experimental stage, but it does show some promise. Even here, the success of the coal burning gas turbine locomotive will depend upon whether Indian Railways can develop a cumbustor burning 20/22% ash coal or gas producer (that can be installed on the locomotive tender) using high ash coals for producing the gas necessary for combustion purposes. Thus for another 10 years at least, much development cannot be visualised in the direction of large scale application of coal burning, gas turbine on Indian Railways. The field is, therefore, left to steam traction on the one side and straight electric traction on the other.

2. The advantages of steam traction are :—

(*i*) Capital outlay is relatively less.

(*ii*) Steam locomotives can be manufactured in the country with the available skill and labour organisation.

APPENDIX I—(*contd.*)

The disadvantages are :—

(*i*) Limitations imposed by axle-loads on tractive effort and power.

(*ii*) Increased dead weight of the locomotive on account of the tender for carrying coal and water.

(*iii*) Dust and smoke nuisance and generally lower degree of comfort.

(*iv*) Low thermal efficiency.

3. Electric traction on the other hand, generally speaking has the following advantages :—

(*i*) Higher speeds in service afford increased line capacity for traffic and also induce more traffic.

(*ii*) Maintenance cost of electric locomotives is lower than that of steam locomotives.

(*iii*) Greater availability of locomotives.

(*iv*) Lighter locomotive units.

(*v*) Cleanliness and comfort.

(*vi*) Higher thermal efficiency resulting in coal consumption being practically halved.

(*vii*) Greater scope for utilisation of slack and lower grade coals in thermal plants.

The disadvantages are :—

(*i*) Higher capital outlay on account of traction equipment, transmission and conversion systems.

(*ii*) Lack of experience and facilities (at least for the next 5 years) in the manufacture of electrical gear in the country.

4. Financial justifications for railway electrification schemes have to bear out with operating costs and gross and net earnings as related to traffic densities. There are two approaches to this financial justification :—

(*a*) *Simple Economic Approach.*—Railways may be treated as independent units generating and using their own electric power. On this basis financial justification for electric traction will be based on the total capital outlay which will include the capital expenditure on power generation and transmission plant and equipment.

(*b*) *Broad National Approach.*—The supply of power from national undertakings will be taken as a starting point in working out financial justification for electric traction, the railway developments being taken as a part of the larger national developments.

Against the " Simple Economic Approach " the traffic densities now registered by most Indian Railways will generally rule out electric traction for majority of main and branch line sections, but against the " Broad National Approach " relatively lower traffic densities may easily admit of a financial justification as capital outlay on plant and equipment would be relatively less and some sections on railways may straightway justify electric traction.

5. The development of national undertakings for supply of electricity from hydro-cum-thermo-electric plants is now well in hand. The idea of washing low grade coals in order that the higher grades may be more efficiently utilised in different purposes is now taking root. Large scale washing of coals is expected to give rise to problem of utilization of middlings. The present trend is to consider utilisation of middlings in large capacity thermo-electric plants situated in the coal-fields and in the manufacture of soft coke. There is, therefore, considerable scope for large capacity thermal stations being associated with coal washing plants at the collieries. This aspect has not received much attention in the Electricity Supply Schemes so far worked out, but the possibilities of more power being made available as a result of the utilisation of washery middlings in large capacity thermal station do exist. The alternating current traction at 50 cycle frequency is making progress and is gradually coming into new undertakings. The capital outlay on alternating current traction is less than on the D. C. traction. It is easy to visualise that the railways would go in for greater and greater degree of electrification. It is, therefore, worthwhile to collect data relating to the traffic densities that railway systems have registered for the main and branch line sections and to the developments in traffic densities expected in the course of the next 5 or 10 year periods. This data may be utilised as a basis for working out railway electrification schemes.

(*i*) **Will the Railways please furnish information about traffic densities in gross tons per single track mile per annum, over successive sections of important originating and terminating points of loads. They will have registered for the main and branch line sections during the last one year and submit forecasts of developments in traffic densities in the course of the next 5 and 10 year periods ?**

(*ii*) **Will the Railways please furnish details of electric traction schemes they have so far worked out and of financial justifications in support of the schemes ?**

SECTION 5

GENERAL

5·1—Payment of Coal Bills.

5·2—Ground Balances.

5·3—Coal Handling.

5·4—Fuel Organisation.

5·5—Outlying Coal Fields.

5·6—Miscellaneous.

5·1—Payment of Coal Bills.

The procedure laid down by the Railway Board is that Accounts Officers or other authorities on Railways will make payments immediately on the receipt of bills from colliery owners along with coal despatch particulars, and make adjustments later in cases where the actual receipts do not agree with the bills. The colliery owners, on their part, are required to submit bills on the 1st and 16th of every month covering the coal despatches during the successive fortnightly periods.

(1) **Will the Railways indicate whether they make payments on coal bills along with despatch particulars or on receipt of advices of the coal wagons arriving in sheds and at other consuming points ?**

(2) **When payments are made on the strength of despatch particulars furnished by colliery owners, can it be said that except in rare cases the coal despatches tally with the actual receipts. Details of cases where adjustment on account of despatches not tallying with receipts have been found necessary during the financial year ending March 1951 may please be furnished.**

(3) **If the system is to make payment on arrival of coal at destination, are there any cases of undue delay in payment which may have arisen from non-receipt of advices of the arrival of coal at receiving points. If so, please submit a statement giving details of such cases covering the financial year ending March 1951.**

5·2—Ground Balances.

(1) **It is believed that the accounting of coal issues and consumption in railway sheds is being periodically cross-checked with actual supplies and ground balances. Certain differences will have come to notice in the booked and checked ground balances from time to time. Will the Railways submit a statement giving particulars of the checks carried out on the issues and consumption and ground balances year by year for the period 1949-51 on the lines of the proformas 'A' and 'B'.**

5·3—Coal Handling.

(1) **Will the Railways furnish particulars of handling charges paid during the financial year ending March 1951 on the lines of the following form.**

Items.	Rate per ton	Total quantity handled	Total cost Rs.
(*a*) Unloading.			
(*b*) Carrying to stacks.			
(*c*) Stacking.			
(*d*) Breaking to size (where necessary)			
(*e*) Reloading.			

(2) **Is the handling of coal departmental or under contract system ? Comments on arrangements adopted by individual Railways regarding departmental or contract labo employed on the coal handling work and their advantages and disadvantages with particular reference to (a) losses of coal by pilferage (b) wagon detentions in sheds and demurrage charges etc., may please be furnished.**

5·4—Fuel Organisation

The committee is interested in the type of men the Railways have employed in their fuel organisation from time to time. Will the Railways furnish particulars year by year, on the lines of the proforma 'C' covering the period from 1944 to date ?

PROFORMA 'A'

ANNUAL COAL RETURN FOR THE FINANCIAL YEAR 1949-50 IN QUARTERLY OR HALF-YEARLY PERIODS AS MAINTAINED ON THE RAILWAYS—OTHERWISE FOR THE YEAR AS A WHOLE.

Name of Colly.	Grade of coal	Rate per ton				Opening balances		Receipts		Total Qty. on hand 7+9)	Total cost (8+10)	Issues		Closing Balances		Shortages				Excesses		Remarks
		Pithead	Transport.	Handling	Total	Qty. in tons	Cost as per Col. 6	Qty. in tons	Cost as per Col. 6			Qty. in tons	Cost as per Col. 6	Qty. in tons-	Cost as per Col. 6	Qty. accounted for due to Pilferage/ theft		Error of issue/ Consn.	Cost as per Col. 6	Qty. accounted for	Cost as per Col. 6	
																In transit	In shed					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		17	18	19	20	21	22	23

APPENDIX I—(*Contd.*)

PROFORMA 'B'

STATEMENT OF CONSUMPTION OF COAL SERVICEWISE ETC. FOR THE YEAR APRIL 1949 MARCH 1950 MONTH BY MONTH

Service etc.	Coal consumed	Gross tons	Train miles	G.T.M.	Lbs per 00 GTM	lbs per Engine mile in the case of shunting and departmental	Total cost of coal	Rs. per 1000 GTM	Rs. per Engine mile for shunting and Departmental
(*a*) Mail and Express									
(*b*) Passenger									
(*c*) Fast Goods . .									
(*d*) Slow (pick up) Goods									
(*e*) Suburban . .									
(*f*) Shunting . .									
(*g*) Departmental .									
(*h*) Shed use ("lighting up" "banking" fire etc.)									
(*i*) Pumping stations									
(*j*) Workshops . .									
(*k*) Power houses									
(*l*) Carriage sheds									
(*m*) Civil Engineering Departments.									
(*n*) Private sale									
(*o*) Write-off . .									

PROFORMA 'C'

FUEL ORGANISATION ON RAILWAY.

1944—1951

Designation	No. Employed.	*Scale/ Grade	1944						1945
			No. of years served as						No. of years served as
			1	2	3	4	5	6	
Fuel Officer									
Sr. Fuel Inspector									
Jr. Fuel Inspector									
Asstt. Fuel Inspector									
Shed Fuel Inspector									

NOTES :—

1. The categories of staff given under the column entited "Designation" are those commonly employed in Fuel Organisations. If there are staff other than those covered by the categories shown, they may be included under the column in question.

2. *Schedule of columns* 1 *to* 6.

(1) Service as Apprentice.
(2) „ „ Fitter.
(3) „ „ Shunter.
(4) „ „ Driver.
(5) „ „ Foreman.
(6) „ „ Loco Inspector/Fuel Inspector.

3. In the case of direct rectuits to posts under column entitled "Designation" a separate note may be attached giving basic education, technical qualification and railway experience in different capacities.

*Old and prescribed.

APPENDIX I—(*contd.*)

5.5—Outlying Coal Fields.

(1) The future development of the outlying coalfields is expected to be considerably helped by the two main factors—

(1) The drive towards conservation of high grade coking coals which are at present being produced chiefly in the Jharia coalfields.

(2) The adoption of measures to reduce transport of coal from the collieries to consuming points by regional development of coal supply sources.

The Railway Fuel Economy Enquiry Committee is interested in these future developments for obvious reasons. It would be greatly appreciated if information can be furnished on the following points :—

(1) Name of the colliery,

(2) Name of the base station serving the colliery,

(3) Monthly raisings and despatches for the period January 1951 to date; despatches to be given in respect of (a) each railway, separately, and (b) industries and public (preferably Province-wise),

(4) Increase in monthly raisings that can be immediately achieved with existing equipment, labour and other facilities,

(5) Development plan for stepping up production over a period of say, 5 years. New sites to be opened etc. etc.

(6) Requirements of additional capital, transport and other facilities in connection with the 5 year development plan, and

(7) Proposals, for setting up individually under single colliery or jointly under colliery groups, laboratories manned by qualified fuel technologists or inspection units manned by qualified inspectors for control of quality.

(2) Information is required by Railway Fuel Economy Enquiry Committee on the following points from Singareni Coal-fields.

Present Operations.

(1) Number of Collieries working.
(2) Organisation of each colliery, labour and supervisory.
(3) Raisings of each colliery per month.
(4) Man-shifts employed in each colliery, number per month.
(5) Siding capacity of each colliery for loading coal.
(6) Capital outlay for each colliery separately and total for the coal fields.

(*a*) Power plant.
(*b*) Mining equipment.
(*c*) Administrative buildings, etc.
(*d*) Residential buildings, civic improvements and other facilities.

(7) Equipment, housing and other facilities required for stepping up the output by 80,000 tons per month from all collieries put together.

(8) Estimated available coal reserves of the mines now worked.
(9) Monthly output and despatches from each colliery.
(10) Present stock position, and seasonal fluctuations.
(11) Estimated reserves of virgin areas.

Development Programme.

(12) Immediate possibilities of increasing output from each colliery without incurring additional capital expenditure.

(13) Time necessary for this development, and rate of increase in output expected over successive six monthly periods—

(14) Whether assistance is required from the Central Government in capital investment or in other manner.

5.6—Miscellaneous.

(A) Information is required by the Committee on the following points :—

(*i*) Average coal consumption of locomotives by classes.

(*ii*) Average coal consumption of locomotives employed on services other than they are designed for *i.e.*, the consumption of

(*a*) passenger locomotives utilised on the suburban services.
(*b*) Goods locomotives utilised on passenger services and suburban services separately.
(*c*) Passenger or goods or suburban locomotives utilised in shunting services.

APPENDIX I—*(contd.)*

(*iii*) Quantity of coal written off yearly since 1937.

(*iv*) Coal consumption by classes of engines and of services on the lines of the following proforma :—

PROFORMA.

Services.	Class of engines.	Total No. in each class	Total GTMs.	Total Net ton miles	Lbs. per 1000 GTM	Engine miles
Mail, Express, Fast Passenger .	*Locos designed for the service.* BESA . 1924 IRS . . . . Latest IRS . . . . *Locos not designed for the service* BESA . . . . . 1924 IRS . . . . Latest IRS					
Slow Passenger. .	*Locos designed for the service* BESA . . . . . 1924 IRS . . . . Latest IRS . . . . *Locos not designed for the service—* BESA . . . . . 1924 IRS . . . . Latest IRS . . .					
Suburban . .	*Locos designed for the service* BESA . . . . . 1924 IRS . . . . Latest IRS . . . . *Locos not designed for the service* BESA . . . . . 1924 IRS . . . . Latest IRS . . .					
Fast Goods . .	*Locos designed for the service .* BESA . . . . . 1924 IRS . . . . Latest IRS . . . *Locos not designed for the service* BESA . . . . . 1924 IRS . . . . Latest IRS					
Slow goods shunting and transhipment trains.	*Locos designed for the service .* BESA . . . . 1924 IRS . . . . Latest IRS . . . . *Locos not designed for the service* BESA . . . . 1924 and latest IRS . .					
Yard shunting .	1. Standard yard shunting . 2. Loco prior to 1924 . . 3. Loco after 1934 . . 4. BESA . . } . . 5. 1924 IRS . . } Goods 6. Latest IRS . } locomotives					

APPENDIX I—(*contd.*)

(B) Railways are requested to submit statements on the following items of fuel accounts :—

(*i*) Quantities of coal and their costs in rupees for " coal not received but paid for " as on the 31st March 1951 and on the 31st of March 1952. Oldest outstanding claims under this item should be clearly indicated.

(*ii*) Quantities of coal and their costs in rupees for " coal received but not paid for " as on the 31st of March 1951 and on the 31st of March 1952.

NOTE.—(The figures for market and govt. collieries should be shown separately).

(*iii*) Costs and quantities of coal "disposed of " yearly in the case of coal wagons not traced. Information should be furnished for the last five years.

(*iv*) If records are maintained for missing coal wagons a statement should be furnished giving yearly figures of such missing wagons covering the period of the last ten years. A statement should indicate clearly whether the numbr of missing wagons has increased or otherwise since 1944.

(C) Railways may please furnish information on the following points :—

(*i*) Number of wagons received on the railway without side labels.

(*ii*) Number of wagons received on the railway without despatch advice notes and invoices.

(*iii*) Number of references (with details) made to the Coal Area Superintendent regarding missing wagons showing in each case the number of wagons the Coal Area Superintendent was unable to trace.

(*iv*) The quantities of unlinked coals and their costs in rupees " adjusted off " any account, on the authority of the Railway Board. Information in respect of the market and government collieries should be furnished separately.

(*v*) Quantities of coal and (their costs in rupees) diverted to industries for which credit has not yet been received.

(D) Will Coal Manager Adra, D. S. Asansol, D. S. Dhanbad, Supdt. (Transp.) Bilaspur, Asstt. Supdt. (Transp) Khurda Road, DTSS. Nainpur, Nagpur, and Hyderabad, please supply the information on the lines of the following proforma :—

PROFORMA.

Item	For the month of October 1952.															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	and so on
1. Surplus empties on hand in the division after meeting the day's allotment																
2. Empties on road from the adjoining divisions																
3. Empties likely to be available by 8 hours the next day from the adjoining division.																
4. Releases . .																
5. Total wagons available for coal loading																
6. Original allotment by CTO.																
7. Actual despatches																

APPENDIX 2

(Chapter I)

MEETINGS, VISITS AND CONSULTATIONS

A. COMMITTEE

Date	Place	Particulars
24th to 27th October 1951	Calcutta.	Committee meeting (all members)
3rd November, 1951	Calcutta.	Committee meeting (all members)
14th to 17th November, 1951	Calcutta.	Committee meeting (all members)
18th November, 1951	Madras..	Meeting with Dy. C. O. P. S., Divl. Mech. Engineer & Fuel Officers of Southern Railway.
19th November, 1951.	Madras	(i) Visit to Madras Docks. (ii) Consultation with :— (a) Officers of Southern Rly. (b) Madras Govt., Madras Port Trust & Southern Rly. officers.
20th & 21st November 1951	Neveli	Visit to Lignite Coal fields.
22nd November, 1951.	Madras	Consultation with Dy. C.O.P.S. & Fuel Officer of S. Rly.
26th to 29th November, 1951.	Calcutta.	Committee meeting (all members)
26th & 27th December, 1951	Calcutta.	Committee meeting (all members)
21st to 24th January, 1952	Calcutta	Committee meeting (all members)
14th to 16th February, 1952	Calcutta	Committee meeting (all members)
17th February, 1952	Calcutta.	Committee meeting (2 members)
21st to 23rd February, 1952	New Delhi	Committee meeting (3 members)
25th to 27th February, 1952	New Delhi	Committee meeting (2 members)
31st March to 5th April, 1952	Calcutta.	Committee meeting (all members)
2nd April, 1952	Calcutta.	Evidence by Mr. A. Farquhar, Coal Adviser, Tatas.
11th April, 1952	New Delhi.	Committee meeting (2 members)
23rd to 25th April. 1952	New Delhi.	Committee meeting (3 members)
30th April, 1952	New Delhi.	Committee meeting (2 members)
3rd May, 1952.	New Delhi.	Committee meeting (2 members)
10th to 13th May, 1952.	Calcutta.	Committee meeting (all members)
31st May to 6th June, 1952	Bombay.	Committee meeting (4 members)
10th to 12th June, 1952	New Delhi	Committee meeting (3 members)
19th June, 1952	Calcutta.	Committee meeting (all members)
28th June, 1952.	Calcutta.	Committee meeting (2 members)
Ist & 2nd July, 1952	Calcutta	Meeting with G. M. & Departmental heads of Eastern Rly.
3rd July, 1952	Calcutta	Committee meeting (all members)
7th July, 1952	Calcutta.	3 members met Eastern Railway officers & Supdt. Minerals, Garden Reach.
10th July, 1952	Delhi	Visit to loco shed, Delhi Main.
11th July, 1952	New Delhi	Meeting with G.M. & Departmental heads of Northern Railway.
28th July, 1952	Bombay.	Meeting with G. M. & Departmental heads of Central Railway.
29th July, 1952.	Bombay.	Meeting with G. M. & Departmental heads of Western Railway.
3rd August, 1952.	New Delhi.	Committee meeting (2 members)
21st August, 1952.	Calcutta	Meeting of Member-Secretary with Chairman in Calcutta.

APPENDIX 2 —(*Contd.*)

Date	Place	Particulars
4th & 5th September, 1952	New Delhi.	Committee meeting (2 members)
11th to 13th September, 1952	Calcutta	Committee meeting (all members)
15th & 16th September, 1952	New Delhi.	Committee meeting (2 members)
6th October, 1952	Bombay.	Committee meeting (3 members)
7th October, 1952	Bombay.	Meeting with F. A. &. C. A. O. and other Accounts Officers of the Central Railway.
13th & 14th October, 1952.	Calcutta	Committee meeting (all members)
15th October, 1952	Calcutta	(i) Meeting with President & Vice-President of Indian Colliery Owners Association (iii) Consultations with officers of Coal Commissioner's organisation.
25th October, 1952	New Delhi	Committee meeting (2 members)
28th October, 1952	Gorakhpur	Meeting with G. M. & Department heads of North-Eastern Railway.
8th & 9th December, 1952	Bombay.	Committee meeting (all members)
17th December, 1952	Calcutta.	Meeting with G. M. & Departmental heads of Eastern Railway.
18th & 19th December, 1952	Calcutta.	Committee meeting (all members)
10th to 21st Janyary, 1953	New Delhi.	Committee meeting (all members)
21st January, 1953	New Delhi	Consultation with M/S. Aiyer & Co., Chartered Accountants, Bombay.
22nd January, 1953.	New Delhi	Committee meeting (3 members)
23rd, 24th & 27th January, 1953	New Delhi	Committee meeting (2 members)
29th January, 1953	Bombay.	Committee meeting (2 members)
30th January, 1953	Bombay.	Meeting with Chief Electrical Engineer, Central Railway (2 members)
16th to 18th February, 1953	Calcutta	Committee meeting (all members)
24th February 1953	Calcutta	Committee meeting (all members)

B. INDIVIDUAL MEMBERS

Date	Name of Member	Place of Visit	Particulars
30th November,1951	Mr. R. A. Massey	Kharagpur	Consultation with Dy. C. M E., B. N. Rly., Kharagpur.
10th December, 1951	Messrs. R. A. Massey & M. V. Kamlani.	New Delhi	Consultation with Planning Commission Members.
17th December, 1951	Mr. M. V. Kamlani	Calcutta.	Consultation with (1) Asstt. Coal Supdt., E. I. Rly. (ii) Dy. C.M.E. (Running), E. I. Rly.
18th December, 1951	Mr. M. V. Kamlani	Calcutta	Consultation with (i) Jt. Dy. Coal Commissioner (Dis.) (ii) Works Manager E. I. Railway, Lillooah.
19th December, 1951	Messrs. R. A. Massey & M. V. Kamlani.	Adra	Visited loco shed.
20th December,1 951	Messrs R. A. Massey & M. V. Kamlani.	(i) Adra	Consultation with Distt. Ry. Officers of B. N. Rly.
		(ii) Bhojudih	Visited loco shed.
		(iii) Bhaga	Visited Digwadih Colliery (Tatas).
24th & 25th December, 1951	Mr. M. V. Kamlani	Dhanbad	Consultation with Mining Adviser to B. N. & E. I. Railways.
26th December,1951	Mr. M. V. Kamlani	Calcutta	(i) Consultation with C. M. E., E. I. Rly. (ii) Visited M/s. Jessop & Co.
27th December, 1951	Mr. M. V. Kamlani	Calcutta	Consultation with officers of the Dy. Coal Commissioner (Dis.)

APPENDIX 2 —(*contd.*)

Date	Name of Member	Place of Visit.	Particulars
28th December,1951	Messrs R. A. Massey & M. V. Kamlani.	Kharagpur	Consultation with (i) Fuel Officer & Dy. C. M. E. (M), B. N. Railway. (ii) C. M. E., B. N. Rly.
31st December,1951	Mr. M. V. Kamlani	Secunderabad	Consultation with Dy. C. M. E. & Distt. Loco Officer, Central Rly.
2nd January,1952	Mr. M. V. Kamlani	Bhadrachellam Road	Visited Singareni Colliery.
4th January, 1952	Mr. M. V. Kamlani	Bombay.	Consultation with (i) C. M. E. Western Rly. (ii) C. M. E. of old Saurashtra Railway.
5th January, 1952	Mr. M. V. Kamlani	Bombay.	Consultation with (i) Transportation Supdt Central Railway and (ii) C. M. E., Central Railway.
17th January,1952	Messrs. R. A. Massey & M. V. Kamlani	Delhi	Consultation with Fuel Officer, E. P. Rly.
19th January, 1952	Mr. M. V. Kamlani	Delhi	Consultation with the Fuel Officer, E.P. Rly.
29th January, 1952	Mr. R. A. Massey	Khurda Road	Consultation with A. T. O., B. N. Railway.
30th January, 1952	Mr. R. A. Massey	Waltair	Consultation with Local Rly. officers & Vizagapatam Port officers.
31st January,1952	Mr. R. A. Massey	Bezwada	Consultation with D. L. O. & A. T. O., Southern Rly.
	Mr. M. V. Kamlani	Madras	Consultation with Dy. C. O. P. S., Southern Rly.
1st February,1952	Messrs R. A. Massey & M. V. Kamlani	Madras	Consultation with Dy. C.O.P.S., Southern Rly.
2nd February, 1952.	Messrs. R. A. Massey & M. V. Kamlani.	Madras	Consultation with Dy. C. O. P. S., Southern Rly.
5th February, 1952	Mr. M. V. Kamlani	Calcutta	Consultation with G. M., Scindia Steam Navigation Co.
18th February, 1952	Mr. M. V. Kamlani	Moghalsarai	Consultation with Station Superintendent, Moghalsarai.
4th March, 1952	Dr. J.W. Whitaker	Calcutta	Consultation with Coal Commissioner's officers.
20th March, 1952	Dr. J. W. Whitaker	Calcutta	Consultation with E. Railway officers.
28th March, 1952	Dr. J. W. Whitaker	Calcutta	To meet Chairman of the Committee.
5th & 6th April, 1952	Dr. J. W. Whitaker	Bangalore	Gas Turbine Committee (*re*: Locomotives)
6th to 11th April, 1952	Mr. R. A. Massey	Delhi	Consultation with A. M. E .(Operating) E. P. Railway & visit to Loco sned, Ghaziabad.
12th April, 1952	Dr. J. W. Whitaker	Calcutta	Consultation with Joint Dy. Coal Commissioner (Dis.)
1st May, 1952	Mr. R. A. Massey	Ghaziabad	Visited loco shed.
8th May, 1952	Mr. R. A. Massey	Kharagpur	Consultation with Dy. C.M.E. & Fuel Officer, B.N. Rly.
18th to 20th May, 1952	Messrs. R. A . Massey & M. V. Kamlani	New Delhi	Consultation with Planning Commission Members.
23rd May, 1952	Dr. J. W. Whitaker	Calcutta	Consultation with Coal Commissioner's officers.
27th May, 1952	Mr. R. A. Massey	Sealdah	Visited Loco Shed, Sealdah.
28th May, 1952	Mr. R. A. Massey	Chitpur	Visited Loco Shed, Chitpur.
29th May, 1952	Mr. R. A. Massey	Calcutta	Consultation with Fuel Officer & Statistical Officer, E. I. Railway.
21st June, 1952	Mr. R. A. Massey	Delhi	Consultation with Fuel Officer, E. P.
22nd June, 1952	Mr. R. A. Massey	Delhi	Visit to Loco Shed, Delhi.
23rd June, 1952	Mr. R. A. Massey	Delhi	Consultation with F C., E. A., J. D. F. (B) D. D. (St.) of the Railway Board.

APPENDIX 2—(*contd.*)

Date	Name of Member	Place of Visit	Particulars
25th June, 1952	Mr. R. A. Massey	Delhi	Consultation with J. D. (T) and Dy. C. C. S. (Mech) of Railway Board.
6th July, 1952	Dr. J. W. Whitaker	Nagpur	Fuel Officers, E. Rly. & C. Rly.
17th July, 1952	Messrs. D. C. Driver & M. V. Kamlani.	Madras	Consultation with (i) Madras Govt. officers (ii) Southern Rly. officers.
18th July, 1952	Mr. M. V. Kamlani	Madras	Consultation with Southern Railway officers.
20th August, 1952	Mr. M. V. Kamlani	Moghalsarai	Consultation with C. T. S (Power), Central Railway, C. O. P.S (Goods), E. Rly., Dy. Dir., Rail Movements, Railway Board, Supdt., Transp., E. Rly., Dinapore, Supdt., Transp. N. Rly., Allahabad & Fuel Officers, N. Rly.
8th September, 1952	Mr. R. A. Massey	Calcutta	Consultation with Dy. C. M. E., Eastern Railway.
9th September, 1952	Mr. R. A. Massey	Calcutta	Visited Markel Danga Loco Shed, Sealdah, E. I. Rly.
10th September, 1952	Mr. R. A. Massey	Calcutta	Visited Bamangachi Loco shed, Howrah, E. I. Rly.
17th September, 1952	Mr. R. A. Massey	Kanpur	Visited loco shed, N. Rly.
18th & 19th September, 1952	Mr. R. A. Massey	Gorakhpur	Consultation with (i) N. E. Ry. Hd. Qrs. officers ; (ii) visited loco shed.
20th September, 1952	Mr. R. A. Massey	Lucknow	Visited B. G. and M. G. loco sheds. Consultation with R. M. E. of N. E. Rly. and D.M.E. of N. Rly.
22nd September, 1952	Mr. R. A. Massey	New Delhi	Consultation with Dy. Director (Stat.), Railway Board.
3rd & 4th October, 1952	Mr. R. A. Massey	New Delhi.	Consultation with Officer on Special Duty (Stores Reorganisation) and the Director, Finance (Budget).
8th October, 1952	Mr. R. A. Massey	Bombay.	Visit to Statistical Office, Parel, C Rly. Consultation with— (i) Statistical Officer, C. Rly. (ii) Dy. C. A. O., W. Rly.
10th October, 1952	Mr. R. A. Massey	Delhi	Consultation with F. C. and D. F. (E) of Railway Board.
16th October, 1952	Mr. R. A. Massey	Calcutta	Consultation with F. A. & C.A.O, E. Rly.
17th October 1952	Mr. R. A. Massey	Calcutta	Consultation with D. A. O. (S) E. Rly.
20th October, 1952	Mr. R. A. Massey	Delhi	Consultation with F. A. & C. A. O & Dy. C. A. O. of N. Rly.
21st October, 1952	Mr. R. A. Massey	Delhi	Consultation with Sr. Mech. Engineer and Asstt. Mech. Engineer (Fuel) of N. Rly.
22nd October, 1952.	Mr. R. A. Massey	Delhi	Visited Delhi Sarai Rohilla Yard. Consultation with Claims Officer, N. Rly.
27th October, 1952	Messrs. D. C. Driver, R. A. Massey & A. B. Guha.	Kanpur	Visited loco shed.
31st October and 1st November, 1952	Mr. R. A. Massey	Calcutta	Consultation wih D. A. O. (S.), E. Rly.
3rd & 4th November, 1952	Mr. R. A. Massey	Calcutta	Consultation with Controller of Coal Accounts.
7th November, 1952	Mr. R. A. Massey	Delhi	Consultation with Director, Finance (Bdgt.).
8th November, 1952	Mr. R. A. Massey	Delhi	Consultation with Director, Finance (Expr.)
10th November, 1952	Mr. R. A. Massey	Delhi	Director of Rly. Audit & Dr. of Finance (Budget).

APPENDIX 2—(*contd.*)

Date	Name of Member	Place of visit	Particulars
14th November, 1952	Mr. R. A. Massey	Calcutta . .	Consultation with C. M. E., Railway Board.
17th November, 1952	Mr. R. A. Massey .	Adra . . .	Consultation with Coal Manager & Supdt. Power.
17th & 19th November, 1952	Mr. R. A. Massey .	Dhanbad . .	Consultation with Coal Supdt., Coal Area Supdt. and D. S. Dhanbad.
20th November, 1952	Mr. R. A. Massey .	Banaras . .	Consultation with D. M. E., N.E. Rly. Visit to Coal Dump.
21st November, 1952	Mr. R. A. Massey .	Mokamah Ghat .	Visit to Transhipment Yard. Consultation with A. T. S., N. E. Rly.
25th November, 1952	Mr. R. A. Massey .	Delhi . . .	Consultation with F.A & C. A. O., N. Rly.
26th November, 1952	Mr. R. A. Massey .	Delhi . . .	Consultation with Dy. Director (Stat), Railway Board.
27th November, 1952	Mr. R. A. Massey .	Delhi . . .	Consultation with Financial Commissioner & Chairman, Railway Board.
11th December, 1952	Mr. R. A. Massey .	Delhi . . .	Consultation with E. A., Ry. Board.
20th December, 1952	Mr. R. A. Massey .	Calcutta . .	Consultation with Controller of Coal Accounts.
22nd December, 1952	Mr. R. A. Massey .	Calcutta . .	Consultation with Dy. C.M.E. (R)., E. Rly.
23rd, December, 1952	Mr. R. A. Massey .	Calcutta . .	Visited Chitpur Carriage & Wagon Workshop.
29th December, 1952	Mr. R. A. Massey & Dr. J. W. Whitaker	Calcutta . .	Visited Shalimar Carriage Shed.
22nd January, 1953	Mr. D. C. Driver .	New Delhi . .	Meeting with Chairman, Railway Board.
29th January, 1953 .	Mr. R. A. Massey .	Kharagpur . .	Consultation with Supdt. Power (R) Supdt. Power (Fuel)
1st February, 1953 .	Mr. R. A. Massey	Bilaspur . .	Consultation with Supdt. Transportation.
1st February, 1953 .	Dr. J. W. Whitaker	Hyderabad (Deccan)	Consultation with A. T. S. C. Ry.
3rd February, 1953	Mr. M. V. Kamlani	Bombay . .	Consultation with M/s. Aiyar & Co., Chartered Accountants.
4th & 5th February 1953.	Mr. M. V. Kamlani	Bombay. . .	Consultation with Chief Electrical Engineer, C. Ry.
6th February, 1953	Mr. M. V. Kamlani	Bombay . .	Consultation with M/s. Aiyar & Co., Chartered Accountants.

APPENDIX 2—(*contd.*)

C. PARTIES CONSULTED—GOVERNMENT AND OTHER REPRESENTATIVES.

	Name	Designation
	(I) RAILWAY OFFICIALS.	
	SOUTHERN RAILWAY	
Snri	S. R. Sharma]	C. O. P. S.
,,	T. A. Joseph	Dy. G. M.
,,	A. J. Baker	C. M. E.
,,	G. K. Ambady	C. E. E.
,,	M. S. Murty	Dy. C. O. P. S.
,,	A. E. D. Vieyra	Dy. C. O. P. S.
,,	W. E. Shrieves	Fuel Officer.
,,	N. G. Hoskot	R. M. E.
,,	V. S. Ramaswamy	D. M. E.
,,	K. G. Hiranandani	D. L. O.
,,	Raja	A. T. O.
	EASTERN RAILWAY	
Shri	K. B. Mathur	G. M.
,,	K. Ramchandran	C. M. E.
,,	A. K. Mullick	C. M. E.
,,	S. A. Yusoof	C. O. P. S.
,,	D. P. Mathur	F. A. & C. A. O.
,,	H. B. Mitra	Dy. C. M. E.
,,	M. M. Khan	Dy. C. M. E.
,,	G. D. Khandelwal	Dy. C. O. P. S.
,,	P. N. Murthy	Dy. C. E. E.
,,	S. G. Krishnan	Mining Adivser
,,	D. R. Kochhar	Fuel Officer
,,	D. B. Ghosh	D. T. M. (Bilaspur)
,,	A. K. Sarkar	D. T. S. (Dinapore)
,,	A. S. C. Kelly	Power Supdt. (Howrah)
,,	S Sarangapany	D. T. S. (Asansol) Works Manager (Lillooah)
,,	C. Chelapathi Rao	D. L. S. (B. N. R.)
,,	G. K. Varma	D. T. O. (B. N. R.)
,,	A. K. Chakravarti	D. T. S. (B. N. R.)
,,	G. P. Srivastava.	Coal Manager (Adra)
,,	C. D. Chatterjee	Coal Manager (Adra)
,,	L. M. D' cruz	Mineral Supdt. (Garden Reach)
,,	V. Rajgopal	Coal Area Supdt.
,,	C. C. Roberts	Asstt. Coal Supdt. (Dhanbad)
,,	M. R. N. Murty	A. T. O.
,,	N. G. Michael	A. T. O (B. N. R.)
,,	A. Sen	A. L. O. (B. N. R.)
,,	Sen Gupta	Statistical Officer.
,,	S. Simon	Station Supdt. (Moghalsarai)
	CENTRAL RAILWAY	
Shri	H. P. Hira	G. M.
,,	A. Saldanha	Dy. G. M. (Sr.)
,,	M. G; Iyer	C. T. M.
,,	S. L. Saksena	C. M. E.
,,	J. W. E. Gurr	C. M. E.
,,	J. E. Jack	C. E.
,,	K. Krishna Rao	F. A. & C. A. O.
,,	P. L. Verma	Traction Supdt.
,,	R. B. Lal	Dy. C. T. S.

APPENDIX 2—(*contd.*)

Name	Designation
CENTRAL RAILWAY—contd.	
Shri E. G. Kotiswaran	Dy. C. T. S.
,, N. A. Qadeer	Dy. C. T. S.
,, P. V. Ramamurty	Fuel Officer.
,, P. N. Kaul	D. L. O. (Secunderabad).
,, M. Krishna Rao	Dy. C. A. O.
,, K. S. Venkatachelam	D. T. M. (Nagpur)
,, T. P. Ananthan	Accounts Officer (Statistics)
WESTERN RAILWAY	
Shri K. P. Mushran	G. M.
,, C. T. Venugopal	Dy. G. M. (Sr.)
,, B. Venkataraman	C. M. E.
,, B. Moolnarayan	C. O. P. S.
,, M. R. Venkataram	C. E.
,, N. C. Sabikhi	C. R. E.
,, M. R. Swaminathan	Dy. C. A. O.
,, T. S. Subramanian	Dy. C. A. O.
,, P. V. Shah	D. M. E. (H.Q.)
,, P. C. Mathew	D. T. S. (H. Q.)
,, C. N. Kapoor	C. M. E. (Ex. Saurashtra Rly.)
NORTHERN RAILWAY	
Shri Karnail Singh	G. M.
,, B. B. Mathur	C. O. P. S.
,, A. K. Mullick	C. M. E.
,, K. P. Modwell	C. E.
,, Apjit Singh	F. A. & C. A. O.
,, M. Kamath	Dy. F. A.
,, K. C. Lall.	Dy. C. M. E.
,, G. P. Bhalla	Dy. C. M. E.
,, L. K. Dhawan	D. M. E.
,, C. M. Kapoor	D. M. E.
,, Manohar Lal	D. T. S. (Allahabad)
,, G. L. Gulati	Fuel Officer
,, Mohinder Singh	Senior Mech. Engineer.
NORTH EASTERN RAILWAY	
Shri G. Pande	G. M.
,, B. Arora	Dy. G. N. (Sr.)
,, J. S. Mathur	C. O. P. S.
,, P. C. G. Peyton	C. M. E.
,, K. C. Chaudhri	F. A. & C. A. O.
,, S. K. Mukerjee	Dy. C. O. P. S.
,, H. C. Mehra	Dy. C. M. E.
,, K. Swarup	R. M. E.
,, G. Chandra	Fuel Officer
RAILWAY BOARD	
Shri F. C. Badhwar	Chairman
,, A. K. Chanda	Financial Commissioner
,, N. C. Deb	Director, Finance (Budget)

APPENDIX 2—(*contd.*)

	Name	Designation
Shri	K. Sadagopan	Director, Finance (Expenditure)
,,	L. A. Natesan	Economic Adviser
,,	Ranjit Singh	Joint Director (Traffic)
,,	K. L. Ghei	O. S. D. (Stores Reorganisation)
,,	G. Rama Rau	Dy. Director (Stat.)
,,	B. S. Sindhu	Dy. C. C. S (Mechanical)
,,	K. V. Kasturi Rangan	Jt. Director Finance (Budget)
	(II) *COAL COMMISSIONER'S ORGANISATION*	
Shri	I. S. Malik	Dy. C. C. (Dist.)
,,	B. S. Marwah	Jt. Dy. C. C. (Dist.)
,,	B. L. Ohri	Jt. Dy. C. C. (Dist.)
,,	S. N. Sahgal	Coal Supdt. (Dhanbad)
,,	A. E. Ritchins	Asstt. C. C.
,,	Bir Bakshi	Dy. Asstt. C. C.
	(III) *OTHER GOVERNMENT OFFICIALS*	
Shri	B. C. Roy	Chief Minister (West Bengal)
,,	B. P. Tiwari	Planning Commission
,,	Dutta	Planning Commission
,,	Venkateswara Iyer	Chairman, Madras Port Trust.
,,	L. A. Abraham	Traffic Manager, Madras Port Trust
,,	J. M. Lobo Prabhu	Secy. (Devlp) Madras Govt.
,,	T. M. S. Mani	Secy. (P.W.D) Madras Govt.
,,	Vishwanatha Iyer	Director of Controlled Commodities, Madras G
,,	V. V. Subramanian	Director, Controlled Commodities, Madras G
,,	Rama Rao	Dy. Director, Controlled Commodities, Madras Govt.
,,	B. Alikhan	Dy. Director, Controlled Commodities, Madras Govt.
,,	G. Sundaram	C. E. (Electricity) Madras Govt.
,,	A. R. Narayana Rao	Supdt. Eng. (Elec. General)
,,	H. K. Ghosh	Officer-Lignite Investigation
,,	V. A. Krishnaswamy	Dy. C. E. (Irrigation)
,,	S. N. Mahalingam	Chief Inspector of Boilers
,,	C. V. S. Rathnam	Chemist-Lignite Investigation
,,	Paul R. Eyrich	Tech. Adviser-U. S. Bureau of Mines.
,,	S. Nanjundiah	Vizagapatam Port
,,	P. V. S. Rao	Director of Railway Audit, Simla
,,	Penn Anthony	Controller of Coal Accounts
	(IV) *COAL TRADE & OTHER PRIVATE CONCERNS*	
Shri	A. Farquhar	Coal Adviser to TISCO
,,	R. K. Worah	President, Indian Colliery Owners Association.
,,	B. L. Agarwalla	Vice-President, Indian Colliery Owners Associati
,,	T. M. Jagtiani	Director, Singareni Collieries.
,,	P. Berry	G. M. Singareni Collieries.
,,	J. Gallaghar	Dy. G. M. (Devlp) Singareni Collieries.
,,	S. K. Nargundkar	Dy. G. M. (Mines) Singareni Collieries.
,,	H. M. Jagtiani	G. M., Scindia Steam Navigation Co.
,,	Representatives	M/s. Jessop & Co.

APPENDIX 3-b

(Chapter III)

ANTICIPATED ZONAL PRODUCTION AND DISTRIBUTION OF COAL IN 1961

Zone No.	Zone	Demands (in million Tons/annum) met from different zones										Total Demand in 1961
		1	2	3	4	5	6	7	8	9	10	
		Southern	Hyderabad	Western	Ce tral	Rajasthan	Punjab	Uttar Pradesh	Bengal and Bihar	Orissa	Assam	
1	Southern (Madras, Mysore Trav.-Cochin and Coorg).	1·2	1·4	...	...	...	...	...	0·35	0·15	...	3·1
2	Hyderabad	...	0·45	...	...	...	...	...	0·05	...	...	·5
3	Western (Bombay, Saurashtra and Cutch).	...	0·55	...	4·4	...	...	...	0·55	...	...	5·5
4	Central (Madhya Pradesh, V. Pradesh and Bhopal).	..	...	...	2·5	...	...	...	0·3	...	...	2·8
5	Rajasthan (Rajasthan, Madhya Bharat and Ajmer).	...	...	...	0·5	0·1	...	...	1 ·	...	...	2·1
6	Punjab (E. Punjab, Pepsu, Delhi, Kashmir and H. Pradesh).	...	...	...	...	...	...	...	3·9	...	...	3·9
7	Uttar Pradesh	...	...	...	...	...	...	...	4·9	...	...	4·9
8	Bengal and Bihar	...	...	...	...	...	...	...	27 9	...	...	*27·9
9	Orissa	...	...	...	...	...	...	...	0·05	0·65	...	0·7
10	Assam (Assam, Manipur and Tripura).	...	...	...	...	...	...	...	...	...	0·6	0·6
Total Target Production in 1961		1·2	2·4	...	7·4	0·1	...	...	39·5	0·8	0·6	52·0
Present Production in 1951 . .		...	1·2	...	3·8	0·04	...	...	27·4	0·5	0·5	33·44
Increase in Production und		1·2	1·2	...	3·6	0·06	...	...	12·1	0·3	0·1	18·56

* Includes 5 million tons towards demand for Bunker and Export.

APPENDIX 4

(Chapter III)

SUMMARY OF REPLIES TO QUESTIONNAIRE ISSUED TO COLLIERIES IN THE OUTLYING COAL FIELDS SHOWING PRESENT, IMMEDIATE AND FUTURE OUTPUT OF COAL

Name of colliery	Base station serving the colliery	Quantity in lakh tons per annum					
		Present despatches	Increase in despatches immediately possible	Anticipated despatches immediately possible	Possible increase in despatches at the end of 5 years	Anticipated despatches at the end of 5 years	Zonal production target as planned for 1961
(a) CIC FIELDS							
1. North Chirimiri	Manendragarh	0·22	0·8	...	1·56	...	...
2. New Chirimiri	Do.	1·26	0·90	...	4·08	...	...
3. Pure Chirimiri	Do.	0·84	0·72	...	0·72	...	...
4. Rajanagar	Do.	0·18	0·60	...	4·08	...	...
5. Jagrakhand	Do.	4·32	1·20	...	4·20	...	
6. Central Sounda	Do.	0 6	0·72	...	1·38	...	...
7. Burhar	Sahdol	1 0	1·50	...	3·90	...	...
8. Nowrozabad	Do.	2·40	0·60	...	1·20	...	...
9. Birsingpur	Do.	0·90	0·78	...	2·58	...	...
10. Umaria	Do.	0·78	1·02	...	1·02	...	...
TOTAL		13·36	8·88	22·24	24·72	38·08	...
Total for C.I.C. Fields (Including collieries that have not replied).		17·8	8·9	26·7	24·7	42·5	...
(b) PENCH FIELDS							
1. Rawanwara Khas	Junnerdeo	0·30	0·78	...	1·02	...	...
2. Rakhikol	Do.	0·24	1·20	...	3·24	...	...
3. South Panara	Do.	0·34	0·24	...	0·60	...	...
4. Goriwara Kalan	Do.	0·37	0·08	...	0·08	...	...
5. Pench Valley Coal Co. Ltd.	Do.	2·65	0·60	...	2·35	...	...
6. Amalgamated Collieries	Do.	6·60	2·40	...	11·40	...	...
TOTAL		11·50	5·30	16·80	18·69	30·19	...
Total for Pench Fields (Including collieries that have not replied).		15·3	5·3	20·6	18·7	34·0	...
(c) CHANDA FIELD							
1. Mahakali	Balharshah	0·24	0·24	0·48	0·24	0·48	...
Total for Chanda Field (Including collieries that have not replied).		3·0	0·24	3·24	0·2	3·24	
Grand Total for CIC, Pench and Chanda Fields		36·1 (502)	14·44 (201)	50·54 (703)	43·64 (607)	79·74 (1109)	74·0 (1028)
(d) SINGARENI FIELD							
1. Singareni	Dornakal	12·0	2·40	14·4	8·04	20·04	...
Total for Singareni Field		12·0 (167)	2·4 (33)	14·4 (200)	8·1 (112)	20·1 (279)	24·0 (333)
(e) ORISSA FIELD							
1. Hingir-Rampur	Jharsuguda	1·80	1 08	2·88	2·88	4·68	...
Total for Orissa Fields (including collieries that have not replied).		4·5 (62)	1·1 (15)	5·6 (77)	2·9 (40)	7·4 (102)	8·0 (111)
GRAND TOTAL		52·6 (731)	17·9 (249)	70·5 (980)	54·6 (759)	107·2 (1490)	106·0 (1472)

NOTE.—Figures in bracket show requirements of wagons/day on the basis of 20 tons per wagon.

APPENDIX 5

(Chapter IV)

FUEL RESEARCH INSTITUTE'S NEWS

(November 1951)

THE PRICE OF COAL RAW AND WASHED

Indian coals have for some years been graded with regard to quality and price both for export and for internal use. In the coalfields of Bengal and Bihar, which supply 80 per cent. of the coal of the country, definite grading schemes have been in vogue for some 25 years. Originally, in order to improve and standardize the export coals of India, a Coal Grading Board was constituted. In 1926 it issued a regulation which classified the commercial grades of Indian coals according to their ash and moisture, and also according to calorific value. All results were expressed on the basis of " as received " or " as delivered ". The scheme is given in Table I.

The grading (Table I) was drawn up for export coals. Classification, however, was later extended to all coals in general, and the scheme modified and simplified to make it easily applicable to coals not intended for export. Subsequently, pit-head prices were fixed for the various grades according to Government ordinance. The scheme, given in Table II (for Bengal and Bihar, and modified for other provinces), is known as the Coal Commissioner's Grading or occasionally as the Railway Grading, the railways being the chief consumers of coal in India and taking about one-third of the total output. It is the Coal Commissioner's Grading with which the collieries are chiefly concerned, and it is this grading which we shall examine more fully.

TABLE I

Export

INDIAN COAL GRADING BOARD CLASSIFICATION

Low Volatile Coal (mainly Seams of the Barakar Measures).

Grade	Ash per cent.	Minimum calorific value		Remarks
		Cals. per gm.	B.t.u. per lb.	
Selected	up to 13	7,000	12,600	The moisture in all cases must not exceed 2 per cent. All values are on the coal as received or delivered.
No. 1	13 to 15	6,500	11,700	
No. 2	15 to 18	6,000	10,800	
No. 3	over 18	6,000	10,800	

High Volatile Coal (mainly Seams of the Raniganj Measures).

Grade	Ash per cent.	Moisture per cent.	Minimum calorific value		Remarks
			Cals. per gm.	B.t.u. per lb.	
Selected	up to 11	under 6	6,800	12,240	All values are on the coal as received or delivered.
No. 1	11 to 13	under 9	6,300	11,340	
No. 2	13 to 16	under 10	6,000	10,800	
No. 3	inferior to No. 2.		under 6,000	under 10,800	

TABLE II

NOT EXPORT

COAL COMMISSIONER'S GRADING

For Coals of the Raniganj Measures.

Grade	Ash plus Moisture per cent (Maximum)	Remarks
Selected A	under 17·5	(Calorific values are not stipulated.)
Selected B	17·5 to 19·0	
No. 1	19·0 to 24·0	

For other coals (chiefly Barakar Measures of the Jharia and Bokaro fields).

Grade	Maximum Ash per cent.	Remarks
Selected A	under 15	The moisture shall not exceed 2 per cent. as delivered. (Calorific valaues are not stipulated.)
Selected B	15 to 17	
Grade I	17 to 20	
Grade II	20 to 24	
Grade III-A	24 to 28	
Grade III-B	28 to 35	

Representative samples are accordingly taken by staff of the Coal Commissioner from the seams at the collieries, and submitted to moisture and ash determinations. The seams are thus graded and the coal has to be sold at the price fixed by Government through the Coal Commissioner. The present prices (1951) for Bengal and Bihar for the various grades are given in Table III.

TABLE III

PRICE LIST OF VARIOUS GRADES (PITHEAD) JHARIA AND RANIGANJ FIELDS, 1951.

Grade of coal	Maximum Ash (Jharia Coals) per cent.	Maximum Ash and Moisture (Raniganj Coals) per cent.	Price per ton	
			Slack, dust or run-of-mine	Steam, rubble, or smithy
			Rs. As.	Rs. As. = R.
Selected A	15	17·5	15 3	16 4 = 16·25
Selected B	17	19·0	14 3	15 4 = 15·25
Grade I	20	24·0	13 5	14 6 = 14·375
Grade II	24	not graded as yet.	12 15	14 0 = 14·00
Grade III-A	28		11 12	12 12 = 12·75
Grade III-B	35		10 9	11 9 = 11·56

These prices have been drawn up to establish a certain equity between the commercial value of the coal and its quality, taking into consideration the cost of mining.

Coals which are required not simply for combustion but for other purposes (such as carbonization) must have also certain specific properties. Thus, in coals for coking, not only the ash below, but the sulphur and phosphorus must also not exceed certain values, and the coal must be caking and yields a strong coke when carbonized. But when coal is to be utilized simply as fuel, *i.e.*, for heat generation, the main impurities with which we are concerned are truly ash and moisture. The above coal grading schemes have been drafted with these impurities in view.

Present Basis of Pricing.—Two years ago in the *Handbook of Indian Coals*, published by the Fuel Research Institute, it was suggested that a coal grading scheme could be drawn up on the basis of *pro rata* reduction in price for moisture, plus a further reduction in price for ash, the further reduction being proportional to 1½ times the amount of ash. Taking as our standard, Selected A coal ; containing 15 per cent of ash and, say, one per cent. of moisture, as in the Jharia field, and of price (steam, rubble, etc.) Rs. 16-4-0 per ton, we may approach the problem as follows :—

If the ash increases by 1 per cent., the industrial value of this coal certainly decreases by more than 1 per cent. This is not simply because an ash of 10 per cent. means about 11 per cent. of foreign matter in the coal ; it is rather because excessive ash (*a*) interferes with the rate of combustion, (*b*) causes increased losses due to unburnt carbon and (*c*) has to be transported needlessly and (*d*) has eventually to be disposed of. Item (*a*) is important ; a boiler (or other) furnace has to generate heat *per unit time*. It is thus not simply a question of how much potential or theoretical heat is in the fuel as measured by the calorific value, but also of how much heat can be generated efficiently *per minute or per hour*. In other words, it is a question of power, power being the time rate of doing work.

In America and many European countries, an increase of 1 in the percentage of ash is regarded as warranting a reduction of 2 per cent. in the price of the coal. In India, owing to the large proportion of inherent ash and to the difficulty of its removal, and also in the light of experiments done by the Research Staff of the Central Standards Office of the Railways (who have tested the efficiency in locomotives), a more equitable price drop is about 1½ per cent. for each 1 per cent. increase in ash ; we neglect the general inconvenience of ash disposal, etc.

APPENDIX 5—*contd.*

The moisture in the Jharia and similar coals may be taken as 1 per cent. and we shall work from the maximum ash allowed in each grade. The " virtual inerts " in each coal are taken as $(M+1\frac{1}{2}A)$ per 100 parts of coal as supplied and the useful fuel is thus 100 —$(M+1\frac{1}{2}A)$ per 100 parts of coal. In Table IV are shown the values for each grade.

TABLE IV

Grade	Moisture M	Ash A	$(M+1\frac{1}{2}A)$	100—$(M+1\frac{1}{2}A)$ Price points	Equivalent rupees/ton (1951) (see note 2)	1951 Pithead prices rupees/ton
1	2	3	4	5	6	7
Selected A . . .	1	15	23·5	76·5	16·25	16·25
Selected B . . .	1	17	26·5	73·5	15·62	15·25
Grade I . . .	1	20	31·0	69·0	14·65	14·375
Grade II . . .	1	24	37·0	63·0	13·40	14·00
Grade III-A . .	1	28	43·0	57·0	12·12	12·7
Grade III-B . .	1	35	53·5	46·5	9·90	11·56

NOTES.

1. The pure coal substance (*i.e.*, free from moisture and ash) would have 100 points and a theoretical selling price of Rs. 21·25 per ton. It has a calorific value of about 15·500 B.t.u. per lb.

2. Selected Grade A price (screened) is chosen as the standard.

3. The agreement in the two final columns is fairly close except for the proper grades, and here the choice of maximum ash may not be reasonable as there is a wide range. Moreover, allowance has to be made for certain assessed mining costs, which are roughly the same for each grade.

Clearly, if the price is proportionate to 100—$(M+1\frac{1}{2}A)$, the values in this column may be taken as price points. In column 6, we convert these values to rupees and decimals of a rupee on the present standard of Selected Grade A coal selling at Rs. 16—4-0, *i.e.*, Rs. 16·25 per ton. In the final column are given present prices for comparison—for the screened coal in each case.

Moisture.—Turning now to the question of " high moisture ", " high volatile " coals containing more than 3 per cent. of natural moisture (perhaps 3 is a better figure),the existing scheme recognizes only three grades of such coal, *i.e.*, Sel. A, Sel. B, and Gr. I ; and the ash and moisture when added together must not exceed certain values, namely for Sel. A 17·5 per cent, for Sel. B 19.0 per cent, and for Gr. I 24 per cent. The prices per ton of these grades are as before, namely (when screened) Sel. A 16·25 rupees, Sel. B 15·25 rupees, and Gr. I 14·375 rupees. Again, taking Sel. A at 16·25 rupees per ton as our standard, the prices of the various grades calculated from the formula 100—$(M+1\frac{1}{2}A)$ become those given in Table V.

Three quantities of moisture have been conidered, namely 5, 10 and 15 per cent ; and it is also suggested that the grades might equitably be extended following this scheme, if necessary.

The above tables have been drawn up in the light of present-day practice and with a view to extending, if necessary, the grades and prices of the high moisture coals. It will be seen that, consciously or unconsciously, the grades have been drawn up largely on a basis of 100—$(M+1\frac{1}{2}A)$. Such a basis has much to commend it.

New Considerations.—One or two difficulties, however, have been passed over. First, the moisture in a coal is a very difficult value to pin down. Do we mean the moisture of the coal in the bed in the mine, *i.e.*, bed moisture or do we mean moisture on despatch at, say, the weighbridge, or moisture in the coal as received by the customer ? The fact is that moisture varies, bed moisture being usually the highest, and "customer" moisture the lowest. In the dry season in India the variation can be considerable : a coal with 10 or 12 per cent. bed moisture may have as little as 5 or 6 per cent. "customer " moisture. This means that we should first define " moisture ". Now, if we take " bed moisture " it may be quite unfair—as the customer gets better value than this as a rule—and to define " customer " moisture necessitates the use of a temperature and humidity chart, and even then we should be able to give only an approximate figure. These difficulties fortunately, do not arise with coking coals such as those of the Jharia and Bokaro fields : they begin to loom large when the " bed moisture " itself begins to increase, beyond, say, 3 or 4 per cent. and are formidable with really high moisture. A second matter that we have passed over is the well-known fact that all coals do not have the same calorific value—even when the moisture and ash are the same. In other words ; the calorific value of the pure coal substance (unit coal) is different for different types. Good coking coals have a value of about 15,500 B.t.u. per pound unit coal ; good gas coals give about 15,000 ; while high moisture coals give from 15,000 to 14,000, the latter falling rather rapidly when the moisture exceeds 4 per cent. These are the two main is ues which we have passed over ". Can they be faced and dealt with ? In the first place we must admit that under the present scheme the high moisture coals seem to be getting preferential treatment, for they are penalized only on the score of moisture and not on the score of their calorific value which may lie 5 to 10 per cent.below that of the caking

APPENDIX 5—*contd.*

TABLE V.

(*High Volatile and high Moisture , i.e., Coals* 3 *per cent.*)

Grade	Moisture M.	Ash A.	(M+A)	M+1½A	100—(M+1½A)	Theoretical price in Rs./Tons	Existing price in Rs./Tons
1	2	3	4	5	6	7	8
oals with 5 percent. of moisture—							
Selected A. . . .	5·0	12·5	17·5	23·75	76·25	16·25	16·25
Selected B . . .	5·0	14·0	19·0	26·0	74·0	15·8	15·25
Grade I	5·0	19·0	24·0	33·5	66·5	14·2	14·35
iggested—							
Grade II . . .	5·0	22·0	27·0	38·0	62·0	13·2	14·00
Grade III-A . . .	5·0	25·0	30·0	42·5	57·5	12·25	12·75
Grade III-B . . .	5·0	28·0	33·0	47·0	53·0	11·3	11·56
Coals with 10 percent moisture —							
Selected A . . .	10.0	7·5	17·5	21·25	78·75	16·25	16·25
Selected B . . .	10.0	9·0	19·0	23·5	76·5	15·8	15·25
Grade I	10·0	14·0	24·0	31·0	69·0	14·25	14·375
Suggested—							
Grade II . . .	10·0	17·0	27·0	35·5	64·5	13·3	14·00
Grade III A . . .	10·0	20·0	30·0	40·0	60·0	12·4	12·75
Grade III B . . .	10·0	23·0	33·0	44·5	55·5	11·45	11·56
oals with 15 percent moisture—							
Selected A . . .	15·0	2·5	17·5	18·75	81·25	16·25	16·25
Selected B . . .	15·0	4·0	19·0	21·0	79·0	15·80	15·25
Grade I	15·0	9·0	24·0	28·5	71·5	14·30	14·375
Suggested—							
Grade II . . .	15·0	12·0	27·0	38·0	67·0	12·40	14·00
Grade III-A . . .	15·0	15·0	30·0	37·5	62·5	12·50	12·75
Grade III-B . . .	15·0	18·0	33·0	42·0	58·0	11·60	11·56

NOTE 1.—The price of the pure dry combustible in each case becomes :—

	(Per ton)
(*a*) for Jharia coals and coals with about 1 per cent. moisture	Rs. 21·25
(*b*) for coals with 5 per cent. moisture	Rs. 21·30
(*c*) for coals with 10 per cent. moisture	Rs. 20·63
(*d*) for coals with 15 per cent. moisture	Rs. 20·00

coals (unit coal). Ought we not to drop their price *both* on the score of moisture content and on the score of their lower calorific value ? Strangely enough the answer is in the negative. Such coals have special virtues whether for producers or for steam-raising or other furnace work, where rapid combustion and rapid heat release may be required. The performance of a furnace (*e.g.*, a boiler furnace) depends much on the rate of heat release, and it is in the nature of high moisture, moisture coals that they have a large internal surface (hence their high moisture) and are thus reactive and respond readily to heat demands. Cases are common abroad, where high volatile, high moisture coals of 14,500 B.t.u. per lb.(unit coal) are preferred for steam-raising etc. to low volatile coals of 15,500 B.t.u. per lb. ; and where a long flame is necessary there is of course no comparison · the high volatile coals are better.

In addition, it has been shown that moisture added to the coal (up to 10 per cent.) increases the overall efficiency of the boiler. The full reasons for the beneficial effects of such moisture are not yet known, but the facts are now incontestable.

APPENDIX 5—*contd.*

In the light of the above observations it is unusual and indeed unwarrantable to penalise the coal on the score of moisture. How then are we to allow for it, if at all ?

Proposed New Classification using Ash and Calorific Value.—Fortunately there is a sound way by wh ch we can meet both issues with one solution ; it consists in using the calorific value B_u of the pure dry coal substance in conjunction with A_d, the ash of the dry coal. B_u falls always with increasing natural moisture in a coal, and it is after all a measure of heat which we require in a fuel. It is recommended therefore that classification be done on a basis of the product

$$B_u \times \frac{(100-1\frac{1}{2}\,.A_d)}{100}$$

where B_u is the calorific value of the pure dry coal (unit coal) and A_d is the percentage ash in the dry coal.

$$B_u = \frac{\text{Calorific Value obtained from sample}}{100-(M+1\cdot1\,A)} \times \frac{100}{1}$$

The factor 1·1 arises because the ash A is less by 10 per cent. than the mineral matter.

$$A_d = \frac{\text{Ash per cent. found in the sample}}{(100-M)} \times \frac{100}{1}$$

M is the percentage mositure as found in the laboratory sample.

A scale of price grading from this second scheme requires a unit from which to work. This unit may be taken as 15,500 B.t.u. per lb. as in Jharia and Bokar coals. In such coals the moisture is as low as 1 per cent., and we may choose the maximum ash values as previously for each grade and take them as values for the *dry coal.* The existing Jharia scheme can then remain untouched as in Table VI except that the ash is the ash in the dry coal.

TABLE VI

Grade	Maximum A_d Ash	Cal. Val. (B_u) of Unit Coal	1·5A	100—1·5A	$\frac{C\times E}{100} = H_u$	Basis suggested (min. values)
a	b	c	d	e	f	g
Selected A . . .	15	15,500 (say)	22·5	77·5	12,010	12,000
Selected B . . .	17	Do.	25·5	74·5	11,550	11,500
Grade I . . .	20	Do.	30·0	70·0	10,850	10,850
Grade II . . .	24	Do.	36·0	64·0	9,920	10,000
Grade III-A . .	28	Do.	42·0	58·0	8,990	9,000
Grade III-B . .	35	Do.	52·5	47·5	7,360	7,500

Now this scale for the Jharia and other low moisture coals of the coking type has proved fairly satisfactory, but there are border-line cases when it is difficult to choose whether to keep to the above or to treat the coal as a high moisture, high volatile coal, as in the Raniganj series. The Karanpura coals are a good example of such border-line cases—and they are of Barakar age.

Under the proposed ash plus calorific value scheme, however, there is no reason to change from the Jharia coal scheme (dry basis) in assessing the price and grade of high moisture coals, provided that in place of moisture we use the calorific value of the coal substance (unit coal). We really wish to evaluate the worth of the coal to the consumer. Our procedure must be simple, and repeatable, not subject to casual moisture fluctuations, and it must also be suitable. We can achieve this by using the basis of $\frac{(100-1\frac{1}{2}\,A_d)}{100} \times B_u$ where B_u is the calorific value of unit coal (B_u falls with moisture increase).

Considering as before coals with 5, 10 and 15 per cent. moisture and giving appropriate figures for calorific value and ash, we have constructed Table VII.

It will be seen that 5 per cent of moisture has necessitated a drop of 2 in the permissible ash percentage in he dry coal. By proceeding in this way the useful heat given in each grade compares well with the useful heat given by the corresponding grade of the Jharia field. The calorific values chosen, 15,000, 14,500 and 14,000, are stimated to be very near to the actual ones ; but in any case the coal itself would be tested and be awarded its grade on the score of its actual calorific value on a unit coal basis.

It is suggested therefore (1) that the coals be graded basically on the Jharia scheme, (2) that moisture be not considered except for the purpose of calculating the ash in the dry coal and the calorific value of unit coal (moisture variations will thus not vitiate the results), (3) that the grading be done on a basis of useful B.t.u. (H_u) o the consumer as measured by

$$\frac{1}{100}(100-1\tfrac{1}{2}A_u)\times B_d$$

APPENDIX 5—*contd.*

TABLE VII

EXAMINATION OF PROPOSED CLASSIFICATION FOR PRICE GRADING

$$\text{Basis of Price} = \frac{(100 - 1\tfrac{1}{2}\,A_d)}{100} \times B_u$$

where A_d = per cent in dry coal $= \dfrac{\text{Ash per cent}}{100 - \text{moisture}} \times 100$

and B_u = calorific value of unit coal in B . t.u. per lb. $= \dfrac{\text{Cal. value found}}{100 - (M \times 1 \cdot 1A)} \times \dfrac{100}{1}$

Moisture 5 per cent, B_u = 15,000 B.t.u. per lb.

	Ash per cent	A	$(100 - 1\frac{1}{2}A_d)$	$\frac{B_u \times (100 - 1\frac{1}{2}A_d)}{100} = H_u$	Suggested min. value (useful heat)
Selected A . .	12·35	13	80·5	12,100	12,000
Selected B . .	14·25	15	77·5	11,630	11,500
Grade I . . .	17·1	18	73·0	11,000	10,850
Grade II . . .	20·9	22	67·0	10,050	10,000
Grade III-A . .	24·7	26	61·0	9,150	9,000
Grade III-B . .	31·3	33	50·5	7,580	7,500

Moisture 10 per cent, B_u = 14,500 B.t.u. per lb.

	Ash per cent	A_d	$(100 - 1\frac{1}{2}A_d)$	$\frac{B_u \times (100 - 1\frac{1}{2}A_d)}{100} = H_u$	H_u Useful Heat Suggested min. value
Selected A . .	9·9	11	83·5	12,100	12,000
Selected B . .	11·7	13	80·5	11,650	11,500
Grade I . . .	14·4	16	76·0	11,000	10,850
Grade II . . .	18·0	20	70·0	10,150	10,000
Grade III-A . .	21·6	24	64·0	9,270	9,000
Grade III-B . .	27·9	31	53·5	7,750	7,500

Moisture 15 per cent., B_u = 14,000 B. t. u. per lb.

	Ash per cent.	A_d	$(100 - 1\frac{1}{2}A_d)$	$\frac{B_u \times (100 - 1\frac{1}{2}A_d)}{100} = Hu$	H_u Useful Heat suggested min. value
Selected A . .	7·65	9	86·5	12,100	12,000
Selected B . .	9·35	11	83·5	11,700	11,500
Grade I . . .	11·9	14	79·0	11,050	10,850
Grade II . . .	15·3	18	73·0	10,200	10,000
Grade III-A . .	18·7	22	67·0	9,380	9,000
Grade III-B . .	24·7	29	56·5	7,900	7,500

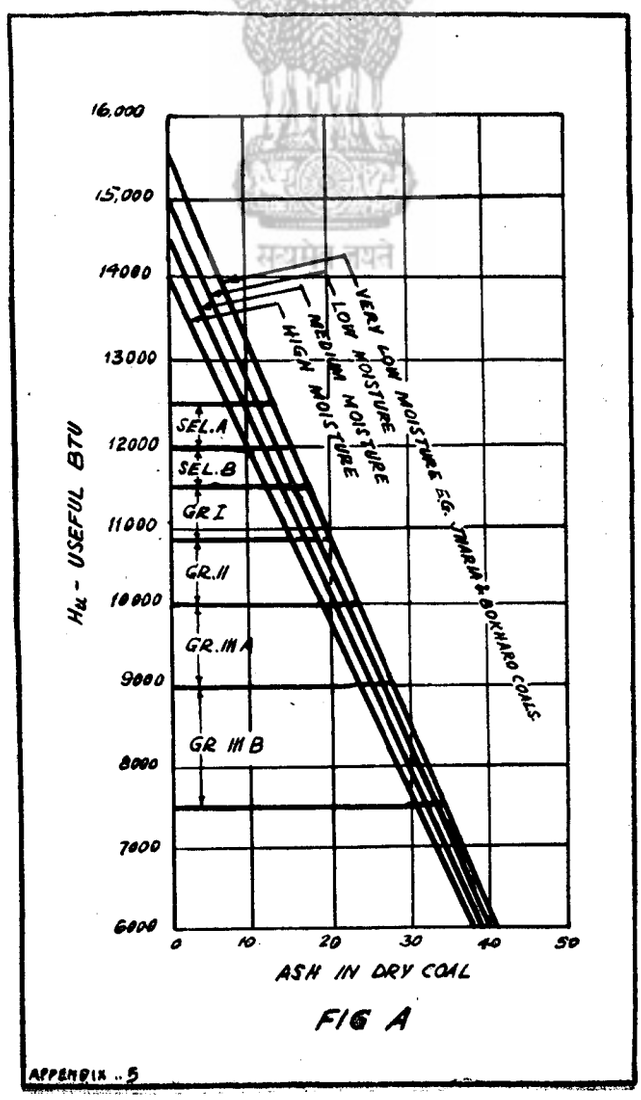
APPENDIX 5—*contd.*

where A_d is the ash in the dry coal and B_u is the calorific value of unit coal. The calculations show that per lb. of dry coal the useful heat minima should be those given in Table VIII, if no major alterations in grading are proposed.

TABLE VIII

SUGGESTED GRADES IN THE NEW CLASSIFICATION SCHEME.

Grade	Min. values of H_u, *i.e.*, useful B.t.u. per lb.	Present price Rupees per ton.	Price per ton for 10,000 useful B.t.u. per lb.		Theoretical prices 1 ton taking Sel. A as Rs. 16·25
			Existing rates	Charged at Rs. 14 per 10,000	
a	b	c	d	e	f
Selected A	12,000	16·25	13·25	16·8	15·25
Selected B	11,500	15·25	13·26	16·1	15·6
Grade I	10,850	14·375	13·25	15·2	14·75
Grade II	10,000	14·00	14·0	14·0	13·6
Grade III-A	9,000	12·75	14·17	12·6	12·2
Grade III-B	7,500	11·56	15·4	10·5	10·2



In the light of the figures in columns d and e of Table VIII, it may be considered whether the higher grades are properly priced. The lower grades cover a wide ash range, and we have chosen maximum ash conditions, hence average values for these coals might come more nearly to Rs. 14 per 10,000 useful heat units (B.t.u.). If this figure (Rs. 14) were used throughout, the prices per ton of the higher grades would become Sel. A 16·80 rupees ; Sel. B 16·1 rupees ; and Gd. I 15·2 rupees as shown in column. Whether such increases are justified and would be useful in helping to conserve the higher grade coal it is difficult to say, but it would be an encouragement to the production of low ash coal by coal washing.

In connection with developments for improving coal quality by washing, it is well to look at the graph, figure A, where we have shown the values of Hu against ash of the dry coal. The graph extensions in the upper range are important.

In the present price structure there is no incentive to proceed into this upper range and to produce better coal than Selected A. Coal washing, however, has made its debut in India, and coals of higher quality than Selected A (Hu, 12,500) will, no doubt, soon be available. The price of such coals can be evaluated at the preceding figures of Rs. 14 per 10,000 B.t.u. if we make no allowance at all for the cost of washing. But in view of the advantages accruing from low and constant ash, and allowing for the expense of washing and for certain unavoidable losses in the process, a more equitable value for such coal would perhaps be at the rate of Rs. 15 per 10,000 useful heat units. It should be stipulated however, that the rate of Rs. 15 per 10,000 is chargeable only for coal of higher grade than Selected A (12,500), while the rate of Rs. 14 per 10,000 for washed coal would be equitable for existing grades.

Summary.—To avoid the difficulties of classification which arise in the present coal grading scheme from seasonal variations in the moisture of high moisture coals, a new scheme of grading is put forward, based upon (1) the amount of ash in the dry coal and (2) the calorific value of the pure coal, substance. The former grading, it has been shown, is consistent with the formula.

$$P = 100 - (M + 1\tfrac{1}{2}A).$$

where P is the price, M is the percentage moisture, and A is the percentage ash in the coal.

The existing scheme is substantially equitable, but difficulties in grading have arisen because of seasonal fluctuations in the moisture of the coals, especially when exposed to the extreme conditions of heat and humidity found in India. The fact that the calorific value of the coal was not considered has probably led only to minor injustices in grading, as high moisture coals, although of somewhat lower calorific value, have certain advantages for steamraising, and for other purposes.

The calorific value of the pure coal substance (dry) falls as the moisture content increases, and it is thus possible to evaluate roughly the "natural moisture" from the calorific value of the pure coal. In any case whether the moisture is accurately evaluated in this manner or not is immaterial, provided that we take the calorific value into consideration in coal grading.

The proposed scheme of grading [which will not differ materially from the recent scheme, except in guaranteeing (1) equity and (2) repeatability of results] may be drawn up on the score of useful heat units as given by the formula :—

$$H_u = \frac{100 - 1\cdot5\ Ad}{100} \times B_u$$

where H_u = the useful units, Ad = the ash in the dry coal, and B_u = calorific value of the pure coal substance (*i.e.*, unit coal) in B.t.u. per lb. The minimum values of Hu for each grade to be in line with the present classification for the coals of the Jharia field are :—

Sel. A	12,000 B.t.u.
Sel. B	11,500
Gd. I	10,850
Gd. II	10,000
Gd. III-A	9,000
Gd. III-B	7,500

The scheme can be extended with equity to all coals, whether high or low ash, high or low volatile, or high or low moisture.

(Chapter IV)

MEMBER SECRETARY'S COMMENTS ON THE NEW GRADING AND PRICING SCHEME PROPOSED BY THE FUEL RESEARCH INSTITUTE.

The main features of the Coal Commissioner's grading scheme are :—

(*a*) Grade classification is based on percentage of ash, for low moisture (low volatile) coals generally of the Jharia coalfields and on percentage of "ash plus moisture" for high moisture (high volatile) coals generally of the Raniganj coal fields.

(*b*) The price structure is arbitrary as it does not take into account the utility factor *i.e.*, the usefulness of each grade of coal in different industrial purposes.

In short, the defects in the present grading scheme are that :—

(*a*) Calorific value has been given no consideration.

(*b*) Difference in the behaviour of moisture and ash on combustion conditions is not indicated. For instance, coals having 4 per cent. moisture and 20 per cent. ash or those having 10 per cent. moisture and 14 per cent. ash are treated alike under this scheme, although the latter are capable of producing more useful heat in the boiler.

(*c*) The scheme does not allow for variations in the moisture content, which occur over a wide range in high moisture (high volatile) coals. One redeeming feature of the Coal Commissioner's scheme however, is that it deals with low moisture coals (moisture 2 to 3 per cent.) in a fairly just manner.

The scheme proposed by the Fuel Research Institute has the following advantages :—

(*a*) It eliminates difficulties in grading which arise from variations in the moisture content, particularly of the high moisture (high volatile) coals, by adoption of "moisture free" (dry sample) basis for grade evaluation.

(*b*) It takes into consideration the calorific value by adopting a relationship between the basic heat value of the pure coal substance (unit coal) and the moisture in coal. This relationship has been experimentally determined for Indian coals with moisture ranging from nil to 15 per cent.

(*c*) It introduces a Price Point Scale which penalises ash in coal in accordance with the influence of ash on combustion conditions

(*d*) It offers a common basis for grading low moisture (low volatile) and high moisture (high volatile) coals.

The only controversial point about the Fuel Research Institute's scheme is the assumption of the factor for penalising ash. The Fuel Research Institute assumes a value of 1·5 for this factor.

Figure 2 has been developed to show a comparison between the performances of the stationary and the locomotive boilers. The locomotive boilers considered here are both of the new and old designs. In this figure, values of useful heat have been derived for each grade of coal on the basis of :—

(*a*) combustion efficiencies actually achieved ;

(*b*) formula recommended by the Fuel Research Institute using a factor for penalising ash as 1·5 for the stationary boilers, 2·0 for the locomotive boilers of new designs and 2·5 for the locomotive boilers of old designs.

The derived useful heat values are presented in tables I, II, and III shown on Fig. 2. It will be seen that the useful heat values based on the formula and the actual combustion efficiencies agree closely both in the case of the stationary and locomotive boilers.

In Table IV, the useful heat values have been reduced to prices, by assuming a unit price, as rupees 14 per 0,000 Btu.

Conclusions that may be drawn from the data presented in fig. 2 and table IV are as follows :—

(*i*) The factor 1·5 adopted by the Fuel Research Institute for penalising ash fits well into the performances of stationary boilers. For locomotive boilers of new designs, this factor should be 2·0 and for locomotive boilers of old designs, 2·5.

(*ii*) Penalty for ash relates to boiler performances only. It does not take into account the extra freight paid on transport of inert matter.

(*iii*) For grade 1 and higher quality coals, the prices determined by the Fuel Research Institute formula agree fairly with the existing prices. In fact they are slightly higher than the existing prices. In the case of grade II coals, however, the existing price is higher than the price determined by the proposed formula. This shows that grade II coals are at present priced unduly high and this acts to the disadvantage of the consumers.

(*iv*) On a straight comparison of prices as derived for actual boiler efficiencies in table IV, the coals that should be given to locomotive boilers of new designs should be one grade higher than the coals given to the boilers of stationary plants. Similarly coals that should be given to locomotive boilers of old designs should be two grades higher than the coals given to the stationary plants.

APPENDIX 6—*contd.*

Locomotive boilers of older designs will be gradually replaced by those of the recent designs in the course of the next five years or so. A fair value of the factor for penalising ash in the Fuel Research Institute formula should, therefore, be 2·0. This value will give the necessary advantage to the stationary boilers in the matter of extra freight charges on transport of inert matter.

There should, however, be no objection to the figure 1·5 being adopted provided the policy in regard to distribution of coals between the railways and the industries is such that relatively higher grades of coals are given to the railways. That is to say, when grade I and grade II coals are to be distributed between the railways and the industries, the railways get preference for grade I coals.

M. V. KAMLANI,
Member-Secretary,
Railway Fuel Economy Enquiry Committee.

Dated February, 1952.

TABLE IV

RELATIVE PERFORMANCE OF STATIONARY AND LOCOMOTIVE BOILER AND PRICES OF DIFFERENT GRADES OF COAL BASED ON USEFUL HEAT VALUE.

1	2	3			4			5			6
Grade of coal	Average Calorific value	Combustion efficiency (see fig. 2-Appendix 6)			Useful heat value (2) × (3)/100			Price based on Rs. 14 for 10,000 BTU of use ful heat (4×14)÷10000			Present price Structure
		Station-ary Boiler	Loco-motive Boiler New Design	Loco-motive Boiler old Design	Station-ary Boiler	Loco-motive Boiler New Design	Loco-motive Boiler Old Design	Station-ary Boiler	Loco-motive Boiler New Design	Loco-motive Boiler Old Design	
Selected 'A' .	12750	91·8	85·8	78·7	11700	10900	10000	16·4	15·26	14·0	16·25
Selected 'B' .	12200	91·0	83·5	75·5	11100	10200	9280	15·54	14·28	13·0	15·25
Grade I . .	11700	90·0	80·5	71·4	10500	9400	8350	14·7	13·14	11·7	14·3
Grade II . .	10800	89·0	77·3	66·0	9620	8350	7120	13·5	11·7	9·97	14·0

It will be seen from the above table that the present price structure (column *vi*) more or less fits into the scale of prices determined on the basis of useful heat realised from the different grades of coal in stationary boiler practice. Where loco boilers are concerned the performance of grade I coal in the boilers of new designs and Sel. B coal in the boilers of old designs compare with that of grade II coals in the stationary boilers of thermal plants. This observation clearly shows that for steam raising purposes locomotive boilers should receive higher grades of coal as compared to stationary boilers.

APPENDIX 7

(Chapter V)

A Note containing evidence of Mr. A. Farquhar, Coal adviser to Messrs. Tatas, recorded at the Railway Fuel Economy Enquiry Committee meeting held in Coal Commissioner's Office on 2nd April, 1952.

Mr. A. Farquhar, Coal Adviser to Messrs. Tatas, attended the meeting and gave evidence before the Committee on the prospects of coal washing in India, particularly the performance of the West Bokaro Washing Plant of Tatas. A copy of the note handed over to the Committee by Mr. Farquhar is attached.

In the course of discussion on coal washing, Mr. Farquhar made the following observations :—

(*i*) Heavy medium plant such as chance sand washery or American Magnetite washery in his opinion is the best for Indian conditions ;

(*ii*) West Bokaro washery is washing practically Grade II coal, 20 to 22 per cent ash ; the performance are as follows :—

(a) High grade product . . . . 85 per cent. at 15 per cent. ash.

(b) Middlings . . . . . 5 per cent. at 29 per cent. ash.

(c) Rejects . . . . . 9 per cent. at 55 per cent. ash.

The rejects include a loss of 0·34 per cent carried away as slurry.

(*iii*) Low grade Indian coals such as Grade III-A and Grade III-B can be washed on a heavy media plant. The yield of products would depend on the washing characteristics of the coal. A yield of 40—60 per cent. of good coal could be expected in many cases. There would also be a middling fraction recovered and the total rejects would not exceed 20 to 35 per cent. There are many collieries washing coal on this basis in England, America and in South Africa.

(*iv*) Capital cost of the plant at West Bokaro dealing with 135 tons of raw coal per hour was 15 lakhs. This did not include the capital cost of the raw coal handling plant which would have been necessary even if a washing plant had not been installed. The table attached is the operation data for capital charges and revenue costs. These costs are based on 50 per cent operation, since the mine is still on only half production. With full production, no additonal labour would be employed and capital and revenue charges would be correspondingly reduced. The costs therefore on full operation would be halved.

(*v*) Phosphorus in the raw coal is too high for making metallurgical coke. It is not known whether the phosphorus is in the organic or inorganic form. It is found however that the washing process reduces the phosphorus contents of the clean coal by 50 per cent. The phosphorus is more highly concentrated in the middlings fraction of the products which are not used for coke making.

(*vi*) If a washing plant had not been installed at West Bokaro a "crushing-screening and sizing" plant would have been necessary. This would have cost at least 2/3rds of the capital involved in the washing plant. At Jamadoba, the old mechanical screening plant was 32 years old and would have required replacement if a washing plant had not been decided on instead. The replacement of the old plant would have cost 2/3rds of the capital cost of the washing plant, which was decided on. From this it will be seen that there is not much more capital involved in a washing plant than in a mechanical coal screening and sizing plant and the washing plant combined the two purposes washing and sizing.

(*vii*) West Bokaro plant works 2 shifts a day, 8 hours each shift. 24-hour or 20-hour working is not recommended as the plant will suffer from inattention and lack of maintenance.

(*viii*) The Chance sand plant (or any heavy media plant) is a primary plant designed to wash large sizes of coal from 1/8" to 8" in size. It incorporates crushing, screening and sizing sections to give any size of product required within the above limits. For metallurgical purposes the basis of operation has been fixed at 1/8" to 3" , but for boiler or loco requirements the basis of operation can be made to give any desirable size.

(*ix*) The operational results vary with the washability characteristics of the different coals. In other words, the recovery of marketable products varies with those characteristics. All coals with similar washability characteristics can be washed together with the maximum recovery of products if coals with different characteristics have to be washed together then statisfactory blending of the coals must be done. This is much more costly, difficult and unsatisfactory than washing them separately at the optimum specific gravity for each coal. For example at West Bokaro, washing by mixing two coals of different washability characteristics, results in a fluctuation of 1 to 1½ per cent. in the ash of the clean coal. For such conditions it is better to provide storage bunkers and wash the different coals separately and at the specific gravity pertaining to each coal. The Chance plant is designed for immediate change of gravity in the media for this purpose. A stock of one kind of coal can be processed, and so on. The only limits are the provision of bunkers for storing the different coals but this not a serious matter where coals can be grouped accordingly to their washability characteristics. For a central plant at least two 1,000 ton bunkers are necessary to enable different coals to be washed, and the plant could deal with them alternatively. For the purpose of a central plant, small collieries could be grouped according to the characteristics of their coals. Such collieries could combine to put up a plant. Alternatively, a public company could put up a central plant, purchase the inferior coal, process it and place the products on the market.

APPENDIX 7—*contd.*

(*x*) The problems of transport to a central plant can be solved with the assistance of the Government. These are mainly as follows :—

(1) *Minimum Rail Freight.*—There is a minimum rail freight charged on coal when despatched. Whether it is despatched 100 yards or 20 miles the freight is the same. The incidence of this on central washing plant will be serious,since the minimum freight will be charged up to the plant and again the full freight will be charged for transport from the plant to the consumer. The minimum freight rule should be abolished.

(2) *Cess.*—This is levied on despatch from the colliery. It can again be levied on despatch from the Central plant. This needs consideration.

(3) *Wagons.*—A regular supply of open type wagons must be guaranteed.

(4) *Sidings.*—A central plant will necessitate adequate siding accommodation for discharging, reloading and marshalling. Formerly assisted terms were granted to collieries. These concessions have now been withdrawn. Unless they are restored there will be no encouragement to instal a central washing plant.

(*xi*) The ash percentage of the rejects from the West Bokaro plant is about 55 per cent. These rejects cannot be avoided if washing is adopted. Moreover, such rejects are considerably lower than the actual losses in hand picking. The ash in the rejects is too high for use as fuel or for any other purposes. They however serve as good stowing material. If at any future date combustion practice is evolved to use such high ash fuel, the rejects can be recovered for the purpose. Some years ago a Czechoslovak Mission had come to India and had claimed that a process had been developed to use such ash coals in boilers. This process consisted in slagging of the ash and its removal as slag. Processes have been evolved in Europe for recovery of gas from washery rejects having ash over 50 per cent. Such processes may not be economical in India.

NOTE.—In the discussion, Mr. Guha observed that Indian coals exported to Japan have been washed successfully in that country.

A note on West Bokaro Washing Plant by Mr. A. Farquhar handed over to the R. F. E. E. Committee at a meeting at Calcutta on 2nd April 1952.

WEST BOKARO WASHING PLANT

Capacity . . . . . 135 tons per hour.
16 hours daily operation . . . . . 2,160 tons daily.
Monthly—6 days per week . . . . . 56,160 tons monthly.

Month	Tons washed	Revenue cost in annas	Estimated cost on full capacity in annas per ton.
Augus 1951	17,437	8·4	2·6
September 1951	15,940	9·0	2·5
October 1951	15,659	9·7	2·7
November 1951	16,983	10·7	3·2
December 1951	19,648	11·0	3·8
January 1952	21,374	10·7	4·7

Cost of Plant and erection . . . . . Rs. 15 lakhs approx.
Preparation of site and civil work . . . . . Rs. 4 lakhs approx.

Rs. 19 lakhs approx.

Yearly capacity on full production . . . . . 6,72,000 tons.
Total depreciation per year at annas eight per ton . . 3,36,000 approx.

depreciation rate would only be annas two per ton on full production.

APPENDIX 7—*contd.*

West Bokaro Colliery

COST SHEET OF WASHING PLANT FOR OCTOBER 1951

Coal washed this month : Tons 15,650

Item of Expenses	Amount	Total	Grand Total	Cost per ton in annas	
				This month	Last month
	Rs. A. P.	Rs. A. P.	Rs. A. P.		
1. WAGES—					
Supervisors—					
Superintendent	450 0 0	...	...	...	...
Shift Foremen	500 8 6	...	...	...	...
Asstt. Shift Supervisors	160 10 6	1,111 3 0	...	...	...
Washing—					
Raw Coal Supervisors	307 3 0	...	...	...	...
Cone Operators	139 0 0	...	...	...	...
Sand supply cost	295 11 0	...	...	...	...
Basement attendants	88 11 6	...	...	...	...
Greasers	149 11 0	...	...	...	...
Cleaners	191 2 6	...	...	...	...
Shale Pickers	324 1 6	...	...	...	...
Apprentice	94 6 6	...	...	...	...
Overtime and Badlee payments	69 10 0	1,659 9 0	...	...	...
Rejection Disposal—					
Fireman	169 9 6	...	...	...	...
Haulage Khalasies	114 12 0	...	...	...	...
Boiler Kamins	76 9 9	...	...	...	...
Trammers	326 7 0	...	...	...	...
Overtime	44 0 6	731 6 9	..	....	...
Others—					
Chemists	224 14 0	...	...	...	...
Clerk	64 1 0	...	...	...	...
Guards	160 2 0	...	...	...	...
Office Chaprasies	79 5 0	528 6 0	...	...	...
Other Benefits—					
Foodstuff loss	722 3 0	...	...	...	...
P. F. Contribution	62 10 0	...	...	...	...
Workmen's compensation	38 0 0	...	...	...	...
		822 13 0	4,853 5 9	4·9	4·5
2. Reserve for Bonus	...	...	521 8 0	0·6	0·6
3. Consumable stores drawn	...	...	301 4 0	0·3	0·2
4. Sand supplies tons 58	...	...	1,508 0 0	1·6	1·4
5. Coal supplied to Refuse Boiler tons 81 at Rs. 13/2/2	...	...	1,063 15 6	1·1	1·0
Maintenance	...	...	237 14 3	0·2	0·3
Depreciation at the rate of -/8/- per ton	...	...	7,829 8 0	8·0	8·0
Administration charges at the rate of -/1/- per ton	...	...	978 11 0	1·0	1·0
			17,294 2 6	As. 17·7	As. 17·0

(Sd.) R. K. PILLAI,
Accountant.

(Sd.) W. W. SCOTT,
Dy. Agent. 27th November 1951.

APPENDIX 7—*contd.*

West Bokaro Colliery

MONTHLY WASHING PLANT OPERATION

Colliery : West Bokaro. Month: December, 1952.

Total time operated : 278 hrs. 15 minutes. Average tons per hour : 113·0.

A. Operation	Tons	Percentage	Average Ash
1. Raw Coal	31,692	100	...
2. Clean Coal	27,263	86	13·72
3. Dust	...	...	...
4. Middlings	1,076	4·4	27·24
5. Middlings to Boilers	332	...	...
6. Total (2+3+4+5)	28,671	90·4	...
7. Rejections	3,021	9·6	51·19
8. Slurry	...	...	...
9. Total (7+8)	...	...	...
10. Hand Clean Coal	...	...	...

B. Costs	Washed Coal Rs. per ton (Tons=28,671)	Raw coal Rs. per ton (Tons=31,692)
1. Administration	0 1 0	0 0 11
2. Operation, Salaries and Allowances	0 0 11	0 0 10
3. Operation, Wages and Allowances	0 1 7	0 1 5
4. Maintenance, Salaries and Allowances	...	...
5. Maintenance, Wages and Allowances	0 0 5	0 0 4
6. Operation Stores : (*a*) Sand. (*b*) Oil and Grease. (*c*) Water Supply. (*d*) Other Stores.	0 0 6	0 0 5
7. Maintenance Stores for repairs and renewals	0 3 5	0 3 1
8. Refuse disposal service	...	..
9. Power and Lighting	0 2 2	0 2 0
10. Depreciation	0 3 8	0 3 4
11. Total	0 13 8	0 12 4

APPENDIX 9

(Chapter VII)

A REVIEW OF THE FUEL PROBLEM

on

Indian Railways

(6 Notes)

NOTE NO. 1

PROGRESS WITH THE UTILISATION OF INDIAN COALS FOR LOCO PURPOSES ON INDIAN RAILWAYS

The earlier Indian locomotives were of the British designs suitable for burning high grade coking coals of calorific values ranging upward of 13,000 BTUs per lb. and ash content below 12 per cent. These locomotives, however, used high grade coking coals raised in the Bengal and Bihar Coal Fields ; that is coals of calorific values ranging from 12,000 to 13,000 BTUs and ash content generally between 14 to 16 per cent.

The first world war gave considerable impetus to the Indian Coal industry. Certain new fields (outside Bengal and Bihar) were opened up and the production of coal, both in the Bengal and Bihar areas and elsewhere, was increased. High grade coals began to find good market in export and bunker demands with the result that the coals offered for indigenous consumption were relatively of poor grades.

These conditions called for departure from the British practice in locomotive design. New designs of locomotives suitable for burning coal of a calorific value as low as 11,500 BTU per lb. and ash as high as 20/22 per cent. were considered necessary. As the coals accepted for locomotive use were still of the coking varieties, the main departure from British practice lay in the provision of a larger grate area in the locomotive boiler.

The Locomotive Standards Committee (which came into being in the year 1924), developed designs of the first series of I R S locomotives (" XA ", " XB " and " XC " for passenger services and " XD " and " XE " for goods services on the BG system, " YB " and " YC " for passenger services and " YD " for goods services on the MG system). The new designs were tested and adopted as standards during the years 1925-27. Experiments were, however, continued right upto the year 1935 with the object of determining locomotive rating and performance and studying modifications in the mechanical features of the I. R. S. designs.

The larger grates provided with the boilers of the " X " and " Y " series called for an additional carrying axle in the rear of the engine. The wheel arrangements of the BESA designs (0-6-0, 2-6-0, 4-6-0 and 2-8-0) were replaced by the New wheel arrangements of 4-6-2 and 2-8-2 in the IRS designs. An idea of the increase in the grate areas of the IRS locomotives can be obtained from the following table :—

Earlier BESA Locos.	New IRS Locos.	
14/16 sq. ft.	26/30 sq. ft.	M. G. Locomotives.
24/26 sq. ft.	32 sq. ft.	B. G. Locomotives.
32 sq. ft.	45 sq. ft.	
38 sq. ft.	58 sq. ft.	
	60 sq. ft.	

With the opening up of new sites for raising coals and with the increase in the production of the collieries lready in existence (particularly those lying outside the Bengal and Bihar group), Railways began using coals upplied by the nearer collieries.

In the early thirties the G.I.P. Railway initiated experiments with the CP and CIC coals and under- ook regular Dynamometer Car trials to study the haulage capabilities of the BESA and the earlier IRS loco- iotives burning medium and low grade non-coking coals raised in these fields. Dynamometer Car trials ere also extended to the prepartition NW and BN Railways with the object of making an exhaustive study of ie performances of the IRS and BESA engines using coals normally supplied to them on these Railways.

Vast amount of boiler performance data was thus collected from the Dynamometer Car trials and other periments carried out over a period of 15 years (1930 to 1945) on boilers of varying proportions and coals of dely varying characteristics. Analyses of this data has yielded new ideas on boiler design which have been corporated in the latest IRS locomotives—WPs/WGs for the BG system and YPs/YGs for the MG system. iese new locomotives can burn non-coking coals of calorific values as low as 11,300/11,600 BTU. per lb. and high as 20/22%.

Locomotives in shunting services are subjected to firing rates which at one moment rise to 2,000/2,500 lbs. r hour and at another drop to practically nil. The steam production rates also fluctuate from, say 10,000 12,000 lbs. per hour to practically nil. The average ratings on shunting locomotives however represent steam oduction of 2,500 to 3,000 lbs. per hour and firing rates of 450 to 500 lbs. per hour. Thus the maxima d minima of the firing and steam production rates on a shunting locomotive vary widely from the average ings and can only be met satisfactorily by maintaining furnace temperatures at a high level (above 2,000 F), fuel efficiency is not to be sacrificed. This would be possible only by using coking coals of Calorific Values t below 11,500 BTUs; the coking coals, because of their ability to stay on the grate, maintain high furnace nperatures and cope with heavy fluctuations in combustion rates with little loss of efficiency. Thus the coals ed on shunting locomotives should not be below grade I in quality and should be of coking variety, whatever type of locomotive used in shunting duties.

APPENDIX 9—(*contd.*)

The position with regard to efficient utilisation of coal in the four categories of locomotives is now summed up as follows :—

(i) BESA LOCOMOTIVES—should normally be given to burn selected grade coking or semi-coking coals. These locomotives can burn medium grade (grade I) coking or semi-coking coals and can produce the power required for operating scheduled services, but there will be a certain loss in efficiency which in any given service may cause an increase in coal consumption of the order of *10 to 15 per cent.*

(ii) 1926 IRS DESIGNS—should normally be given to burn medium grade (grade I) coking or semi-coking coals. These locomotives can burn medium grade non-coking coals or low grade (grade II) coking coals and produce the power required for operating scheduled services, but there will be a certain loss in efficiency which, in a given service, may cause an increase in coal consumption of the order of *20 to 25 per cent.*

(iii) LATEST IRS WP/WG AND YP/YG DESIGNS (1948)—should normally be given to burn medium grade (grade I) non-coking coals. These locomotives can burn low grade non-coking coals (calorific value 10,500 to 10,700 BTU per lb. and ash content upto 24 per cent.) and produce the power required for operating scheduled services, but there will be a loss in efficiency which, in a given service, may cause an increase in coal consumption of the order of *15 per cent.*

(iv) LOCOMOTIVES EMPLOYED IN SHUNTING DUTIES—irrespective of the types used, these locomotives should normally be given to burn grade I coals preferably of the coking varieties. Coals below grade I will cause considerable wastage through the chimney and the grate, and firing to meet heavy fluctuations obtaining in combustion rates in shunting duties is both difficult and onerous.

NOTE.—The BESA and the earlier IRS locomotives which have been designed to burn high and medium grade coking coals, respectively, can accept non-coking coals of the corresponding grades without loss in power but with a loss in efficiency, resulting in an increase in coal consumption on an average of *15 to 20 per cent.*

The number of locomotives on Indian Railways in each of the above four categories and their estimated coal consumption per duty day are given in the following table :—

Category of Locomotives	No. of locomotives	Percentage of total No.	Total consumption per duty day (tons)	Percentage of total consumption in each category
(1)	(2)	(3)	(4)	(5)
Earlier BESA and non-standard designs .	4056	49.2	13400	49.6%
Earlier IRS and War period USA built locos. based on earlier IRS designs . . .	2085	25.2	7520	28%
Latest IRS designs	576	7.0	2690	10%
Locomotive in shunting duties . . .	1529	18.6	3380	12.4%
Total number of locomotives . .	8346	100%	26990	100%

An ideal loco coal programme would provide for the supply of most suitable grades and varieties of coals in proportions required for each of the four categories of locomotives operating on the different Railways. The ideal conditions cannot be met in practice. We have, therefore, to approach the "ideal" by making such allowances as will not cause fuel wastage (*i.e.* increases in consumption) of more than 10 or 15% as compared to the 'ideal'.

Table below gives grade allocations covering the total requirements of coal for all Indian Railways. These allocations compare the 'ideal' requirements with those acceptable in practice.

Coals		Ideal				Practice as based on an overall increase in consumption of 10 to 15%			
Grade	Coking/Non Coking (C) (NC)	100% Coking	40% C 60%NC	20% C 80%NC	100% NC	100% C	40% C 60%NC	20% C 80%NC	100% NC
Sel	C . . .	49·0	19·1	9·9	..	9·99	·9	5·0	..
	NC . . .	..	46·6	62·1	77·6	..	29·6	37·7	59·6
	Total . . .	49·6	66·4	72·0	77·6	24·8	39·7	44·7	49·6
I	C . . .	40·4	16·2	8.1	..	45·0	18·0	9·0	..
	NC . . .	..	13·4	17·9	22·4	..	27·2	36·3	45·4
	Total . . .	40·4	29·6	26·0	22·4	45·0	45·2	45·3	45·4
II	C . . .	10·0	4·0	2·0	..	30·2	6·0	6·0	..
	NC . . .	..	..	..	..	..	3·0	4·0	5·0
	Total . . .	10·0	4·0	2·0	..	30·2	15·1	00·0	0.5

The current loco. programme represents 41% coal supplies in coking varieties and 59% in non-coking varieties, the grade proportions are 36.4% Selected coals, 39.8% grade I coals and *23.8% grade II coals. Coking coals are expected to be replaced by non-coking coals, within the next 5 years. The change over from the coking to the non-coking coals is shown in the table to cover three steps.—(a) "40% coking and 60% non-coking supplies" (b)"20% coking and 80% non-coking supplies" and (c) "100% non-coking supplies". The current loco coal programme compares with the second step in the change over from coking to non-coking coals. If the grade allocation is to be rational the current programme should provide for 40 % of coal in Selected grades, 45% in grade I coal and 15% in grade II coals as shown in the table. The proportion of Selected grades should increase to 49.6% and that of Grade II should reduce to 5% when 100% supplies are drawn from non-coking coals.

Under ideal conditions, the proportion of coals in Selected grades should increase to about 75% and that of coals of grade I quality should reduce to 25%, leaving grade II coals completely out of loco coal supplies. The reasons why the grade II coals are not considered suitable for loco. power purposes are only partly explained in the above note and will be discussed in detail in a separate note.

NOTE No. 2

SCOPE FOR UTILISATION OF GRADE II COALS IN LOCOMOTIVES

There is an impression amongst some colliery owners and also amongst the general public that the latest IRS designs of locomotives—WP/WG for the BG system and YP/YG for the MG system—are capable of burning efficiently grade II coals and coals of still lower grades. It may be remembered that the Railways have, for some time past, been asked to accept the non-coking coals in place of the coking coals that have so far continued to be supplied. The new IRS locomotives have been primarily developed to make this changeover from the coking to non-coking coals possible without adverse effect on efficiency. The non-coking coals to be supplied in replacement of the coking coals have, however, to be at least of medium quality, that is of a grade giving a calorific value of about 11,500 BTU per lb. and ash not higher than 20/22%. The new IRS locomotives can be made to burn grade II non-coking coals without much loss in power but the performance efficiencies will be poorer in that coal consumption will increase by about 25 to 30%. Coals lower than grade II quality will even affect the power developed and will not at all be acceptable for these locomotives.

The point is that the locomotive boiler cannot be easily designed to burn coals of low calorific value and of high ash content, without heavy loss in fuel. The main reasons for this handicap lie in the limited proportions of the boiler. The first limitation is of the size of grate which cannot be too long as difficulties would arise in firing. The grate of the locomotive boiler is, therefore, of necessity small in size and this results in heavy rates of firing. In normal working the firing rates on a locomotive are of the order of 60 to 80 lbs. per SFG/hr. In heavy working the firing rates arise upto 170 lbs. per SFG/hr. With mechanical stoking they are known to reach and even exceed 200 lbs. per SFG/hr. The corresponding firing rates of the stationary boiler are of the order of 20 to 25 lbs. per SFG/hr. in normal working, and 35 to 40 lbs. in heavy working. The second limitation lies in the provision of adequate combustion space. Furnace proportions of a locomotive boiler are restricted by the loading gauge ; combustion volume provided in the normal designs ranges from 3.5 to 5.5 Cub. ft. per sq. ft. of grate. In more recent designs (WP/WG, YP/YG) the combustion volume of 6.7 Cub. ft. per sq. ft. of grate has been reached. In stationary boiler furnace proportions are larger. Cumbustion space of 15 Cub. ft. of grate is rather on the low side ; a furnace volume of 25 Cub. ft. per sq. ft. of grate is not uncommon.

A large furnace allows the coal to stay on the firebed and in the cumbustion space to burn out completely even if the coal is low in calorific value giving relatively lower cumbustion space temperature and slower rate of cumbustion.

With the restricted cumbustion space in the case of the locomotive firebox higher combustion temperatures in the combustion space (temperatures above 20000 F) are a sheer necessity. The rate of cumbustion, dependent as it is on the cumbustion temperature, should indeed be fast enough to completely burn out the fuel so that little of it may pass out of the combustion zone in partially burnt state. If grade II and still lower grade coals are used the combustion space temperatures will be generally below 20000 F with the result that losses by way of partially burnt fuel through the chimney and the grate are considerably increased.

Ash in cost which is high when the calorific value is low, has an adverse effect on the efficiency of combustion. High ash requires frequent rocking of the fire in order to maintain a clean firebed and this frequent rocking results in qauantities of partially burnt coal (cinders) being discharged into the ash pan. The influence of low calorific value and high ash content on boiler efficiency can be seen from the performance given in table below :—

Grade of coal	Representative Calorific Value	Percentage decrease in Calorific Value	Units of coal consumption	Percentage increase in consumption
Sel. 'A' .	12,750 BTU's/lb.	0	100	0
Sel. 'B' .	12,200 BTU's/lb.	4·3	107	7
Grade I .	11,700 BTU's/lb.	8.3	120	20
Grade II .	10,800 BTU's/lb.	15·3	140	40

*The coals raised in outlying fields are not graded; but they actually vary from grade I to grade III. For purposes of allocation owever, half the quantities of coals supplied from outlying fields may be taken to be of grade II quality.

APPENDIX 9—(*contd.*)

It will be seen that the substitution of Selected B for Selected A coal reduces the calorific value by 4.3% but increases the consumption by 7%. Similarly the substitution of Grade I for Selected A coal reduces the calorific value by 8.3% but increases the consumption by 20%. The grade II coal has a calorific value 12.7% lower than that of Selected A coal but its consumption is 40% higher than that of Selected A coal. In short, use of coals below grade I result in considerable increase in consumption.

It is not physically impossible to design a locomotive boiler that will efficiently burn Grade II and still lower grade coals but there are axle load restrictions which will call for a much larger number of axles to be provided in the wheel arrangement so as to accommodate a boiler of enormous proportions that will be needed for such a task. Besides this the weight of the locomotive boiler will be much too heavy and it would mean carrying extra dead weight, and reducing thereby the corresponding pay load for a locomotive designed to burn such low grade coals.

Moreover concentration of heavy weight in the locomotive itself may call for strengthening of bridges and certain portions of track on all railways. Economic considerations would, therefore, militate against the use of a boiler of large proportions necessary for efficient burning of Grade II and still lower grades of coal in locomotives.

There is a general impression that low grade coals can be used in less important or less arduous services without ill-effect on the performance efficiency. From the point of view of boiler operation, type of service which the locomotive operates carries little meaning. The locomotive boiler is designed to meet steam production requirements for given service conditions. In normal operation it will maintain firing rates of the order of 60 to 80 lbs. per SFG/hr. now and then touching the design rating of 100 lbs. per SFG/hr., and occasionally exceeding the design rating by 20 to 25% for short bursts of 15 to 20 minutes. Therefore the boiler rating rather than the type of service is important from the point of fuel economy. And as long as steam requirements of a given service can be met within the design rating of the boiler matters little as to whether the services operated by the locomotive are slower or faster or have other varying characteristics in respect of loads and gradients.

Goods services have been generally regarded as *less important* than passenger services. Actually the Goods locomotives sustain higher steaming rates than the passenger locomotives of the same boiler proportions. For instance on level track the WP locomotive will require 18000 to 20,000 lbs. of steam per hour, to haul a load of 450 tons at a speed of 60 miles per hour whereas the WG locomotive will require 22,000 to 24,000 lbs. of steam per hour to haul a load of 1200 tons at a speed of 40 miles per hour. Moreover the goods traffic' handled by any railway is generally greater than the passenger traffic, and that the requirements of steam for handling goods traffic are appreciably greater than those for handling passenger traffic. *From consideration of fuel economy therefore the goods locomotives should be given higher grades of coals ; at any rate, they should not be given any grades of caals poorer than those given to passenger locomotives.*

From the traffic point of view shunting duties are also regarded as less important than the passenger or the goods duties and the locomotives performing shunting duties are invariably given poorer grades of coal. This again is not the right approach from the fuel economy considerations.

It has been stated in Note 1 that average rate of steam production in a shunting locomotive is 2,000 to 2,500 lbs. per hour and the corresponding rate of firing is of the order of 450 to 500 lbs. per hour. This average rating is indeed low for a locomotive boiler, but the point, really, is that shunting duties call for considerable fluctuations in steam demands and firing rates. Maximum steam production in shunting duties is of the order of 10,000 lbs. per hour ; and the firing rate rises to 2,000/2,500 lbs. per hour. The minimum values are practically nil. Such heavy fluctuations, occurring every few minutes, require better grades of coal to maintain heat more evenly in the firebox so that combustion is reasonably satisfactory.

In main line services both goods and passenger conditions of operation are fairly well sustained, and the coal consumption with the substitution of Grade II for grade I coal is increased by 25 to 30%. In shunting services which suffer from heavy fluctuations in the combustion rates, the increase in coal consumption for Grade II in place of Grade I coal would be still greater. Thus from consideration of fuel economy shunting locomotives should not be given to burn Grade II coals. In fact coals allotted to a shunting locomotive should be the high grade coking coals.

One may examine other possibilities of extending the use of grade II coals in locomotives. Grade II coals may prove economical if the present price structure is revised so that the increased coal consumption is offset by the difference in prices of the grade II and the higher grade coals. In fact, to minimise coal transport, inferior coals should be used at consuming points nearest to the supply sources and the better grades at consuming points farthest from the supply sources. The present price structure does not encourage the trend in this direction and its revision on proper lines would require careful consideration. Another possibility of extending the use of grade II coals lies in the adoption of benefication measures. Coal washing will result in high grade product which can be drawn away for loco purposes and in a certain percentage of low grade (high ash) middlings which can be utilised in large and medium capacity thermal stations. There is considerable scope for coal washing and the Indian Railway Fuel Committee has already set up a Sub-Committee to study the economics of wahing low grade coals from the point of view of railway coal supplies.

NOTE No. 3

PROCUREMENT/SUPPLY

(Loco Coal Programme)

Upto the year 1944, that is prior to the setting up of the Coal Commissioner's Organisation, railways obtained practically 1/3rd of their coal supplies from the railway-owned collieries and placed contracts for the balance of 2/3rds with market collieries of their choice, through the Chief Mining Engineer, Railway Board. The contract system guaranteed supplies to grade specification. Moreover, the varieties of coal which the railways handled at individual sheds were few in number. This helped in the efficient utilisation of coals, for the simple reason that the engine crew got used to a few varieties of coals in day to day work.

The Chief Mining Engineer, Railway Board manages the railway-owned collieries. The Railways, on their part, keep the Chief Mining Engineer regularly posted with their monthly coal requirements and the distribution of coal to the various sheds, or other receiving points. The Chief Mining Engineer manages the entire supply and distribution work on behalf of the railways and carries out these and other duties under the control of the Coal Commissioner. Some of the Company railways did in the past take advantage of the existing Organisation and obtained their supplies regularly or on occasions through the agency of the Chief Mining Engineer. No Company railway now exists.

The Coal Section of the Railway Board maintains statistics of consumption of coal on railways. It communicates regularly with the Chief Mining Engineer on matters concerning adjustments necessary from time to time in the procurement and distribution of coal for individual railways. The entire policy with regard to matters of procurement and distribution of railway coal is therefore centrally controlled by the Coal Section of the Railway Board.

During the World War II, the balance between production and distribution of coal in the country got badly upset for certain reasons and it is on this account that the Government set up an organisation under Coal Commissioner to direct production of coal in the various coalfields and its distribution to the various consumers in the country, in due regard to the prevalent supply and demand conditions. This organisation started functioning with the implementation of the Colliery Control Order in 1944. The Chief Mining Engineer was absorbed in the Coal Commissioner's Organisation, and was given to perform dual duties, in that, he continued to function as Chief Mining Engineer, Railway Board to look after the railway-owned collieries, placed under the administrative control of the Ministry of Industry and Supply (now Ministry of Works, Production & Supply) with the setting up of the Coal Commissioner's Organisation, and receive monthly advices from individual railways regarding their requirements of coal and of their distribution to sheds. He also continued to receive complaints from railways about inferior or incorrect supplies and to deal with such complaints by imposing penalties on defaulting collieries. On the Coal Commissioner's side, he became responsible for the entire production of the coal in the country including the Railway-owned collieries.

Under the Coal Commissioner's Organisation coal supplies to Railways are now arranged on the basis of Loco Coal Programmes which cover periods of 3 or 6 months and are framed in advance by the Coal Commissioner in consultation with Coal Advisory Committee on which the Coal Industry and the *Railway Board are represented. These programmes relate to allotments of loco coal orders to the various collieries and are based on the requirements of individual railways first forecast and finally estimated by the Coal Section of the Railway Board from monthly consumption figures of the previous period of four months and the latest reserve stock position reported by railways. The distribution of the supplies from the collieries to the railways is directed by the Chief Mining Engineer on behalf of the Coal Commissioner.

The system functioning under the control of the Coal Commissioner has lacked in one important feature and that is that the inspection of the coal loadings at the colliery pit-heads or at the railway sidings where groups of collieries collect their stocks for loading purposes, has been inadequate. This lack of proper inspection has resulted in numerous complaints coming from railways about excessive amount of slack and dust and/or shale, in the coals supplied to railways. In fact, run-of-mine coal seems to be supplied by many collieries in place of steam coal.

The Indian Railway Fuel Committee has gone into the question of quality control in detail. At one stage, this Committee decided to tighten up the fuel control organisation of each railway, so that screening and picking tests and drawing up of samples from inferior supplies, could be done more frequently to enable the railways to collect proper evidence in support of their complaints, and furnish it to Chief Mining Engineer who may take effective action to eliminate inferior supplies. During recent years the cases of inferior supplies have been so many and so numerous on each railway, that it has been practically impossible to furnish evidence to the Chief Mining Engineer in support of all cases of complaints. On the other hand, the Coal Commissioner is unable to tighten up inspection on his side to cope with the situation.

The solution frequently suggested is to exclude from the loco coal programme, collieries with an output of less than 2,000 tons of coal per month. This suggestion has gained favour because the smaller collieries do not possess proper screening and picking facilities and are therefore inclined to load run-of-mine coal in place of steam coal particularly when the inspection of coal loading has proved inadequate. Besides, the accumulation of slack and dust at pit-head also offers a temptation for the collieries to load run-of-mine coal so as to dispose of slack and dust in this manner. Moreover, normal fluctuations in the wagon supply for loading and in the production of different grades of coal, go to tempt the colliery-owners (more so, the owners with small output) to load inferior grades in wagons allotted for better grades. With a fewer collieries on the loco coal programme, inspection organisation of the Coal Commissioner should function more effectively and in course of time, should arrest the tendency that now obtains for bad loading at pit-heads.

* Railway Board representation began from Sept., 1950.

APPENDIX 9—(*contd.*)

The Coal Commissioner in his Loco Coal Programme for the period commencing from September, 1951 has raised the output of collieries eligible for loco coal orders to 1,000 tons per month. This is the first step he proposes to take in reducing the number of collieries on the Loco Coal Programme from 500 down to a maximum of about a 100, a number which perhaps could be easily handled by his inspection organisation.

There has been hue and cry from the coal trade on the proposed action of the Coal Commissioner. The argument put forth is that exclusion of smaller collieries from loco orders will affect the sales of these collieries and may in course of time, result in their closing down. This argument should carry little conviction, as normal production and consumption (including export) should remain fairly well balanced in any arrangement that may exist or may be introduced for allocation of railway, industrial or other public coal orders to the various collieries. If the smaller collieries go off the loco orders, the public orders/released by the bigger collieries as a result of increased intake of loco orders should naturally go to the smaller collieries. The sales of the smaller collieries can, therefore, be affected only if the supplies made by these collieries are defective or inferior and generally not acceptable to the industrial and other public concerns. In such matters, the responsibility rests entirely with the colliery-owners, who should see to the supplies being made to grade specification.

There may, however, be other causes affecting sales of the smaller collieries. Such causes will require investigation. If it can be established that reduction in the number of collieries on the loco coal programme will hit badly the smaller collieries, the whole question will need to be re-examined from the view point of the measures to be adopted to strengthen inspection at coal loading points so that quality is assured in coal supplies to railways without materially reducing the number of collieries on the coal programme. It will however be necessary on the part of the collieries to introduce screening and picking plants, (where smaller collieries are concerned this may be done somewhat on co-operatitve basis) in order that correct grades of coal are produced and Coal Commissioner's Organisation is not over burdened with cases of bad loadings.

NOTE No. 4

DISTRIBUTION

A map giving distribution of colliery and consumer zones over the different part of the country is attached. Consumer zones, (areas fed by particular coal fields) are shown in distinctive notations representing coal fields. Where more than one coal field supplies coals to any particular consuming area, a form of chequered representation combining the notations of the respective coal fields marks out the particular area. In order to get a fair idea of the production and distribution of coal in the country, an attempt has been made to work out from available data the production of the individual coal fields, the proportionate supplies from these coal fields to railways and to other consumers, the supplies from the coal fields to individual railways and the cost per ton of coal at pit-heads as well as on individual railways. This data is shown in tables I to III attached to the map.

It will be seen that Bengal and the Bihar coal fields account for over 80% of the total production of coal in the country. Supplies made to railways also aggregate to about 70% from the Bengal and Bihar coalfields. On this basis, the production and distribution seem to more or less balance up. The distribution, however, suffers from unduly long leads for consuming points on certain railways. Examples that may be cited in this connection are the Saurashtra and Southern Railways which receive their supplies by rail-*cum*-sea route. This has resulted in considerable disparity in the cost per ton of coal supplies to each railway.

Railways who receive all their coal supplies by rail seem to get a fair proportion of coals from the coal fields nearer to them. For these railways the cost of coal (including freight) have ranged from Rs. 22 to Rs. 32 per ton. Variations in these costs are partly due to the variations in production costs. The freight on coal must have therefore been fairly even for rail route supplies affording a low range of variation in the costs per ton including freight.

As regards the railways which receive coal supplies partly by rail and partly by sea or mostly by sea, the cost per ton have ranged from Rs. 48 to Rs. 61. If distribution were rational these railways should be receiving coal from the nearer collieries and the areas now receiving coals from such collieries should be receiving coal from collieries further behind, so that Bengal and Bihar coals are not despatched all the way to Saurashtra and Southern Railways by rail-*cum*-sea route. This would mean adjustment in production of the different coal fields. Rational distribution would involve a kind of rational production. That is to say, the raisings from coal fields should be such as would make certain specified areas surrounding them reasonably self-sufficient in the matter of coal requirements for all purposes.

Ideal conditions for rational production cannot be easily attained as the different coal fields do not produce coals in various grades which will make the areas surrounding them self-sufficient in coal requirements, nor do certain coal fields have sufficient reserves to enable them to increase their production without exhausting the reserves within a short space of time. A practical approach will be to increase the production of the outlying fields so as to push more coal by rail to Southern Railway and curtail as much as possible the transport of coal by sea.

Another point to consider is the gradual replacement of coking coals by non-coking coals for railways. Coal raised by other than the Bengal and Bihar coalfields are generally of the non-coking varieties, and the gradual change over from coking to non-coking coals will also necessitate the development of the outlying fields.

In a long term plan, rational distribution would call for correct assessment of the coal requirements of railways and public concerns both in the coking and the non-coking varieties, area-wise (possibly province-wise) and would call for reorientation of production policy in order to establish balance between production and demands for specified areas.

So far as the Ministry of Railways is concerned, the Indian Railway Fuel Committee has set up a Sub-Committee to examine the issues bearing on rational distribution and utilisation of railway coal. *This Sub-Committee has laid down certain principles on which grade allocations in respect of individual railway requirements can

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Item No. 20 and Appendix XXVI of 4th Report of the Indian Railway Fuel Committee.

be based and loco orders can be allotted to collieries to reduce as far as practicable the leads between collieries and consuming points. The Coal Commissioner has been requested to follow the general lines of the Sub-Committee's recommendations in making allocations and distribution of supplies to railways in order to ascertain how far the principles laid down can be worked to or in what respects should they be modified.

Rational distribution and utilisation policy has a close bearing on the price scale set up for the different grades of coals. The Sub-Committee has suggested that Calorific Value, ash and moisture should be taken into account in the price structure. This suggestion is also linked up with the Specification for loco coal. As far as can be seen, the coal industry does not view with favour this approach to the rationalisation of distribution and utilisation of coals in the country.

NOTE No. 5

GROUND STOCKS ON RAILWAYS

Non-availability of wagons, lack of transhipment facilities at junction points at certain periods of the year and restrictions imposed on train movements as a result of breaches or other line defects, cause fluctuations in coal movements and justify the holding of adequate ground reserves at consuming points on railways.

Coal mines maintain maximum rates of production during the dry season but the wagon supply for loading coal during this season is not enough to move the coal raised and prepared for Market. During the wet season a good portion of the labour returns to agricul tural pursuits and the production comes down considerably. The wagon availability for coal transport on the other hand is high. The coal mines, therefore, maintain large reserves at pit-heads which they build up during the dry season and clear up during the wet season. This to some degree introduces an element of uncertainty in the supply position and calls for suitable reserves to be maintained by individual railways.

In the pre-war days railways worked out annual requirements of coal on the basis of daily or monthly consumption and the allowances necessary for recoupment of ground stocks. They obtained coal supplies from the collieries of their choice and had little difficulty in maintaining ground stocks at levels of 25 to 40 days over all consumption for all railways put together. During the war production and distribution of coal got badly upset with the result that ground reserves on railways frequently fell to danger points (10 days' stocks or lower) and it often became necessary to set minimum targets below which the stocks would not fall on any railway.

Considering the capital locked up in ground reserves and the strain produced on production and transport of coal during the war, the Viceroy's War Board fixed ground reserves for individual railways on the basis of an overall figure of 16.7 days consumption for all railways put together. This basis has continued to function upto date. The targets that the railways have worked to from the pre-war period to date are given in the table below :—

Ground stocks for Individual Railways based on the Over-all figures of 40, 30, 20, 16.7 and 24 days consumption for all Railways put together.+(Over-all figures of 16.7 days was fixed by Viceroy's War Board in June, 1944 and that of 24 days is based on the recommendations which the Indian Railway Fuel Committee made at its Fourth meeting.)

Railways	Prewar Stocks approved by Board		No. of days stocks which Rlys. should hold based on a minimum over-all figure of				
	Based on max. of 40 days	Based on Min. of 25 days	45 days	30 days	20 days	16.7 days	24 days
N.W.*	50	30	60	40	27	23	27 (E.P.)
E.I.	25	10	30	20	13	11	15
G.I.P.	40	30	50	33	22	18	26
BB & CI.							
B.G.	40	30	55	37	25	21	30
M.G.	60	30	55	37	25	21	30
M & SM.	70	70	70	47	31	26	30
S.I.	60	30	80	52	35	29	60
O.T.	40	30	55	37	25	21	40
B.N.	25	10	20	13	9	8	13
Jodhpur	..	..	60	40	27	22.5	40
Bk. S.	..	..	60	40	27	23	40
N.S.	..	..	30	20	13	11	20

*After partition (E.P.)

APPENDIX 9—(*contd.*)

During the war, fuel economy assumed little importance. The ground reserves based on the overall figure of 16.7 days consumption generally proved satisfactory as the sheds that ran low in stocks were helped by diversions of coal from different directions and no particular discrimination was exercised in the use of coals in different services.

During the post-war period fuel economy has assumed considerable importance. The Indian Railway Fuel Committee has gone into the question of ground reserves the individual railways should maintain in order that sufficient discrimination could be exercised by sheds in issuing coals to different services. The Committee first recommended that the ground reserves be fixed for each railway on the basis of the following formulae.

Ground reserves (in number of days consumption)=twice the transit days+10 days

The railways nearest to the collieries have found ground reserves, based on this formula, too high and those far away from the collieries have found them too low. The Indian Railway Fuel Committee has reviewed the position and recommended at its 4th Meeting that the formula should cover a band giving the upper and lower boundaries/limits so that the railways nearest to the collieries may work to the lower boundary/limit and the railways farthest from the collieries may work to the upper boundary/limit. The railways midway between the two extremes may fix their ground reserves somewhere on the band. The formulae recommended by the Indian Railway Fuel Committee at its 4th Meeting to define the boundaries/limits of the band are —

Number of days stock = transit days+10 days (lower boundary/limit).

Number of days stock = 2½ times the transit days +10 days (upper boundary/limit).

Individual railways have suggested targets for the ground reserves they would like to maintain within the band. These targets are shown in the above table under the Column for over-all figure of 24 days consumption for all railways put together.

The question of ground reserves is to some extent linked up with rational distribution of coal. If the leads from the collieries are generally reduced the transit days will also be reduced simultaneously reducing the ground reserves to be maintained by each railway.

NOTE No. 6

FUEL ECONOMY

In railway operation fuel economy is dependent upon several factors. Some of them are inherent in the design of the locomotive and in the characteristics of the fuel used. Some bear on the o perating skill of the engine crew and the co-operation obtaining between the loco and traffic staff in running the train services. Some arise from the operating conditions and some relate to the mechanical condition of the locomotive itself.

The Railway Fuel Economy Committee which came into being in the year 1922 and the Indian Railway fuel Committee which took over the functions of the Railway Fuel Economy Committee in the year 1948 have both endeavoured to reduce the fuel bill by improving performance efficiency and by eliminating wastages in the handling of fuel on individual railways.

Loco Design Features

Engine and Boiler proportions.—Dynamometer Car trials have been carried out over the last 20 years to study the various design features with a view to improving performance efficiency. Compared to the earlier types of locomotives, the valve gear and engine proportions have now been completely revised. The boiler has been designed to efficiently burn medium grade (grade I) non-coking coals. The over-all efficiency of the locomotive (energy at the draw-bar to energy in fuel) has thus been raised from 3.0/3.5% to 4.0/4.5%. The modern Indian Locomotives thus give a saving in fuel of 20 to 25% over the earlier designs.

Grate design.—Trials have been carried out with different types of grates. For hand firing conditions, the most suitable grate has been found to be the finger rocking grate with $1\frac{1}{8}''$—$1\frac{1}{4}''$ air spacing and this design of grate is now being standardized. Trials have still to be carried out to establish a suitable design of grate for mechanical firing conditions. The indications, however, are that the most suitable grate for mechanical firing would be the honey comb pattern, table grate.

Application of feed water heater.—Railways have experimented with a few makes of feed water heaters for recovering heat from the exhaust steam otherwise wasted to atmosphere. Dynamometer Car trials have been carried out on some feed water heaters. Saving in fuel of the order of 4 to 0% (dependent upon the operating conditions) can be obtained but the railways are prejudiced against this equipment on account of maintenance troubles. The present view is that locomotives burning more than Rs. 25,000 worth of coal per annum should be fitted with the feed water heater. Maintenance has however to be specially organised to encourage engine crew to operate them. The Indian Railway Fuel Committee and the loco Standards Committee have both recommended regular trials on two railways (the G.I.P. and the B.N. Railways) with sufficient number of feed water heater fitted locomotives based on a single shed to justify provision of a special gang for maintenance of the equipments. These trials are being organised and are expected to finally indicate as to what scope the feed water heater has in effecting savings in fuel on Indian locomotives.

Secondary Air

Use of Secondary air.—Preliminary investigations have been carried out with the use of secondary air in order to stimulate combustion in the locomotive furnace and reduce thereby the chimney losses. The preliminary trials have shown that the secondary air, to be effective, should be well regulated and should enter the firebox in such a manner as would go to set up turbulance in the combustion space. Regular trials are being planned with the object of investigating further into this problem and developing a suitable device for admitting secondary air into the locomotive firebox which will produce the best results.

Boiler Draught

Combustion conditions are very sensitive to the draughting arrangement provided with the boiler. A much too large an orifice reduces the draught effect and makes the combustion rather sluggish and a much too small an orifice intensifies the draught effect so much that it often tears the firebed and lifts up the coal and the combustion on the grate becomes anything but efficient. A range of draught orifices that were found suitable for the different types of locomotives on the basis of the Dynamometer Car trials carried over a priod of 15 years has been furnished to each railway and railways have been asked to carry out experiments with the sizes of the orifice recommended for each type of locomotive and those other sizes that will have been found satisfactory, with due regard to local conditions With the data that will be furnished by the railways it will be possible to finalise on the draughting arrangement that would provide for the best combustion conditions with each type of locomotive burning specific grades of coking and/or non-coking coals. This investigation is in progress.

Alternative Forms of Power

Electric traction.—The over-all performance efficiency of Electric traction is something of the order of 13/15% as against 4.0/4.5% of the modern Indian design of steam locomotive. The Indian Railway Fuel Committee has considered the possibility of the application of Electric traction on Indian Railways and has examined the whole issue with the help of a sub-Committee which has reported its findings to the main body at its 3rd meeting. The Sub-Committee has come to the conclusion that electrification will assist in economic utilization of lower grade coals and will also provide the best means of consuming slack coals and the middlings from the coal washery plants.

Capital outlay on Electric traction is, however, considerable and it is this factor which restricts the application of Electric traction to sections where traffic densities (as related to the costs of coal) are high enough to justify a scheme financially and without detriment to national economy. In the provincial thermo-*cum*-hydro-electric projects and in the inter-provincial grid schemes the railways may be called upon to share the capital expenditure on the generating plants and transmission systems. Such an arrangement may reduce the capital outlay on a railway electrification scheme and may justify Electric traction for sections carrying relatively lower traffic densities.

Gas Turbine Locomotive.—The overall efficiency of the gas turbine locomotive (energy at draw bar to energy fuel) would be of the order of 12/14 % as against 4·0 to 4·5% of the modern Indian design of steam locomotive. The gas turbine locomotive which can find large scale application on Indian Railways, is the coal burning type. The coal burning gas turbine locomotive is, however, still in an experimental stage. While Indian Railways may benefit from the experiments and service trials now being carried out with this type in other countries (particularly in the U.S.A.). The combustor of the gas turbine has to be one of the types suitable for Indian coals and develop such a combustor, considerable exprimentation will be necessary in this country.

Fuel and their Characteritics

Trials have been initiated to study combustion characteristics of the varieties of coals that each railway has been receiving from the collieries. An attempt has been made to group the varieties in each grade regionally and tentative groups have been formed for the coals raised in the Bengal and the Bihar coal fields. Similay groups are to be formed for coals raised in the "other fields". Coals in the "other fields" have not yet been graded by the Coal Commissioner and efforts are being made to collect data on chemical analysis of such coals the railways have been receiving from time to time. The entire task of grouping coal regionally is in the hands of a Sub-Committee set up for this specific purpose. The information regarding the analysis of coals from other fields after being collected by C. S. O. will be passed on to the Coal Commissioner to enable him to expedite grading of coals raised in the "other fields".

The idea of studying the combustion characteristics of the various Indian coals is to weed out coals that are found to be slow burning or to possess clinkering tendencies. Such coals, even of the very best grades, will not be suitable for loco power purposes and should be removed from loco supplies.

The assistance of the Fuel Research Institute, Dhanbad, has been sought by the I.R.F.C. from time to time in the laboratory investigations on coals which have been reported by railways as having clinkering tendencies. The Fuel Research Institute is now being asked to study friability characteristics of coals with a view to selecting coals for sea transport such as would withstand loading and unloading operations at docks without deterioration in size etc.

As railways will receive in not too distant a future their entire supplies of coals from non-coking varieties, the Indian Railway Fuel Committee has set up a Sub-Committee to examine possibilities to beneficiation of low grade non-coking coals. Investigations have already been started on the study of washability characteristics of non-coking coals in the Fuel Research Institute and if in the national interest, low grade non-coking coals have to be used in order to conserve higher grade non-coking coals for chemical and other industries, full scope for utilisation of low grade coals could be found in locomotive through beneficiation processes. The whole problem may give rise to proposals for setting up centralised washeries financed by colliery combines or by large consumer interests to such as Railawy etc.

**Draft Specification for Loco Coal.*

A detailed specification for Loco coal has been prepared by a Sub-Committee of the I.R.F.C. This specification has been passed on to the Coal Commissioner for comments and to the Indian Standards Institution for consideration with a view to having its main features incorporated in the general specification for steam coal. During the interim period the Indian Railway Fuel Committee has decided to prepare a simplified specification for loco coals which will take into account the following factors :—

(a) Moisture content.

(b) Ash content.

(c) Calorific Value.

(d) Volatile matter.

*Appendix XVIII of the 3rd Report of the Indian Railway Fuel Committee.

APPENDIX 9—(*contd.*)

(e) Ash fusion temperature.

(f) Size grades which should take into account not only the normal sizes of coals but also the minimum proportion of dust and slack.

(g) Percentage of Sulphur.

(h) Price point scale as embodied in the detailed specification.

NOTE.—The coal trade appears to be rather critical of certain of the features of the loco coal specification.

Fuel Control Organisation

Fuel Control Organisations have been established on railways :—

(a) to undertake training of the engine crew,

(b) to regularly report to the running sheds on the mechanical condition of the locomotives (leaky joints and glands, loose or worn components, defective valve gear setting, defective draughting conditions, troubles with injectors and ejectors, dirty boilers etc) and to see to the defects being put right.

(c) to evolve in consultation with the traffic staff suitable engine links as would provide for minimum shed hours and maximum returns in engine mileage per day or per month.

(d) to supervise the handling of coals in details such as unloading and stacking operations at sheds, coaling of locomotives, coal accountal as to issues and consumptions, and measures, for elimination of cases of thefts and pilferages etc.

Due to lack of experienced personnel, the progress with the building up of the Fuel Control Organisation on a few railways, has been somewhat slow. Most of the railways have, however, come up to a reasonable strength already.

Trip Rationing

Trip rations have been fixed for different services on the basis of practical tests. The performances of the engine crew are being judged on the basis of these trip rations. A method of calculating trip rations has been evolved from the principles which have been established as a result of analyses of the vast data collected during the Dynamometer Car trials. This theoretical method is to be used for a cross check on the trip rati ons determined by practical tests so that the railways are prevented from acquiring a tendency to fix the trip rations too liberally.

Efficient Utilisation of Cinders and Smokebox Char

Economical methods of collecting cinders from ashes and efficient utilisation of cinders and smokebox char in various railway purposes, are being studied by a *Sub-Committee appointed by the I.R.F.C. The Sub-Committee is expected to submit its report to the main body at the next meeting.

Fuel Statistics

Coal consumption targets, in terms of lbs/1000 GTM, have been laid down for "passenger and proportions of mixed" and "goods and proportions of mixed" services in respect of each railway. The progress that each railway is making towards the attainment of targets is being watched at the regular and informal meetings of the Indian Railway Fuel Committee. Causes that will have hampered or or are likely to hamper the progress towards he attainment of targets are analysed at these meetings and measures are suggested for eliminating them.

The statistical unit of fuel consumption in terms of lbs/1000 GTM, as applied to the two main groups of services—"passenger and proportions of mixed" and "goods and proportions of mixed"—has however been found to give a rather unfair comparison of performance between any two railways, because each of the two groups of services covers a very wide range of operating conditions as to loads, speeds, gradients, etc. The two groups of services will therefore need to be split up into smaller groups with a view to establishing greater uniformity in the operating conditions covered by each single group which may be little effected by local variations on any railway.

The whole statistical procedure is now under examination of a Sub-Committee appointed by the Indian Railway Fuel Committee and an interim report of this Sub-Committee is expected to be examined by the parent Committee at its meeting to be held some time in February, 1952.

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Dated Oct. 1951.

*Item No. 17 Appendix No. XXIII of the 4th Report of the Indian Railway Fuel Committee.

APPENDIX 10

(Chapter VII)

Fuel Statistics of Shunting Services

Report for the month of	Coal consumption-lb. per shunting engine mile.					
	Broad Gauge			Metre Gauge		
	Ex. B.B.&C.I.R. (Gr. II)	Ex. E.I.Rs. (Gr. II)	Ex. S.I.Rs. (Gr. II)	Ex.. (B.B.&C.I.R. Gr. II)	Ex. J.R. (GGr.	Ex. S.I.R (Gr.I)
January 1949	81·9	90·7	53·2	54·4	35·3	35·3
February	78·5	86·3	53·5	57·1	33·9	36·3
March	77·3	85·5	52·0	54·0	35·3	33·9
April	82·6	80·5	53·2	52·5	36·9	34·6
May	81·5	83·6	51·4	48·5	35·2	34·6
June	77·0	78·4	55·8	51·2	36·4	32·8
July	78·8	76·3	54·5	53·0	38·2	32·5
August	82·8	78·4	52·1	53·6	36·5	32·7
September	82·3	85·1	47·7	54·6	39·9	31·0
October	78·6	80·5	46·6	51·7	39·0	30·7
November	81·7	84·3	50·2	51·4	38·5	32·0
December	83·6	85·1	50·7	51·4	39·9	32·3
January 1950	82·7	86·4	46·6	56·5	42·3	31·7
February	82·4	82·0	45·1	54·4	42·7	31·9
March	84·1	80·8	48·0	56·1	39·4	31·7
April	81·6	79·5	49·1	54·1	41·0	31·2
May	75·2	74·1	50·4	52·4	42·0	31·1
June	80·4	81·3	50·8	51·6	40·4	31·2
July	75·0	87·1	53·6	53·4	45·7	31·1
August	77·5	87·6	53·7	53·0	46·4	31·2
September	77·6	80·0	52·6	33·5	46·2	31·5
October	79·8	79·8	51·6	51·5	41·9	30·6
November		83·6	50·3		41·9	30·1
December		88·9	50·6		41·7	30·6
January 1951		82·8	47·5		44·6	
February		81·4	46·4		40·8	
March			47·6			
April			46·8			
May			43·4			

APPENDIX

(Chapter VIII)

TABLE I

NUMBER OF COLLIERIES THAT HAVE SUPPLIED COAL TO RAILWAYS YEAR BY YEAR FROM 1935-36 TO 1950-51

Year	Number of Collieries		
	Ex. E.I. Railway	Ex. G.I.P. Railway	Ex. B.N. Railway
1935-36	..	..	11
1936-37	..	..	11
1937-38	..	..	16
1938-39	..	..	11
1939-40	23	..	12
1940-41	28	..	13
1941-42	52	..	15
1942-43	64	..	16
1943-44	50	70	49
1944-45	258	174	60
1945-46	298	157	84
1946-47	356	22	90
1947-48	386	74	79
1948-49	390	274	102
1949-50	502	335	122
1950-51	511	371	113

TABLE II

NUMBER OF COLLIERIES THAT HAVE SUPPLIED COAL TO CENTRAL (EX. G.I.P.) RLY. YEAR BY YEAR

Quantity supplied by a single colliery.	1943-44	1944-45	1945-46	1946-47	1947-48	1948-49	1949-50	1950-51
50 (upto)	2	22	24	..	..	34	79	62
51 to 100	..	13	7	..	..	12	24	39
101 to 500	1	34	29	..	..	84	86	104
501 to 1000	4	21	14	..	3	34	22	33
1001 to 2000	4	21	20	4	19	32	27	29
2001 to 5000	14	22	24	6	25	29	36	39
5000 and above	45	41	39	12	27	49	61	65
TOTAL	70	174	157	22	74	274	335	371

APPENDIX II—(*Contd.*)

TABLE III

MAXIMUM NUMBER OF COLLIERIES THAT HAVE SUPPLIED COAL TO SHEDS IN A MONTH DURING THE YEAR 1950-51.

(Summary of Answers to Questionnaire).

Range of average daily consumption for each shed group	Central Rly. (Ex-G.I.P.)		Ex-Nizam's State Rly.		Ex-Bengal Nagpur Rly.		Ex-Eastern Punjab Rly.	
	No. of sheds in the shed-gro up	Maximum number of collieries that have supplied coal to the shed-group	No. of sheds in the shed-group	Maximum number of collieries that have supplied coal to the shed-gr oup	No. of sheds in the shed-group	Maximum numbers of collieries that have supplied coal to the shed-group	No. of sheds in the shed-group	Maximum number of collieries that have supplied coal to the shed-group
Upto 25 tons.	10	34	11	4	3	3	6	27
From 26 to 50 tons.	10	28	2	2	2	4	2	38
From 51 to 100 tons.	9	23	1	2	12	22	3	53
From 101 to 150 tons.	7	42	1	1	3	15	3	66
From 151 to 200 tons.	3	46	..	..	5	26	3	68
From 201 to 250 tons.	2	39	1	2	4	27	1	26
From 251 and above.	4	75	..	..	3	27	..	..

APPENDIX 12

(Chapter IX)

Grouping Scheme for Rationalising Supply Sources in Bengal and Bihar Coalfields.

NOTE.—Bengal and Bihar coal bearing areas comprise Raniganj, Jharia, 'Bokarao and Karanpura' and Giridih coalfields.

Collieries of Raniganj, Jharia and 'Bokaro & Karanpura' fields have been brought under the grouping scheme to form such groups as are normally served by one particular pilot and have annual raisings normally exceeding 80,000 tons of one grade of coal.

Care has been exercised to divide each field into areas, bearing coal of the same physical characteristics as far as possible, so that collieries of each area are conveniently combined to form gradewise and pilot-wise groups. In exceptional cases, individual collieries on adjacent pilot which are found to lie in close proximity to the groups already formed, are for convenience included in such groups. Grade III raisings have been eliminated from the grouping scheme, since these are not required for loco supplies.

A. GROUPING OF COLLIERIES IN RANIGANJ COAL-FIELDS.

Base Depot—Ondal (E.I.R.)

Seam Area (Designation)	Group Desig-nation	Pilot	Pilot/ Colli-ery	Name of Colliery	Grade of coal	Annual raisings
Raniganj/I		Kasta 'A'	A/1	Poriapur	Sel. B	4,950
		Do.	A/2	Kasta	Do.	8,758
		Do.	A/3	Sultanpur	Do.	**
		Do.	A/4	Korabad Nardiha	Do.	12,778
	SB/1	Do.	A/5	Jorekuri	Do.	15,775
		Do.	A/6	Beldanga khas	Do.	2,836
		Do.	A/7	Borekuri	Do.	9,331
		Do.	A/11	Palasthali	Do.	10,490
				TOTAL FOR GROUP		64,918
	GI/I	Do.	A/4	Korbad Nardiha	G. I.	9,844
		Do.	A/8	East Parsundi	Do.	**
		Do.	A/9	Kankartola	Do.	7,123
		Do.	A/10	Kasta Bengal	Do.	3,491
		Do.	A/12	Russa	Do.	13,980
				TOTAL FOR GROUP		34,447
Raniganj/II	GII/I	Pandaveswar 'B'	B/13	Victory	G. II	11,842*
				TOTAL FOR GROUP		11,842
		Do.	B/14	Central Samla	..	**
		Do.	B/16	Samla Badyanathpur	G. I.	10,577
		Do.	B/17	Samla Mandarboni	Do.	87,824
	GI/2	Do.	B/18	Pure Samla	Do.	27,743
		Do.	B/19	South Adjoy	Do.	**
		Do.	B/20	Darula	Do.	**
		Do.	B/21	South Samla		**
				TOTAL FOR GROUP		126,144
		Do.	B/15	Samla Gobindpur	Sel. B	30,022
		Do.	B/16	Samla Badyanathpur	Do.	12,137
	SB/2	Do.	B/22	Ramnagar New Pit No. 3	Do.	85,750
		Do.	B/23	Ramnagar	Do.	26,888
		Do.	B/24	Kundra	Do.	79,678
		Do.	B/25	Ramnagar (same as B/22)	Do.	..
				TOTAL FOR GROUP		234,475

*Isolated group with very low output of specific grade.
**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
iganj/III	GII/2	Ukhra 'C'	C/26	Kumardihi	G. II	9,900
		Do.	C/35	Sree Diamond Sitalpur	Do.	12,111
				TOTAL FOR GROUP		22,011*
		Do.	C/26	Kumardihi	G. I.	8,420
		Do.	C/29a	Shamsundarpur	Do.	20,542
		Do.	C/31	Gurugopinath		**
		Do.	C/32	Sunkepur	Do.	30,954
	GI/3	Do.	C/36	Khandra Sitalpur	Do.	12,473
		Do.	C/50	Parascole	Do.	6,339
		Do.	C/57	Kajora (Roy & Datta)	Do.	33,360
		Do.	C/59	Lachipur	Do.	**
		Do.	C/59a	Sarpi Kajora	Do.	**
		Dn. Asansol I, II & III	M171	Madanpur	Do.	16,734
				TOTAL FOR GROUP		130,822
iganj/III	..	Ukhra	C/27	Bankola	Sel. B	83,289
		Do.	C/29	East Sitalpur	Do.	17,836
	SB/3	Do.	C/32	Sunkerpur	Do.	46,026
		Do.	C/33	Jotedhemo	Do.	17,275
				TOTAL FOR GROUP		164,426
		Ukhra 'C'	C/28	East Kajora	Sel. B	26,153
		Do.	C/30	Moira	Do.	47,823
		Do.	C/41	Siduli	Do.	11,864
		Do.	C/45	Modhujore	Do.	14,765
	SB/4	Do.	C/47	Jaipuria Kajora	Do.	71,146
		Do.	C/55	Kajora Khas	Do.	34,777
		Do.	C/56	Kajora (P. Dutta)	Do.	40,156
				TOTAL FOR GROUP		246,684
		Do.	C/34	Pure Sitalpur	Sel. B	9,923
		Do.	C/37	Khas Sitalpur	Do.	31,344
		Do.	C/38	Sitalpur	Do.	124,190
		Do.	C/39	Jambad Kajora	Do.	33,064
	SB/5	Do.	C/40	Central Jambad	Do.	23,481
		Do.	C/42	Selected Kajora Jambad	Do.	34,777
		Do.	C/44	Khas Jambad	Do.	24,813
		Do.	C/46	Lower Jambad (Same as C/40)		
				TOTAL FOR GROUP		281,592
		Do.	C/48	Parascole (Bengal Coal Co.)	..	**
		Do.	C/49	Real Kajora	Sel. B	17,969
		Do.	C/51	Upper Kajora	Do.	55,405
		Do.	C/52	Pure Kajora	Do.	53,250
	SB/6	Do.	C/53	Kajora (Pal Chowdury)	..	**
		Do.	C/54	Kajora	Do.	37,171
		Do.	C/58	Kajora Central	Do.	12,989
		Do.	E/87	Madhatpur	Do.	16,621
				TOTAL FOR GROUP		193,395
		Do.	E/71	Pure Kenda	G. II	5,429
	GII/3	Do.	E/85	Parasia	Do.	101
				TOTAL FOR GROUP		5,530*

*Isolated group with very low output of specific grade.

**Collieries either closed or their raisings of grade not known.

APPENDIX 12—(*Contd.*)

1	2	3	4	5	6	7
		Chara	E/67	Haripur		**
		Do.	E/68	Haripur North	..	**
		Do.	E/69	West Jotedhemo	G. I.	**
		Do.	E/71	Pure Kenda	Do.	10,124
		Do.	E/72	Chora Khas	..	**
		Do.	E/73	Khas Kenda	..	**
	GI/4	Do.	E/74	Lower Kenda	Do.	46,053
		Do.	E/77	Central Kenda	Do.	1,340
		Do.	E/79	New Kenda 4&5	Pits	32,566
		Do.	E/83	West Jambad	Do.	**
		Do.	E/84	Selected Jambad	Do.	60,429
		Do.	E/86	South Parasia	Do.	10,875
		Do.	E/88	Bibisol		**
		Do.	E/89	Kajora (Mandal)		**
		Jamuria	F/103	Singaran	Do.	4,683
				TOTAL FOR GROUP		166,070
Raniganj/III		Ukhra & Chara	CE/43	North Jambad	Sel. B	33,000
		Do.	E/70	North Chara	Do.	30,445
		Do.	E/75	Real Jambad	Do.	70,952
		Do.	E/76	Pure Jambad	Do.	34,714
	SB/7	Do.	E/78	South Kenda	Do.	18,147
		Do.	E/80	East Jambad	Do.	20,883
		Do.	E/81	Jambad		21,028
		Do.	E/82	South Jambad	Do.	10,175
				TOTAL FOR GROUP		239,344
		Jamuria	F/100	Balbaid	Sel. B	20,421
		Do.	F/101	Toposi	Do.	8,570
		Do.	F/104	Jotejanki Khas	Do.	11,289
	SB/8	Do.	F/105	Bansara	Do.	15,563
				TOTAL FOR GROUP		55,843
Raniganj/IV		Jamuria	F/90	Pretoria	Sel. A	82,184
		Do.	F/91	Viceroy	Do.	11,070
	SA/1	Do.	F/95	Central Poniati	Do.	1,674
				TOTAL FOR GROUP		94,928
		Do.	F/97	Ikra Nondi	G.I.	13,398
			F/98	Central Jamuria	Do.	9,149
			F/99	East Jamuria	..	**
			F/102	Mukherjee's Jotajanki	..	**
	GI/5	Toposi I & II	H/109	Saripur & Sripur	..	**
				No. 4 and 5 pits	Do.	30,954
		Do.	H/111, H/112	Jamuria A & B pits	Do.	164,739
		Do.	H/115	Mithapur	Do.	15,712
				TOTAL FOR GROUP		233,952
		Baraboni	G/106	Charanpur Top and Bottom.	Sel. A	127,443
	SA/2	Do.	G/107	Banksimolla	Do.	215,885
		Do.	G/108	Seebpur	Do.	126,990
				TOTAL FOR GROUP		470,318

*Isolated group with very low output of specific grade.

**Clolieries either closed or their raisings or grade not known.

3	4	5	6	7
Toposi I & II	H/109	Sripur & Sripur Nos. 4 & 5 pits.	Sel. A	315,959
Do.	H/110 H/111	West Jumuria	Do.	101,700
Do.	& 112	Jamuria A & B pits	Do.	85,107
Do.	H/113	Ackalpur		74,872
Do.	H/113 A	Ackalpur 5 & 6 pits		**
Do.	H/114	Mondalpur	Sel. A	148,863
		TOTAL FOR GROUP		726,501
Do.	H/110	West Jamuria	Sel. B	58,265
Do.	H/111 & 112	Jamuria A & B pits	Do.	85,107
Jamuria	F/92	Real Nandi	Do.	**
Do.	F/93	Nandi	Do.	**
Do.	F/94	Central Nandi	Do.	8,054
Do.	F/96	Paniati	Do.	16,778
		TOTAL FOR GROUP		168,204
Do. Asansol I, II and III	M/145	North Mosila	G.I.	9,392
Do.	M/146	Bhutdoba		**
Do.	M/147	Doralia & West Doralia		**
Do.	M/150	Ratibati	Do.	20,104
Do.	M/152	Central Jamabari	Do.	**
Do.	M/153	Central Sathgram		24,268
Do.	M/154	Joba	Do.	**
Do.	M/155	New Sathgram		10,028
Do.	M/156	Binali	Do.	24,169
Do.	M/161	North Brook	Do.	7,395
Do.	M/162	Pure Searsole	Do.	10,826
Do.	M/163	South Jameshari	Do.	419
Do.	M/166	Sitaldasji selected	Do.	30,606
		TOTAL FOR GROUP		137,207
Do.	M/145	North Mosila	Sel. B	9,770
Do.	M/148	Khas Chalbalpur	Do.	44,371
Do.	M/149	Chalbalpur	Do.	70,151
Do.	M/150	Ratibati	Do.	36,484
Do.	M/151	Chapni Khas	Do.	101,182
Do.	M/155	New Sathgram	Do.	19,968
Do.	M/156	Benali	Do.	12,610
Do.	M/157	Sathgram	Do.	80,147
Do.	M 158	Jaykayanagar	Do.	68,944
Do.	M/159	East Sathgram	Do.	51,776
Do.	M/160	Modern Sathgram	Do.	20,779
		TOTAL FOR GROUP		516,182
Do.	M/164	Jamehari selected	Sel. B	**
Do.	M/165	East Jamehari	Do.	48,994
Do.	M/167	Searsole	Do.	43,103
Do.	M/168	East searsole	Do.	2,685
Do.	M/169	Kajora Selected	Do.	30,665
Do.	M/170	Kahabir	Do.	38,704
		TOTAL FOR GROUP		164,151

low output of specific grade.

their raisings or grade not known.

APPENDIX 12—(*Contd.*)

1	2	3	4	5	6	7
Raniganj/V	..	Gourangdih	D/61	Diguli	G. I.	6,260
		Do.	D/62	Churulia	Do.	25,421
	GI/7	Do.	D/63	Churulia (New Incline No. 5)	Do.	**
		Do.	D/64	Deshermohan	Do.	8,706
				TOTAL FOR GROUP		40,387
		Do.	D/60	Gourangdih Begunia	G. II	10,472
	GII/4	Do.	D/65	Tara	Do.	**
		Do.	D/66	East Churulia	Do.	2,561
				TOTAL FOR GROUP		13,033*
Raniganj/V	..	Up Raniganj 'L'	ML/135	Damuda	Sel. B	57,199
		Do.	L/136	Selected Searsole	Do.	45,165
		Do.	ML/137	Nimcha	Do.	75,371
		Do.	ML/138	Kanrdih	Do.	38,913
	SB/12	Do.	L/139	Ghusick (Ghusick Muslia Colliery Ltd.).	..	**
		Do.	L/140	Ghusick (Coal Mineral Syndicate Ltd.)	Do.	21,878
		Do.	L/142	Damra New Pits	..	**
		Do.	L/143	Muslia	..	**
		Do.	L/144	New Ghusick	..	**
				TOTAL FOR GROUP		238,526
Raniganj/VIII	..	Sodepur 'O'	O/173	Sodepur	..	**
		Do.	O/174	Poidih	Sel. A	67,336
	SA/4	Do.	O/175	Belrni Dishergarh	Do.	2,943
		Do.	O/176	Buradhemo	Do.	18,603
		Do.	O/177	Dhemo Main	Do.	236,981
				TOTAL FOR GROUP		325,863
		Do.	O/175	Belrni Dishergarh	G.I.	16,917
		Do.	O/176	Buradhemo	Do.	20,649
	GI/8	Do.	O/176a	East Dhemo	Do.	13,463
		Do.	O/177a	Dhaka	Do.	9,139
				TOTAL FOR GROUP		60,168

BASE DEPOT—SITARAMPUR (E.I.R.)

Raniganj/IV		Toposi III 'I'	I/116	Poniati Baraboni	Sel. A	9,471
	SA/5	Do.	I/117	East Baraboni	Do.	99,275
		Do.	I/118	Bhanosa	Do.	175,418
				TOTAL FOR GROUP		284,164
	GI/9	Do.	I/119	Brights Rana	G.I.	26,984
		Do.	I/124	Banksimulla Nos. 7 & 8 pits.	..	**
		Do.	I/125	Banksimulla Nos. 11 & 12 pits.	G. I.	242,754
				TOTAL FOR GROUP		269,738

*Isolated group with very low output of specific grade.

**Collieries either closed or their raisings or grade not known.

APPENDIX 12—*contd*

1	2	3	4	5	6	7
		Toposi III 'I'	I/111	Selected Baraboni . .	Sel. B.	26,495
	SB/13	Do.	I/122	Adjoy Second . . .	Do.	48,529
		Do.	I/123	Girimut . . .	Do.	11,989
				TOTAL FOR GROUP . . .		87,013
		Damohani 'J'	J/126	New South Baraboni .		**
		Do.	J/127	South-East Baraboni Khas	Sel. A	133,083
	SA/6	Do.	J/133	Baramondia Nos. 3 & 4 pits	Do.	67,403
				TOTAL FOR GROUP . . .		200,486
Raniganj/IV		Domohani 'J'	J/128	East Joyramdanga . .		**
		Do.	J/129	South Nawapara . .		**
		Do.	J/130	Khas Chinchuria . .	G. I.	27,947
	GI/10	Do.	J/131	Moncharbahal . .		**
		Do.	J/133	Barmondia Nos. 3 & 4 pits		22,410
		Do.	J/134	Chakballar . . .	Do.	**
		Narsamuda 'N'	N/172	Barachuck Fatehpur .		3,861
				TOTAL FOR GROUP . . .		54,218
		Domohani 'J'	J/132	South Joyramdanaga .	G. II	9,494
	GII/5	Do.	J/134a	Nag's Ramjibanpur . .	Do.	10,256
				TOTAL FOR GROUP . . .		19,750*
		Borea-Kenda 'P'.	P/178	Kenda . . .	Sel. A	93,137
		Do.	P/179	Ramnagar . . .		**
	SA/7	Do.	P/180	Borea . . .		**
		Do.	P/181	Jamdiha . . .		**
		Do.	P/182	Victoria . . .	Do.	121,177
				TOTAL FOR GROUP . . .		214,314
Raniganj/VII		Salanpur Lachipur 'Q'	Q/197	Salanpur (A Seam) . .	Sel. B	23
	SB/14	Do.	Q/199	New Damagoria . .	Do.	20,198
				TOTAL FOR GROUP . . .		20,221*
	G/11	Do.	Q/145	Binodikatia . . .	G.I.	20,000
		Do.	Q/196	Bon/Jamehari . . .	Do.	6,339
				TOTAL FOR GROUP . . .		26,339
		Do.	Q/184	North West Salanpur .	.	**
		Do.	Q/185	Mohanpur . . .	G.II.	805
		Do.	Q/186	Khas Mohanpur . .	Do.	**
		Do.	Q/188	Dhanbaband . .	Do.	27,257
		Do.	Q/190	Dalmya . . .	Do.	3,100
		Do.	Q/191	Dabar . . .	Do.	12,367
		Do.	Q/193	Alkusa Gopalpur . .	Do.	39,772
	GII/6	Do.	Q/194	Alkusa . . .	Do.	23,121
		Do.	Q/196	Bon/Jamehari . . .	Do.	24,601
				TOTAL FOR GROUP . . .		131,023

*Isolated group with very low output of specific grade.

**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
		Salanpur Lachiur 'Q'	Q/198	Chaptoria	G. II	6,014
		Do.	Q/199	New Damagonia	Do.	49,139
		Do.	Q/200	East Ramnagar	Do.	7,116
		Do.	Q/201	Neamatpur	Do.	**
		Do.	Q/202	Bamondiha	Do.	**
	GII/6a	Do.	Q/203	Bamondiha-Lachipur	Do.	9,086
		Do.	Q/204	Hew Lachipur	Do.	**
		Do.	Q/205	Lachipur West	Do.	**
		Do.	Q/206	Lachipur	Do.	**
		Do.	Q/207	West Barmondiha	Do.	**
				TOTAL FOR GROUP		71,355
Raniganj/IX	..	Chanch and Begunia 'R'	R/208	Bagunia	Sel. A	87,947
		Do.	R/214	Chanch	Do.	105,548
	SA/8	Do.	R/215	New Laikdih	Do.	22,622
		Do.	R/216	Laikdih Deep	Do.	112,455
				TOTAL FOR GROUP		328,572
	SB/15	Do.	R/218	Junkundar	Sel. B	36,742
				TOTAL FOR GROUP		36,742
		Do.	R/209	East Kumardubi	G. II	41,311
		Do.	R/210	Merah	Do.	**
	GII/7	Do.	R/211	Sandmera	Do.	**
		Do.	R/213	Bhagya Lakshmi	Do.	5,024
		Do.	R/217	East Laikdih	Do.	2,796
				TOTAL FOR GROUP		49,131
	SA/9	Mugma I & II (including Victoria West) 'S'.	S/285	Victoria West	Sel. A	148,545
				TOTAL FOR GROUP		148,545
Raniganj/X	SA/10	Do.	S/229	Lower Badjna	Sel. A	24,176
				TOTAL FOR GROUP		24,176
		Do.	S/219	Badjna & Badjna Sindri includes Nos. 4, 5, 6 and 7.	Sel. B	87,440
		Do.	S/225	Khas Badjna	Do.	26,416
		Do.	S/232	New Badjna	Do.	4,690
	SB/16	Do.	S/233	North Badjna	Do.	28,755
		Do.	S/243	West Badjna	Do.	42,695
		Do.	S/244	West Laikdih	Do.	16,248
				TOTAL FOR GROUP		206,244
		Do.	S/221	Central Kaikdih	G. I.	12,121
		Do.	S/226	Khas Nirsa	Do.	23,689
		Do.	S/235	Pure Laikdih	Do.	21,052
	GI/12	Do.	S/236	Pure Shampur	Do.	9,796
		Do.	S/238	Selected Baljuri	Do.	11,891
		Do.	S/244	West Laikdih	Do.	12,235
			S/269	Kampasani	Do.	13,329
				TOTAL FOR GROUP		104,113

**Collieries either closed or their raisings or grade not known.

Base Depot—Barkar (E.I.R.)—contd. APPENDIX 12—*contd.*

1	2	3	4	5	6	7
		Mugma I & II (Including Victoria West)'S'.	S/221	Central Laikdih	G. II	6,895
		Do.	S/235	Pure Laikdih	Do.	2,495
		Do.	S/237	Pure Singpur	Do.	4,384
		Do.	S/239	Selected Laikdih	Do.	9,169
		Do.	S/240	Sree Gopinathpur		**
		Do.	S/241	Sreelakshoimata	Do.	6,746
		Do.	S/242	South Marma	Do.	4,338
		Do.	S/245	West Shampur		**
		Do.	S/246	Bhaljuri		**
		Do.	S/248	New Laikdih	Do.	928
		Do.	S/249	North Laikdih	Do.	16,155
		Do.	S/250	Selected Fatka	Do.	10,918
		Do.	S/253	Shampore (Kamla Coal Co.)	Do.	1,717
	GII/8	Do.	S/254	Sudarshanahampore	Do.	3,484
		Do.	S/255	Shampore (K.S. Coal Co.).	Do.	39,332
		Do.	S/256	West Barakar		**
		Do.	S/261	Raj	Do.	5,506
		Do.	S/265	Basantimatajandohi		**
Raniganj/X	GII/8	Mugma I & II (Including Victoria West).	S/271	Ranjit	G. II	4,361
		Do.	S/276	Edgncoor (P. Chotubhai)	..	**
		Do.	S/278	Khas Kalimata	..	7,166
		Do.	S/282	West Marine	..	**
		Do.	S/283	Pure Rajpura	..	**
		Do.	S/284	Victoria West	..	**
				TOTAL FOR GROUP		123,594

Base Depot—Radhanagar (B.N.R.)

Raniganj/VIII	SA/11	Patmohna 'a' Aldih-Bejdih	a/286	..	Sel. A	116,288
		Methani 'b'	b/287	Bejdih	Do.	253,825
		Methani 'b'	b/288	Methani	Do.	246,812
				TOTAL FOR GROUP		616,925
		Dishergarh 'c'	c/290	Deoli	Sel. A	71,490
	SA/12	Sodepur Sitalpur 'c'	c/173	Sodepur	Do.	184,908
				TOTAL FOR GROUP		256,398
		Dishergarh 'c'	c/289	Mandal's Sanotoria	Sel. B	43,473
	SB/17	Chinakuri 'd'	d/291	Chinakuri	Do.	.. **
		Sodepur Sitalpur 'e'	e/292	Sitalpur	Do.	124,190
				TOTAL FOR GROUP		167,663

Base Depot—Chaurasi (B.N.R.)

Raniganj/VIII	SA/13	Chaurasi I 'f'	f/293	Parbolia	Sel. A	290,377
				TOTAL FOR GROUP		290,377

**Collieries either closed or their raisings or grade not known.

B.—GROUPING OF COLLIERIES IN JHARIA COAL-FIELDS

APPENDIX 12—*contd.*

Base Depot—Patherdih (E.I.R.)

1	2	3	4	5	6	7
	SA/13a	Chaurasi II 'g'	g/296	Saltare	Sel. A	120,596
	SA/13a	Do.	g/297	Deoli	Do.	71,490
			g/298	Ranipur	Do.	155,413
				TOTAL FOR GROUP		347,499
		Chaurasi I 'f'	f/294	Dhamuria	Sel. B	5,495
	SB/18	Do.	f/295	Hirakhun	Do.	875
				TOTAL FOR GROUP		6,370*
Jharia/I		Jeenogorah-Goluckdih'A'	A/1	East Jharia	G. II	.. **
		Do.	A/2	Ghanoodih	Do.	23,771
		Do.	A/3	Kujama	Do.	22,144
		Do.	A/4	North Kujama	Do.	24,297
	GII/1	Do.	A/5	Central Kujama	Do.	8,710
		Do.	A/6	Kujama Pandebera	Do.	12,636
		Do.	A/7	Pure Kujama	Do.	15,230
		Do.	A/8	Kujama (K.S. Nanji)	Do.	24,324
		Do.	A/9	South Kujama	Do.	34,189
				TOTAL FOR GROUP		165,301
		Do.	A/10	Goluckdih	G. II	43,520
		Do.	A 11	South Goluckdih	Do.	13,919
		Do.	A/13	Central Jharia	Do.	6,721
		Do.	A/15	Lower & Upper Jharia	Do.	29,575
		Do.	A/16	Tisra (Diamond Colly)	Do.	34,326
		Do.	A/17	Tisra Dharji Devji	Do.	18,883
	GII/2	Do.	A/18	Tisra Amar Singh Guamal	Do.	17,800
		Do.	A/19	Tisra East Madhuban Coal Co.	Do.	4,734
		Do.	A/20	Bengal Jharia	Do.	20,316
		Do.	A/21	Bright Jharia	Do.	.. **
		Do.	A/22	South Tisra	Do.	11,646
		Do.	A/23	Junagorah	Do.	23,763
				TOTAL FOR GROUP		225,203
		Do.	A/5	Central Kujama	G. I.	8,960
		Do.	A/12	Madhuban	Do.	22,402
		Do.	A/20	Bengal Jahria	Do.	27,045
	GI/1	Jeenogorah 'B'	B/28	Khas Jeenagorah	Do.	30,431
		Do.	B/38	Khas Joyrampur	Do.	30,046
		Suratar 'E'	E/68	Panderbera	Do.	11,928
		Do.	E/78	Kalithan Suratar	Do.	.. **
				TOTAL FOR GROUP		130,812
		Jeenogorah 'B'	B/25	Central Jeenogorah	G. II	16,779
		Do.	B/26	North Bararee	Do.	19,976
		Do.	B/27	Pure Jeenagorah	Do.	14,277
		Do.	B/31	Jhinagora (East Bararee)	Do.	22,151
	GII/3	Do.	B/35	Lachmi	Do.	3,174
		Do.	B/36	Upper Jeenagorah	Do.	.. **
		Do.	B/37	Pure Joyrampur	Do.	50,910
		Do.	B/38	Khas Joyrampur	Do.	30,046
		West Line 'C'	C/54	Real Sudamdih	Do.	966
		Do.	C/43	New Sudamdih	Do.	7,203
				TOTAL FOR GROUP		165,482

*Isolated ground with very low output of specific grade.

**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
		Jeenagorah 'B'	B/38	Khas Joyrampur	Sel. B	30,046
		West Line 'C'	CD/40	Bararee (Jealgora)	Do.	91,451
		Do.	C/42	Bhulanbararee	Do.	77,873
	SB/1	Do.	C/51	New Tasra	Do.	459
		Do.	C/53	North Tasra	Do.	.. **
		Do.	C/55	Pure Tasra	Do.	5,053
				TOTAL FOR GROUP		204,882
Jharia/I	..	West Line 'C'	CD/40	Bararee (Jealgora)	Sel. A.	230,915
	SA/1	Do.	C/42	Bhulanbararee	Do.	114,242
		Lodna 'D'	D/59	Lodna (Lodna Colly. Co. Ltd.)	Do.	153,506
				TOTAL FOR GROUP		498,663
		Do.	D/59	Lodna (Lodna Cly. Co. Ltd.)	Sel. B	184,698
		Do.	D/60	Lodna (New Standard)	Do.	83,261
		Surtar 'E'	E/63	Fatehpur	Do.	639
	SB/2	Do.	E/74	Lodna (North Burrakur Coal Co.)	Do.	.. **
		Do.	E/75	Phularibad	..	.. **
		Do.	E/76	Suratar (North Barrakar Coal Co.)	Do.	.. **
		Do.	E/77	New Suratand	Do.	.. **
				TOTAL FOR GROUP		268,598
Jharia/II		Do.	E/64	Kuya	G. II	1,735
		Do.	E/65	Khas Kuya	Do.	4,655
		Do.	E/66	New Golukdih	Do.	2,556
		Do.	E/69	Pure Durgapur	Do.	14,874
		Do.	E/80	Model Jharia	Do.	16,836
	GII/4	Do.	E/89	Dobari (Kashabji Pitamber)	Do.	4,958
		Do.	E/90	Khas Bhuggaldih	Do.	9,990
		Do.	E/91	Rajapur	Do.	12,818
		Do.	E/92	Upper Jharia Dhansar North.	Do.	12,234
		Do.	E/94	Bhuggatdih Haripur	Do.	69,690
		Do.	E/95	Bright Kusunda	Do.	14,400
		Do.	EF/100	Bastocolla	Do.	67,466
		Bhuggatdih 'F'	F/101	Industry	Do.	48,103
		Do.	F/102	West Ena	Do.	.. **
		Gopali Chak 'G'	G/106	South Jharia	Do.	5,476
				TOTAL FOR GROUP		285,791
		EF	EF/100	Bastacolla	G. I.	27,117
	GI/2	Bhuggatdih	F/103	Bhuggatdih	Do.	14,792
				TOTAL FOR GROUP		41,809
		FG	FG/105	East Bhuggatdih	G. I.	30,773
	GI/2a	Gk	Gk/110	East Bhalgora	Do.	44,505
				TOTAL FOR GROUP		75,278
		Bhuggatdih	F/103	Bhuggatdih	Sel. B	41,688
	SB/3	Do.	FG/104	Ena	Do.	21,274
				TOTAL FOR GROUP		62,942

**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
		Gopalichuck 'G'	FG/105	East Bhuggatdih . .	Sel. B	14,784
		Do.	G/106	South Jharia . . .	Do.	26,848
		Do.	G/107	Selected Khas Jharia .	Do.	8,505
	SB/3a	Do.	G/108	Khas Jharia . .	Do.	13,525
		Do.	Gk/109	Bhalgora	Do.	57,294
		Do.	Gk/110	East Bhalgora . .	Do.	45,691
				TOTAL FOR GROUP . . .		166,647
ıaria/III	.	Kusunda 'H'	H/111	Central Angarpathra .	G. II	17,255
		Do.	H/115	Khas Sijua . . .	Do.	1,89
		Do.	H/117	Pure Bansjora . . .	Do.	5,9
		Do.	H/118	Pure Chemdore . .	Do.	15,7
		Do.	H/124	Chendore (Dwarka Prasad Agarwal).	Do.	4,54
		Do.	H/127	Nichitpur . . .	Do.	44,161
		Do.	H/127a	West Mudidih . .	Do.	15,121
	GII/5	Do.	H/129	North Sundra . . .	Do.	192
		Do.	H/130	North Tentulmori . .	Do.	25,213
		Do.	H/132	Pure Nichitpur . .	Do.	2,096
		Do.	H/133	Pure Selected Bansjora .	Do.	12,081
		Do.	H/135	Selected Jogta . .	Do.	9,135
		Do.	HJ/137	Sundra Bansjora . .	Do.	116,039
		Do.	H/139	West Bansjora . .	Do.	**
		Do.	H/140	West Chandore . .	Do.	18,832
		Do.	H/141	Gararia Colly Co. . .	Do.	17,218
		Do.	H/142	Gararia (Gopiram Ram-Chander).	Do.	5,987
		Do.	HJ/144	North Ekra . . .	Do.	6,904
				TOTAL FOR GROUP . . .		318,414
		Do.	H/122	Central Gararia . .	G. II	12,330
		Do.	H/145	East Busseriya . .	Do.	32,360
		Do.	H/146	Chota Bower . . .	Do.	20,534
		Do.	H/149	Surindra East Layabad .	Do.	9,242
		Do.	H/150	Busseriya . . .	Do.	19,609
	GII/6	Do.	H/151	Dhariajoha & Dhariajoha South.	Do.	20,221
		Do.	H/152	East Kendwadih . .	Do.	23,231
		Do.	H/152	Gandardih . . .	Do.	56,576
		Do.	H/155	Khas Kusunda . .	Do.	30,931
		Do.	H/159	East Ekra . . .	Do.	38,192
		Khoira 'I'	I/162	Ganshadih . . .	Do.	2,434
		Do.	I/163	Alkusa . . .	Do.	26,141
		Do.	I/173	Dhansar . . .	Do.	11,950
				TOTAL FOR GROUP . . .		303,751
		Kusunda 'H'	H/150	Busserija . . .	G. I	14,321
	GI/3	Khoira 'I'	I/164	Pure Kustore . . .	Do.	58,109
		Do.	I/166	Kusunda & Nayadih .	Do.	36,454
				TOTAL FOR GROUP .		108,884

**Collieries either closed or their raisings or grade not known.

Base Depot—Kusunda (E.I.R.)—contd. APPENDIX 12—*contd.*

1	2	3	4	5	6	7
		Kusunda 'H'	H/133	Pure Selected. Bansjora .	Sel. B	14,731
		Do.	HJ/144	North Ekra . . .	Do.	9,992
		Do.	H/150	Busseriya . . .	Do.	6,282
	SB/4	Do.	H/160	Bansdeopur . . .	Do.	21,106
		Khoira 'I'	I/161	Godhar . . .	Do.	42,532
		Do.	I/169	Kirkand (Kirkand Coal Co.)	Do.	17,228
				TOTAL FOR GROUP . . .		111,871
	SA/2	Kusunda 'H'	H/150	Busseriya . . .	Sel. A	20,096
				TOTAL FOR GROUP . . .		20,096
	GI/4	Khoira 'I'	II/165	Kustore	G. I.	121,846
		Do.	Im/172	Central Kirkand . .	Do.	27,282
				TOTAL FOR GROUP . . .		149,128
		Bansjora 'J'	J/176	Sundra	Sel. B	127,971
		Do.	Jn/177	Loyabad . . .	Do.	325,357
	SB/5	Do.	J/178	Ekra Khas . . .	Do.	88,110
				TOTAL FOR GROUP . . .		541,438
Jharia/III . .	...	Bansjora 'J'	J/176	Sundra	G. II	16,356
		Do.	J/178	Ekra Khas . .	Do.	65,602
		Sijua 'K'	K/184	Sri Mahabir Angarpatra .	Do.	9,538
		Do.	K/188	Kanthapahari . .	Do.	2,522
		Do.	K/190	Angarpathra . . .	Do.	52,961
		Do.	K/191	Angarpathra (National Coal Co.)	Do.	2,522
		Do.	K/192	Diamond Angarpathra .	Do.	9,947
	GII/7	Do.	K/195	Angarpathra (Traigunait) .	Do.	**
		Do.	K/199	Angarpathra (Union Coal Co.)	Do.	910
		Do.	K/201	Budroochuck . . .	Do.	**
		Do.	K/202	Mudidih . . .	Do.	73,019
		Do.	K/203	Jogta (Jogta Coal Co.) .	Do.	41,756
		Do.	K/204	Jogta (Khatun Mavji Sethia)	Do.	17,953
				TOTAL FOR GROUP . . .		293,086
		Bansjora 'J'	J/178	Ekra Khas . . .	G. I.	80,639
	GZ/5	Sijua 'K'	K/200	Gazlitand . . .	Do.	21,381
		Do.	K/201	Budroochuck . . .	Do.	29,758
				TOTAL FOR GROUP . . .		131,778
		Do.	K/188	Kantapahari . . .	Sel. B	6,610
		Do.	K/189	Angarpathra Khas . .	Do.	16,443
	SB/6	Do.	K/191	Angarpathra (National Coal Co.)	Do.	6,610
		Do.	K/198	Jharia Khas . . .	Do.	53,266
		Do.	K/202	Mudidih . . .	Do.	53,316
		Do.	K/203	Jogta (Jogta Coal Co.) .	Do.	50,417
				TOTAL FOR GROUP .		186,662
		Do.	K/199	Angarpathra (U.C.C.) .	Do.	109,342
	SB/7	Do.	K/200	Gazlitand . . .	Do.	133,700
		Do.	K/201	Budroochuck . . .	Do.	31,830
				TOTAL FOR GROUP . .		274,872

**Collieries either closed or their raisings or grade not known.

APPENDIX 12—*contd.* *Base Depot—Katrasgarh (E.I.R.)*

1	2	3	4	5	6	7
			BASE DEPOT—KATRASGARH (E.I.R.)			
Jharia/IV	...	Katri 'L'	L/205	Kendwadih	G. II	35,707
		Do.	L/206	Khas Kendwadih	Do.	13,990
		Do.	Lu/210	West Phularitand	Do.	10,061
		Do.	Lmr/211	Ashakuti Phularitand	Do.	92,616
	GII/8	Jamuni 'M'	M/301	Mahespur	Do.	21,611
		Do.	Mu/317	East Dharmabad	Do.	19,189
		Do.	M/318	East Mandra	Do.	8,172
		Do.	Mu/331	Pure Benidih	Do.	15,532
				TOTAL FOR GROUP		216,878
		Katri 'L'	L/212	Barora	G. II	12,753
		Do.	L/217	East Bundih	Do.	20,368
		Do.	L/221	Central Kendwadih	Do.	20,606
	GII/9	Do.	Mu/314	Central Ganeshpur	Do.	30,400
		Do.	Mu/321	Khedo Valley	Do.	28,572
		Do.	Mu/326	Pure Ganeshpur	Do.	18,800
				TOTAL FOR GROUP		131,489
Jharia/IV	...	Katri 'L'	Lu/443	New Phularitand	G. II	17,139
		Do.	L/250	Sonardih	Do.	26,696
		Do.	LM/256	Diamond Tethurya	Do.	10,311
		Do.	LM/257	Khas Mehtadih	Do.	35,130
		Do.	L/258	New Gobindpur	Do.	14,448
	GII/10	Do.	LM/262	Selected Jamumatand	Do.	48,878
		Do.	L/264	Agardih	Do.	7,278
		Do.	L/265	Koiludih	Do.	23,643
		Do.	LM/266	Khas Koiludih	Do.	26,946
		Do.	L/270	West Katras	Do.	12,683
		Jamuni 'M'	M/299	North Tandoo Khas	Do.	1,158
				TOTAL FOR GROUP		224,310
		Katri 'L'	LM/253	South Gobindpur	G. II	7,821
		Do.	LM/260	New Talhurja	Do.	52,293
		Do.	LM/263	Tentulia Khas	Do.	
	GII/11	Do.	LMp/267	Katras Ghoitudih	Do.	37,0
		Jamuni 'M'	M/298a	Balbira	Do.	21,8
		Do.	M/300	Sinidih	Do.	22,1
				TOTAL FOR GROUP		141,108
		Katri 'L'	Lp/269	East Katras	Do.	112,802
		Do.	L/271	Khas Gobindpur	Do.	18,118
		Do.	L/273	North Akash Kanari	Do.	15,773
		Do.	L/280	East Salanpur	Do.	26,889
		Do.	L/282	North Salanpur	Do.	16,235
	GII/12	Do.	L/283	Selected Salanpur	Do.	8,229
		Do.	L/290	Salanpur	Do.	10,566
		Do.	L/293	West Ramkanali	Do.	23,892
		Do.	L/295	New Lakurka	Do.	10,359
		Do.	L/296	Ram Kanali	Do.	8,672
				TOTAL FOR GROUP		251,535

**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
		Do.	LM/252	Jealgora Gobindpur .	G. I.	2,617
		Do.	LM/253	South Gobindpur . .	Do.	597
	G. I/6	Do.	LM/255	Central Kooridih . .	Do.	15,257
		Do.	LM/256	Diamond Tethurya . .	Do.	17,651
		Do.	L/258	New Gobindpur . .	Do.	7,721
				TOTAL FOR GROUP . . .		43,843
		Do.	Lu/251	West Jugidih . . .	Sel. B	2,053
		Do.	L/260	New Tethurja . .	Do.	40,956
		Do.	LM/263	Tenthulia Khaia . .	Do.	**
		Do.	LMp/267	Katras Ghiruds . .	Do.	153,068
	SB/8	Do.	IM/298	Central Tentulih . .	Do.	6,224
				TOTAL FOR GROUP . . .		202,301
	SB/8a	Do.	Lp/297	Lakurka	Do.	105,664
				TOTAL FOR GROUP . . .		105,664
		Jamuni 'M'	M/303	New Bansjora . . .	G. I.	**
		Do.	M/306	Isabela	Do.	**
	GI/7	Do.	M/330	Sudreadih . . .	Do.	11,968
		Katri 'L'	LMr/211	Ashakuti Phularitand .	Do.	10,113
				TOTAL FOR GROUP . .		22,081*
Jharia/I		Kalithan 'a'	a/361	Kohinoor . . .	Sel. A	1,451
	SA/3	Do.	a/362	Sitanalla . . .	Do.	43,470
		Do.	a/363	Kalithan Gurgaon . .	Do.	**
				TOTAL FOR GROUP . . .		44,921
	SB/9	Do.	a/365	Amlabad . . .	Sel. B	120,252
				TOTAL FOR GROUP . . .		120,252
		Sudamdih 'b'	b/366	Pure Chensulla Collys.	G. II	366
	GII/14	Do.	bc/370	Mohabani . . .	Do.	8,001
		Bhowrah	c/372	Bhowrah . . .	Do.	1,186
		Jorapakur	d/374	Central Bhowrah . .	Do.	1,142
				TOTAL FOR GROUP . . .		10,695*
		Sudamdih 'b'	b/368	East Swardih . . .	Sel. B	290
		Do.	b/369	Selected Patherdih . .	Do.	1,897
	SB/10	Do.	bc/370	Mehalbami . . .	Do.	3,962
		Bhowrah	c/372	Bhowrah . . .	Do.	137,677
		Jorapukur	d/374	Central Bhowrah . .	Do.	29,858
				TOTAL FOR GROUP . . .		173,684
		Sudamdih 'b'	cb/44	Patherdih Sudamdih .	Sel. A	17,402
	SA/4	Bhowrah 'c'	C/372	Bhowrah . . .	Dc.	34,928
		Jorapukur 'd'	dj/373	Jamadoba . . .	Do.	170,236
				TOTAL FOR GROUP . . .		222,566
	GI/8	Digwadih'e'	e/375	Digwadih . . .	G. I.	5
				TOTAL FOR GROUP . . .		5

*Group with very low output of specific grade.

**Collieries either closed or their raisings or grade not known.

APPENDIX 12—*contd.* *Base Depot—Bhaga (B.N.R.)*

1	2	3	4	5	6	7
	SA/5	Jeetpur 'f'	f/377	Bhagaband . . .	Sel. A	152,311
				TOTAL FOR GROUP . . .		152,311
	SB/11	Digwadih 'e'	e/375	Digwadih . . .	Sel. B	170,701
		Jeetpur 'f'	f/376	Nunoodih Jeetpur . .	Do.	123,939
				TOTAL FOR GROUP . . .		294,640
	SB/12	Jamadoba II	g/378 'g'	Bhulgoria . . .	Sel. B	253,692
		Do. I 'h'	h/379	Kendwadih . . .	Do.	260,155
				TOTAL FOR GROUP . . .		513,847
Jharia/I . .	SA/6	Stanard 'i'	Ei/79	Standard . . .	Sel. 'A"	83,344
				TOTAL FOR GROUP .		83,344
Jharia/II . .	SB/13	Huralidih 'j'	j/380	Hurriladih . .	Sel. B	101,679
		Burragarh 'k'	k/381	Simlabahal . .	Do.	27,636
		Do.	k/382	Pure Burragarh . .	Do.	21,942
		Do.	k/382a	East Bhalgora . . .	Do.	163,870
				TOTAL FOR GROUP . . .		315,127
		Bhutgoria I & II 'm'	Im/167	S.B. Kendwadih . .	Do.	215,717
	SB/10	Do.	Im/168	New Marine . .	Do.	59,506
		Do.	m/383	Ballihari (Ballihari Coal Co.)	Do.	109,228
		Do.	m/384	Balliary (Chunilal Coal Co.)	Do.	18,933
		Gopalichuck 'n'	n/386	West Gopalichuck . .	Do.	70,727
				TOTAL FOR GROUP . . .		474,111
	SA/7	Bhutgoria 'm"	Im/167	S.B. Kendwadih . .	Sel. A	53,380
		Do.	Im/170	Khas Mirkand . .	Do.	13,442
				TOTAL FOR GROUP . . .		66,822
	SA/8	Do.	m/385	Pootkee	Do.	180,900
				TOTAL FOR GROUP . . .		180,900
		Do.	Im/170	Khas Kirkend . .	G. II	4,562
	GII/15	Do.	Im/172	Central Kirkand . .	Do.	41,694
		Gopalichuck 'n'	n/386	West Gopalichuck . .	Do.	27,825
				TOTAL FOR GROUP . . .		74,081
Jharia/III . .	GI/9	Sijua 'o"	o/388	Central Kankanee . .	G. I.	5,840*
				TOTAL FOR GROUP . . .		5,840
		Do.	o/387	Kankanee . . .	Sel. B	100,425
	SB/15	Do.	o/388	Central Kankanee . .	Do.	26,287
		Do.	o/389	Sijua	Do.	241,198
		Do.	o/390	Bheltand . . .	Do.	69,399
				TOTAL FOR GROUP . . .		437,309

*Isolated group of very low output of specific grade.

Base Depot—Mohuda (B.N.R.) APPENDIX 12—*contd.*

1	2	3	4	5	6	7
Jharia/IV	SB/16	Malkera III 'q'	o/391	Malkera Choitudih	Sel. B	195,399
				TOTAL FOR GROUP		195,399
		Malkera I 'r'	r/392	Khas Dharmaband	Sel. A	30,021
Jharia/V	SA/9	Do	r/393	Dharmaband	Do.	17,504
				TOTAL FOR GROUP		47,525
Jharia/V		Malker2 I ,r'	r/392	Khasharmaband	Sel. B	9,781
		Do.	r/394	New Suridih	Do.	8,272
	SB/17	Do.	r/395	Kharkhari	Do.	32,420
		Bokaro-Jharia	t/398	New Huntudih	Do.	**
		I & II 't'	t/399	Bhurangya	Do.	**
		Do.	t/402	East Lohapati	Do.	7,102
		Do.	t/404	South Jamdiha	Do.	45,481
		Do.	t/405	Pathergaria	Do.	31,789
		Katras-Khamudih I & II 'u'	u/414	East Mucheridih	Do.	14,345
				TOTAL FOR GROUP	Do.	149,190
	SA/10	Murulidih 's'	S/396	Murulidih	Sel. A	105,290
				TOTAL FOR GROUP		105,290
	SB/18	Do.	S/397	Bhatdih	Sel. B	67,211
				TOTAL FOR GROUP		67,211
	GI/10	Do.	s/396	Murulidih	G. I.	73,739
			s/397	Bhatdih	Do.	8,608
				TOTAL FOR GROUP		82,347
		Bokaro-Jharia I & II 't'	t/398	New Huntudih	Do.	17,849
		Do.	t/399	Bhurangya	Do.	7,103
	GI/11	Do.	t/409	Karmatand	Do.	**
		Katras Khanudih I & II 'u'	u/414	East Mucherdih	Do.	16,887
				TOTAL FOR GROUP		41,839
		Malkera I 'r'	r/395.	Kharkeri	G. II	35,698
		Bokaro-Jharia 't'	t/401a	Khas Bhurangya	Do.	2,780
		Do.	t/401b	Jamdiha	Do.	688
	GII/16	Do.	t/403	New Damodar	Do.	4,220
		Do.	t/408	Pure Murmlidih	Do.	**
		Do.	t/411	North Damodar	Do.	**
		Do.	t/412	Bokaro Jharia	Do.	**
				TOTAL FOR GROUP		43,386

**Collieries either closed or their raisings or grade not known.

APPENDIX 12—*contd.* C.—BOKARO & KARANPURA COALFIELDS (E.I.R.)

Base Depot—Gomoh

1	2	3	4	5	6	7
		Katras Khan-udih I & II 'u'	u/415	Khas Ganeshpur . .	G. II	21,575
		Do.	u/416	Ganeshpur . . .	Do.	32,338
		Do.	u/423	East Mandra . . .	Do.	8,172
	GII/17	Do.	u/429	Bandih East . . .	Do.	20,358
		Do.	u/434	Ganeshpur (Bharat Mining Co.)	Do.	14,154
				TOTAL FOR GROUP . .		96,597
Jharia/IV .		Katras-Khan-udih.	u/304	Benedih . . .	G. II	17,511
		Do.	u/305	Khas Benedih .	Do.	13,759
		Do.	u/306	Isabela . .	Do.	14,358
		Do.	u/307	West Bussariya . .	Do.	21,337
		Do.	u/308	Juyramdih . . .	Do.	12,498
		Do.	u/310	Pure Joyramdih . .	Do.	101,395
	GII/13	Do.	u/312	Nudkhurlee . . .	Do.	7,745
		Do.	u/313	Pure Damuda . . .	Do.	10 096
		Do.	u/319	Khas Jayramdih .	Do.	10,395
		Do.	u/323	Model Juyramdih . .	Do.	15,359
		Do.	u/327	Selected Sudreadih .	Do.	**
		Do.	u/328	Kessargarh . . .	Do.	64,013
				TOTAL FOR GROUP .		288,465
Bokaro/I . . .		Dhori 'A'	A/1	Selected Kargali . .	G. II	6,260
		Do.	A/2	Turiyo	Do.	26,649
		Do.	A/3	Selected Dhori . .	Do.	15,217
		Do.	A/4	Bitchri . . .	Do.	13,838
	GII/1	Do.	A/5	Khas Dhori . .	Do.	20,640
		Do.	A/6	New Selected Dhori .	Do.	12,002
		Do.	A/7	Kalyani Selected Kargali.	Do.	5,171
		Do.	A/8	East Bokaro . .	Do.	3,470
		Do.	A/9	Dhori . .	Do.	43,683
				TOTAL FOR GROUP .		146,930
	SB/1	Do.	A/9	Dhori . . .	Sel. B	76,548
				TOTAL FOR GROUP .		76,548
	GI/1	Kargali 'B'	B/10	Kargali (GIP) .	G. I.	534,462
				TOTAL FOR GROUP . .		534,462
	GI/2	Bokaro 'C'	C/11	Bokaro Joint (EI & BN)	G. I	1,029,202
				TOTAL FOR GROUP .		1,029,202
	GII/2	Jarangdih 'D'	D/12	Jarangdih Joint (MSM & BB & CI)	G. II	23,265
				TOTAL FOR GROUP . .		23,265
	GI/3	Do.	D/13	Jarangdih Joint (MSM & BB & CI).	G. I.	34,135
				TOTAL FOR GROUP		34,136

**Collieries either closed or their raisings or grade not known.

1	2	3	4	5	6	7
Bokaro/I		Kuju 'E'	E/14	Pipradih	G. I.	19,506
		Do.	E/16	West Bokaro	Do.	101,572
		Do.	E/18	Datma	Do.	11,682
	GI/4	Do.	E/20	Rauta	Do.	10,526
		Do.	E/23B	Banwar	Do.	4,315
				TOTAL FOR GROUP		147,601
		Do.	E/15	Laiyo	G. II	15,717
		Do.	E/19	Hesagomrah	Do.	9,568
	GII/3	Do.	E/21	Ara	Do.	5,898
		Do.	E/22	Modovn Dhori	Do.	6,863
		Do.	E/23a	Maurpa	Do.	2,481
				TOTAL FOR GROUP		40,527
	SB/2	Do.	E/17	Kuju	Sel. B	5,200
				TOTAL FOR GROUP		5,200
Karanpura/I	SB/3	Sirka 'F'	F/24	Sirka	Sel. B	189,396
		Do.	F/25	Sirka West	Do.	**
				TOTAL FOR GROUP		189,396
	†GI/5	Do.	F/26	Argada (B.N. R.)	G. I.	97,750
				TOTAL FOR GROUP		97,750
	†GI/6	Bhurkunda 'G'	G/27	Lapanga	G. I	18,220
			G/30	Saunda 'D'	Do.	6,948
				TOTAL FOR GROUP		25,168
Karanpura/I	GI/7	Bhurkunda 'G'	G/28	Bhurkunda (Rly.)	Sel. B	65,611
				TOTAL FOR GROUP		65,611
	SB/4	Do.	G/28	Bhurkunda (Rly.)	Sel B.	87,458
				TOTAL FOR GROUP		87,458
	SB/5	Do.	G/29	Religorah	Sel. B	116,514
				TOTAL FOR GROUP		116,514
		Khalari 'H'	H/31	Central Saunda	Sel. B	36,442
				TOTAL FOR GROUP		36,442
	SB/7	Do.	H/34	Churi	Sel. B	41,392
				TOTAL FOR GROUP		41,392
		Do.	H/32	Damodar Valley	G. II	9,739
	GII/4	Do.	H/33	Hindergir	Do.	6,423
		Do.	H/38	Dakra Bukbuka	Do.	10,270
		Do.	H/40	West Tumang	Do.	5,688
				TOTAL FOR GROUP		32,120
		Do.	H/35	Ray	G. I.	7,344
	GI/8	Do.	H/37	Karanpura Dewarkhand	Do.	29,079
		Do.	H/39	Karkata	Do.	20,155
				TOTAL FOR GROUP		56,578

†Now regarded as selected 'B'.

**Collieries either closed or their raisings or grade not known.

APPENDIX 12—*contd.*

GROUPING OF COLLIERIES IN BENGAL & BIHAR FIELDS

(SUMMARY)

Fields	Base Stations	Number of Collieries					Number of Groups					Raisings—Tons per annum (1950-51)				
		Sel. A	Sel. B	Gr. I	Gr. II	Total	Sel. A	Sel. B	Gr. I	Gr. II	Total	Sel. A	Gr. B	Sel. I	Gr. II	To
RANI GANJ	Ondol	12 (1)	76 (7)	61 (23)	8 (1)	157 (32)	3	11	7	4	25	1,292,000	2,329,000	869,000	52,000	4,542,
	Asansol	5 (1)	9 (4)	4 ..	.. ..	18 (5)	1	1	1	...	3	326,000	239,000	60,000	...	625
	Sitarampur	11 (4)	5 ..	12 (5)	21 (8)	49 (17)	3	2	3	3	11	699,000	107,000	350,000	222,000	1,378,(
	Barakar	6 ..	7 ..	7 ..	29 (11)	49 (11)	3	2	1	2	8	501,000	243,000	104,000	173,000	1,021,(
	Radhanagar	5 ..	3 (1)	.. ..	.. ..	8 (1)	2	1	...	...	3	873,000	168,000	...	...	1,041,(
	Chaurasi	4	2	..	..	6	2	1	...	...	3	638,000	6,000	...	...	644,(
	TOTAL	43 (6)	102 (12)	84 (28)	58 (20)	287 (66)	14	18	12	9	53	4,329,000	3,092,000	1,383,000	447,000	9,2
JHARIA	Patherdih	3 ..	21 (5)	11 (1)	46 (4)	81 (10)	1	4	3	4	12	499,000	703,000	248,000	842,000	2,292,
	Kusunda	1	18	8	44 (3)	71 (3)	1	4	2	3	10	20,000	1,115,000	390,000	915,000	2,440,0
	Katrasgarh	.. ..	6 (1)	9 (2)	41 (1)	56 (4)	...	2	2	5	9	...	308,000	66,000	966,000	1,340,(
	Bhojudih	7 (1)	10 ..	1 ..	4 ..	22 (1)	3	4	1	1	9	420,000	1,102,000	58,000	11,000	1,591,0(
	Bhaga	4	13	1	3	21	3	3	1	1	8	331,000	1,227,000	6,000	74,000	1,638,0(
	Mohuda	3	11 (2)	6 (1)	24 (4)	44 (7)	2	3	2	3	10	153,000	412,000	124,000	428,000	1,117,0(
	TOTAL	18 (1)	79 (8)	36 (4)	162 (12)	295 (25)	10	20	11	17	58	1,423,000	4,867,000	892,000	3,236,000	10,418,(
BOKARO & KARAN PURA	Gomoh	..	1	3	10	14	...	1	3	2	6	...	77,000	1,598,000	170,000	1,845,0(
	Barkakana	..	7	12	9	28	...	6	5	2	13	...	476,000	393,000	73,000	942,00
	TOTAL	..	8	15	19	42	...	7	8	4	19	...	553,000	1,991,000	243,000	2,787,0(

NOTE.—Figures in brackets show number of collieries either closed or whose raisings are not available.

APPENDIX 13-C

(CHAPTER IX)

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR SOUTHERN RAILWAY

(Wagons per day are based on 20 tons average coal load per wagon)

(1) BEZWADA DISTRICT (B.G.)

(a) *Requirements in Tons/day.*

Waltair	70
Cocanada	10
Rajahmundry	130
Bhimavaram	25
Bezwada	250
Tenali	25
Bitragunta	170
Tondiarpet	120
Total tons/day	800
or wagons/day	40

(b) *Supply in wagons/day.*

Talcher via Waltair	30
Singareni via Bezwada	10

(2) RAYAPURAM DISTRICT (B.G.).

(a) *Requirements in tons/day.*

Basin Bridge	241
Pattabiram	6
Arkonam	180
Renigunta	18
Nandalur	60
Gooty	105
Raichur	65
Walaja Road	3
Katpadi	10
Jalarpet	130
Bowringpet	10
Bangalore Cantt	72
Total tons/day	900
or wagons/day	45

(b) *Supply in wagons/day.*

Ondal base via Madras Port	20 (Sel. B)
Singareni via Bezwada	10
CIC via Raichur	15

(3) PODANUR DISTRICT (B.G.).

(a) *Requirements in tons/day.*

Salem	21
Erode	120
Podanur	30
Coimbatore	23
Mettupalaiyam	15
Coonoor	9
Olavakkot	3
Shoranur	70
Cochin Harbour	20
Ernakulam	2
Calicut	35
Cannanore	22
Mangalore	30
Total tons/day	400
or wagons/day	20

(b) *Supply in wagons/day.*

Ondal base via Madras Port	10 (Sel. B)
Ondal base via Cochin Port	10 (Sel. A)

(4) VILLUPURAM DISTRICT (M.G.).

(a) *Requirements in tons/day.*

Villupuram	160
Cuddalore	1
Egmore	20
Tambaram	20
Chinglepet	16
Mayavaram	31
Tirutturaipundi	7
Arantangi	5
Tanjore	30
Trichinipoly	85
Vriddhachalam	25
Total tons/day	400
or wagons/day	20

(b) *Supply in wagons/day.*

Ondal base via Cuddalore Port	20 (Sel. A)

APPENDIX 13-C—*contd.*

SOUTHERN RAILWAY (contd.)

(5) MADURA DISTRICT (M.G.).

(a) *Requirements in tons/daty.*

Dindigul	30
Madura	140
Pollachi	20
Manamudarai	10
Mandapam	5
Dhanushkodi	10
Tuticorin	20
Tinnevelly	40
Shencottah	40
Quilon	20
Trichinopoly	65
Total tons/day	400
or wagons/day	20

(b) *Supply in wagons/day.*

Ondal base via Tuticorin Port	20

(Sel. A)

(6) HUBLI DISTRICT (M.G.).

(a) *Requirements in tons/day.*

Hospet	25
Gadag	50
Telgi	25
Hotgi	30
Hubli	140
Alnawar	2
Lodna	3
Belgaum	45
Miraj	115
Koregan	30
Ghorpuri	50
Castle Rock	45
Collem	5
Vasco-da-Gama	35
Total tons/day	600
or wagons/day	30

(b) *Supply in wagons/day.*

CIC via Balharshah Raichur	23
Pench via Dhond-Ghorpuri	4
Pench via Dhond-Hotgi	3

(7) BANGALORE DISTRICT (M.G.).

(a) *Requirements in tons/day.*

Bangalore (MG)	110
Bangalore (NG)	11
Kolar	8
Arsikere	51
Shimoga	30
Harihar	25
Chikjajur	5
Birur	5
Mysore	55
Total tons/day	300
or wagons/day	15

(b) *Supply in wagons/day.*

Singareni via Dronachellam	15

(8) GUNTAKAL DISTRICT (M.G.).

(a) *Requirements in tons/day.*

Tadepalli	20
Macherla	10
Gudur	18
Donakonda	48
Giddalore	2
Nandyal	18
Dronachellam	2
Guntakal	85
Pakala	48
Dharmavaram	21
Hindupur	22
Bellary	6
Total tons/day	300
or wagons/day	15

(b) *Supply in wagons/day.*

Singareni via Tadepalli	15

APPENDIX 13-C (*contd.*)

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR CENTRAL RAILWAY

JHANSI DIVISION

(*a*) *Requirements in tons/day.*

New Delhi	71
Agra Cantt.	150
Muttra	85
Juhi	55
Mohuba	16
Banda	15
Jhansi	305
Gwalior	15
Bina	200
Guna	15
Bhopal	136
Ujjain	75
Barkhera	42
Itarsi	100
Total tons/day	1280
or wagons/day	64

(*b*) *Supply in wagons/day.*

Barakar base via Kanpur	18 (Sel.A)
Do.	2 (Gr. II)
Gomoh base via Kanpur	23 (Gr.I)
CIC via Katni	21

2. JUBBULPORE DIVISION

(*a*) *Requirements in tons/day.*

Cheoki	40
Jubbulpore	145
Katni Murwara	65
Katni	135
Satna	80
Manikpur	30
Damoh	105
Itarsi	60
Total tons/day	660
or wagons/day	33

(*b*) *Supply in wagons/day.*

Barakar base via Cheoki	9 (Sel.B)
Gomoh base via Cheoki	8 (Gr. I)
CIC via Katni	16

3. BHUSAVAL ZONE.

(*a*) *Requirements in tons/day.*

Bhusaval	550
Igatpuri	172
Nandgaon	180
Itarsi	237
Harda	35
Nasik	6
Manmad	35
Chalisgaon	14
Pachora	8
Khandwa	35
Jalgaon	8
Total tons/day	125
or wagons/day	

(*b*) *Supply in wagons/day.*

Radhanagar base via Cheoki	2 (Sel.A)
Pench field via Itarsi	3
Chanda field via Wardha	

4. BOMBAY DIVISION.

(*a*) *Requirements in tons/day.*

Byculla	
Kurla	
Kalyan	
Lonavla	
Dehru Road	
Poona	
Neral	
Karjot	
Total tons/day	
or wagons/day	

(*b*) *Supply in wagons/day.*

Radhanagar base via Cheoki	
Pench field via Itarsi	

APPENDIX 13-C (*contd.*)

CENTRAL RAILWAY (contd.)

NAGPUR ZONE.

(*a*) *Requirements in tons/day.*

Ajni	205
Amla	155
Junnerdeo	71
Balharshah	60
Wardha	91
Phulgaon	12
Badnera	148
Murtazapur	28
Khamgaon	5
Shegaon	5
Total tons/day	780
or wagons/day	39

(*b*) *Supply in wagons/day.*

Chaurasi base via Ajni	9 (Sel.A)
Pench field via Ajni	21
Chanda filed via Wardha	9

SHOLAPUR DIVISION.

(*a*) *Requirements in tons/day.*

Sholapur	158
Dhond	226
Shahabad	128
Puntamba	38
Raichur	10
Total tons/day	560
or wagons/day	28

(*b*) *Supply in wagons/day.*

Chaurasi base via Ajni	8 (Sel.A)
Pench field via Dhond	20

7. SECUNDERABAD DIVISION.

(*a*) *Requirements in tons/day.*

Lalagudda	220
Bidar	12
Purli	12
Wadi	15
Kazipet	130
Dornakal	120
Balharshah	50
Begampalli	1
Nizamabad	30
Purna	60
Jalna	15
Manmad	15
Kankuntta	12
Dronachellam	5
Shakarnagar	3
Total tons/day	700
or wagons/day	35

(*b*) *Supply in wagons/day.*

Singareni field via Dornakal	35

APPENDIX 13-C *(contd.)*

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR WESTERN RAILWAY

1. GANGAPUR DISTRICT (B.G.)

(a) Requirements in tons/day.

Ratlam	200
Shamgarh	130
Kotah	100
Gangapur	170
Bayana	20
Idgah	40
Total tons/day	660
or wagons/day	33

(b) Supply in wagons/day.

Kusunda base *via* AEB	12 (Sel.B)
Do.	17 (Gr.I)
Do.	4 (Gr.II)

2. AHMEDABAD ZONE (B.G.)

(a) Requirements in tons/day.

Baroda	280
Anand	43
Kankaria	200
Viramgam	70
Godhra	165
Ankleshwar	9
Broach	13
Total tons/day	780
or wagons/day	39

(b) Supply in wagons/day.

Kusunda base *via* AEB	18 (Sel.B)
Do.	4 (Gr.II)
Gomoh base *via* AEB	17 (Gr.I)

3. BULSAR ZONE (B.G.)

(a) Requirements in tons/day.

Parel	110
Bandra	130
Bulsar	210
Udhna	100
Nandurbar	50
Total tons/day	600
or wagons/day	30

(b) Supply in wagons/day.

Kusunda base *via* Bhusaval	1 (Sel.B
Do.	(Gr.II
Gomoh base *via* Bhusaval	1 (Gr. I

4. ABU DISTRICT (M.G.)

(a) Requirements in tons/day.

Sojat Road	
Abu	
Mehsana	
Kadi	
Vijapur	
Sabarmati	1
Ajmer	
Total tons/day	400
or wagons/day	20

(b) Supply in wagons/day.

Katrasgarh base *via* AEB	6 (Sel.B)
Do.	3 (Gr.II)
Gomoh base *via* AEB.	11 (Gr. I)

APPENDIX 13-C (*contd.*)

WESTERN RAILWAY—(*contd.*)

5. BANDIKUI DISTRICT (M.G.)

(*a*) *Requirements in tons/day.*

Phulera	106
Achnera	28
Idgah	25
Bandikui	83
Jaipur	27
Sawai Madhopur	7
Sikar	12
Lohara	7
Rewari	25
Total tons/day	320
or wagons/day	16

(*b*) *Supply in wagons/day.*

Katrasgarh base via AEB	6 (Sel.B)
Do.	3 (Gr.II)
Gomoh base *via* BEB	7 (Gr.I)

6. MHOW DISTRICT (M.G.)

(*a*) *Requirements in tons/day.*

Khandwa	12
Mhow	64
atlam	28
eemuch	38
Ajmer	60
Udaipur	8
Mavli	10
Chitorgarh	9
Khamblighat	11
Total tons/day	240
or wagons/day	12

(*b*) *Supply in wagons/day.*

Kusunda base *via* AEB	6 (Sel.B)
Do.	6 (Gr.I)

7. SAURASHTRA ZONE (M.G.)

(*a*) *Requirements in tons/day.*

Bhavnagar	110
Junnagarh	270
Jamnagar	140
Surendranagar	30
Bhuj	10
Total tons/day	560
or wagons/day	28

(*b*) *Supply in wagons/day.*

CIC field *via* Ujjain	28

8. PRATAPNAGAR DISTRICT (N.G.)

(*a*) *Requirements in tons/day.*

Goalando	5
Halol	7
Devgad Baria	5
Nadiad	10
Bilimora	8
Kosamba	7
Pratapnagar	3
Dabhoi	50
Petlad	5
Total tons/day	100
or wagons/day	5

(*b*) *Supply in wagons/day.*

CIC field *via* Ujjain	5

APPENDIX 13-C (*contd.*)

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR NORTHERN RAILWAY

1. SAHARANPUR ZONE.

(*a*) *Requirements in tons/day.*

Kalka	80
Ambala	180
Saharanpur	150
Ludhiana	153
Ferozepur	77
Jullundur	78
Amritsar	190
Pathankot	43
Mukerian	9
Total tons/day	960
or wagons/day	48

(*b*) *Supply in wagons/day.*

Patherdih base *via* Saharanpur	13 (Sel. A)
Do.	25 (Sel. B)
Do.	7 (Gr. I)
Do.	3 (Gr. II)

2. GHAZIABAD ZONE.

(*a*) *Requirements in tons/day.*

Ghaziabad	133
Delhi	190
Jind	53
Bhatinda	100
Meerut	10
Shakurbasti	23
Hissar	11
Total tons/day	520
or wagons/day	26

(*b*) *Supply in wagons/day.*

Patherdih base *via* Ghaziabad	10 (Sel. A)
Do.	8 (Sel. B)
Do.	5 (Gr. I)
Do.	3 (Gr. II)

3. BIKANER ZONE.

(*a*) *Requirements in tons/day.*

Delhi Sarai Rohilla	26
Rewari	70
Sirsa	30
Fazilka	10
Bhatinda	4
Bikaner	40
Sadulpur	60
Churu	60
Total tons/day	300
or wagons/day	15

(*b*) *Supply in wagons/day.*

Patherdih base *via* Delhi Sarai Rohilla	9 (Sel. B)
Do.	1 (Gr. II)
Gomoh base via Delhi Sarai Rohilla	5 (Gr. I)

4. JODHPUR ZONE.

(*a*) *Requirements in tons/day.*

Jodhpur	100
Marta Road	60
Total tons/day	160
or wagons/day	8

(*b*) *Supply in wagons/day.*

Kusunda base *via* AEB	5 (Sel. B)
Do.	3 (Gr. I)

APPENDIX 13-C(*contd.*)

NORTHERN RAILWAY—(*contd.*)

5. ALLAHABAD DIVISION.

(*a*) *Requirements in tons/day.*

Allahabad	280
Kanpur	330
Tundla	245
Mirzapur	5
Total tons/day	860
or wagons/day	43

(*b*) *Supply in wagons/day.*

Giridih base *via* Moghalsarai	12 (Sel.A)
Gomoh base *via* Moghalsarai	23 (Gr. I)
Katrasgarh base *via* Moghalsarai	8 (Gr. II)

6. LUCKNOW DIVISION.

(*a*) *Requirements in tons/day.*

Lucknow	375
Pratabgarh	110
Fyzabad	65
Jaunpur	6
Banaras	7
Rae Bareli	17
Total tons/day	580
or wagons/day	29

(*b*) *Supply in wagons/day.*

Barkakana base *via* Moghalsarai	12 (Sel. B)
Gomoh Do	11 (Gr. I)
Katrasgarh Do	6 (Gr. II)

7. MORADABAD DIVISION.

(*a*) *Requirements in tons/day.*

Moradabad	274
Rosa	115
Bareilly	40
Lhaksar	45
Hardwar	12
Najibabad	13
Dehradun	3
Balamau	8
Khurja	30
Total tons/day	540
or wagons/day	27

(*b*) *Supply in wagons/day.*

Barkakana base *via* Lucknow	12 (Sel. B)
Gomoh Do.	9 (Gr. I)
Katrasgarh Do.	6 (Gr. II)

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR EASTERN RAILWAY

1. SEALDAH DIVISION.

(*a*) *Requirements in tons/day.*

Dock Junction	35
Narkaldanga	190
Beliaghata	140
Chitpore	185
Naihati	85
Ranaghat	40
Santipur	5
Krishnapur	35
Bongaon	5
Total tons/day	720
or wagons/day	36

(*b*) *Supply in wagons/day.*

Ondal base via Burdwan	23 (Sel. B)
Do.	13 (Gr. I)

2. HOWRAH DIVISION.

(*a*) *Requirements in tons/day.*

Howrah loco	310
Bandel	100
Burdwan	160
Panagarh	10
Rampur Hant	70
Sahibganj	175
Jamalpur	90
Azimganj	65
Total tons/day	980
or wagons/day	49

(*b*) *Supply in wagons/day.*

Ondal base via Burdwan	20 (Sel. B)
Do.	9 (Gr. I)
Ondal towards Jamalpur	13 (Sel. B)
Do.	7 (Gr. I)

3. DINAPORE ZONE.

(*a*) *Requirements in tons/day.*

Madhupur	40
Jhajha	220
Mokameh	50
Dinapore	140
Moghalsarai	600
Sone East Bank	50
Burdwan	70
Gaya	375
Gujahandi	15
Total tons/day	1560
or wagons/day	78

3. DINAPORE ZONE (*contd.*)

(*b*) *Supply in wagons/day.*

Asansol base via Jhajha	10 (Sel. A)
Sitarampur Do.	5 (Sel. B)
Do.	5 (Gr. I)
Do.	4 (Gr. II)
Gomoh base via G. Chord	4 (Sel. B)
Do.	28 (Gr. I)
Do.	5 (Gr. II)
Barkakana base via G. Chord	17 (Sel. B)

4. ASANSOL ZONE.

(*a*) *Requirements in tons/day.*

Ondal	240
Asansol	440
Sitarampur	80
Dhanbad	280
Patherdih	80
Giridih	20
Barkakana	80
Gomoh	280
Total tons/day	1500
or wagons/day	75

(*b*) *Supply in wagons/day.*

Each base to take coal from its own area	1 (Sel. A)
	21 (Sel. B)
	31 (Gr. I)
	22 (Gr. II)

5. ADRA DIVISION.

(*a*) *Requirements in tons/day.*

Adra	280
Anara	180
Purulia	80
Bhojudih	180
Total tons/day	720
or wagons/day	36

(*b*) *Supply in wagons/day.*

Mohuda base via Adra	12 (Sel. B)
Do.	7 (Gr. I)
Do.	8 (Gr. II)

EASTERN RAILWAY—(*contd.*)

5. ADRA DIVISION (*contd.*)

Bhojudih base to Bhojudih	4 (Sel.B)
Patherdih base to Bhojudih	5 (Gr. II)

6. CHAKRADHARPORE DIVISION.

(*a*) *Requirements in tons/day.*

Chakradharpore	340
Tatanagar	250
Dongoaposi	100
Jharsugudah	230
Total tons/day	920
or wagons/day	46

(*b*) *Supply in wagons/day.*

Bhojudih base via Chakradharpore	23 (Sel.B)
Gomoh Do.	17 (Gr. I)
Mohuda Do.	6 (Gr.II)

7. KHARGPUR DIVISION.

(*a*) *Requirements in tons/day.*

Khargpur	500
Santragachi	150
Shalimar	54
Bhadrak	86
Khurda Road	230
Total tons/day	1020
or wagons/day	51

(*b*) *Supply in wagons/day.*

Bhaga base via Khargpur	25 (Sel. B)
Gomoh base via Khargpur	18 (Gr. I)
Mohuda base via Khargpur	8 (Gr. II)

8. WALTAIR DIVISION.

(*a*) *Requirements in tons/day.*

Palasa	80
Nanpada	6
Waltair	194
Rayaghada	70
Kantabanji	90
Raipur	100
Total tons/day	540
or wagons/day	27

(*b*) *Supply in wagons/day.*

Chaurasi base via Khargpur	13 (Sel. A)
CIC field via Raipur	14

9. BILASPUR DIVISION.

Requirements in tons/day.

Katni	42
Sahdol	110
Manendragarh	68
Bilaspur	240
Dongargarh	175
Nagpur	125
Total tons/day	760
or wagons/day	38
Local from CIC fields	38

10. NAINPUR DIVISION (NG).

(*a*) *Requirements in tons/day.*

Chindwara	7[illegible]
Nainpur	6[illegible]
Gondia	6[illegible]
Howbagh	2[illegible]
Motibagh	5[illegible]
Naghbir	4[illegible]
Total tons/day	34[illegible]
or wagons /day	1[illegible]

(*b*) *Supply in wagons/day.*

Local from Pench fields	1[illegible]

DISTRICT OR ZONAL REQUIREMENTS OF COAL FOR NORTH EASTERN RAILWAY

1. BAREILLY ZONE.

(*a*) *Requirements in tons/day.*

Moilani	40
Pilibhit	15
Bareilly	80
Izatnagar	25
Kashipur	20
Kathogodam	20
Total tons/day	200
or wagons/day	10

(*b*) *Supply in wagons/day.*

Barakar base via Bareilly	6 (Sel. A)
Do.	4 (Gr. I)

2. KANPUR ZONE.

(*a*) *Requirements in tons/day.*

Kasganj	50
Fatehgarh	20
Kanpur	30
Total tons/day	100
or wagons/day	5

(*b*) *Supply in wagons/day.*

Barakar base via Kanpur	3 (Sel.A)
Do.	2 (Gr. I)

3. LUCKNOW ZONE.

(*a*) *Requirements in tons/day.*

Charbagh	50
Gondia	150
Total tons/day	200
or wagons/day	10

(*b*) *Supply in wagons/day.*

Sitarampur base via Lucknow	7 (Sel. A)
Do.	1 (Gr. I)
Do.	2 (Gr. II)

4. BANARAS ZONE.

(*a*) *Requirements in tons/day.*

Banaras	82
Jhusi	6
Bhallia	2
Mau Jn.	25
Aunrihar	15
Bhatni Jn.	20
Gorakhpur	190
Total tons/day	340
or wagons/day	17

(*b*) *Supply in wagons/day.*

Sitarampur base via Banaras	10 (Sel. A)
Do.	7 (Gr. I)

5. MOKAMEH ZONE.

(*a*) *Requirements in tons/day.*

Mokameh Ghat	70
Baranni Jn.	85
Samastipur	90
Dharbhanga	30
Nirkatiaganj	40
Muzaffarpur	15
Sonepore	73
Dighaghat	25
Savan	20
Chupra	60
Saharsa	12
Total tons/day	520
or wagons/day	26

(*b*) *Supply in wagons/day.*

Sitarampur base via Mokameh Ghat	16 (Sel. A)
Do.	7 (Gr. I)
Do.	3 (Gr. II)

6. ASSAM ZONE.

(*a*) *Requirements in tons/day.*

Barari	20
Thansbihpur	10
Katihar	200
Siliguri	90
Alipur Duar	100
Domohani	20
Darjeeling	50
Mal	10
Total tons/day	500
or wagons/day	25

(*b*) *Supply in wagons/day.*

Ondal base via Manihari Ghat	3 (Sel. B)
Ondal base via Bhagalpur	11 (Sel. B)
Ondal base via Bhagalpur	8 (Gr. I)
Sitarampur base via Mokameh Ghat	3 (Sel. A)

APPENDIX 14

(CHAPTER IX)

SAVING IN TURN-ROUND (WAGON AVAILABILITY) DUE TO MOVEMENT OF WAGONS IN BLOCK LOADS TO SPECIFIED DESTINATIONS

1. 'DISPERSED LOAD' IN TRAIN FORMATION—LENGTH OF SECTION 100 MILES.—

(*a*) Average speed of goods train (12·5 m.p.h.)	8·0 hrs/100 miles.
(*b*) Detentions in principal yards (taken from statistics in tables I and II)	15·0 " "
(*c*) Total time for the journey	23·0 " "

2. 'BLOCK LOAD' IN TRAIN FORMATION—LENGTH OF SECTION 100 MILES.—

(*a*) Average speed of goods train (12·5 m.p.h.)	8·0 hrs/100 miles.
(*b*) Detentions in principal yards [25% less than in 1 (b) above]	11·25 " "
(*c*) Total time for the journey	19·25 " "

3. EXAMPLE OF WESTERN RAILWAY.—

Case I (Dispersed loads in train formation)

Average lead for loco coal from Bengal and Bihar collieries to destinations. 1050 miles.

∴ Transit time (forward journey) $\frac{1050 \times 23}{100}$ =242 hours or 10 days.

Return journey (70% of transit time in forward journey). 7 days.

Total 17 days.

Case II (Block loads in train formation)

Let it be assumed that block load movement is for the first 650 miles (*i.e.*, up to Agra East Bank).

For rest of the 400 miles the wagon movement is as at present

∴ Transit time for the first 650 miles (Block movement) $\frac{650 \times 19 \cdot 25}{100}$ =125 hrs.

Transit time for the remainder 400 miles (dispersed movement) $\frac{400 \times 23}{100}$ =92 hrs.

Hence total transit time (forward journey) 217 hrs. or 9 days.

Return journey (assumed same as in Case I) 7 days.

Total 16 days.

4. Hence it may be generally accepted that by despatching of coal loads in blocks, (as for the Western Railway coal from Bengal and Bihar fields) the " turnround" time can be reduced by about 5·9%. This reduction in " turnround" time may generally increase the availability of wagons by 5% all round.

APPENDIX 14—(*contd.*)

TABLE I

EAST INDIAN RAILWAY

AVERAGE DETENTIONS TO INWARD LOADED WAGONS AT PRINCIPAL YARDS FOR THE FINANCIAL YEAR 1950-51

Months	Naihati	Asansol	Jhajha	Gaya	Moghal-sarai	Allahabad	Kanpur	Tundla	Lucknow	Morada-bad
›ril 1950	32·2	17·6	32·5	14·0	26·3	37·1	18·5	13·4	27·3	24·5
ay 1950	32·7	15·3	33·0	14·0	21·3	24·6	18·7	13·6	19·5	24·4
ne 1950	33·7	11·8	39·6	13·0	23·3	23·2	29·9	13·5	14·8	22·7
ly 1950	33·1	14·0	34·7	14·0	24·4	17·0	17·4	11·3	24·3	22·5
gust 1950	41·4	13·5	28·5	25·0	25·7	17·2	17·2	11·5	20·5	21·3
ptember 1950 . . .	38·4	32·7	26·7	12·0	31·8	21·6	22·4	17·3	24·0	21·2
tober 1950	38·6	23·5	24·0	14·0	26·0	23·7	21·5	14·9	26·5	20·3
vember 1950	45·6	23·0	24·8	11·6	18·7	18·1	15·6	13·7	26·7	20·9
cember 1950	33 7	22·5	22·6	13·3	19·4	14·7	20·4	21·2	25·6	20·9
uary 1951	39·5	22·0	30·4	14·0	20·8	21·4	18·3	28·1	26·9	20·8
bruary 1951	36·3	19·9	24·1	12·3	27·2	18·0	15·5	18·3	25·4	20·0
rch 1951	30·1	24·8	19·7	12·5	25·4	19·6	15·4	15·1	25·2	22·2
Average . . .	36·8	20·05	28·4	14·1	24·2	21·4	18·4	16·0	23·9	21·8

TABLE II

APPENDIX 14—(*contd.*)

AVERAGE DETENTIONS IN PRINCIPAL YARDS WORKED OUT FOR THE ROUTES (*a*) ASANSOL-TUNDLA (*b*) ASANSOL-MORADABAD

Principal Yard	Average Detentions (hours)	Cumulative Detentions (hours)	Cumulative Distance (miles)	Detentions in hours per 100 miles
(*a*) *Asansol to Tundla*—				
Asansol	20·05	...	...	...
—	...	20·05	134	15·0
Gaya	14·1	...	...	...
—	...	34·15	260	13·1
Moghalsarai	24·2	...	...	...
—	...	58·35	354	16·5
Allahabad	21·4	...	...	...
—	...	79·75	473	16·8
Kanpur	18·4	...	...	...
—	...	98·15	617	15·9
Tundla	16·0	...	...	...
	...	114·15	...	...
			Average	15·5
(*b*) *Asansol to Moradabad*—				
Asansol	20·05	...	...	...
—	...	20·05	134	15·0
Gaya	14·1	...	...	...
—	...	34·15	260	13·1
Moghalsarai	24·2	...	...	...
—	...	58·35	458	12·7
Lucknow	23·9	...	...	...
—	...	82·25	660	12·5
Moradabad	21·8	...	...	...
	...	104·05	...	...
—			Average	13·8

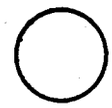
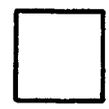
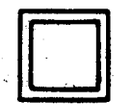
Hence approximate detentions for goods traffic in dispersed wagon movement per 100 miles 15 hour

APPENDIX 15

(CHAPTER IX)

LABELLING SYSTEM

(a) SYMBOLS (RAILWAY REPRESENTING)

Western Railway		(Circle)
Southern Railway		(Triangle)
Central Railway		(Square)
Eastern Railway		(Two concentric circles)
Northern Railway		(Two concentric triangles)
North-Eastern Railway		(Two concentric squares)

(b) COLOUR SCHEME REPRESENTING GRADE OF COAL.

Selected 'A'		(Red)
Selected 'B'		(Green)
Grade I		(Yellow)
Grade II		(Blue)

ENDIX 15—*(concld.)*

(*c*) SERIAL NUMBERS (REPRESENTING INDIVIDUAL DISTRICTS OR ZONES)

EXAMPLE OF WESTERN RAILWAY :

District/zone	*Distributing Centre*	*Serial No.*
Bulsar	Nandurbar	1
Saurashtra	Ratlam	2
Pratabnagar	,,	3
Ahmedabad	,,	4
Mhow	Agra East Bank	5
Gangapur	,,	6
Abu	,,	7
Bandikui	,,	8

(*d*) ILLUSTRATIVE LABEL.

Railway	Western
District	Gangapur
Grade of coal . . .	Slected 'A'

APPENDIX 16

(CHAPTER IX)

ESTIMATE OF SAFE GROUND STOCKS

Western Railway

1. **Case I.—Safe ground stocks, with transit time based on the distribution from collieries to individual sheds.**

Formula for safe ground stocks (number of days consumption)=2T +10.

Where T=Number of days in transit from supply point to receiving point (colliery to shed).

A representative district of Western Railway is given in Fig. A below.

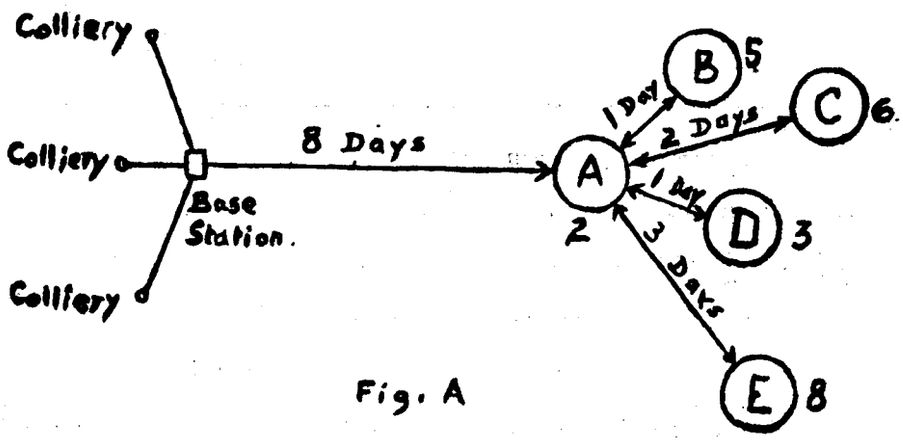


Fig. A

A, B, C, D, and E are five sheds in the district with their daily coal requirement given as 2, 5, 6, 3 and 8 wagons respectively or total of 24 wagons for the district.

The total transit time ' T' in respect of individual sheds is 8, 9, 10, 9 and 11 days respectively.

Therefore the ground stock required

$$=2(2\times8+10)+5(2\times9+10)+6(2\times10+10)+3(2\times9+10)+8(2\times11+10)$$
$$=52+140+180+84+256$$
$$=712 \text{ wagons.}$$

This is equivalent to 712/24=29·7 or 30 days consumption (for the whole district).

2. **Case II.—Safe ground stocks with transit time based on supplies from collieries to distributing centres : and Distribution to sheds directed from the distributing Centre at 'A'.**

Formula for safe ground stock (number of days consumption)=$2T_1+T_2+10$.

Where T_1=number of days in transit from colliery to distributing centre.

&

T_2=number of days in transit from distributing centre to shed.

The same district of Western Railway as given in Fig. A is considered with Shed A as distributing centre (Fig. B below).

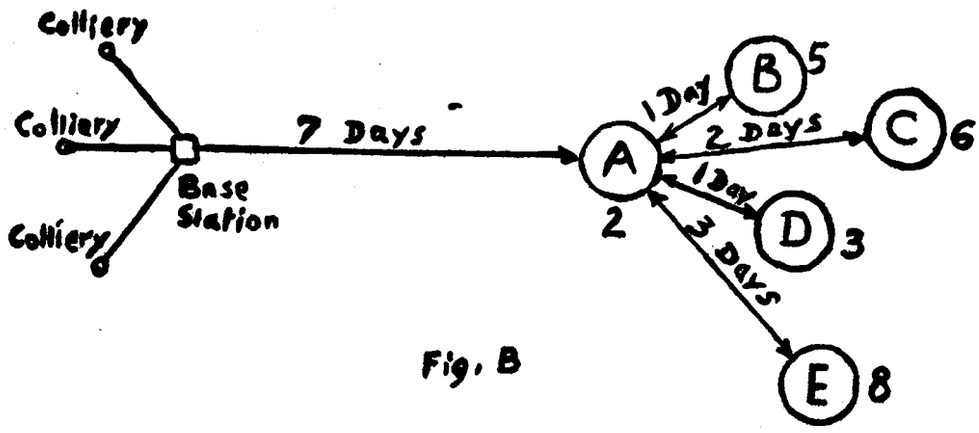


Fig. B

Due to " speeded up" coal movement, the transit time T_1 from colliery to distributing centre reduces to approximately 7 days. Transit time T_2 from distributing centre to sheds A, B, C, D and E is the same (0, 1, 2, and 3 days respectively) as in Fig. A.

Therefore the ground stocks required.

$$=2(2\times7+10)+5(2\times7+1+10)+6(2\times7+2+10)+3(2\times7+1+10)+8(2\times7+3+10)$$
$$=48+125+156+75+216$$
$$=620 \text{ wagons.}$$

This is equivalent to 620/24=25·8 or 26 days consumption for the district.

APPENDIX 16—(*Contd.*)

3. Hence with planned distribution for the Western Railway, the safe ground stocks can be reduced from 30 days consumption to 26 days. This gives a reduction in ground stocks of about 13 %.

4. *THE REDUCTION IN CAPITAL LOCKED UP IN GROUND STOCKS.*

	As recommended by Indian Railway Fuel Committee on the basis of existing supply arrangements. (4th I.R.F.C. Report)	As estimated for the planned distribution of coal.
1. Ground stocks in number of days consumption . . .	30	26
2. Daily consumption in tons	3,660	3,660
3. Total ground stocks in tons	109,800	95,160
4. Average cost in rupees per ton of coal for Western Rly. .	35·4	35·4
5. Capital locked up in ground stocks	Rs. 38,90,000	33,70,000

Therefore the reduction in the capital locked up in ground stocks for the Western Railway will be about Rs. 5·2 lakhs.

APPENDIX 17

(CHAPTER IX)

Working cost of a Coal distribution organisation

(*a*) PRESENT ORGANISATION AT GHAZIABAD—NORTHERN RAILWAY

The Staff and Emoluments

Staff	Scale of pay	Number	Total emoluments per month (inclusive of allowances.)
	Rs.		Rs.
Distributing Supervisor	160—220	1	260
Head Clerk	80—160	1	180
Clerks:—			
(*a*) D.A. Note posting clerks for C.I. Register	55—130	2	260
(*b*) Freight clerks	,,	2	260
(*c*) D.A. Note and Invoice clerks	,,	3	390
(*d*) Distribution clerks	,,	3	390
(*e*) Transhipment clerks	,,	1	130
(*f*) Despatch clerks	,,	1	130
(*g*) Typists	,,	1	130
Daftries	35—40	1	90
Peons	30—40	2	160
Labelling men	,,	3	240
Water and Lamp men	,,	1	80
Total per month			2,700

Total wagons handled per day=100.

$\therefore$ Cost of the organisation per ton of coal $= \frac{2700 \times 192}{100 \times 20 \times 30\frac{1}{2}} = 8\frac{1}{2}$ pies.

(*b*) ADDITIONAL COST OF INSPECTION UNIT

The Staff and Emoluments

Staff	Scale of pay	Number	Total emoluments per month (inclusive of allowances)
	Rs.		Rs.
Fuel Technologist	160—220	1	260
Sampling porters	30—40	10	800
Total per month			1,060

$\therefore$ Cost of Inspection Organisation (capacity of distributing centres 100 wagons/day) per ton of coal $= \frac{1060 \times 192}{100 \times 20 \times 30\frac{1}{2}} = 3\frac{1}{2}$ pies.

Hence total cost of Distribution Organisation, inclusive of inspection unit (capacity 100 wagons/day) will be about As. 1 per ton of coal handled.

APPENDIX 17—(*Contd.*)

(*c*) WORKING COST OF A SMALLER DISTRIBUTION-CUM-INSPECTION UNIT FOR HANDLING 20 AND 40 WAGONS A DAY

Staff	Scale of pay	Unit capacity 20 wagons/day.		Unit capacity 40 wagons/day.	
		Number	Emoluments per month	Number	Emoluments per month
Fuel Supervisor	120—180	1	220	1	220
Head Clerk	80—160	...	...	1	180
Clerks	55—130	3	390	4	520
Daftries	35—40	...	...	1	90
Peons	30—40	1	80	1	80
Labelling and lamp men	,,	1	80	2	160
Fuel Technologist	120—180	1	220	1	220
Sampling porters	30—40	2	160	4	320
			1150		1790
∴Cost of Organisation per ton of coal handled			18 pies		14 pies

(*d*) COST OF DISTRIBUTION-CUM-INSPECTION ORGANISATION FOR WESTERN RAILWAY.

Distributing Centre	Capacity		Cost of Organisation	
	Wagons/day	Tons/annum	Pies/Tons	Rs./annum
Agra East Bank	81	591000	12	37000
Ratlam	72	526000	12	32900
Nandurbar	30	219000	16	18300
Total	183	1336000	12·7 average	88200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APPENDIX 18

(Chapter X)

Plan for supply of coal to the south

REVIEW OF THE PRESENT POSITION

1. *Requirements of coal for the South in the year* 1951-52.

	tons a month
Railways	12,000
Public	155,000

2. *Actual despatches in the year* 1951-52

Southern Railway

	Tons a month (approx.)
By Rail	60,000
By Rail-cum-sea	120,000
Industries	
By Rail	66,000
By Rail-cum-sea	12,000
Short supply	77,000

3. *The Rail routes so far utilised for carrying Coal to South*

(*i*) Bengal Bihar—and Talcher coals *via* Waltair.

(*ii*) C.P. and C.I.C. coals—

(*a*) *Via* Balharshah-Bezwada

&

(*b*) *Via* Balharshah-Raichur

(*iii*) Singareni coals—

(*a*) *Via* Secunderabad-Dronachellam

&

(*b*) *Via* Bezwada.

4. *Capacity of Docks for handling Coal Cargo* —

Discharge rate from coal carrying steamer.—

(*a*) Discharge rate at coal berth ranges from 600 to 1,000 tons a day, average rate being 750 tons a day Due to labour and other difficulties discharge rate goes down to the lower limit of 600 tons a day

(*b*) Discharge rate in mid-stream averages at 400 tons a day.

Thus a coal carrying steamer will take 8 to 10 days to complete unloading alongside the berth and about 15 days in the mid-stream. Three steamers a month can be taken alongside the berth and two steamers in the mid-stream.

5. *Capacity at Madras Docks.*—Madras Docks have two permanent coal berths which maintain a discharge rate of about 40,000 tons a month. Two additional steamers can be taken in for discharging in the mid-stream. Thus the total capacity at present works out to 8 steamers giving a discharge rate of about 52,000/55,000 tons a month. If public and railway coals are shipped in the same vessel the discharge rate gets reduced. The capacity of the docks under the circumstances reduces to 45,000/50,000 tons a month.

6. *Additional Capacity that can be developed at Madras Port.*—One berth at the outer quay could be brought into commission by incurring some expenditure on rail lines leading to the berth and providing other facilities. This additional berth will also take three steamers a month for about 8 months in a year as during four months of monsoon the berth cannot be easily used. By bringing this berth into commission, additional capacity that can be obtained will give a discharge rate of 12,000 tons a month for the whole year or 18,000 tons a month for 8 months of the year.

7. *Capacity at other Ports*—

Name of Port	Discharge capacity.	
Cuddalore	2 steamers	12,000 tons a month.
Tuticorin	2 do.	12,000 do.
Cochin	2 do.	12,000 do.
Marmugao	3 do.	18,000 do.
Total	9 do.	54,000 do.

APPENDIX 18 (*contd.*)

The capacity at Cuddalore can be increased at about 4 steamers a month if enough number of lighters were made available at this port. Cochin is said to have possibilities of developing further capacity but it is felt that s long as food imports continue at this port, coal imports cannot be easily stepped up.

8. *Capacity for all ports for feeding South by Sea—*

(*a*) *Present capacity—*

15/17 ship loads a month (6/8 for Madras).

(*b*) *Capacity for all ports when developed—*

22 ship loads a month for 8 months of the year.

19 ship loads a month for 4 months of the year.

i.e. 21 ship loads a month for 12 months of the year.

Coal is now being discharged into wagons in two basket loads at a time, each basket weighing about 4 cwts. If regular tubs were used and labour somewhat strengthened, 1½ tons instead of 1 ton could be discharged per operation. This would step up the discharge capacity at each port by about 50 per cent.

9. *Rail facilities at ports.*—Madras Port can accept coal for supply by the B.G. line without affecting the rate of discharge. State controlled dumps at Cuddalore, Tuticorin and Cochin should improve coal handling at the ports and coal movement by rail and may possibly allow one or more ships to be taken in each port every month. Marmugao being a port in the foreign territory offers difficulties in that the required number of coal wagons cannot be easily made available against the guarantee of fixed number of wagons the Southern Railway have to supply for other commodities. As far as possible supply of coal to Southern Railway *Via* Marmugao Port should not be encouraged.

DEVELOPMENT OF OUTLYING COALFIELDS

10. *Immediate possibilities of increasing Rail-borne supplies from the outlying coalfields—*

	Present supplies to Southern Railway.	Additional quantities that can be immediately offered.
Singareni	24,000 tons per month	20,000 tons per month
Talcher	12,000 tons per month	6,000 tons per month
C.I.C.	21,000 tons per month	30,000 tons per month.

11. *Development of Singareni coalfields—*

(*i*) Singareni fields can feed the Southern Railway at more than one point. There are therefore greater possibilities of increasing rail-borne supplies to the south by developing these fields.

(*ii*) A long term project involving an expenditure of about Rs. 4 crores has already been undertaken by the Singareni coalfields to step up the output from 100,000 tons a month to 180,000 tons a month. Funds to the extent of Re. 1 crore have already been spent on purchase of new power plant and mining equipments against this project. Negotiations for raising the remaining Rs. 3 crores for the project are in progress. The project will take 5 years to complete with the development programme as follows:—

	Aggregate output per month.	Increment in output per month.
Immediately with transport made available . . .	1,20,000 tons	20,000 tons
December 1953	1,28,000 tons	8,000 tons
December 1954	1,36,000 tons	8,000 tons
December 1955	1,56,000 tons	20,000 tons
December 1956	1,80,000 tons	24,000 tons.

A greater portion of this quantity of coal could be moved down to South *Via* Bezwada if the Bezwada-Madras line were doubled as the intake of wagons at Bezwada should then be more than 300 wagons a day. This will enable two block trains of coal to move every day from Bezwada down South in addition to present quota of coal wagons as a permanent measure. *Doubling of the Bezwada-Madras line however cannot fit into an immediate or a short term plan.*

12. *Public dump river side at Bezwada.*—It was stated by the late Mr. Vishwanathan Iyer (Director of controlled commodities, Madras Government) at the meeting of the Committee held in the Port Commissioner's Office, Madras, jointly with the Port Commissioner, the representatives of the Southern Railway and the representatives of the Madras Government on 19th November 1951, that the Madras Government will be able to move 14,000 to 16,000 tons of coal a month by river transport if a dump can be set up along the river side at Bezwada with necessary siding facilities for loading and unloading of coal. This additional quantity will be utilised for distribution to industries and public.

RECEIVING POINTS

13. *Bezwada and Waltair.*—Extending of loops and sidings Bezwada on the Madras Section should increase the intake at Bezwada by about 120 wagons a day of which 80 wagons could be allotted for carrying Public and Loco coal. These 80 wagons can be distributed as 30 for Waltair and 50 for Bezwada.

14. *Tadepalli, Raichur and Dronachellam.*—The other points at which Southern Railway can receive coals from Singareni are:—

(*i*) Tadepalli

(*ii*) Raichur *via* (Secunderabad)

(*iii*) Dronachellam (transhipment at Secunderabad).

Transhipment dumps already exist at Tadepalli and Secunderabad. Extension of these dumps will improve the intake of wagons to the extent of two train loads per week at Dronachellam and Tadepalli respectively. The extension of line and yard capacities between Singareni and Raichur and provision of additional power can easily increase the intake of coal wagons at Raichur to the extent of three train loads per week.

15. With the facilities for increasing the intake at the different points on the Southern Railway and the necessary developments of Singareni and Talcher coalfields, it will be possible to workout a short-term five year plan with the programme covering five phases. The details of the five phases are developed in Fig. 14 and tables I & II.

WORK TO BE EXECUTED

16. *Phase I—To be completed by December 53 or earlier.*—

(*i*) Southern Railway have to extend/set up dumps at Hotgi, Guntakal and Tadepalli and provide necessary transhipment and/or handling facilities.

(*ii*) Eastern Railway have to clear up bottle-necks over the line from Talcher coalfields to Waltair in order that the increased supplies from Talcher are delivered at Waltair as per plan.

17. *Phase II—To be completed by December 54 or earlier.*—Government of Madras have to set up a public dump alongside Kistna canal at Bezwada and provide facilities for handling 8,000 tons of coal a month by December 54 and 14,000 tons a month by December 56, in consultation with Southern Railway who may have to extend railway line on to the Kistna canal bank and provide necessary siding facilities.

18. *Phase III—To be completed by December 55 or earlier.*—

(*i*) Central Railway are to clear up bottle-necks on the section from Singareni coalfields to Raichur to admit of increased coal supplies from Singareni coalfields *via* Secunderabad-Raichur.

(*ii*) Southern Railway are to provide adequate locomotive power to cater for increased wagons intake at Raichur in the order of 50 wagons a day by Dec. 55 and 70 wagons a day by Dec. 47.

19. *Phase IV and V.—To be completed by December 56 and December 57 respectively or earlier.*—

(*i*) Central Railway are to extend facilities at Secunderabad so that supplies from Singareni coalfields averaging at 25 wagons a day by Dec. 56 and 30 wagons a day by Dec. 57 can be made to the Southern Railway and the industries in the South *via* Dronachellam. Secunderabad yard is reported to be congested already, as such, will not allow further development in capacity. It has been suggested that a suitable site for the dump and/or the transhipment sidings of the required capacities can be found near the Metre Gauge station at Hyderabad. This will involve extension of BG line from Secunderabad to a suitable/site near the Metre Gauge station in question and a considerable expenditure. The work will need to be given a high priority so that the required capacity can be attained as indicated in the plan.

(*ii*) The Southern Railway are to complete the work on the extending of loops and sidings, provision of additional crossing stations and remodelling of yards on the Bezwada-Madras section and procure necessary power for working trains of 60 coal loads (average weight per loaded wagon 32 tons) or 80 combined loads (average weight per loaded wagon 25 tons) by Dec. 56 to enable wagon intake at Bezwada to be increased as per plan.

20. *Reduction in the Railway Fuel Bill.*—Net savings in railway fuel bill on account of transfer of sea-borne supplies to rail route which occur in the first and the final phases of the plan are worked out in tables III and IV. Losses to revenue on account of additional wagons to be employed in coal traffic have been fully accounted for. In addition to this, an allowance of 20 per cent increase in consumption of coal from C.P. and C.I.C. (Singareni and Talcher) coalfields against Bengal and Bihar sea-borne coal has also been made in the calculations for working out net savings.

RAIL, BORNE SUPPLIES OF COAL TO SOUTH — TABLE I

N SHOWING COAL WAGON INTAKE (WAGONS/DAY) & SUPPLY QUANTITIES (TONS/MONTH) AT POINTS OF SUPPLY/DISTRIBUTION

ree of Supply / al field	Points of supply/Distribution & their coal intake in wagons per day																				Total quantities from each source in tons per month			Increment over existing supplies in tons/month
	Ghorpuri			Hotgi			Raichur			Dornachellam			Bezwada			Waltair			Total					
	Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industr	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	...	20	20	...	20	12,000	...	12,000	...
	...	...	...	...	...	...	35	...	35	...	...	...	...	17	17	...	...	...	35	17	52	21,000	10,000	31,000	...
areni	...	...	...	...	...	...	...	...	...	15	...	15	25	43	68	...	...	...	40	43	83	24,000	26,000	50,000	...
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	50	55	5	50	55	3,000	3,000	33,000	...
l	...	...	...	...	...	...	35	...	35	15	...	15	25	60	85	25	50	75	100	110	210	60,000	66,000	126,000	...
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	...	30	30	...	30	18,000	...	18,000	+6,000
	4	...	4	3	...	3	38	7	45	...	...	...	...	...	...	...	...	...	45	7	52	27,000	4,000	31,000	...
areni	...	...	...	...	...	...	...	...	...	15	...	15	35	60	95	...	...	...	50	60	110	30,000	36,000	66,000	+16,000
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
l	4	...	4	3	...	3	38	7	45	15	...	15	35	60	95	30	50	80	125	117	242	75,000	70,000	145,000	+19,000
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	...	40	40	...	40	24,000	...	24,000	+12,000
	4	...	4	3	...	3	38	7	45	...	...	...	...	...	...	...	...	...	45	7	52	27,000	4,000	31,000	...
areni	...	...	...	...	...	...	...	...	...	15	...	15	35	60	95	...	...	...	50	60	110	30,000	*44,000	74,000	+24,000
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
l	4	...	4	3	...	3	38	7	45	15	...	15	35	60	95	40	50	90	135	117	252	81,000	78,000	+159,000	33,000
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	5	45	40	5	45	24,000	3,000	2 ,000	+15, 00
	4	...	4	3	...	3	35	10	45	...	...	...	...	...	...	...	...	...	42	10	52	25,000	6,000	31,000	...
areni	...	...	...	...	...	...	5	...	5	15	5	20	40	65	105	...	...	...	60	70	130	36,000	*50,000	86,000	+36,000
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
l	4	...	4	3	...	3	40	10	50	15	5	20	40	65	105	40	55		142	135	277	85,000	89,000	174,000	+48,000
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	10	50	40	10	50	24,000	6,000	30,000	+18,000
	4	...	4	3	...	3	28	17	45	...	...	...	...	...	...	...	...	...	35	17	52	21,000	10,000	31,000	...
areni	...	...	...	...	...	...	15	...	15	15	10	25	40	75	115	...	...	...	70	85	155	42,000	†65,000	107,000	+57,000
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
l	4	...	4	3	...	3	43	17	60	15	10	25	40	75	115	40	60	100	145	162	307	87,000	111,000	198,000	+72,000
her	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	15	55	40	15	53	24,000	9,000	33,000	+21,000
	5	...	5	10	...	10	15	25	40	...	...	...	...	...	...	...	...	...	30	25	55	18,000	15,000	33,000	+2,000
areni	...	...	...	...	...	...	30	...	30	15	15	30	50	85	135	...	...	...	95	100	195	57,000	†74,000	131,000	+81,000
al & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
l	5	...	5	10	...	10	45	25	70	15	15	30	50	85	135	40	65	105	165	190	355	99,000	128,000	227,000	+101,000

oo tons received in Bezwada Dump for river transport.
,000 tons received in Bezwada Dump for river transport.

APPENDIX 18 (*contd.*)

RECEIVING POINTS

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RAIL, BORNE SUPPLIES OF COAL TO SOUTH

TABLE I

PLAN SHOWING COAL WAGON INTAKE (WAGONS/DAY) & SUPPLY QUANTITIES (TONS/MONTH) AT POINTS OF SUPPLY/DISTRIBUTION

Supply Plan Phase No.	Source of Supply Coal field	Points of supply/Distribution & their coal intake in wagons per day																				Total quantities from each source in tons per month			Increment over existing supplies in tons/month
		Ghorpuri			Hotgi			Raichur			Dornachellam			Bezwada			Waltair			Total					
		Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industr	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	Railway	Industry	Total	
(Existing supplies)	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	...	20	20	...	20	12,000	...	12,000	...
	CIC	...	...	...	...	...	...	35	...	35	...	...	...	...	17	17	...	...	...	35	17	52	21,000	10,000	31,000	...
	Singareni	...	...	...	...	...	...	...	...	...	15	...	15	25	43	68	...	...	...	40	43	83	24,000	26,000	50,000	...
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	50	55	5	50	55	3,000	3,000	33,000	...
	Total	...	...	...	...	...	...	35	...	35	15	...	15	25	60	85	25	50	75	100	110	210	60,000	66,000	126,000	...
I	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	...	30	30	...	30	18,000	...	18,000	+6,000
	CIC	4	...	4	3	...	3	38	7	45	...	...	...	...	...	...	...	...	...	45	7	52	27,000	4,000	31,000	...
	Singareni	...	...	...	...	...	...	...	...	...	15	...	15	35	60	95	...	...	...	50	60	110	30,000	36,000	66,000	+16,000
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
	Total	4	...	4	3	...	3	38	7	45	15	...	15	35	60	95	30	50	80	125	117	242	75,000	70,000	145,000	+19,000
II	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	...	40	40	...	40	24,000	...	24,000	+12,000
	CIC	4	...	4	3	...	3	38	7	45	...	...	...	...	...	...	...	...	...	45	7	52	27,000	4,000	31,000	...
	Singareni	...	...	...	...	...	...	...	...	...	15	...	15	35	60	95	...	...	...	50	60	110	30,000	*44,000	74,000	+24,000
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	−3,000
	Total	4	...	4	3	...	3	38	7	45	15	...	15	35	60	95	40	50	90	135	117	252	81,000	78,000	+159,000	33,000
III	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	5	45	40	5	45	24,000	3,000	2 ,000	+15, 00
	CIC	4	...	4	3	...	3	35	10	45	...	...	...	...	...	...	...	...	...	42	10	52	25,000	6,000	31,000	...
	Singareni	...	...	...	...	...	...	5	...	5	15	5	20	40	65	105	...	...	...	60	70	130	36,000	*50,000	86,000	+36,000
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
	Total	4	...	4	3	...	3	40	10	50	15	5	20	40	65	105	40	55		142	135	277	85,000	89,000	174,000	+48,000
IV	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	10	50	40	10	50	24,000	6,000	30,000	+18,000
	CIC	4	...	4	3	...	3	28	17	45	...	...	...	...	...	...	...	...	...	35	17	52	21,000	10,000	31,000	...
	Singareni	...	...	...	...	...	...	15	...	15	15	10	25	40	75	115	...	...	...	70	85	155	42,000	†65,000	107,000	+57,000
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
	Total	4	...	4	3	...	3	43	17	60	15	10	25	40	75	115	40	60	100	145	162	307	87,000	111,000	198,000	+72,000
V	Talcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	15	55	40	15	53	24,000	9,000	33,000	+21,000
	CIC	5	...	5	10	...	10	15	25	40	...	...	...	...	...	...	...	...	...	30	25	55	18,000	15,000	33,000	+2,000
	Singareni	...	...	...	...	...	...	30	...	30	15	15	30	50	85	135	...	...	...	95	100	195	57,000	†74,000	131,000	+81,000
	Bengal & B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50	50	...	50	50	...	30,000	30,000	—3,000
	Total	5	...	5	10	...	10	45	25	70	15	15	30	50	85	135	40	65	105	165	190	355	99,000	128,000	227,000	+101,000

* Includes 8,000 tons received in Bezwada Dump for river transport.
† Includes 14,000 tons received in Bezwada Dump for river transport.

COAL FIELD-WISE

PLAN FOR SUPPLY OF COAL TO INDUSTRIES IN THE SOUTH

TABLE II—(*contd.*)

Source of Supply (Coal field)	Route followed	Point of supply or distribution	Supply plan											
			Existing Phase		Phase I		Phase II		Phase III		Phase IV		Phase V	
			Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	per Tons Month
CP/CIC	Balharshah-Bezwada	Bezwada	17	10000	..	..	..	..	..	..	..	..	..	..
	Balharshah-Wadi	Raichur	..	..	7	4000	7	4000	10	6000	17	10000	25	15000
Singareni	Via Bezwada	Bezwada	43	26000	60	36000	60	36000	65	39000	75	45000	85	51000
	Secunderabad-Dronachellam	Dronachellam	..	..	..	..	..	..	5	3000	10	6000	15	9000
	Secunderabad-wadi	Raichur	..	..	..	..	..	..	..	..	..	..	..	..
	Rail *Cum* River	Bezwada Dump	..	..	..	..	13	8000	13	8000	23	14000	23	14000
Talcher	Via Waltair	Waltair	..	..	..	..	..	..	5	3000	10	6000	15	9000
Bengal & B.	Via Waltair	Waltair	50	30000	50	40000	50	30000	50	30000	50	30000	50	30000
Total	. . . . .	. . . . .	110	66000	117	70000	130	78000	148	89000	85	111000	213	128000

TABLE II

DISTRICTWISE
PLAN FOR SUPPLY OF COAL TO SOUTHERN RAILWAY

No.	District	Source of Supply (Coal field)	Route followed	Point of Supply or distribution	Supply Plan									
					Phase I To be completed by Dec.'53		Phase II To be completed by Dec., 54		Phase III To be completed by Dec. '55		Phase IV To be completed by Dec.' 56		Phase V To be completed by Dec. '57	
					Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month	Wagons per Day	Tons per Month
1	Bezwada (B.G.)	Talcher Singareni	Via Walt air Via Bezwada	Waltair Bezwada	30 10	18,000 6000	40 ..	24000 ..	Complete district on Talcher Coal (no further change in plan).					
	Total				40	24000	40	24000						
2	Hubli (M.G.)	CP/CIC. ,, ,,	Monmad-Dhond ,, Balharshah-Wadi	Ghorpuri Hotgi Raichur (Guntakal)	4 3 23	2400 1800 13800	Complete district on CP/CIC Coal (As in Phase I)						5 10 15	3000 6000 9000
	Total	. . .	. . . .	. . .	30	18,000							30	18000
3	Guntakal (M.G.)	Singareni	Bezwada-Tadepalli	Bezwada (Tadepalli)	15	9000	Complete district on Singareni Coal —(No further change in plan)							
4	Bangalore (M.G.)	Singareni	Secunderabad-Dronachellam	Dronachellam	15	9000	Complete district on Singareni Coal—(No further chage in plan)							
5	Rayapuram (B.G.)	CIC. Singareni ,, Bengal & B.	Balharshah-Wadi Secunderabad-Wadi Bezwada-Madras Rail *cum* Sea	Raichur ,, Bezwada Madras	15 .. 10 20	9000 .. 6000 12000	15 .. 20 10	9000 .. 12000 6000	12 5 25 3	7000 3000 15000 2000	5 15 25 ..	3000 9000 15000 ..	.. 20 25 ..	.. 12000 15000 ..
	Total	. .	. . . .	. . .	45	27000	45	27000	45	27000	45	27000	45	27000
6	Podanur (B.G.)	Bengal & B. ,, Singareni ,,	Rail *cum* Sea ,, Secunderabad-Wadi Bezwada-Madras	Madras Cochin Raichur Bezwada	1 Ship per month 1 Ship per month	6000 6000	No Change (As in Phase I)						 10	 6000
	Total	. . .	. . . .	. . .	2 Ships per Month	12000							10 20*	6000 12000*
7	(Villupuram M.G.)	Bengal & B.	Rail *cum* Sea	Cuddalore	2 Ships per Month	12000	Complete district on Bengal & B. Coal—(No further change in plan)							
8	Madura (M.G.)	Bengal & B.	Rail *cum* Sea	Tuticorin	2 Ships per Month	12000	,, ,,							

*At the end of fifth phase, complete district on Singareni Coal (Sea borne supplies for the district are elimiuated)

NOTE.—Not included above are two extra shipsper month kept in reserve for supplementing supplies by Sea route.

TABLE III APPENDIX 18—(*contd.*)

REDUCTION IN RAILWAY FUEL BILL DUE TO TRANSFER OF SUPPLIES FROM SEA TO RAIL ROUTE FOR HUBLI DISTRICT

(PHASE 'I')

	Extra intake of 20 wagons via. Guntakal amounting to about 400 tons of C.P./C.I.C. Coal.			Extra intake of 1 ship month (10 wagons) via Madras instead of Marmugao amounting to about 200 tons.		
	Hubli			Madras Marmugao		
	Rate per ton		Savings per day	Rate per ton		Savings per day
	CP/CIC Rs. as.	B & B* Rs. as.		B & B Rs. as.	B & B* Rs. as.	
1. Pitmouth cost	15 8	15 8		15 8	15 8	
2. Operating cost of rail transport sea freight, transhipment and, handling charges.	23 8	56 8		42 8	56 8	
3. Total	39 0	72 0		58 0	72 0	
4. Add about 4% wastage on the total of CP/CIC Coal used.	1 8	..		..	..	
Total	40 8	72 0		58 0	72 0	
	on 400 tons Rs. 16,200	on 320 tons Rs. 23,040	Rs. 6,840	on 200 tons Rs. 11,600	on 200 tons Rs. 14,400	Rs. 2,800

Total Savings per day . . . . . Rs. 9,640

Total Savings per year . . . . . Rs. 9,640 × 365 = 35,18,600.

@The consumption of Bengal and Bihar Sea-borne coal (Selected grades) has been taken as 20% less than the consumption of CP/CIC Coal under identical operating conditions.

*Bengal and Bihar.

Loss in revenue on extra wagons put into coal traffic—Hubli District

1. Number of additional wagons involved in carrying coal to Southern Railway in place of Sea-borne Supplies: 20 wagons/day
2. Average turn-round of a wagon for a lead of about 600 miles . . . . . 10 days
3. Total number of wagons required against Rail-borne supplies for Hubli District . 200 wagons
4. Average earnings per wagon per day in general merchandise traffic . . . Rs. 26
5. Average operating cost per wagon per day . . . . . Rs. 14
6. Loss to revenue per wagon per day in loco coal traffic . . . . . Rs. 12
7. Amount involved in this loss per day against Rail-borne supplies for Southern Railway. Rs. 2,400
8. Amount involved in this loss per year against Rail-borne supplies for Southern Railway. Rs. 8,76,000

Net saving in fuel Bill for Southern Railway

1. Total savings in fuel costs with rail-borne replacing sea-borne supplies and in Hubli District. Rs. 35,18,600
2. Total loss in earning on account of 200 extra wagons employed in loco coal traffic Rs. 8,76,000
3. Net saving in Fuel Bill for Southern Railway . . . . . Rs. 26,42,600

APPENDIX 18—(*contd.*)

TABLE IV

REDUCTION IN RAILWAY FUEL BILL DUE TO TRANSFER OF SUPPLIES FROM SEA TO RAIL ROUTE FOR PODANUR DISTRICT

(PHASE 'V')

	Extra intake of 10 wagons via Bezwada-Madras amounting to about 200 tons of Singareni Coal.			Extra intake of 10 wagons via Raichur amounting to about 200 tons of Singareni Coal.		
	At Shoranur			At Erode		
	Rate per ton		Saving per day	Rate per ton		Saving per day
	Singareni Rs. as.	B & B† Rs. as.		Singareni Rs. as.	B & B† Rs. as.	
1. Pitmouth cost	22 8	15 8†		22 8	15 8	
2. Operating cost of rail transport, sea freight, transhipment and handling charges.	14 8	47 0*		15 0	42 8@	
3. Total	37 0	62 8		37 8	58 0	
4. Add about 4% wastages on total of Singareni coal used.	1 8	..		1 8	..	
5. Total	38 8	62 8		39 0	58 0	
	on 200 tons Rs.7,700	on 160 tons** Rs.10,000	Rs.2,300	on 200 tons Rs.7,800	on 160 tons** Rs.9,280	Rs.1,480

Total saving per day . . . . . Rs. 3,780

Total saving per year . . . . . Rs. 3,780 ×365=Rs. 1,383,480

*Via Cochin port.

@Via Madras port.

**The consumption of Bengal and Bihar Sea-borne coal (selected grades) has been taken as 20% less than the consumption of Singareni coal under identical operating conditions.

†Bengal and Bihar.

Loss in revenue on extra wagons put into Coal Traffic for Podanur District

Existing Arrangements (*Sea-borne supplies*)

1 a. Number of wagons carrying coal to Podanur District per day . . . 20

1 b. Average turn round of a wagon for a lead of about 250 miles . . . 5 days

1 c. Total number of wagons employed against sea-borne supplies to Podanur District 100 wagons.

Rationalised Arrangements (*Rail-borne Supplies*)

2 a. Number of wagons required for carrying coal to Podanpur District per day . 20

2 b. Average turn round of a wagon for a lead of about 800 miles . . . 13 days.

2 c. Total number of wagons employed against all rail-borne supplies to Podanur District 260 wagons.

3. Therefore number of additional wagons involved in carrying coal to Podnaur District. 160 wagons.

4. Average earnings per wagon per day in general merchandise traffic . . . Rs. 26

5. Average operating cost per wagon per day . . . . . Rs. 14

6. Loss to revenue per wagon per day in loco coal traffic . . . . . Rs. 12

7. Amount involved in this loss per day against rail-borne supplies to Podanur District. Rs. 1,920

8. Amount involved in this loss per year against rail-borne supplies to Podanur District. Rs. 7,00,800

Net saving in fuel bill for Podanur District

1. Total savings in fuel cost with rail-borne replacing sea-borne supplies in Podanur District. Rs. 13,83,480 per yr.

2. Total loss in earning on account 160 extra wagons employed in loco coal traffic . Rs. 7,00,800 per yr.

3. Net saving in Fuel Bill for Southern Railway . . . . . Rs. 6,82,680 per yr.

TABLE V

APPROXIMATE COST OF WORKS ON CENTRAL AND SOUTHERN RAILWAYS IN CONNECTION WITH THE PLAN FOR SUPPLY OF COAL TO SOUTH

	Cost (Approx.) Rs.
CENTRAL RAILWAY—	
1. Provision of 3 crossing stations between Dornakal and Bezwada for increasing section capacity.	4·2 lakhs
2. Additional facilities in Wadi yard	3·5 lakhs
3. Reopening of block section at Thangundi for increasing the capacity of Wadi-Raichur section.	1·75 lakhs
4. Provision of additional accommodation and facilities in the M.G. yard at Secunderabad.	10·0 lakhs
5. Provision of additional facilities in Kazipet yard	7·5 lakhs
6. Provision of additional facilities in Dornakal yard.	2·45 lakhs
7. Provision of 3 crossing stations between Dornakal and Kazipet for increasing section capacity.	4·2 lakhs
Total cost of Central Railway	33·6 lakhs
SOUTHERN RAILWAY—	
1. Improvements to Sitanagaram Cabin between Kistna River and Kistana Canal (involving the construction of a bridge over the Kistana Canal to separate Metre and Broad Gauges)	10·0 lakhs
2. Transhipment improvements at :	
(*a*) Arkonum yard	10·0 lakhs
(*b*) Katpadi yard	10·0 lakhs
(*c*) Bangalore yard.	20·0 lakhs
3. Extension of loops and improvements to station yards between Bezwada and Madras for the increasing section capacity.	170·0 lakhs
4. Remodelling of Bezwada yard	75·0 lakhs
5. Improvements to Rajahmundry yard	20·0 lakhs
6. Provision of 12 crossing stations between Bezwada and Madras for increasing section capacity.	50·0 lakhs
Total for Southern Railway	365·0 lakhs
Grand Total	398·6 lakhs or rupees 4 crores.


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APPENDIX 19 B
(Chapter XI)

BOTTLENECKS FOR COAL TRAFFIC ON INDIAN RAILWAYS

(Summary of replies)

Railways	Route/Section		Traffic free or limited	Section capacity wagons/ day	Present quota in B.G. Wagons/day					Reasons for Bottleneck	Suggested improvements and other remarks.
	From	Towards			Loco coal	Public coal	Total coal	Other goods	Total		
1	2	3	4	5	6	7	8	9	10	11	12
1. Western	Agra E.B. . .	Ratlam . .	Limited	..	..	..	205	40	245	Yard limitations at interchange and limited track capacity south of Kotah.	Additional interchange at Tundla and provision for extra crossing stations south of Kotah.
,,	,,	Bandikui (M.G.)	,,	..	..	..	45	15	60	Acute shortage of M.G. stock and locomotive power and limited track capacity between Agra E.B.—Bandikui and Sojat Rd.	Capacity can be increased to 100 wagons if stock and power is made available but the track will not permit this extra traffic.
,,	Ujjain . .	Baroda . .	,,	..	..	..	220	20	240	Limited track capacity on Ratlam-Baroda station.	Provision of additional crossing stations on Ratlam Baroda section.
,,	,,	Indore (M.G.)	,,	40	..	..	25	5	30	Shortage of M.G. stock and locomotive power.	Provision of B.G. link between Ujjain and Indore.
,,	Bhusawal . .	Surat . .	,,	150	..	..	50	30	80	Shortage of locomotive Power and limited capacity of section.	Provision for additional power and additional crossing stations.
,,	Sabarmati . .	Mehsana (M.G.)	,,	120	..	..	..	..	80	Transhipment yard limitations and limited capacity of Sabarmati-Mehsana Section.	Additional facilities in M.G. yard and provision of additional crossing stations between Sabarmati and Mehsana or doubling of track.
,,	Viramgam . .	Surendranagar (M.G.)	,,	45	..	..	22	13	35	Shortage of M.G. stock and yard limitations at Surendranagar.	Provision for minor alterations in the Surendranagar and Viramgam yards.
,,	Ratlam . .	Ajmer (M.G.) .	,,	40	..	..	5	15	20	Shortage of M.G. stock and power.	Additions to yard layouts to increase capacity of more than 40.
,,	Sawai-Madhopur	Jaipur (M.G.) .	,,	30	.	..	5	15	20	Shortage of M.G. stock	Additional transhipment facilities to increase capacity of more than 30.
,,	Khandwa . .	Indore (M.G.) .	,,	..	..	..	..	..	..	Mhow Ghat section is limiting factor.	


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BOTTLENECKS FOR COAL TRAFFIC ON INDIAN RAILWAYS
(Summary of replies)

APPENDIX 19B—(*contd.*)

Railways	Route/Section		Traffic free or limited	Section capacity wagons/day	Present quota in B.G. Wagons/day					Reasons for Bottleneck	Suggested improvement and other remarks
	From	Towards			Loco coal	Public coal	Total coal	Other Goods	Total		
1	2	3	4	5	6	7	8	9	10	11	12
2. Central	Cheoki	Jubbulpore . .	imited	5 (trains)	...	...	...	1145 free	145 free	Lack of crossing stations .	Proposals for additional crossing stations havebeen postponed for want of funds.
"	Katni	Bina . . .	"	6 (trains)	...	...	...	...	250	Lack of crossing stations and yard limitations at Katni.	Two crossing stations and Chord line from New Katni to Katni South are included in 1953/54 Works Programme.
"	Bina	Bhopal . .	"	8 (trains)	...					Lack for crossing stations and yard limitations at Bina.	One additional crossing station and yard facilities at Bina are proposed for 1953/54.
"	Bhopal	Ujjain . .	"	...	...					Lack of sufficient loops etc.	Improvements will be necessary when the Western Railway has removed the bottlenecks on Ujjain-Ratlam section.
"	Itarsi	Bhopal . .	"	...	...	...	...	80	7(trains)	Line restrictions on account of the doubling of Budni-Barkhera section and yard limitations at Itarsi.	Doubling of Budni-Barkhera section will be completed in 1953. Yard facilities at Itarsi are also programmed.
"	Ambala	Itarsi . .	"	...	...					Shortage of Power . .	Additional traffic facilities included in 1953-54 programme.

Railways	Route/Section		traffic free or limited	Section capacity	Present quota in B. G. Wagons/day					Reasons for Bottleneck	Suggested improvements and other remarks.
	From	Towards		wagons /day	Loco coal	Public coal	Total coal	Other goods	Total		
1	2	3	4	5	6	7	8	9	10	11	12
Central	Kazipet . .	Secunderabad .	Limited	...	...	...	...	...	...	Shortage of heavier locomotives.	
,,	Balharshah . .	Kazipet . .	,,	...	...	...	...	...	...	Shortage of Power.	
,,	Kazipet . .	Bezwada . .		...	...					Lack of crossing stations and yard limitations at Kazipet and Dornakal.	Three additional crossing stations and yard facilities at Kazipet and Dornakal are proposed for 1953/54.
,,	Shahabad . .	Raichur . .		...	...	...	...	...	135	Lack of crossing stations and yard limitations at Kazipet and Dornakal.	Three crossing stations and remodelling of Wadi yard are proposed. These will however, be required only when Southern Railway can accept more wagons at Raichur.
,,	Ajni . . .	Wardha . .		...	...	...	...	...	...	Yard limitations at Ajni .	Ajni yard improvements are programmed for 1953/54.
,,	Manmad . .	Secunderabad (MG)		...	...	...	1	...	...	Shortage of MG empties and lack of proper transhipment facilities.	The present quotas could be increased by improving the availability of empties on the Western and Southern Railways. Plans for extension of transhipment facilities at Secunderabad are being examined.
,,	Hotgi . .	Gadag (MG) .		...	...		3				
,,	Poona . .	Miraj (MG) .		...	...		3				
,,	Khandwa . .	Indore (MG) .		...	...		2				
,,	Secunderabad .	Nizamabad and Dronachellam (MG).		...	...		35				
3 Eastern	. ,,		Free	...	...	...	...	...	10	...	No bottlenecks on ex. E.I.R. Can allot 1,100 wagons for coal for above Moghalsarai if empties are made available. Provision for doubling of Adra-Asansol and Anuppur-Katni sections and also provision for extra crossing stations on Chirmiri-Kotma section will be necessary for future development of coal fields.

Railways	Route/Section		Traffic free or limited	Section capacity wagons /day	Present quota in B. G. Wagons/day				Total	Reasons for Bottleneck	Suggested improvements and other remarks
	From	Towards			Loco coal	Public coal	Total coal	Other goods			
1	2	3	4	5	6	7	8	9	10	11	12
Northern	..	..	Free	..	..	..	..	..	..	..	No bottlenecks on Ex. E.P.R. Ex. J. R. and Ex. Bik. S.R.
5. North Eastern (ex O. T.R.)	Mokameghat .	..	Limited	125 (64 coal)	..	..	51	55	106	Shortage of rolling stock and overage flotilla for river transhipment.	
	Bhagalpur . .	..	„	50 (30 coal)	..	..	30	17	47		
	Banaras . .	..	„	40 (30 coal)	..	..	30	10	40	Shortage of rolling stock and other physical limitations at break of gauge points.	Provision for additional M.G. rolling stock and renewal of overage flotilla. The transhipment difficulties have been eliminated by creation of dumps.
	Mandnadih .	..	„	60 (26 coal)	..	..	26	34	60		
	Bareilly . .	..	„	25 (16 coal)	..	..	16	free	16+free		
	Barabanki . .	..	„	25 (6 coal)	..	..	6	19	25		
	Lucknow . .	..	„	25 (15 coal)	..	..	15	9	24		
(ex-Assam)	Kishinganj . .	Siliguri . .	..	..	20	18	38	133	171*	Limited capacity of new rail link.	These quotas are in M. G. wagon as allotted by Assam Rail Link Committee.
	Siliguri . .	Alipur Duar .		..	10	5	15	114	129*		
6. Southern.	Waltair . .	Madras . .	„	..	25	50	75	130	205	Limited track capacity between Bezwada and Madras and yard limitation at Bezwada and Rajahmundry.	Creation of Coal Dump at Tadepalli and extension of loops and provision of additional crossing stations between Bezwada and Madras. Ultimate solution in doubling of this section.
	Bezwada . .	Madras . .	„	..	25	50	75+ 3 trains week.	75	150+ 3 trains week.		
	Raichur . .	Madras . .	„	..	35	..	35+ 1 train week.	100	135+ 1 train week.	Shortage of power and limited track capacity.	Provision for additional power, creation of coal dump at Guntakal for M. G. transhipment.
	Dronachellam .	Mysore . .	„	..	..	..	30	..	..	Shortage of M.G. Power.	Provision for additional M.G. power.


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APPENDIX 21-A

(**Chapter XI**)

Eastern Punjab Railway

STATEMENT SHOWING QUANTITY OF UNDERLOADING ON WAGONS DESPATCHED FROM THE COLLIERIES FROM APRIL 51 TO AUGUST 51

Name of Collieries	Quantity of under-loading
	T. C.
Angarpathra	..
Angarpathra Union	18—5
Alkusa	..
Badjna	..
Borakuri	..
Bank Sanla	0—10
Bhulanbararee	39—10
Bansdeopur	0—15
Bonjamahari	..
Budruchuck	0—5
Bararee	37—5
Bermondia	0—5
Bastarcolla	34—5
Bhuggatdih	2—0
Begonia	..
Belrui Dishergarh	..
Bhanora	..
Bokaro	46—10
Bilbera	..
Bengal Jharia	..
Bussurya	1—5
Balhari	1—15
Burragarh	49—10
Benali	0—15
Bhalgora	1—0
Central Kujama	..
Churi	..
Central Gararia	..
Chhota Bawa	13—15
Central Jeanagora	0—15
Central Sounda	1—16
Central Kendwadih	..
Chanch	52—5
Charanpur	5—0
Chupai Khas	..
Chunchuria	..
Central Laikdih	..
Churulia	..
Central Jambad	..
Central Tisra	..
Central Koaridih	2—0
Central Tentulia	2—10
Chalbalpur	2—5
Central Angarpathra	2—15
Dera Buk Buko	..
Dhriajoba	1—10
Dhadka	1—0
Dhemo Main	..

Name of Collieries	Quantity of under-loading
	T. C.
Diamond Tisra	..
Dhansar	..
Damudea	5—15
Doshar Mohan	..
Darra	..
Datna	..
Dharmaband	12—10
Dhori	2—15
Diamond Titturya	0—10
East Keredwadih	..
East Ekra	29—05
Ekra Khas	74—15
East Kajora	..
East Satgram	..
East Ena	1—0
East Basurya	22—15
East Bhuggatdih	..
East Bhalgora	0—5
East Sitalpur	..
East Kumardhobi	1—10
East Katras	1—0
Godhaur	..
Giridihpur (Serampur)	28—15
Giridihpas (Kurhurbaree)	41—10
Gandhoodih	..
Gandoodih	..
Gonshadih	..
Gararia	4—5
Gaslitan	0—5
Golulkdih	..
Hessagoa	..
Issabella	0—10
Jamuria	..
Jagaldaga	..
Jogta	..
Jayake Nagar	..
Jamehri Khas	2—15
Junkunder Khas	..
Kurkend's Kirkend	..
Khas Sitalpur	..
Khas Kajora	2—5
Khas Kirkend	..
Khas Kusunda	1—5
Khas Joyrampur	..
Kargali	1—5
Khas Jeenagora	35—10
Kasta	..
Kujama	..
Kendwadih	10—10
Khas Koiludih	..
K.S. Kujama	..
Khas Angarpathra	9—5
Karanpur Dewarkhand	5—15
Khas Nira	..

APPENDIX 21-A—(*contd.*)

Names of Collieries	Quantity of under-loading
	T. C.
Korrabad Nadiah	..
Kosurgarh	..
Khas Chalbalpur	..
Khas Jharia	..
Katras Ghoitodih	33—15
Kajora Selected	0—10
Kuju	2—5
Kuya	1—0
Kapasaram	4—0
Koiladih	1—0
Kujama Pandewera	1—0
Lower Badjna	..
Lodna	0—15
Lower Joyrampur	..
Loyabad	..
Laikdihdeep	..
Laiyo	..
Laphanga	4—0
M.R. Kirkend	..
Model Jharia	..
Mundalpur	3—0
Mondal's Sheikhpur	..
Model Dhori	3—10
Muslia	..
N.S. Lodna	..
North Bararee	..
N.P. Jharia	..
N. Tellulmuri	1—5
North Ekra	0—10
New Damagoria	1—5
New Lakurka	..
New Kenda	..
New Laikdih	..
New Tetturya	..
New Gobindpur	..
North Kujama	..
New Buntodih	..
New Sinaldih	..
Nichitpur	..
New Marine	..
Nimcha	0—10
Pure Joyrampur	3—0
Pure Jharia	..
Pure Selected Bansjora	..
Pure Jennagorah	4—10
Pure Bansiora	1—15
Pathardih	..
Pure Tisra	..
Pure Kujama	..
Pichri	6—0
Pure Samla	..
Poniati Baraboni	..
Pretoria	..
Pure Laikhdih	..

APPENDIX 21-A—(*concld.*)

Name of Collieries	Quantity of under-loading
	T. C.
Plasthali	..
Pure Kajora	..
Pathardih Sudamdih	0—5
Religorah	1—10
Rajhara	..
Real Jambad	2—15
Real Kajora	0—10
Rajapur	..
Ranidih	..
Radhamadhalbpur	..
Rawatta	..
Selected Dhori	..
Sendra Bansjora	..
Seelepur	..
South Adjai	..
Sudamdih	..
South Tisra	..
Shree Diamond Sitalpur	..
Sudreadih	..
South East Baraboni	..
Selected Jharia	0—15
Satgram	..
Sendra	3—15
Sirka	1—10
Searsole	..
Sunkurpur	..
Selected Jambad	..
Sripore	..
Selected Baraboni	..
Samla Gobindpur	..
Sitalpur	..
Shampur	..
South Govindpur	6—0
South Jharia	..
Samla Chatrisganda	..
Selected Solanpur	8—15
Sounda	1—5
S.B. Kendwadih	0—5
Sitanala	3—10
Selected Sureadih	7—10
Tisra (A.S.)	0—5
Turia	..
Tisra	..
Tisra Dhandji Devji	0—15
Upper Jharia	..
Victoria	..
Victoria (West)	5—10
West Bassurya	0—15
West Mudidih	..
West Laikdih	2—5
West Jamuria	38—0
West Tumang	2—10
West Godhar	1—5
West Badjna	6—15
Grand Total	783—11

APPENDIX 21—B

(Chapter XI)

Eastern Railway

STATEMENT OF LOCO COAL DESPATCHED TO INDIAN RAILWAYS FROM ONDAL WEIGH-BRIDGE FROM 1-5-1952 to 10-5-1952

Name of Colliery	Total number of wagons	Total Tonnage of wagons	Total under-loaded wagons	Quantity of Under-loading
		T. C.		T. C.
Central Satgram	9	201—10	...	...
N. B. Barmondia	10	218—12	5	2—14*
Pure Kendu	6	136—10	...	...
Korrabad Nodiha	13	296—6	2	1—10
New Kendu	16	355—17	3	1—1
Shyamsunderpur	14	296—11	1	0—10
Upper Khujara	16	352—19	4	2—5*
Kunkar Tala	4	98—5	1	0—10
Ikhra Nandi	10	221—13	...	...
Samla Govindur No. 5	12	274—4	...	...
Khas Sitalpur	33	738—2	9	5—16*
Mandalpur	5	119—7	...	...
South Parasia	7	161—4	...	...
Sunkerpur Colly.	10	221—2	...	...
Pure Sitalpur	22	408—35	1	0—7
Khas Chinchuria	9	198—14	1	0—7
Brights Rana	24	467—17	11	8—0
Central Jamuria	30	678—2	1	0—9
North Chora	19	400—0	3	0—18
Lodna	12	273—4	...	...
Samla No. 1	22	487—1	3	0—16
Pure Samla	13	292—17	...	...
Ratibati	32	712—3	7	5—3*
Devji Ghilabhai	48	1039—16	7	6—4*
East Jamuria	4	90—12	...	...
East Sitalpur	13	293—15	1	0—8
Parasea Colly.	21	489—15	...	...
C. I. Benkalee	15	330—9	1	0—4
K. C. Pal Choudhury	17	402—0	...	...
Samla No. 2	18	405—15	...	...
P. Dutta Kajora	26	483—0	3	0—14*
East Jameshary	22	491—13	1	1—3*
S. K. Jambad	20	462—5	...	...
Khas Kajora	9	204—12	...	...
Khas Kenda	14	309—7	3	0—17
Searsol Colliery	20	457—12	1	0—2
Kuardi Colliery	24	545—11	...	...
Real Kajora	10	219—4	1	0—8
Madanpur	1	22—5	...	...
Nagsi Ramjibanpur	6	132—8	1	0—17
Adjoy 2nd	18	421—4	...	...
Sitaldarji Selected	13	295—16	...	...
Jaypuria Kajora	39	862—19	4	2—15
Selected BBI	20	453—14	...	...
C. L. Kumar Nimcha	5	114—4	...	...
Mahujora Colly.	7	165—17	2	1—5*
Central Kajora	5	113—12	...	...

APPENDIX 21—B—(*concd.*)

Name of Colliery	Total number of wagons	Total Tonnage of wagons	Total under-loaded wagons	Quantity of underloading
		T. C.		T. C.
North Jambad	14	310—19	1	3—10
Rorsa Colly.	12	262—0	5	4—15*
Barsara	7	160—13	1	0—6
South Jamabad	17	390—7	6	6—10*
Nageswar Satgram	52	1146—16	12	10—16*
East Satgram	29	625—8	10	9—0*
Shewkaram & Sons	6	138—11	...	...
Moira Colly.	8	187—5	...	...
Samla No. 4	9	199—5	3	5—15*
Samla No. 3	54	1178—9	3	0—18
Joti Dhemo	10	218—12	3	4—2
Sri Diamond Sitalpur	14	298—13	1	0—5
Samla No. 6	57	1248—17	16	8—3*
East Jambad	13	253—14	1	0—8
Sitalpur Colly.	17	390—4	3	3—1*
Girimint Colly.	7	165—15	...	...
Central Jamuria	9	203—6	1	1—8*
Krishna Valley	8	180—0	...	...
North Brook	5	112—12	...	...
Owner's Kasta	19	439—13	...	...
Mahabir Colly.	6	132—17	1	0—7
Damuda Colly.	3	70—0	...	...
Kajora Lachipur	1	23—0	...	...
South Parasea	1	20—0	...	...
Jore Kuri	1	23—4	...	...
Bengal C. Coy.	6	140—11	...	...
Bankola	5	114—19	...	...
Apkar	1	23—5	...	...
Kajora Selected	5	113—1	1	0—2
Shyamsundarpur	1	19—15	...	...
Jambad Kajora	2	44—9	1	0—7
JMA A & B	1	23—10	...	...
Real Kajora	10	119—4	1	0—8
Khas Jambad	2	47—16	...	...
TOTAL	1155	25443—16	147	104—14

(1) Percentage of underloaded wagons—12·7

(2) Underloading per wagon—0·71 ton.

APPENDIX 21 B—*(contd.)*

STATEMENT OF LOCO COAL DESPATCHED TO INDIAN RAILWAYS FROM KUSUNDA WEIGH-BRIDGE FROM 1-5-52 *to* 10-5-52

Name of Colliery	Total number of wagons	Total Tonnage of wagons	Total under-loaded wagons	Quantity of underloading
		T. C.		T. C.
Alkusa Nyadee	7	160—16	2	08—1
Angarpathra Colly. Co.	19	424—11	...	...
B. K. Roy Godhar	8	183—19	...	...
Budroochuck Coal Ming. Co.	25	550—0	7	3—14*
Busserya Coal Co.	11	255—10	...	...
Bararee Coke Co.	6	114—2	1	0—13*
Central Kirkend Coal Co.	13	343—14	1	0—9
Central Alkusa	14	319—15	1	0—5
Baratar Coal Co.	...	...	...	...
Muddidih	6	140—10	...	...
Central Angarpathra	6	126—15	2	0—13
Diamond Angarpathra	5	112—13	2	0—17
East Kendwadih	11	249—10	2	0—18
Chhotapowa Colly.	8	186—14	...	...
East Basuria Coal Co.	39	816—18	26	23—10
Dhariajoba Colly.	5	111—10	...	...
Gararia Colliery	10	229—14	1	0—8
Jogta Coal Co.	13	296—15	...	...
Khas Kusunda Coal Co.	15	323—15	8	5—8*
K. M. Sethia Jogta	5	118—7	...	...
Kirkend Coal Co.	8	177—13	3	1—1
Kosoonda Nyadee	62	1393—4	3	1—3
Motiram Rashanlal Coal Co.	8	185—18	1	0—4
New Bansdeopur Coal Co.	16	359—15	...	...
Nichitpur Coal Co.	14	313—3	1	0—6
New Marine Coal Co.	14	308—3	2	0—12
North Tetulmari	6	135—12	2	2—6*
Pure Kustora	2	44—0	1	0—2
Pure Bansjora Colly.	8	176—15	3	1—6
Pure Chandore	4	90—12	...	...
Pure Sel. Bansjora	9	199—9	2	2—0*
Pure Dhansar Coal Co.	7	161—3	...	...
Sendra Bansjora Coal Co.	4	1893—14	5	1—18
Trigunait Bros' Jharia Khas	8	349—18	...	...
West Mudidih Colly.	15	153—11	2	3—8*
West Godhar	7	118—4	...	...
West Chandore	10	212—5	3	2—3*
TOTAL	507	11388—12	81	54—11

*Cases of bad underloading.

(1) Per centage of underloaded wagons : 15.7

(2) Underloading per wagon : 0.7

(**Chapter XII**)

***Coal saving through the use of brick arch**

Coal Saving %	Source of Information
5 to 8	Report of Coalsville Tests W. F. M. Goss
12	Report of Coatsville Tests W. F. M. Goss
6 to 8	Penn, R. R. Co. Test Dept. Bulletin No. 30
12 to 13	Penn. R. R. Co. Test Dept. Bulletin No. 6

*Extract from the University of Illinois Bulletin (Circular No. 8) of September 1918 on "The Economical use of coal in Railway Locomotives".


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APPENDIX 25

(Chapter XII)

BEST PERFORMANCE FIGURES FOR THERMAL STATIONS

Type of Prime mover	Installed capacity of station in KW.	Boiler Efficiency %	Engine or Turbine Efficiency %	Generator Efficiency %	Exiter, Windage and bearing friction losses %	Transformer Efficiency %	Overall, Generation Efficiency %	Overall, Thermal Efficiency (3)×(4)×(8) %	Overall performance	
									Lb. of coal per KWH (cal, value 11,000 Btu/lb)	Lb. of coal/KWH (including 10% consumption for idling & 10% for auxiliaries)
1	2	3	4	5	6	7	8	9	10	11
Reciprocating Steam Engine	250	70	10·0	91	1·2	94	85·0	5·95	5·2	6·2
	500	74	12·5	92	1·1	95	87·0	8·0	3·87	4·6
	750	78	14·5	93	1·0	96	88·5	10·0	3·1	3·7
	1000	81	16·0	94	0·9	97	90·5	11·75	2·64	3·15
Steam Turbine	500	74	24·0	92	1·1	95	87·0	16·5	1·88	2·26
	750	78	26·0	93	1·0	96	88·5	18·0	1·72	2·06
	1000	81	28·0	94	0·9	97	90·5	20·6	1·6	1·92
	2000	83	29·0	65	0·8	98	92·5	22·3	1·39	1·67
	3500	85	30·0	96	0·7	98	93·5	24·0	1·28	1·54

APPENDIX 26

(Chapter XII)

PERFORMANCE DATE OF CHOLA POWER HOUSE

Month	Units generated	Coal consumed	Oil consumed	Ratio of coal used to oil burnt	Cost of coal @ Rs. 30 per ton	Cost of oil @ Rs. 180 per ton	Total cost of fuel (coal and oil)	Average cost of fuel	Remarks
	(MWHr)	(Tons)	(Tons)	**1949**	(Rs.)	(Rs.)	(Rs.)	(As./KWH.)	
April '49 . . .	12,800	9470	1625	5·82	284,100	292,500	576,600		
May '49 . . .	13,000	9930	1627	6·10	297,900	292,800	59,700		For the average ratio of Coal ; oil of 6.1, the cost of power House fuel (coal & oil) per ton would be $\frac{6\cdot1\times30+180}{71}$ =Rs. 51·4
June '49 . . .	12,800	9310	1536	6·06	279,300	276,500	555,800		
July '49 . . .	12,600	9120	1400	6·51	273,600	252,000	525,600		
August '49 . . .	14,300	9760	1491	6·69	292,800	268,500	561,300		
Sep. '49 . . .	13,800	9580	1667	5·75	287,400	300,000	587,400		
Total for 6 months . .	79,300	57170	9346	6·10	1,715,100	1,682,300	3,397,400	0·682	
				1952					
July '52 . . .	21,400	17,100	627	27·2	513,000	112,800	625,800		
August '52 . . .	14,900	12,500	367	34·0	375,000	66,100	441,100		For the average ratio of coal : oil of 33·5 the cost of Power House Fuel (coal & oil) per ton would be $\frac{33\cdot5\times30+180}{34\cdot5}$ =Rs. 34·4
Sept. '52 . . .	19,600	16,400	422	39·0	482,000	76,100	568,100		
Oct. '52 . . .	21,200	17,500	657	26·6	525,000	118,200	643,200		
Nov. '52 . . .	21,000	18,600	539	34·3	555,000	97,200	652,200		
Dec. '52 . . .	24,900	21,400	479	44·7	642,000	86,200	728,200		
Total for 6 months . .	123,000	103,400	3091	33·5	3,102,000	556,600	3,658,600	0·476	


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APPENDIX 28

(Chapter XII)

COMPARATIVE COSTS OF COAL HANDLING OPERATIONS ON THE BASIS OF DATA FURNISHED BY RAILWAYS

Description of operations	Nature of operations	Departmental or Contractual	Handling cost per ton of Coal	Remarks
1. Unloading & stacking	Manual	Departmental	4 to 9 annas	The costs vary according to the quantity of coal handled per day and the extent to which work is done at other than "day light" hours.
2. Unloading & stacking	Manual	Contract	2 1/2 to 5 annas	The costs are 50 to 80% cheaper than departmental costs.
3. Loading into wagons at transhipment points	Manual	Contract	5 to 8 annas	The cost varies according to local conditions.
4. Loading into locomotive tenders (at sheds and stations)	Manual (Head Basket Method).	Departmental	9½ to 18 annas	The costs vary according to the quantity of coal handled per gang day (three shifts), ranging from 20 to 120 tons.
5. Loading into locomotive tenders (at sheds and stations)	Manual (Head Basket Method).	Contract	6½ to 13½ as.	The costs vary according to the quantity of coal handled per gang day (three shifts), ranging from 20 to 120 tons. (The costs are 50 to 80% cheaper than departmental costs).
6. Loading into locomotive tenders (at sheds and stations)	Mechanical steam operated mobile crane).	Departmental	4 to 10 annas (6 to 15 annas)	The cost varies with the quantity of coal handled, ranging from 100 to 300 tons per day.
7. Loading into locomotive tenders (at stations)	Mechanical (Electrically operated over-head bunker type).	Departmental	6 to 14 annas (9 to 21 annas)	The cost varies with the quantity handled, ranging from 50 to 150 tons per day.
8. Loading into locomotive tenders (at sheds)	Mechanical (Electrically operated traverser type).	Departmental	3 to 9 annas (5 to 14 annas)	The cost varies with the quantity handled, ranging from 100 to 400 tons per day.

NOTE.—Figures in brackets are costs of mechanical loading, estimated on the basis of present day prices of mechanical handling equipment.


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APPENDIX 30

(Chapter XIII)

NOTE BY MR. R. A. MASSEY, MEMBER, RAILWAY FUEL ECONOMY ENQUIRY COMMITTEE

STATISTICAL REVIEW

1. **Statistics.**—If statistics are to be used to gauge the efficiency of the Railways and more particularly the fuel organisation of a Railway, it is essential that statistics should be compiled from basic figures which leave little room for manipulation.

The function of the Railways is to provide transport for passengers and goods traffic and it is from this source, that the Railways derive their income. In providing transport, the largest single item of expenditure is coal and in order to judge whether or not we have obtained the maximum value for the coal used, our efficiency should be calculated, taking into consideration net traffic handled, the miles hauled and the coal consumed directly or indirectly for the purpose. The statistical figure should be lb. per 1000 net ton miles.

2. **Net Ton Miles**—The 'Net ton miles' takes into consideration the weight of the traffic carried and the distance it is carried. In the Administration Report net ton miles for both goods and passengers are not available. It is appreciated that it is difficult to obtain the actual weight of each passenger and his luggage, but the following average figures already adopted by Railways should provide a fair degree of accuracy.

1st class passenger (with luggage)	0·10 ton.
2nd class passenger (with luggage)	0·08 ton.
Inter class passenger (with luggage)	0·06 ton.
Third class passenger (with luggage)	0·06 ton.
Head of cattle	0·25 ton.
Head of sheep, goats, pigs etc.	0·25 ton.
Elephant	2·5 ton.
Carriage average 4-wheeler	0·34 ton.
Horse	0·44 ton.
Dog	0·01 ton.
Poultry	0·03 ton.

The statistics given in the Administration Report, Part II, contains the average miles a passenger was carried and with the help of the Statistical Officer of the Ex. G. I. P. Railway it has been possible to work out the net ton mile figure for passenger and proportion of mixed on Class 1 Railways BG and these figures have been used in the table below.

Coal consuption lb. per **1000** *ton miles on Railways Broad Gauge Class* 1

Mail and Express etc.	Pass. and proportion of mixed lb. per 1000 N. T. M.	Goods and proportion of mixed lb. per 1000 N. T. M.	Overall lb. per 1000 N. T. M.
1942-43	4374	341·7	679·3
1950-51	3093	359·1	736·4

Under 'Passenger and proportion of mixed' the coal consumption in 1950-51 has dropped. Under 'Goods and proportion of mixed' the coal consumption per thousand net ton miles has increased, while the overall rate of consumption which includes coal consumed in pumps, workshops, powerhouses etc. all of which in one way or another are connected with rail transport show an increase in the consumption over 1942-43. It is this figure *i. e.* lb. per 1000 net ton miles which is important and should receive attention of the sanctioning authority, as from it the overall fuel efficiency of rail transport can be gauged as it gives the rate of coal consumed for remunerative traffic only.

3. **lb. per thousand gross ton miles.**—The figure lb per thousand gross ton miles is the yard stick for gauging efficiency of fuel consumption on Indian Railways. This statistical figures gives an overall picture of the fuel consumed in the operation of trains carrying passengers and goods and also the movement of empty vehicles or coaches required for carrying passengers and goods, but does not take into consideration the fuel consumed on departmental work, locomotive repairs and numerous other factors. This figures, there, will not necessarily show whether fuel has been economically consumed or show which railway has worked efficiently or inefficiently. The table below shows the coal consumed by fully loaded trains, trains of open empties and trains of covered empties and the variation and relation between the lb. per engine mile and lb. per 1000 G. T. M.

PPENDIX 30—(*contd.*)

Coal consumption on the Moghalsarai-Gaya section in respect of through goods trains worked by CWD Class engines

Particulars	Loaded train	Load of open empties	Load of covered empties
Load in 4 wheelers	61	64	68
Gross load in tons including weight of engines.	1985	769	780
Coal consumption in pounds per engine mile.	97·7	93·4	88·8
Coal consumption in lb. per 1000 G.T.M.	53·7	132·9	125·6

From the above table it will be seen that with a loaded train of 1985 tons, the coal consumption was only 53·7 lb per thousand G. T. M. An open empty train of 769 tons, the consumption was 132·9 lb. per thousand G. T. M. and a covered empty train of 780 tons (heavier than the open empty train) the consumption was only 125·6 tons or lighter than the open empty train.

A summary of coal consumed per 1000 G. T. M.(B. G.) when the G. T. M. is constant, but the coal consumed is taken from different heads of accounts is given below :—

	1942-43	1950-51	Increase
1. *Lb./1000 G. T. M.* Coal consumed on all loco services 27(b)-13/total G.T.M. (excluding weight of engine and deptl.) pass. and pro. of mixed and goods and pro. of mixed Statt. 16 Col. 4 & 5 .	235·5	255·0	19·5
2. *Lb./1000* G.T.M. Coal consumed on all loco services and pumps 27(b) 13 and 14/ Total G. T. M. Statt. 16, cols. 4 & 5 . . .	241·2	262·2	21·0
3. *Lb./1000 G. T. M.* Coal on all loco services and other than loco purposes 27(b) (13 and 17)/ Total G.T.M. Statt. 16, col. 4 & 5 .	259·6	282·6	23·0

From the above figures it will be seen that there is a gradual increase in the difference under each head. In 1942-43 the increase from 1 to 2 was 5·7 lb and from 2 to 3 was 18·4 lb, whereas in 1950-51 from 1 to 2 it was 7·2 lb and from 2 to 3 it was 20·4 lb. which shows that the proportion of coal for other purposes, apart from coal actually consumed on the services has also increased.

The figures of coal consumption in lb per thousand gross ton miles as shown in the Administration Report under the heading 'Passenger and proportion of mixed' and 'Goods and proportion of mixed' are not prepared from the total coal 'actually consumed" by each service. The total coal consumed by a passenger train or a goods train is apportioned on the basis of a formula to the goods carried on a passenger train or passengers carried on a goods train. This obviously makes the figure unreliable. Again the system for issuing coal is such that it is quite possible to reduce the coal consumed for the working of trains and so bring about a reduction in the lb per thousand gross ton miles under each service (a figure which is always watched to check the efficiency of the department) by increasing the rate of issues to other heads of accounts such as departmental, shunting, miscellaneous, pilferage and physical losses of coal.

From the above it is quite obvious that figures of lb per thousand gross ton miles as at present derived do not give sufficient indication of the economic utilisation of our locomotives and of fuel. If this figure is, therefore, to be used for the purposes of controlling fuel consumption then it is obviously necessary that the services should be split up into comparable units and the assessment of coal for all other purposes should be more accurately controlled.

4. Individual Railway Performance.—

Lb. consumed per 1000 G. T. M. on B. G. of Class I Railways

Pass. and Prop. mixed	1942-43	1950-51
(a)		
E. I. R.	184·5 rose up to	218·1 by 33·6 lb.
G. I. P.	180·6 dropped to	159·4 by 21·2 lb.
(b)		
Highest figure in the year . . .	211·5 B. N.	218·1 E. I.
Lowest in the year	150·1 BB & CI	159·4 G. I. P.
(c)		
Goods & Prop. of mixed		
B. B. & C. I.	132·8 increased to	172·7 by 39·9 lb.
B. N.	196·1 dropped to	185·6 by 10·5 lb.
Highest figure	196.1 B. N.	190·6 E. P. 185·6 B. N.
Lowest figure	132·8 B. B. & C. I.	145·5 S. I.

From part (a) of the above statement, it will be seen that the E. I. Rly. was responsible for a rise of 33·6 lb. under the heading of passenger and proportion of mixed while the G. I. P. figures for 1950-51 showed a drop by 21·2 lb. It is interesting also to note that while the difference between E. I. R. and G. I. P. in 1942-43 was 3·9 lb. per thousand gross ton miles, the difference today is 58·7 lb. per thousand gross ton miles. This increase requires closer investigation.

The statement under (b) shows the Railways with the highest and lowest coal consumption in lb. per thousand gross ton miles. Statement (c) shows as increase on the B. B. & C. I. of 39·9 lb. while the B. N. Rly. dropped by 10·5 lb. Although the B. N. Rly's figure shows a drop it is still high when compared with the B. B. & C. I. Railway.

5. Average Train Load.—

(1) *Pass. and Prop. mixed*

	Gross weight including weight of engine	
	1941-42	1950-51
All Class I Railways (B. G. Steam)	418 increased to	465 by 47 tons.
B. B. & C. I.	470 increased to	554 by 84 tons.
N. S.	490 dropped to	470 by 20 tons.
Highest figure in the year	490 N. S.	554 B. B. & C. I.
Lowest figure	306 S. I.	374 S. I.

(2) *Goods and Prop. mixed*

	% of loaded to total wagons (Main lines)	
	1941-42	1950-51
All class I Railways (B. G.)	69·1	70·7
Highest in the year	86·6 S. I.	80·7 S. I.
Lowest in the year	66·9 E. I.	66·4E. I.
B. B. & C. I.	71·4 rose up to	80·4 by 9%
E. I.	66·9 dropped to	64·3 by 2·6 %

	Gross weight including weight of engine	
	1941-42	1950-51
All class I Railways (B. G.)	829	916
Highest in the year	967 E. I.	1087
Lowest in the year	629 S. I.	705
E. I. Rly.	629 rose up to	765
G. I. P.	804 dropped to	777

Passenger and Proportion of mixed.—

The gross weight (or load) of passenger trains has increased from 418 to 465. The increased load of passenger train should show better results in the lb. per 1000 gross ton miles, but in spite of this, the coal consumption under this head is high.

Goods and Proportion of mixed.

Here again, loads have increased, but the effect on coal consumption has not been satisfactory.

The individual railways results shown above, under each head, require further investigation to explain the causes in detail.

6. Lb. per shunting engine mile.—

	1941-42	1950-51
All class I Railways (B. G.)	68·8	85·9
B. N. Rly.	55·5 increased to	79·0 by 23·5 lb.
M. S. Rly.	72·5 dropped to	59·0 by 13·5 lb.
Highest figure	81·4 MSM	102·2 MSM
Lowest figure	45·7 S. I.	50·4 S. I.

Lb. per shunting engine mile.—

Coal consumption per shunting engine mile has risen from 68·8 to 85·9 or 17·1 per engine mile. It is difficult to find the cause of this increase in coal consumption.

Shunting engine miles take into consideration all shunting performed by locomotives, whether working trains or yard shunting, therefore, heavy passenger and goods locomotives utilised for detaching of sick vehicles or hot boxes, or performing other yard duties, are all accounted for under this head of account, the coal consumption is worked out on a formula and, it is not possible to say whether this increase is actually due to the quality of coal, inefficiency or from any other cause.

Individual railway figures show that the B. N. Rly. consumption has increased by 23·5 while the Nizam State Railway has dropped to 13·5 . The highest figure for shunting engine coal consumption is on *the M. & S. M. Railway with 102·2* lb per engine mile, while the lowest is on the South Indian Railway 50·4 lb per mile. These considerable differences require further investigation.

APPENDIX 30—(*contd.*)

7. **Light Engine Mileage.—**

Light Running.—The light engine miles per 100 train miles of light and assisting required under passenger and proportion of mixed show an improvement from 2·2 in 1941-42 to 1·58 in 1950-51 but under goods and proportion of mixed, the figure has increased from 7·46 to 8·79. In the case of light and assisting not required, the passenger again shows an improvement from 2·77 in 1941-42 to 1·79 in 1950-51 whereas the goods from 8·68 has gone up to 9·55. The increase shows that full use is not being made of goods locomotive power resulting in a wastage of fuel.

8. **Hot Boxes and Unserviceable Wagons.—**

(*i*) *Hot Boxes Wagon* (Monthly)	1943-44	1950-51
All Class I Railways B. G.	1359	2448
E. I. R.	458	1209

It will be seen that the hot boxes have increased by 1089 in 1950-51 over 1943-44. The average miles per hot box in 1943-44 was 1,33,000, whereas in 1950-51 the average miles per hot box was 71,000. If the efficiency had remained at the standard of 1943-44 the number of hot boxes in 1950-51 should have been 1,305 per month or 1,143 less per month than what it was in 1950-51.

Examining the individual railway performance it will be seen that on the East Indian Railway the number of hot boxes increased by 751. Statistics are, however, not available to show the mileage per hot box for individual railways.

(*ii*) *Unserviceable wagons in mechanical workshops* (*B.G.*)	1943-44	1950-51
All Class I Railways (daily)	1,102	1,706
Percentage of total	0·76	1·16

The number of unserviceable wagons in mechanical workshops has increased from 1102 or ·76 per cent of the total number on line to 1706 in 1950-51 or 1·16 per cent of the total number on line. The increase in percentage shows the standard of efficiency has dropped. Here again, if the efficiency was maintained on the 1943-44 level, the mileage per unserviceable wagons should have been 5392 per day instead of 3346. This would have meant a reduction in the daily number of unserviceable wagons to 1059 or 647 wagons less than what it was in 1950-51. This increase of wagons in workshops should result in a lesser number of wagons being under repairs in sick lines and transportations workshops. This, however, does not prove to be the case as will be seen from the following paragraphs.

(*iii*) *Unserviceable wagons in sick line and transportation workshops* (B. G.)

	1943-44	1950-51
All Class I Railways (daily)	4,693	8,972
Percentage of sick to total	3·24	6·12

The number of unserviceable wagons daily in sick lines and transportation depots in 1943-44 was 4693 or 3·24 per cent of the total number on line. This figure in 1950-51 rose to 8,972 or 6·12 per cent of the total number on line. Here again, if the efficiency was maintained on the 1943-44 standard, when the average miles per sick wagon was 1,266 the total number of sick wagons per day detached would have been 4509 or 4463 less than that it was per day in 1950-51.

The importance of reducing hot axles and sick vehicles is twofold. One is a reduction in fuel consumption and the other is the increased availability of wagons.

(1) *Effect on fuel consumption.*—For each sick vehicle or hot axle several shunting operations are necessary. The sick vehicle has first to be removed from the train, placed on spare line, the next day placed in sick siding, the following day taken out and placed again on a spare line and then placed on the train. This works out to approximately five miles per wagon. The fuel used on account of detaching the additional vehicles or wagons calculated on the basis of coal consumed per shunting engine mile on the 1950-51 figure of 85·9 lb per mile would be 360,256 tons or very nearly one-third of the total coal consumed by shunting engines in 1950-51. At an average cost of Rs. 31-0-0 per ton, the total amount will come to Rs. 11,167,936 for the year.

(2) *Loss of earning capacity.*—Taking the earning capacity of wagon as Rs. 21-0-0 per day, the loss on 1,878,866 wagons detached in excess of what it should have been on the 1943-44 basis, works out to Rs. 39,456,186 for the year.

9. **Wagon Stock and its repairs**—The Indian Railway Enquiry Committee of 1947 commented on the increase over the ten year period prior to 1947 in the number of wagons under or awaiting repairs on Indian Railways. This position has unfortunately further deteriorated. Since 1941-42 replacements of B. G. goods stock has been 47,263 by 1950-51. It is not possible to say what the actual position of goods stock is at present as far as it relates to the percentage of new to old wagons owing to the transfers to Pakistan. A drive must be made to reduce this figure to the minimum. If necessary, the question of repair gangs attending to trains in traffic yard should be considered so as to avoid detaching wagons for sick line repairs.

10. **Locomotive Utilisation (steam engines).—**

Engine Usage

Engine miles per engine day per engine on line.

	1941-42	1950-51
All Class I Railways. (B. G.)	87	76
Best performance of individual Railway	102 BN, GIP	95, GIP
Worst performance of individual Railway	74 BBCI	63EI
B. N. Railway's performance	102 dropped to	88
E. I. Railway's perfcrmance	79 dropped to	63

The above statistics show a deterioration in locomotive utilisation. This deterioration must have an adverse effect on fuel consumption. There is no doubt that a locomotive on extended runs whereby the mileage per locomotive day is increased to the maximum extent is most economical on fuel.

The Indian Railway Enquiry Committee, in their report of 1947, strongly recommended the more intensive use of locomotives and suggested that the target figure of engine miles per day per engine on line should be 100. The peak figure in the last 21 years was in 1941-42 when the figure was 87· Since then there has been a marked deterioration in this figure. The figure in 1950-51 was 76. As this figure takes into consideration repairs, washouts, engines stored in good condition and spare engines it may safely be taken that if it was possible in 1941-42 to attain the figure of 87 miles per day per engine on line, it should be possible to do the same today. If, therefore, we fix our target at the 1941-42 figure, the number of engines surplus to requirements today would be 665 on the B. G. and if we could attain the figure of 100 miles per day, as suggested by the Indian Railway Enquiry Committee (1947) the number of surplus locomotives today would be 1262. When we take the estimated cost of a locomotive at six lakhs, this amounts to 7,572 lakhs and represents a considerable amount of capital tied up.

Examining individual railway figures, it will be seen that the best performance in 1950-51 was the G. I. P. Railway with 95, the G. I. P. performance was also outstanding in 1041-42 when the figure was 102 miles per day. The worst figure for the year was of E. I. Rly. 63 miles per day, their figure in 1941-42 was 79 miles per day. The B. N. R. which tied with the G. I. P. in 1941-42 for the best place has also dropped to 88 miles per engine per day. With a lot of new locomotives and the regrouping of Railways, there should be no difficulty now to make better use of our locomotives and reach the figure of 100 miles per day as suggested by the Indian Railway Enquiry Committee in 1947.

11. **Locomotive Usage Hours.—**

Engine Hours.

To get the best out of a locomotive we obviously have to make use of every hour of an engine's life in working trains. Engines under repairs and standing in steam or idle engine hours do not earn revenue and coal consumed during these periods is unremunerative.

The statistics as published in the Administration Report, Vol. II do not give a true picture of the utilisation of our locomotives and the need for improving these statistics to afford a better control will be dealt with in a later paragraph.

An explanation of what is meant by train engine hours and total engine hours and average speed is given below.

12. **Total Engine Hours.**—Engine hours include all time of engines in steam, calculated from the time of engines in steam, calculated from the time the engine starts from the shed at the commencement of its daily work, until it returns to the same or another shed on completion of the day's work.

13. **Train Engine Hours.**—Train engine hours show the hours during which engines are employed on trains, counting in each case from the time the engine starts with the train, until it reaches the station at which the engine terminates its run with the train. The time occupied in halts at stations is included, but that occupied in shunting *en route* is excluded and shown under shunting hours.

The average speed of trains is calculated by taking the total time an engine or train is actually moving and/or standing between engine changing stations and dividing the mileage run by that time. Thus an increase or decrease in the average speed may not indicate that the actual speed of a train has been increased. This figure therefore does not indicate the advantage gained by the use of more powerful locomotives.

Passenger service.—On this service, although we have quite a number of very powerful locomotives capable of hauling heavier loads at higher speeds, it is noticed that the average speed as compared with 1941-42 has dropped by 1·6 miles per hour.

Goods service.—On this service, we have actually recorded an increase in the average speed by ·1 mile per hour over the 1941-42 period. If the speed in both the passenger and goods services has increased, it means that the standing time or idle engine hours while working a train has also increased.

The above figures indicate that the advantage gained by the use of more powerful locomotives resulting in an increase in actual speed is not reflected in our statistics.

15. **Percentage of train engine hours to total engine hours.**—This figure takes into consideration the hours an engine was actually employed on working of trains as compared with the total hours 'booked' against the train as explained in a previous paragraph. The figure shows that in 1941-42 we utilised only 49 per cent of the total engine hours for working trains, whereas in 1950-51 the figures dropped to 45 per cent. The better performance in 1941-42 can only be attributed to the more intensive use of locomotives and locomotives on extended runs. To give an example of the saving in locomotive hours on extended runs, in the case of a train working from loco station A, running through loco station B and changing at loco station C. The time at loco station B could be reduced from anything over four to five hours to about 1/2 an hour, when a locomotive is on an extended run. This reduction in time not only means a saving in fuel, but a considerable saving in wagon hours by speeding up of trains. A locomotive is allowed anything from 1 3/4 hours to 2 hours for detaching from the train, proceeding to shed, and for the new locomotive prepared in shed to be brought on to the train.

APPENDIX 30—(*contd.*)

The journey to and from he shed varies from a mile to (in some cases) five miles. All this means a loss of fuel.

16. **Un-utilised engine hours.**—This statement is prepared from the figures obtained in the Administration Report, Vol. II, and refers to the difference between the total engine hours on the line as compared to total engine hours utilised for operational purposes. The summary below gives us a fair idea of our locomotives utilisation in 1941-42 and 1950-51.

	1941-42	1950-51		Difference
1. Total available engine hours based on total engines on line	45,709,680	46,042,560	plus	3,32,88
2. *Hours spent in running*—				
1. Passenger assumed @ 40 m. p. h. . . .	1,486,200	1,345,525	minus	1,40,675
2. Goods assumed @ 30 m. p. h. . . .	1,777,400	1,539,200	,,	2,38,200
3. Other engine hours	9,202,600	9,095,600	,,	1,07,000
4. Balance of idle train hours—				
i. Passenger	1,241,900	1,320,575	plus	78,675
ii. Goods	3,247,700	2,779,900	minus	4,67,800
5. Un-utilised engine hours	28,753,880	29,961,760	plus	1,207,880
	45,709,680	46,042,560		

The above figures show that although more locomotives were available in 1950-51 as compared to 1941-42, full utilisation does not appear to have been made of them.

APPENDIX 31

CHAPTER X IV

CHARACTERISTIC FEATURES OF THE DIFFERNT TYPES OF LOCOMOTIVE POWER

CHARACTERISTICS	TYPES OF LOCOMOTIVE POWER			
	Steam	Diesel	Gas Turbine	Straight Electric
Initial Cost (Capital outlay)	Lowest .	High (on account of the price of diesel loco being about 1·5 to 2·5 times that of the steam locomotive)	High (on account of the price of gas turbine loco being 2·5 tot 3·0 imes that of the steam locomotive)	High (on account of additional costs of fixed installations such as Transmission, Conversion, Distribution, and Control equipment. Price of electric loco is also 5% higher than that of the steam locomotive).
Thermal Efficiency (to rail)	5 to 7% (6%) . *(4·5%) *With coal handling and pilferage losses and consumption in 'lighting up' 'banking fire', 'standby' and 'boiler hot water washout' services which are inherent in steam traction, the all year thermal efficiency drops 4 to 5%	24 to 28% (26%) .	(a) Oil burning type 18 to 22% (20%) (b) Coal burning internal . combustion type— 14 to 18% (16%) (c) Coal burning external combustion type— 12 to 16% (14%)	14 to 18% (16%)
Power Weight ratio (H orse Power per ton of locomotive weight)	8 to 10 . (9)	12 to 14 . (13)	10 to 12 (11)	20 to 25 (22)
Acceleration (MPH/Sec.)	(0·15) to 0·25 0·20	0·3 to 0·6 (0·45)	0·3 to 0·6 (0·45)	0·5 to 0·8 (0·65) (1 ·0 to 1·3 for suburban traffic)
Mechanism & Component design	Simple and rugged with liberal size and wear tolerances.	Equipment more complicated in component design with tighter size and wear tolerances.	Rotary equipment with standard electrical gear.	Standard electrica equipment of simple design generally.
Maintennace Costs .	High on account of heavy boiler repairs— Rs. 0·4 to 0·6 per engine mile.	High standard of skill required. Maintenance charges generally low in the first 5 years but later they become higher than those of the steam locomotive on account of renewals of diesel engine units and replacements (rather than repairs) of components Rs. 0·5 to 0·8 per engine mile.	Except for heavy wear on turbine blades, maintenance is expected to be reasonably low. Locomotive has not been in regular service long enough to provide reliable figures. Estimated figures are Rs. 0·3 to 0·4 per engine mile.	Easy to maintain Rs. 0·2 to 0·4 per engine mile
Availability . .	Low. (Chiefly on account of inspection and repairs of boilers in shops and sheds and on account of service requirements such as coaling, watering, fire-cleaning, "Washout" lighting up etc.)	High. Less time is required for inspection and repairs than with steam power.	High. Much less time is expected to be required for inspection and repairs than with steam power.	High. Minimum attention for inspection and repairs as maintenance of electrical gear is rather routine.
(a) *Average hours per day in service.*	12	18	18	22
(b) *Days per year in service.*	240	280	280	32
(c) *Availability Ratio* .	1·0	1·87	1·87	2·66
$\left\{\begin{matrix}(a_1 \times b_1) : (a_2 \times b_2) \\ (a_3 \times b_3) : (a_4 \times b_4)\end{matrix}\right\}$				
(d) *Utility Ratio* .	1·0	1·25	1·25	1·5

APPENDIX 31—*contd.*

Characteristics	Steam	Diesel	Gas Turbine	Straight Electric
Utility as distinct from availability depends upon traffic conditions and radius of operation. The figures given here are representative of present day conditions on Indian Railways and are expected to rise to these shown in bracket with expansion of rail transport.	(1·0)	(1·5)	(1·5)	(2·0)
Track stresses/Track Maintenance.	Generally high due to hammer blow and to greater tendency for lateral oscillation.	Comparatively low except in cases where designs provide for axlehung motors causing heavy impact on joints.		
General—				
(a) Fire hazard .	Generally high, due to tendency for emission of sparks from locomotive chimney or live ashes from ash pans. Can be reduced by suitable design of spark arrester and ash-pan.	High, in oil storage during hot weather.	High in oil storage during hot weather. Nil, in the case of coal burning types.	Nil
(b) Comfort & Cleanliness	Poor	Good	Good	Best.
(c) Water requirements	Very high (7 to 8 lb. per lb. of coal consumed)	Negligible (only for coaling radiation and cleaning purposes).	Negligible with air as working medium. If steam is used as the working medium water requirements will be 3 to 4 lb. per lb. of coal consumed.	Practically Nil.
(d) Engine crew requirements. (Main Line)	One driver, one fireman and one khalasi.	One Mechanic and one driver.	One Mechanic, one driver and one assistant.	One driver and one assistant.
Suburban and branch line)	One driver and one fireman.	One driver (control provided with deadman's handle).		One driver (control provided with deadman handle).
Adaptability to traffic .	Requires many types of locos to suit varying conditions of traffic.	Minimum number of types required as this type of power is adaptable to multiple unit operation and to common designs for goods and passenger services, etc.	Not yet known, but expected to be the same as diesel.	Minimum number of types required as this type of power is adaptable to multiple unit operation and to common designs for goods and passenger service, etc.
Overload capacity in—				
(a) Tractive afford at crawling speed.	Practically nil due to limited adhesion.	Approximate 10 to 15%	15 to 20% probably.	Momentarily 100% but a high value can be maintained over the whole range of speeds.
(b) Horse Power Rating	25% for duration of 15 minutes. Limited by boiler capacity and the quality of coal used.	Upto 15% for short periods.	Upto 15% for short periods.	Over 15% for short periods.

Rating—

Type of Locomotive	Present Conventional Rating	Output that can be sustained for 1 hr. at Draw Bar.	Loco weight	Trailing Load that can be hauled up 1/80 grade at 40 m.p.h.	Total weight, Loco plus train
Diesel . .	1,600 H.P. .	1,280 H. P. .	120 tons . .	250 tons . .	370 tons
Electric . .	3,000 H. P. .	2,550 H. P. .	120 tons . .	600 tons . .	720 tons
Steam . .	1,650 H. P. .	1,150 H. P. .	160 tons . .	180 tons . .	340 tons

APPENDIX 32-A

(Chapter XIV)

SHEET No. 1.

PERFORMANCE AND OPERATING COSTS OF DIFFERENT TYPES OF LOCOMOTIVE POWER (BROAD GAUGE.)

Item No.	Description	Steam		Electric		Diesel		Gas Turbine					
								Internal Coal Burning		External Coal Burning		Oil Burning	
		Pass.	Goods.	Pass.	Goods.	Pass.	Goods.	Pass.	Goods.	Pass.	Goods.	Pass.	Goods.
I	Locomotive H. P. Rating . .	1,650	1,650	1,450	1,450	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
II	Locomotive Weight (Tons) . . .	160* (Average)	160* (Average)	80	80	123	123	145	145	145	145	133	133
III	Annual Mileage per loco . . .	56,000	33,000	84,000	49,500	70,000	41,300	70,000	41,300	70,000	41,300	70,000	4,12,300
IV	Effective Trailing Train Load (Tons)*	450	1,200	450	1,200	450	120	450	1,200	450	1,200	450	1,200
	Gross ,, ,, ,, (,,)	610	1,360	530	1,280	573	13,230	595	1,345	595	1,345	583	1,33
V	Trailing Ton Miles per loco per Annum	$25\cdot2\times10^6$	$39\cdot6\times10^6$	$37\cdot9\times10^6$	$59\cdot4\times10^6$	$31\cdot5\times10^6$	$49\cdot6\times10^6$	$31\cdot5\times10^6$	$49\cdot6\times10^6$	$31\cdot5\times10$	$49\cdot6\times10^6$	$31\cdot5\times10^6$	$49\cdot6\times10^6$
	Gross ,, ,, ,, ,, ,, ,, ,, ,, ,,	$34\cdot2\times10^6$	$44\cdot8\times10^6$	$44\cdot6\times10^6$	$63\cdot4\times10^6$	$40\cdot2\times1p^6$	$54\cdot7\times10^6$	$41\cdot7\times10^6$	$55\cdot6\times10^6$	$41\cdot7\times10^6$	$55\cdot6\times10^6$	$4c^6 9\times10^6$	$55\cdot1\times10^6$
VI	Capital Cost per Loco : Rs. . .	4,35,000	4,35,000	6,50,000	6,50,000	870,000	870,000	12,00,000	12,00,000	13,05,000	13,05,000	10,90,000	10,90,000
VII	Interest & Depreciation per Loco per annum Rs.	26,100	26,100	35,800	35,800	56,600	56,600	78,000	78,000	84,800	84,800	70,900	70,900
VIII	Crew cost per loco per annum Rs. .	8,700	8,500	11,600	10,600	9,700	8,800	9,700	8,800	9,700	8,800	9,700	8,800
IX	Maintenance & Repairs per loco per annum	28,000	16,500	25,200	14,900	45,500	25,900	24,500	14,500	24,500	14,500	24,500	14,500
X	Lubrication, Water & other Supplies per loco per annum Rs. . .	6,700	4,000	1,700	1,000	8,400	5,000	2,100	1,200	2,100	1,200	2,100	1,200

*Average weight of steam locomotive is taken for 75% of coal and and water on tender.

**Effective training load is taken as 75% of the design trailing load on level track.

PERFORMANCE AND OPERATING COSTS OF DIFFERENT TYPES OF LOCOMOTIVE POWER (BROAD GAUGE)

Item No.	Description	Steam			Electric			Diesel			Gas Turbine								
											Internal Coal Burning			External Coal Burning			Oil Burning		
			Pass.	Goods.		Pass.	Goods.		Pass.	Goods.		Pass.	Goods.		Pass.	Goods.		Pass.	Goods.
		Coal Rate Rs. Ton			Ener Rategy As./ kwh			Die-sel oil rate Rs./ Ton			Coal rate Rs./ ton			Coal rate Rs./ Ton			Crude oil rate Rs. / Ton		
	Cost of Fuel Energy in Rs. per loco per annum																		
	Steam {Pass :—175 Lbs. 100 GTM. Goods :—150 Lbs. 1000 GTM.	20	53500	60000	0·3	28400	40500	250	71,700	98,000	20	18,700	24,800	20	21,200	28,300	200	76,800	1,03,300
	Elec :—34 KWH/1000GTM	30	80000	90000	0·4	38000	54000	275	79,000	1,08,000	30	29,000	37,200	30	31,800	42,500	225	86,400	1,16,300
XI	Diesel :—16 Lbs./1000 GTM	40	107000	120000	0·5	47500	67800	300	86,000	1,17,500	40	37,300	49,600	40	42,400	56,700	250	95,000	1,29,000
	Gas Turbine 50 Lbs./1000	50	133500	150000	0·6	56800	81000	325	93,200	1,27,200	50	46,600	62,200	50	53,000	70,900	275	1,05,600	1,42,000
	GTM. Internal Coal Burning. Gas Turbine 57 Lbs./1000	60	160000	180000	0·7	66500	94300	350	1,00,400	1,37,000	60	56,000	74,500	60	6,36,000	85,000	300	1,15,000	1,55,000
	GTM. External Coal Burning. Gas Turbine 21 Lbs./1000 GTM. (crude oil) Burning.																		
		20	123000	115100	0·3	102700	102080	250	1,91,900	1,94,300	20	1,33,000	1,27,300	20	1,42,300	1,37,600	200	1,84,000	1,98,700
	Total Operating Costs .	30	149500	145100	0·4	112300	116300	275	1,99,200	2,04,300	30	1,43,300	1,39.700	30	1,52,900	1,51,800	225	1,93,600	2,11,700
XII	Rs. per loco per annum .	40	176500	175100	0·5	121800	130100	300	2,06,200	2,11,200	40	1,51,600	1,52,100	40	1,63,500	1,66,000	250	2,02,200	2,24,400
		50	203000	205100	0·6	131100	143300	325	2,13,400	2,23,500	50	1,60,900	1,64,500	50	1,74,100	1,80,200	275	2,12,800	2,37,400
		60	229500	235100	0·7	140800	156600	350	2,20,600	2,33,300	60	1,70,300	1,77,000	60	1,84,700	1,94,300	300	2,22,200	2,50,400
		20	4·18	2·91	0·3	2·71	1·73	250	6·1	3·92	20	4·22	2·57	20	4·52	2·77	200	5·85	4·01
	Operating Costs in .	30	5·93	3·67	0·4	2·96	1·95	275	6·33	4·12	30	4·55	2·82	30	4·86	3·06	225	6·15	4·27
XIII	Rs./1000 Trailing Ton . .	40	7·0	4·43	0·5	3·22	2·19	300	6·56	4·26	40	4·81	3·07	40	5·19	3·35	250	6·43	4·53
	Miles. . . .	50	8·05	5·18	0·6	3·46	2·42	325	6·78	4·51	50	5·11	3·32	50	5·53	3·64	275	6·76	4·79
		60	9·1	5·94	0·7	3·72	2·64	350	7·02	4·7	60	5·41	3·57	60	5·87	3·92	300	7·06	5·05
	Average Operating costs .	20	3·57		0·3	2·6		250	4·65		20	3·12		20	3·35		200	4·62	
	On Pass - Goods Ratio	30	4·42		0·4	2·29		275	4·86		30	3·4		30	3·66		225		
XIV	for 1 : 2	40	5·29		0·5	2·53		300	5·03		40	3·65		40	3·96		250	4·9	
	Rs./1000 Trailing Ton Miles .	50	6·14		0·6	2·77		325	5·27		50	3·92		50	4·27		275	5·16	
		60	6·99		0·7	3·0		350	5·47		60	4·18		60	4·57		300	5·45	
																		5·72	
XV	Fixed Costs on Electric Track equipment & Installation. (Rs./Track Mile/Annum.)	..				8700													

APPENDIX 32-A (*contd.*)
SHEET No.3

BASIS FOR ESTIMATING PERFORMANCE AND OPERATING COSTS OF DIFFERENT TYPES OF LOCOMOTIVE POWER

Item No.	Description	Steam	Electric	Diesel	Gas Turbine		
					Coal burning		Oil burning
					Internal	External	
I	Loco H. P. rating (For same hauling capacity).	1,650 (WP/WG)	1,450	1,600	1,600	1,600	1,600
II	H. P. /Ton of weight Loco weight in Tons	160* (WP/WG)	18 80	13 123	11 145	11 145	12 133
III	Annual Mileage Ratio	1	1·5	1·25	1·25	1·25	1·25
	Annual Mileage — Pass.	56,000 (WP)	84,000	70,000	70,000	70,000	70,000
	Annual Mileage — Goods	33,000 (WG)	49,500	41,300	41,300	41,300	41,300
IV	(*a*) Trailing train load† — Pass :	450 (WP.)	.. .. .. Same as in steam				
	(*a*) Trailing train load† — Goods	1,200 (WG.)	.. .. .. Same as in steam				
	(*b*) Gross train Load	Loco weight plus trailing train load					
V	(*a*) Trailing Ton miles per Loco per annum	.. Annual Mileage × Trailing Train load					
	(*b*) Gross ton miles per loco per annum	.. „ „ × Gross „ „					
VI	Loco price Ratio.	1	1·5	2	2·75	3	2·5
	Price in rupees	4,35,000 (WP/WG)	6,50,000	8,70,000	1,20,000	13,05,000	1,09,000
VII	Interest rate per annum Depreciation per annum (on sinking fund method)	2%	1½%	2½%	4% 2½%	2½%	2½%
VIII	Crew	1 Driver 2 Firemen	..	..	1 Driver & 1 Asstt. Driver ..		
	Crew mileage per month—Rs. — Pass.	4,700 (WP)	..	..	Same as in steam ..		
	Crew mileage per month—Rs. — Goods	1,900 (WG)	..	..	Same as in steam ..		
	Crew earning per month—Rs. — Pass.	732	648	..	Same as in electric ..		
	Crew earning per month—Rs. — Goods	490	406	..	Same as in electric ..		
	Crew cost per mile— Rs. — Pass.	0·156	0·138	..	Same as in electric ..		
	Crew cost per mile— Rs. — Goods	0·258	0·214	..	Same as in electric ..		
IX	Maintenance and repair cost for engine mile Rs.	0·5	0·3	0·65	0·35	0·35	0·35
X	Cost per engine mile — Lubrication	0·05	0·01	0·01	0·02	0·02	0·02
	Cost per engine mile — Water	0·05	...	0·01	...	...	...
	Cost per engine mile — Other supplies	0·02	0·01	0·01	0·01	0·01	0·01
XI	Fuell/energy per 1,000 G.T.M.	Coal	Elec. energy	Diesel Oil	Coal	Coal	Crude oil
	Pass.	175 lbs.	34 kwh	16 lbs.	50 lbs.	57 lbs.	21 lbs.
	Goods	150 lbs.					
XII	Operating cost per loco per annum	Sum of items VII, VIII, IX, X, & XI.					
XIII	Operating cost per 1000 trailing ton miles	Item XII ÷ Item V (*a*).					
XIV	Pass : Goods ratio	1 : 2					
XV	Fixed cost of electric track equipment and	...	8,700	...	...	...	...

APPENDIX 32 b

(Chapter XIV)

SHEET No. 4

BALANCING TRAFFIC DENSITY IN MILLION TRAINING TONS PER SINGLE TRACK MILE PER ANNUM

At cost of coal in Rs./Ton.	At cost of electric energy in As./KWH.				
	0·3	0·4	0·5	0·6	0·7
20	5·67	6·70	8·37	10·9	15·3
30	3·68	4·08	4·60	5·27	6·12
40	2·70	2·90	3·15	3·45	3·80
50	2·13	2·26	2·41	2·58	2·77
60	1·77	1·85	1·95	2·06	2·18

NOTE :

{Balancing traffic density in trailing tons per single track mile per annum} × {Operating cost of Electrictraction per trailing ton mile} + {Fixed cost per track mile of electric installation & equipment} = {Balancing traffic density in trailing tons per single track mile per annum} × {Operating cost of steam traction per trailing ton mile}


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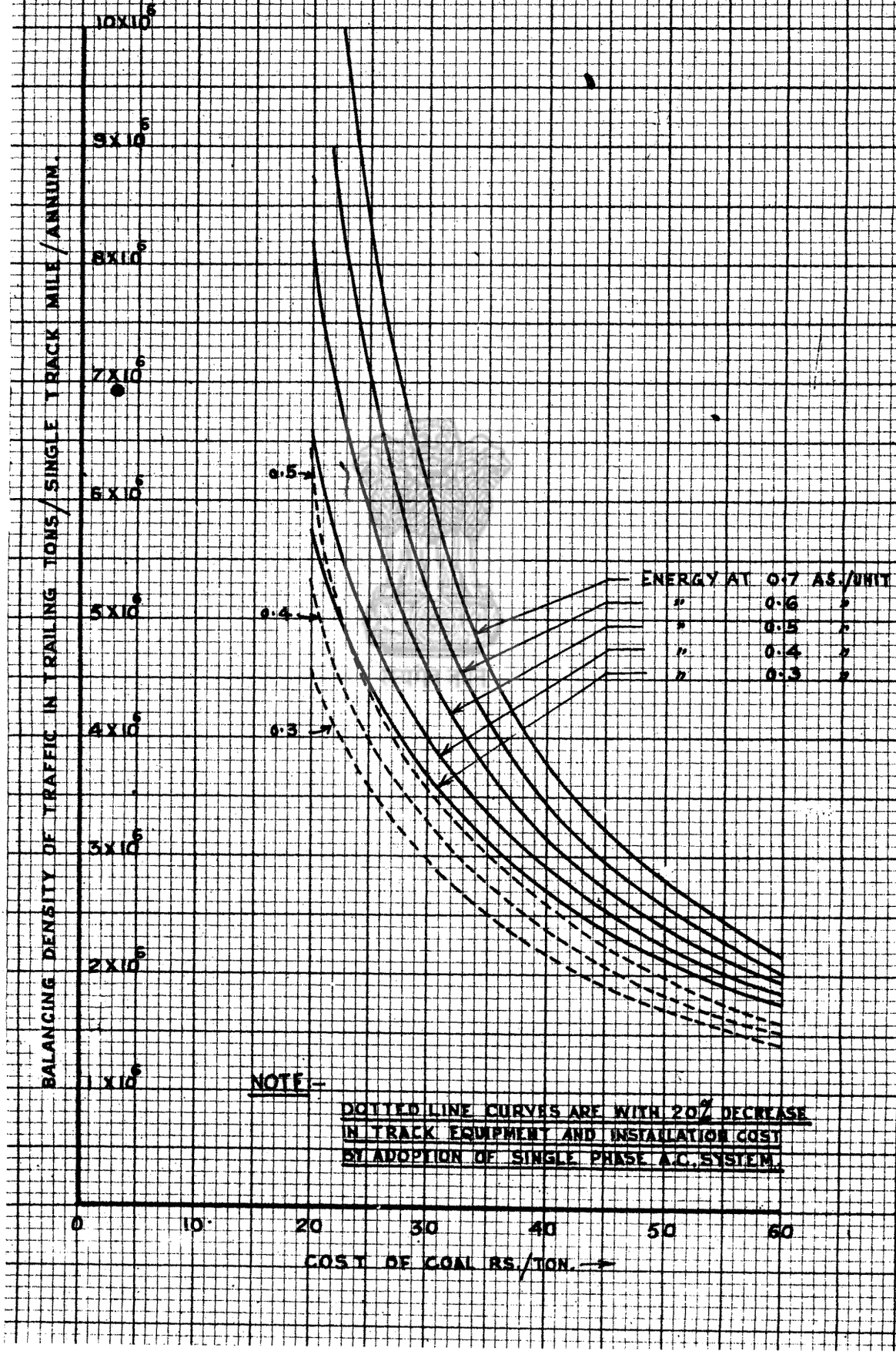
FIG. 24 APPENDIX 32-5 (CHAPTER XIV)

MINIMUM TRAFFIC DENSITY TO JUSTIFY ELECTRIFICATION

BROAD GAUGE



APPENDIX 33

(Chapter XIV)

ECONOMIC COMPARISON BETWEEN STEAM AND DIESEL POWER FOR LIGHT CAR SERVICES

(With 2 trailers for Steam & 1 trailer for Diesel)

Item No.	Description		Steam	Diesel
I.	H. P. Rating of power Unit		600	450
II.	Load in tons	Weight of power unit (w.o.)	40	50
		Number of trailers	2	1
		Wt. of Trailers (w.o.)	80	40
		Gross load of train Unit	120	90
III.	Mileage	No. of trips (40 miles each) per day	3	4
		No. of miles per day	120	160
		No. of days in use per annum	240	280
		Total mileage per annum	28,800	44,800
IV.	Gross Ton Miles per annum		$34{\cdot}6 \times 10^5$	$40{\cdot}4 \times 10^5$
V.	Passenger capacity	Power Unit	...	69
		Trailers	196	98
		Total per train Unit	196	167
VI.	Passenger Miles per annum		$56{\cdot}5 \times 10^5$	$74{\cdot}8 \times 10^5$
VII.	Capital Cost Rs.	Power Unit	225000	350000
		Trailers	250000	150000
		Total per train Unit	475000	500000
		COSTS		
VIII.	Interest on Capital cost	Rate per annum	4%	4%
		Total Rs/annum	19000	20000
IX.	Depreciation on capital cost	Rate per annum (power unit)	2%	2½%
		Rs./annum "	4500	8750
		Rate per annum (trailers)	1½%	1½%
		Rs./annum "	3750	2250
		Total Rs./annum	8250	11000
X.	Crew Cost	Crew.	driver&Fireman	Driver
		*Crew earnings Rs/month	435	310
		Crew mileage/month	3000	3000
		Crew cost Rs./mile	0·145	0·103
		Total crew cost Rs./annum/train unit	4180	4620
XI.	Maintenance & Repairs	Rs./mile-Power Unit	0·35	0·5
		Rs./mile-Trailers	0·2	0·1
		Rs./mile-Total train unit	0·55	0·6
		Total-Rs./annum	15820	26900
XII.	Lubrication, water & other supplies/train unit	Rs./mile	0·1	0·1
		Total Rs./annum	2880	4480
XIII.	Fuel cost Rs./annum for train unit (Fuel consumption rate) (Steam 250 lbs/1000 GTM) (diesel 25 lbs/1000 GTM)		@ coal rate	@ oil rate
			20 7720	250 11300
			30 11570	275 12400
			40 15450	300 13500
			50 19300	325 14650
			60 23200	350 15770
XIV.	Total operating cost/train unit. Rs./annum		20 57850	250 78300
			30 61700	275 79400
			40 65580	300 80500
			50 69430	325 81650
			60 73330	350 82770

APPENDIX 33 (*contd.*)

Item No.	Description	Steam		Diesel	
XV.	Operating cost of train unit Rs./100 passenger miles	20	1·022	250	1·045
		30	1·091	275	1·060
		40	1·159	300	1·075
		50	1·225	325	1·090
		60	1·295	350	1·105

*NOTE CREW EARNINGS /MONTHS	*Driver*	*Fireman*
Pay	120	50
Mileage	100	20
D. A.	60	45
PF. & GR.	30	10
TOTAL Rs/MONTH	310	125

ECONOMIC COMPARISON BETWEEN STEAM AND DIESEL POWER FOR LIGHT CAR SERVICES

(with 4 trailers for Steam & 2 trailers for Diesel)

I.	H. P. Rating of power unit		600	450
II.	Load in tons	Weight of power unit (w.o.)	40	50
		Number of trailers	4	2
		Wt. of trailers (w.o.)	160	80
		Gross load of train Unit	200	130
III.	Mileage	No. of trips (40 miles each) per day	3	4
		No. of miles per day	120	160
		No. of days in use per annum	240	280
		Total mileage per annum	28800	44800
IV.	Gross Ton Miles per annum		$57·6\times10^5$	$58·3\times10^5$
V.	Passenger capacity	Power Unit	..	69
		Trailers	392	196
		Total per train Unit	392	265
VI.	Passenger Miles per annum		113×10^5	$118·5\times10^5$
VII.	Capital Cost Rs.	Power Unit	225000	350000
		Trailers	500000	275000
		Total per train unit	725.00	625000
	COSTS			
VIII.	Interest on capital cost	Rate per annum	4%	4%
		Total Rs./annum	29000	25000
IX.	Depreciation on capital cost	Rate per annum (power Unit)	2%	2½%
		Rs./annum (power Unit)	4500	8750
		Rate per annum (trailers)	1½%	1½%
		Rs./annum (trailers)	7500	4150
		Total Rs/annum	12000	12900
X.	Crew cost	Crew	Driver & fireman	Driver
		*Crew earnings Rs./month	435	310
		Crew mileage/month	3000	3000
		Crew cost Rs./mile	0·145	0·103
		Total crew cost Rs./annum/train unit	4180	4620
XI.	Maintenance & Repairs	Rs./mile—Power Unit	0·35	0·5
		Rs./mile—Trailers	0·4	0·2
		Rs./miles—Total train unit	0·75	0·7
		Total—Rs./annum	21600	31300
XII.	Lubrication, water and other supplies/train unit	Rs./mile	0·10	0·10
		Total Rs./annum	2000	4480

APPENDIX 33—*(contd.)*

Item No.	Description	Steam		Diesel	
XIII.	Fuel Cost. Rs./annum for train unit (Fuel consumption rate:-) (Steam-250 lbs/1000 GTM.) (diesel—25 lbs./1000 GTM).	@ *Coal* rate		@ *Oil* rate	
		20	12850	250	16250
		30	19300	275	17850
		40	25750	300	19500
		50	32150	325	21150
		60	38600	350	22750
XIV.	Total operating cost/train unit. Rs./annum	20	82570	250	94550
		30	88960	275	96150
		40	95410	300	97800
		50	101810	325	99450
		60	108260	350	101050
XV.	Operating cost of train unit. Rs./100 passenger miles	20	0·730	250	0·798
		30	0·788	275	0·812
		40	0·845	300	0·825
		50	0·900	325	0·839
		60	0·958	350	0·851

*NOTE.—CREW EARNINGS MONTH

	Driver	*Fireman*
Pay	120	50
Mileage	100	20
D. A.	60	45
PF. & GR.	30	10
Total Rs./month	310	125

ECONOMIC COMPARISON BETWEEN STEAM AND DIESEL POWER FOR SHUNTING SERVICES

Item No.	Description	Steam	Diesel
	Mileage — Hours in service per day	16	20
	Mileage — Miles per day (@ 5 M.P.H.)	80	100
	Mileage — Days in use per annum	260	300
	Mileage — Total mileage per annum	20,800	30,000
II.	Capital per loco	250,000	400,000
	COSTS		
III.	Interest on Capital cost — Rate per annum	4 %	4%
	Interest on Capital cost — Total Rs./ annum	10,000	16,000
IV.	Depreciation on capital cost — Rate per annum	2%	2 1/2%
	Depreciation on capital cost — Total Rs./ annum	5,000	10,000
V.	Crew cost — Crew	Shunter & Fireman	Shunter
	Crew cost — *Crew earnings. Rs./month	242	140
	Crew cost — Crew mileage per month	1,000	1,000
	Crew cost — Crew cost per mile	0·242	0·14
	Crew cost — Total crew cost Rs./ annum per loco	5,040	4,200
VI.	Maintenance and Repair cost. — Rs./Mile	0·5	0·6
	Maintenance and Repair cost. — Total. Rs./annum	10,400	18,000

APPENDIX 33—*concld.*

Item No.	Description.		Steam		Diesel	
VII.	Lubrication, Water and Other Supplies.	Rs./mile	0·12		0·12	
		Total Rs./annum.	2,500		3,600	
VIII.	Fuel cost Rs./annum		*Coal rate*		*Oil rate*	
	Fuel consumption Rate — Steam—70 Lbs. Coal/Mile		20	13,000	250	20,100
			30	19,500	275	22,100
	Diesel—6 Lbs. Oil/mile.		40	26,000	300	24,100
			50	32,500	325	26,100
			60	39,000	350	28,100
IX.	Total Operating costs	Rs./annum	@ *Coal rate*		@ *Oil rate*	
			20	45,940	250	71,900
			30	52,440	275	73,900
			40	58,940	300	75,900
			50	65,440	325	77,900
			60	71,940	350	79,900
X.	Operating Cost	Rs./Shunting Mile	20	2·21	250	2·40
			30	2·52	275	2·46
			40	2·83	300	2·53
			50	3·15	325	2·60
			60	3·46	350	2·69

*NOTE.—CREW EARNINGS PER MONTH

	Shunter	Fireman
Pay and Mileage	80	50
D. A.	50	45
PF. & G. R.	10	—
Total Rs./month	140	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ECONOMIC COMPARISON BETWEEN STEAM & DIESEL POWER FOR LIGHT RAIL CAR SERVICES.

(WITH 2 TRAILERS FOR STEAM & 1 TRAILER FOR DIESEL.)

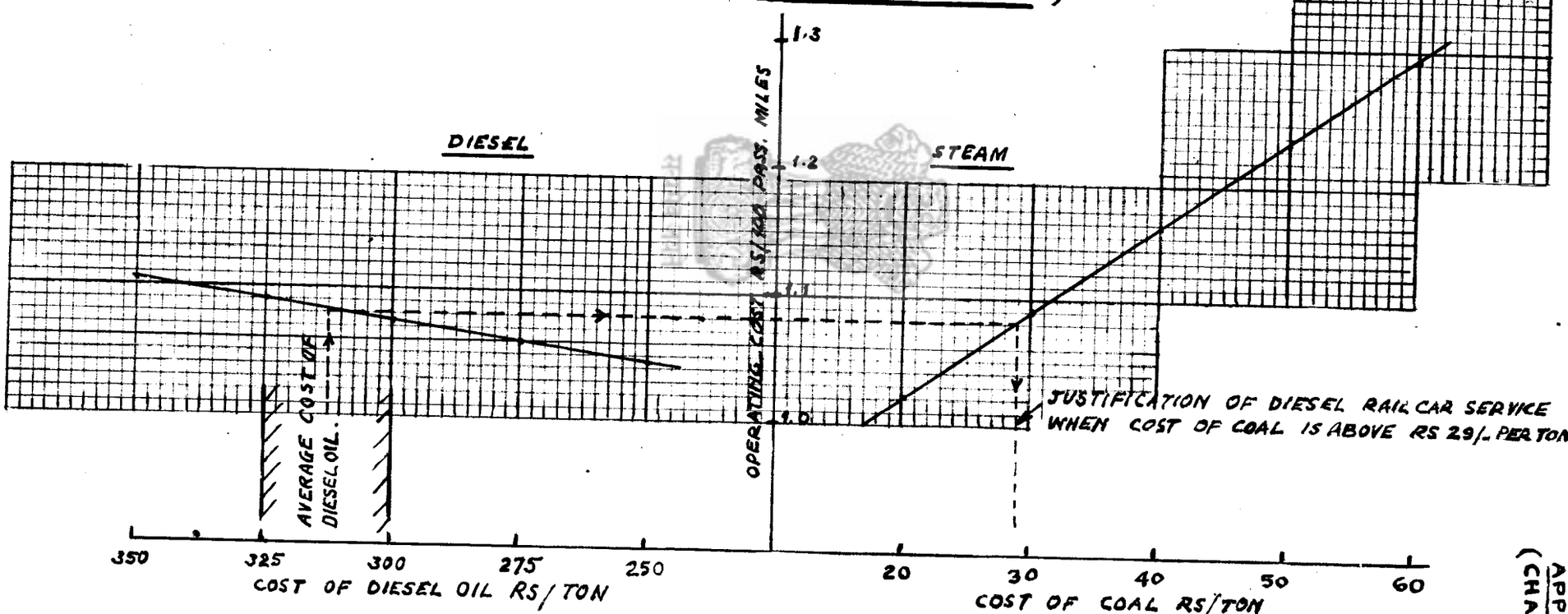

FIG. 25
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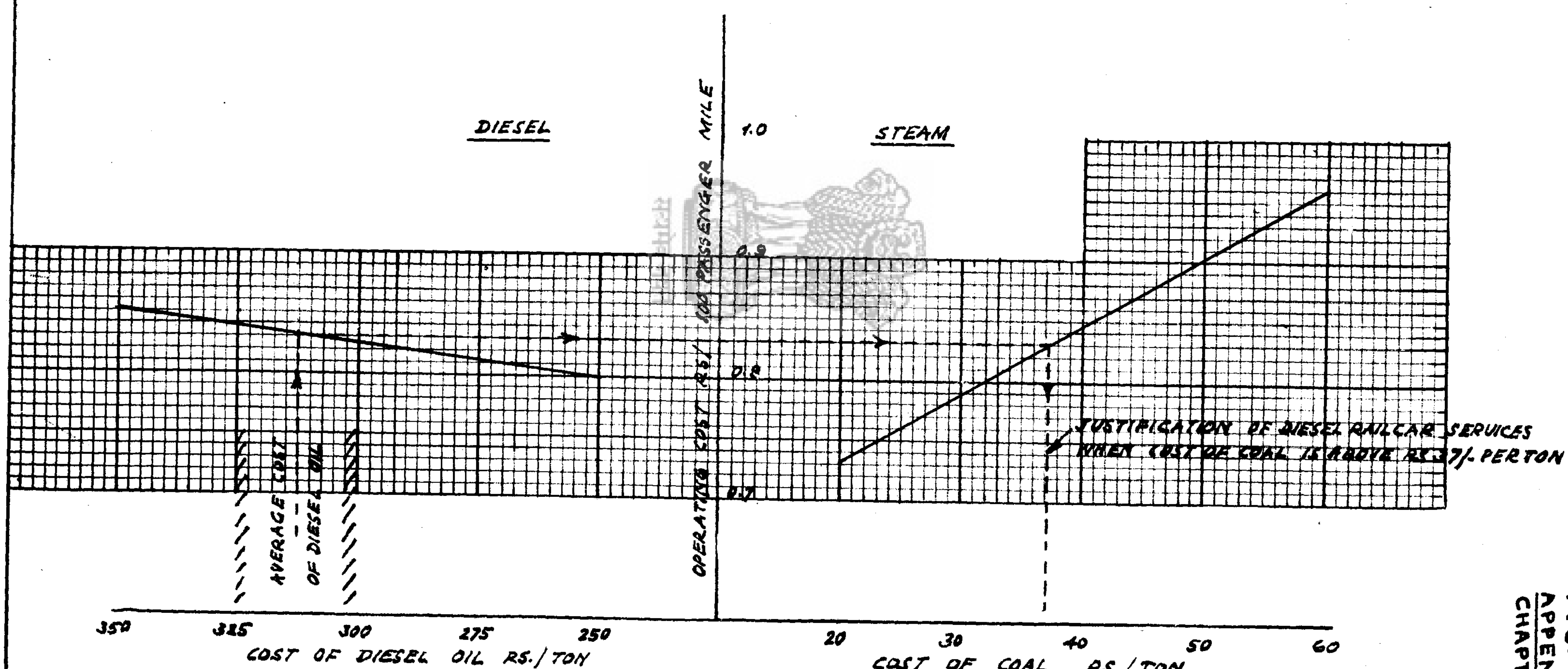
FIG. 26
APPENDIX. 33
CHAPTER (XIV)

ECONOMIC COMPARISON BETWEEN STEAM & DIESEL POWER FOR LIGHT RAILCAR SERVICES

(WITH 4 TRAILERS FOR STEAM & 2 TRAILERS FOR DIESEL)



S.T.A
RFEEC.
14/3/53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REEC.

14/3/53
S.T.A.

ECONOMIC COMPARISON BETWEEN STEAM & DIESEL POWER FOR SHUNTING SERVICES

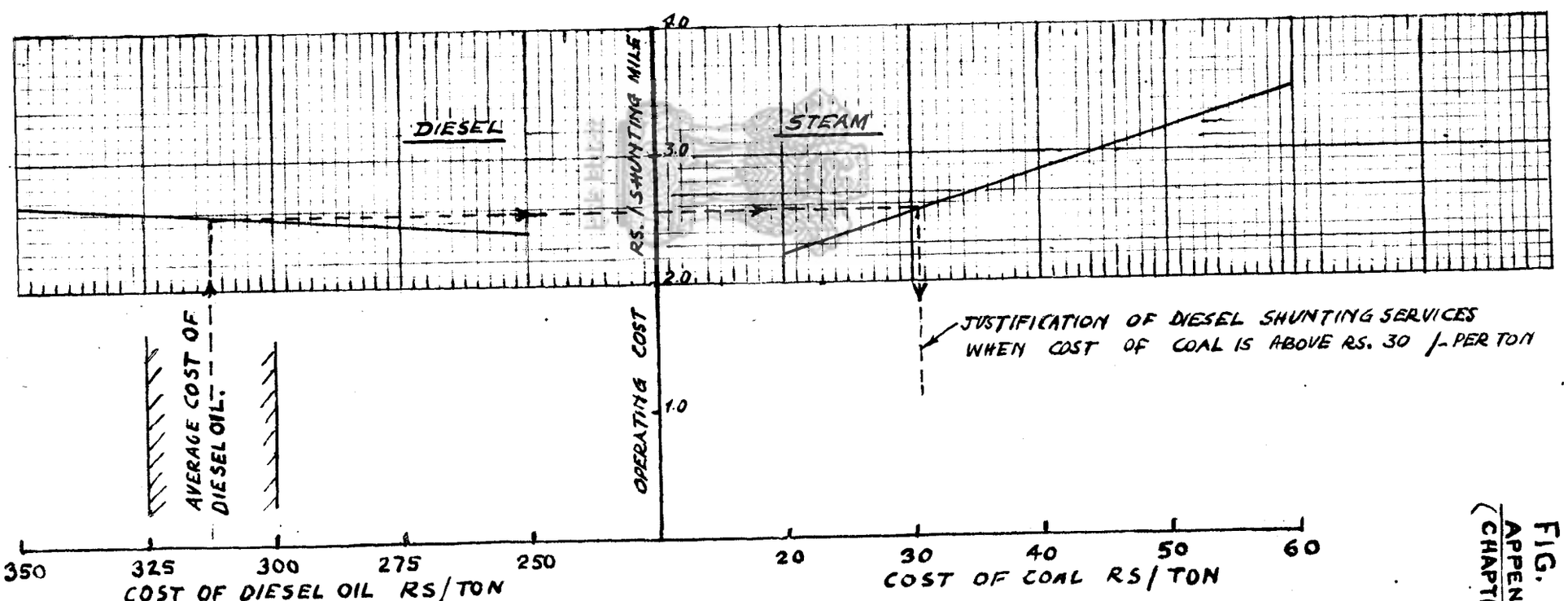

FIG. 27.
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(CHAPTER - XIV)

APPENDIX 34

Chapter XIV

PROJECTS FOR RAILWAY ELECTRIFICATION AND FINANCIAL RESULTS

(Statement showing the Capital Outlay at present day (1952) prices and the financial results based on the working expenses and a percentage of saving on the net outlay for the financially justifiable electrification projects).

Description	Suburban electrification	Main line electrification.	
	Howrah Division	Igatpuri	Bhusaval**
	Howrah-Burdwan *via* Grand Chord and Howrah-Burdwan *via* Main* 1955-56 level of traffic.	1951-52 level of traffic	1955-56 level of traffic
I. *Mileages.*			
(*a*) Route miles	150·74	192	192
(*b*) Track miles	326·77	450	450
(*c*) Train miles } Passenger & Goods in thousands	3,320 (Suburban)	2,900	3,390
(*d*) Ton miles }	25,000 (Coach miles-Elec).	2,407,000	2,792,000
II. *Capital Outlay in Lakhs of Rupees*			
(*a*) Rolling Stock (Locomotives)	370·2 (Elec. equipment of motor coaches).	291·76	312·60
(*b*) Overhead	419·2	285·00	285·00
(*c*) High Tension Transmission	100·4	147·37	147·37
(*d*) Substations	192·8	289·74	289·74
(*e*) Signals	20·7	...	...
(*f*) Miscellaneous	88·2	48·13	48·13
(*g*) General charges	178·4	201·78	205·74
(*h*) *Total Gross Outlay*	*1,375·9*	*1263·78*	*1,288·68*
(*i*) Credit for locos and other works	647·25	384·85	491·71
(*j*) Total net outlay for electrification	728·65	878·93	796·87
III. *Annual Working expenses in lakhs of Rupees.*—			
(A) *Electric Traction.*			
(*a*) Working expenses	33·51	28·13	31·08
(*b*) Cost of energy	38·33	19·39	22·41
(*c*) Contribution to Sinking Fund	24·41	15·85	16·16
(*d*) Interest on Capital at 4%	55·03	50·55	51·54
(*e*) Less Credits	..	0·87	0·94
(*f*) Total (A)	151·78	113·05	120·25
(B) *Steam Traction.*			
(*a*) Working expenses	75·59	56·63	65·33
(*b*) Cost of coal	55·58	55·06	64·10
(*c*) Contribution to Sinking Fund	8·69	7·99	10·23
(*d*) Interest on Capital at 4%	25·89	15·19	19·46
(*e*) Total (B)	165·75	134·87	159·18
IV. *Annual saving due to electrification in lakhs of Rupees.*— III (B)—III (A)	13·97	21·82	38·93
V. Percentage return on *net outlay* after allowing for Interest at 4% and Depreciation [IV÷II (J)]	1·9%	2·48%	4·88%

Remarks.–

*Including Tarakeswar, Naihati, Bandel & Calcutta Chord Sections.

**(*i*) 1955-56 level of traffic being considered as the saturation point for steam traction, it has been taken as the upper limit for comparison.

(*ii*) Operational necessity apart from financial and all other considerations ; saturation point for steam Traction in 1955-56 *vide* a memorandum sent to the Railway Board.


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APPENDIX 36

(Chapter XIV)

CHOICE OF OPERATING VOLTAGE AND THE ELECTRIC CURRENT SYSTEM

The choice of operating voltage and the electric current system is, to a large extent dependent upon the type of service (which may be purely main line, suburban or a combination of both) density of traffic, extent of the length of line to be electrified, local conditions and other technical and economic considerations.

Of the various systems adopted in different countries the following are most commonly in use—

1. Direct Current System . . . . . (i) 1500 Volts.
   (ii) 3000 Volts.
2. A.C. High Tension Single Phase 16-2/3Cycles System.

Direct Current System—Unless the traffic density is sufficiently high the D.C. System may not prove to be economical owing to the large amount of copper required to keep the line voltage under optimum conditions and consequently heavy steel structures required for the purpose. Further the substations are required to be spaced closely (more so under 1500 volts D. C.) thereby increasing the capital cost on substation equipment. Again unless the traffic density is sufficiently high the D.C. System does not as a rule prove economical. Where traffic densities justify, the 3000 volts D.C. System is now adopted all over the world in preference to 1500 volts system. The 3000 volts D.C. System is equally suitable for suburban service as for main line service.

2. *A.C. High Tension Single Phase 16-2/3 Cycles System*—Countries like Switzerland, Germany and Sweden have extensively resorted to electrification at 16-2/3 cycles single phase high tension A.C. system. The disadvantage of this system lies in the fact that it requires special power stations and special high voltage transmission lines for the supply. These special power stations and special transmission lines will serve the purpose of railway traction only and transmission lines of an expensive type were adopted as extensive national electric grid systems had not developed at that time. In case of supply from a power supply system at industrial frequency at railway substations which need to be equipped with rotary phase and frequency changers are necessary and though these substations are smaller in number than under the 3000 volts D.C. system, they are expensive.

One of the serious disadvantages of the A.C. System is its interference with the telegraph and telephone circuits running adjacent to the lines. The remedial measures which are required to be adopted to make the telegraph and telephone circuits proof against interference from the A.C. System absorb the major part of the economic advantage gained by the adoption of the A.C. System.

Further the inherent disadvantage of single phase A.C. System is that it produces low power factor in the 3-phase high tension transmission lines while in the case of D.C. System this can be kept very near unity.

A.C.Single phase 50 cycles System—The 50 cycles single phase A.C. System is being tried out as a regular field experiment in France and this system has great potentiality inasmuch has it enables power to be drawn from the line at industrial frequency thereby dispensing with all phase and frequency changer equipment required for the single hase low fequency systems.

There are various special devices used for converting the single phase H.T. A.C. 50 cycles system such as—

(1) Kando phase converter system.
(2) Ignitron system.
(3) Single phase 50 ∿ traction motors system.

The Kando system has not gained much ground in spite of its being in use for several years in Hungary.

The ignitron system is undergoing experiment in USA and France and has been reported upon favourably.

Great strides have been made in the design of the single phase 50 ∿ 'Direct' motor with improved commutation. Should this prove successful the cost of traction overhead lines and substations would be brought down to the minimum, but against this, arrangements will still have to be made for avoiding interference of the traction system with telephone and telegraph circuits.

In conclusion for conditions that are ordinarily met in India it appears that the final choice rests between 3000 volt D.C. System and the Single phase high tension System at industrial frequency.

As the economic advantages of one system over the other are dependent upon the density of traffic, the extent of electrification, local conditions, type of service and other considerations, it is felt that the matter should be looked into in great detail to enable the adoption of one system or the other for future electrification in India.


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APPENDIX 37

(Chapter XV)

DUTIES OF DIFFERENT CATEGORIES OF STAFF IN THE RAILWAY FUEL CONTROL ORGANISATION

CHIEF FUEL INSPECTORS.—They will be posted at the Railway Headquarters and will be responsible for :—

(1) Supervising the work of all Senior Fuel Inspectors and maintaining discipline among the staff of the organisation,

(2) Ensuring that the fuel economy directives issued by the Centre are properly understood by the staff of the Railway Fuel Control Organisation and that the policy of the Centre is implemented,

(3) Maintaining a general control over the working of the Fuel Control Organisation and bringing all important matters including those arising out of complaints from the Inspectors to the notice of the Fuel Officer,

(4) Periodic inspection of the distributing centres and sheds,

(5) Examining the necessity or otherwise of important trials, experiments, etc., suggested by Senior Fuel Inspectors before obtaining the Fuel Officer's orders in each case ; and the disposal of reports on such trials,

(6) Arranging for any trials, experiments etc. required by the Centre and taking steps to ensure that they are properly carried out,

(7) Preparing reports on trials, experiments etc. mentioned in (6) above, and submitting the same for approval to the Fuel Officer before submission to the Centre,

(8) Holding periodic meetings with Senior Fuel Inspectors, Junior Fuel Inspectors and Shed Fuel Inspectors, to issue necessary instructions and to discuss progress reports submitted by the Senior Fuel Inspectors.

SENIOR FUEL INSPECTORS (TRANSPORTATION).—They will be posted at the Railway Headquarters and will be responsible for :—

(1) Checking on marshalling operations and train detention in yards and on line,

(2) Checking control charts and investigating detention, and

(3) Scrutinising time tables, service links and checking of light engine working etc. for economic utilisation of power.

SENIOR FUEL INSPECTSORS FOR DISTRICTS OR ZONES.—They will normally be postedat the Headquarters of large districts or divisions and will be responsible for :—

(1) Supervising and directing the work of the Junior Fuel Inspectors, Shed Fuel Inspectors and other Staff working under them,

(2) Carrying out trials, experiments or special investigations ordered by the Centre according to the instructions of the Chief Fuel Inspector and/or the Fuel Officer.

(3) Fixing trip rations with the assistance of Junior Fuel Inspectors.

(4) Scrutinising all fuel consumption statements or outlining the action to be taken for improvements.

(5) Making frequent trips to sheds and on locomotives to ascertain that the rations fixed are correct, to check link working, and to find if there are any avoidable reasons for high coal consumption,

(6) Investigations into engine failures and detentions,

(7) Supervising the sampling of coal supplies for analysis and test, and

(8) Holding periodic meetings and drawing up progress resports on the work of their districts with the help of the Junior Fuel Inspectors.

JUNIOR FUEL INSPECTORS.—The duties of the Junior Fuel Inspectors will be:—

(1) To educate engine crews in the best methods of fuel economy and avoidance of wasteful practices,

(2) To carry out coal consumption tests at the direction of Senior Fuel Inspector in oder to fix or revise trip rations,

(3) To investigate and report on the ability of foot plate staff with reference to consistently high fuel consumption,

(4) To ensure that drivers promptly book the necessary repairs and that these repairs are satisfactorily carried out in Sheds, and to keep an eye on the general state of maintenance of the locomotives in so far as it affects their fuel consumption,

(5) To keep a check on the quality of coal received at shed and issued to engines on different services and investigate complaints regarding inferior quality of coal issued to drivers.

(6) To pay periodical visits to the depots and check up on the correct stacking and labelling of coal, and

(7) To see that all fuel books and records are correctly maintained.

APPENDIX 37 (*contd.*)

SHED FUEL INSPECTORS.—The Shed Fuel Inspectors will be incharge of one or more sheds depending on the capacity of the sheds. The duties of the Shed Fuel Inspectors will be more or less similar to those of the Junior Fuel Inspector except that they will carry out them in shed working with particular reference to :—

(1) Checking of tender balances of coal and train service fuel forms with reference to the trip allowances and to investigate and report regarding any excess consumption,

(2) Checking and controlling coal consumption in shed for ' lighting up', ' banking fires ', etc.

(3) Ensuring proper stacking of coal, correct unloading of wagons and checking on the receipts and issues of coal and their records.

(4) Ensuring the efficient working of the Watch and Ward with reference to pilferage of coal from sheds.

INSTRUCTING FIREMEN.—They will be located at divisional or district head-quarters and will work under the instructions of Junior Fuel Inspectors in connection with the training of engine crew in firing methods and general duties.

FUEL CHECKING CLERKS.—Fuel Checking clerks will work under the control of the Shed Fuel Inspectors and their duties will be :—

(1) To estimate the coal left on the tenders of all incoming engines,

(2) To fill in the forms for coal issued,

(3) To issue fuel for use in stationary boilers,

(4) To supervise the work of fuel issuers, and

(5) To maintain fuel issue and con umption records and to work out all the coal consumption statistics required for fuel control.

APPENDIX 38-*a*

(Chapter XV)

REGIONAL FUEL CONTROL ORGANISATION

(*a*) *Assumptions in respect of each Regrouped Railway Systems.*

Number of Divisions	6	
Locomotives on line per Division	240	
Coal Consumption per Division	24,000	tons a month.

The above figures will be generally representative of a regrouped Railway System.

Posts.	Scale of pay.	Number of posts.	Mean cost per month.
(*i*) *Headquarters.*			
Chief Combustion (or Fuel) Engineer	1300—1600	1	1450
Combustion (or Fuel) Engineer (Senior Scale)	600—1150	1	880
Chief Fuel Inspector (L. G. S.) Headquarters	300—800	1	550
Senior Fuel Inspector (Transportation) Headquarters	360—500	1	430
(*ii*) *Division.*			
*Senior Fuel Inspectors	360—500	6	2580
†Junior Fuel Inspectors	300—400	24	8400
**Shed Fuel Inspector	260—350	24	7320
‡Instructing Fireman	160—220	24	4320
			25930
Add about 30% for leave salary, P. F. allowances and contingencies			7780
Total for each regional (regrouped) Railway System			33710
	Rounded off to		35,000 p.m

*One Senior Fuel Inspector for each Division.

†One Junior Fuel Inspector for every 60 locomotives on line.

**Approximately one Shed Fuel Inspector for each major shed.

‡One Instructing Fireman for every 60 locomotives on line.

APPENDIX 38-b.

(Chapter XV)

CENTRAL FUEL CONTROL DIRECTORATE.

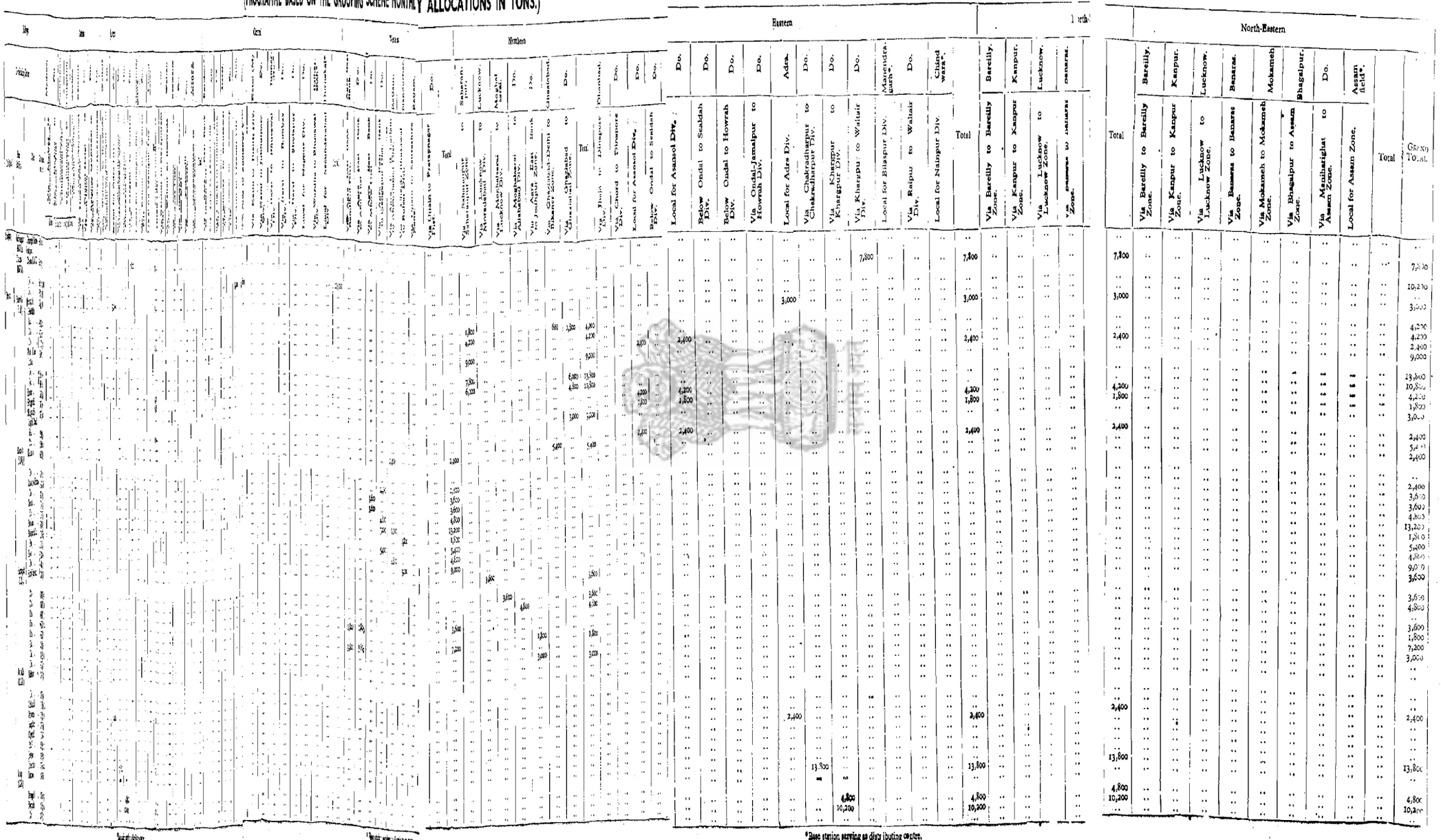
Posts.	Scale of pay.	No. of posts.	Mean cost per month
Director	1800—2000 plus S.P. Rs. 250/p. m.	1	2150
Joint Director	1300—1600 *plus S. P. Rs. 200/- p. m.	1	1650
Deputy Director	600—1150 (Senior scale) plus S.P. Rs. 200/- p. m.	2	2150
Assistant Director	350—850 (Junior Scale) plus S.P. Rs. 150/- p.m.	2	1500
Superintendents	530—710	2	1240
Senior Fuel Inspectors	530—710	6	3720
Assistant-in-Charge	160—450 plus S. P. Rs. 50/- p. m.	2	710
Assistants including Statisticians	160—450	12	3660
Stenographers	160—330	6	1470
Clerks	55—130	15	1390
Typists	55—130	4	370
Record Sorter	40—60	1	50
Daftries	35—50	2	80
Peons	30—35	16	
			20,660
Add about 30% for leavy salary, P. F. allowances and contingencies			6,200
	TOTAL		26,860
	Rounded off to a max. of about		Rs. 30,00 p.m

*When it is certified that incumbent would hold J.A.post on his railway but for deputation.

GIPD—1—35RB—25-2-55—1500

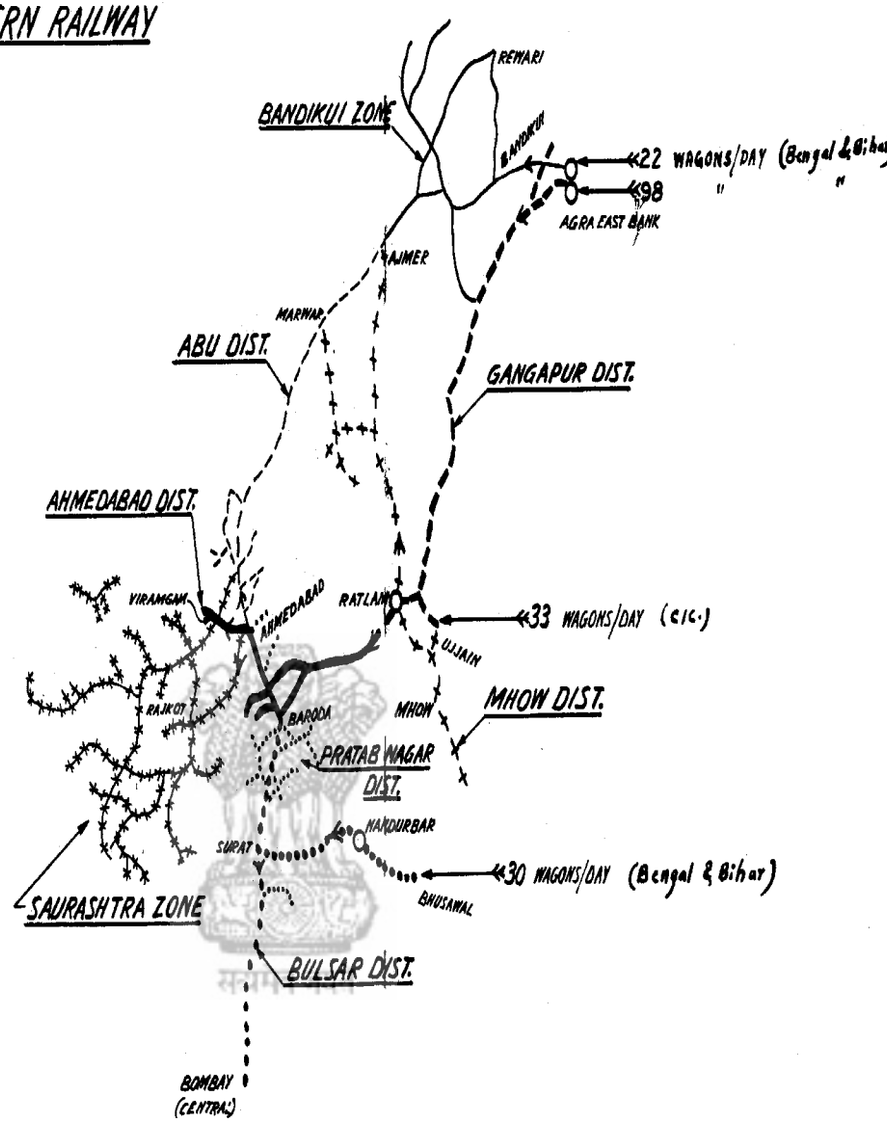
PLAN FOR SUPPLY AND DISTRIBUTION OF LOCO COAL

(PROGRAMME BASED ON THE GROUPING SCHEME MONTHLY ALLOCATIONS IN TONS.)



*Base station serving as distributing centre.

PLAN FOR SUPPLY OF COAL TO WESTERN RAILWAY



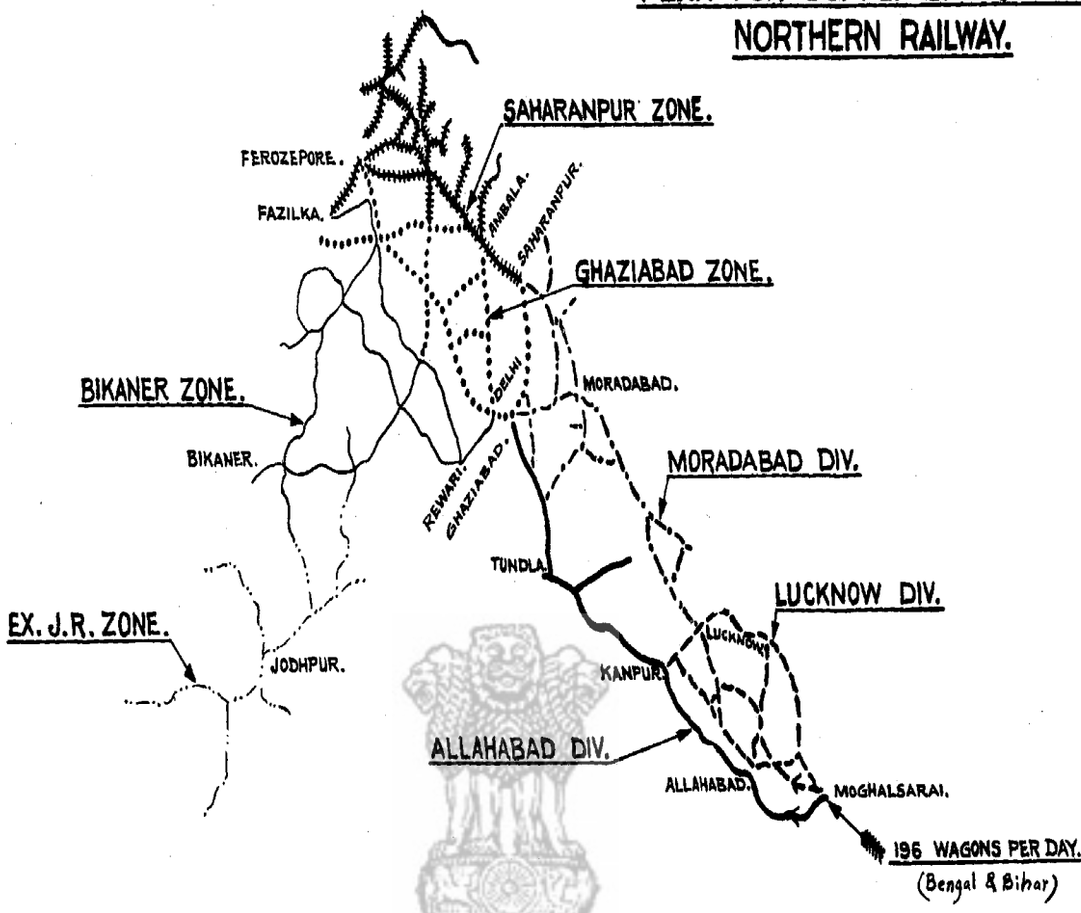
No	DISTRICT OR ZONE	COAL REQ. WAGONS PER DAY	DISTRIBUTING CENTRE	SUPPLY ARRANGEMENT				
				COAL FIELD	WAGONS PER DAY	POINT OF INTAKE	ROUTE FOLLOWED	TRANSHIPMENT POINTS
1	GANGAPUR	33	AGRA EAST BANK	BENGAL & BIHAR	33	AGRA EAST BANK	VIA. AEB.	–
2	AHMEDABAD	39	RATLAM	"	39	"	"	–
3	BULSAR	30	NANDURBAR	"	30	BHUSAWAL	VIA. CHEOKI	–
4	BANDIKUI	16	AGRA EAST BANK	"	16	AGRA EAST BANK	VIA. AEB.	AEB (M.G)
5	ABU	20	"	"	20	"	"	3 AT AEB. 17 AT SABARMATI
6	MHOW	12	"	"	12	"	"	3 AT AEB. 9 AT RATLAM
7	SAURASHTRA	28	RATLAM	C.I.C.	28	UJJAIN	VIA. UJJAIN	12 AT VIRAMGAM 16 AT SABARMATI
8	PRATAB NAGAR	5	"	"	5	"	"	–
	TOTAL	183	–	–	183	–	–	–

FIG. 10 – APPENDIX – 13-C (CHAPTER IX)

RFEEC.

S.T.A 15/5/53

PLAN FOR SUPPLY OF COAL TO NORTHERN RAILWAY.

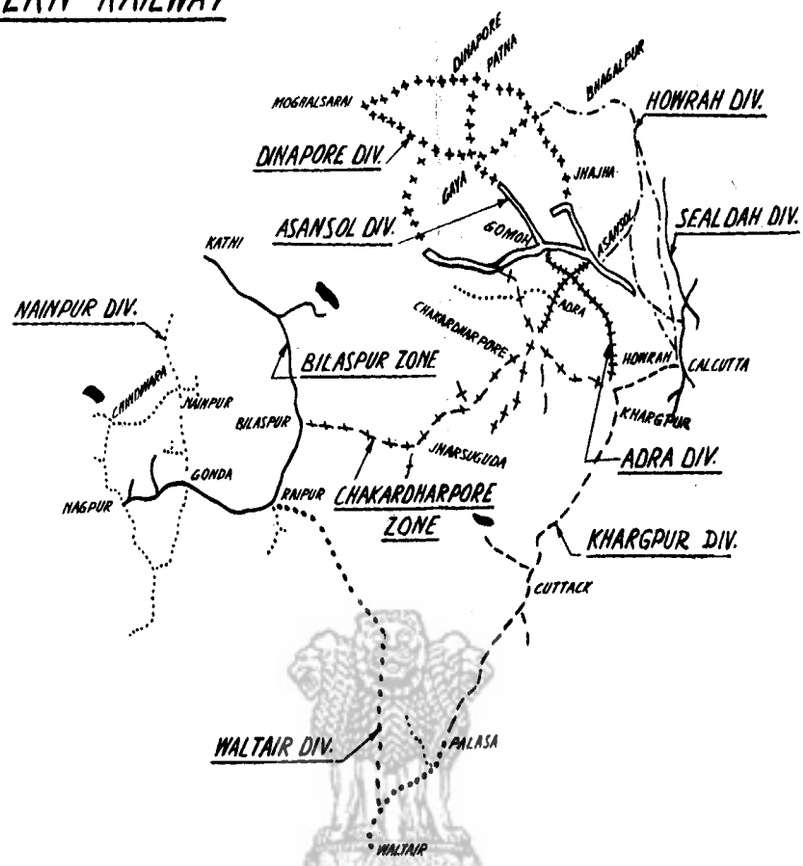


No.	DIVISION OR ZONE.	COAL REQR. WAGONS PER DAY.	DISTRIBUTING CENTRE.	SUPPLY ARRANGEMENTS.				
				COAL FIELD.	WAGONS PER DAY.	POINT OF INTAKE.	ROUTE FOLLOWED.	TRANSHIPMENT POINTS.
1.	SAHARANPUR	48	SAHARANPUR	BENGAL & BIHAR	48	MOGHALSARAI	VIA. SAHARANPUR	—
2.	MORADABAD	27	LUCKNOW	"	27	"	" LUCKNOW	—
3.	LUCKNOW	29	MOGHALSARAI	"	29	"	" BANARAS	—
4.	ALLAHABAD	43	"	"	43	"	" ALLAHABAD	—
5.	JODHPUR (M.G)	8	"	"	8	"	" AGRA EAST BANK	AEB (M.G.)
6.	BIKANER (M.G.)	15	GHAZIABAD	"	15	"	" GHAZIABAD	DELHI SARAI ROHILLA
7.	GHAZIABAD	26	"	"	26	"	" "	—
TOTAL		196	—	—	196	—	—	—

FIG. 11 - APPENDIX ... 13 - C (CHAPTER IX)

PLAN FOR SUPPLY OF COAL TO

EASTERN RAILWAY



Nº	DIVISION OR ZONE	COAL REQR. WAGONS PER DAY	DISTRIBUTION CONTROL CENTRE	SUPPLY ARRANGEMENT		
				SUPPLY FROM	ROUTE FOLLOWED	WAGONS PER DAY
1	SEALDAH	36	DHANBAD	ONDAL BASE	VIA. ONDAL	36
2	HOWRAH	49	,,	,,	29 VIA. BELOW ONDAL 20 VIA. JAMALPUR	49
3	ASANSOL	75	DHANBAD	LOCAL FOR & FROM ONDAL BASE	LOCAL	12
				,, ,, ASANSOL ,,	,,	22
				,, ,, SITARAMPUR ,,	,,	4
				,, ,, PATHERDIH & DHANBAD ,,	,,	18
				,, ,, GOMOH ,,	,,	14
				,, ,, BARKAKANA ,,	,,	4
				,, ,, GIRIDIH ,,	,,	1
4	DINAPORE	78	DHANBAD	ASANSOL BASE	VIA JHAJHA	10
				SITARAMPUR ,,	,, ,,	14
				GOMOH ,,	VIA. GRAND CHORD	37
				BARKAKANA ,,	,, ,,	17
5	ADRA	36	ADRA	PATHERDIH BASE	LOCAL FOR BHOJUDIH	5
				BHOJUDIH ,,	,, ,, ,,	4
				MOHUDA ,,	VIA. ADRA	27
6	CHAKARDHAR PORE	46	ADRA	BHOJUDIH BASE	VIA. ADRA - CKP.	23
				MOHUDA ,,	,, ,, ,,	6
				GOMOH ,,	,, ,, ,,	17
7	KHARGPUR	51	ADRA	BHAGA BASE	VIA. ADRA-KGP.	25
				MOHUDA ,,	,, ,, ,,	8
				GOMOH ,,	,, ,, ,,	18
8	WALTAIR	27	ADRA & BILASPUR	CHAURASI BASE	VIA. ADRA-KGP.	13
				JHARSUGUDA ,,	VIA. RAIPUR	14
9	BILASPUR	38	BILASPUR	MANENDRAGARH ,,	VIA. ANUPPUR	38
10	NAINPUR (N.E.)	17	,,	CHINDWARA ,,	VIA NAINPUR	17
TOTAL		453	–	–	–	453

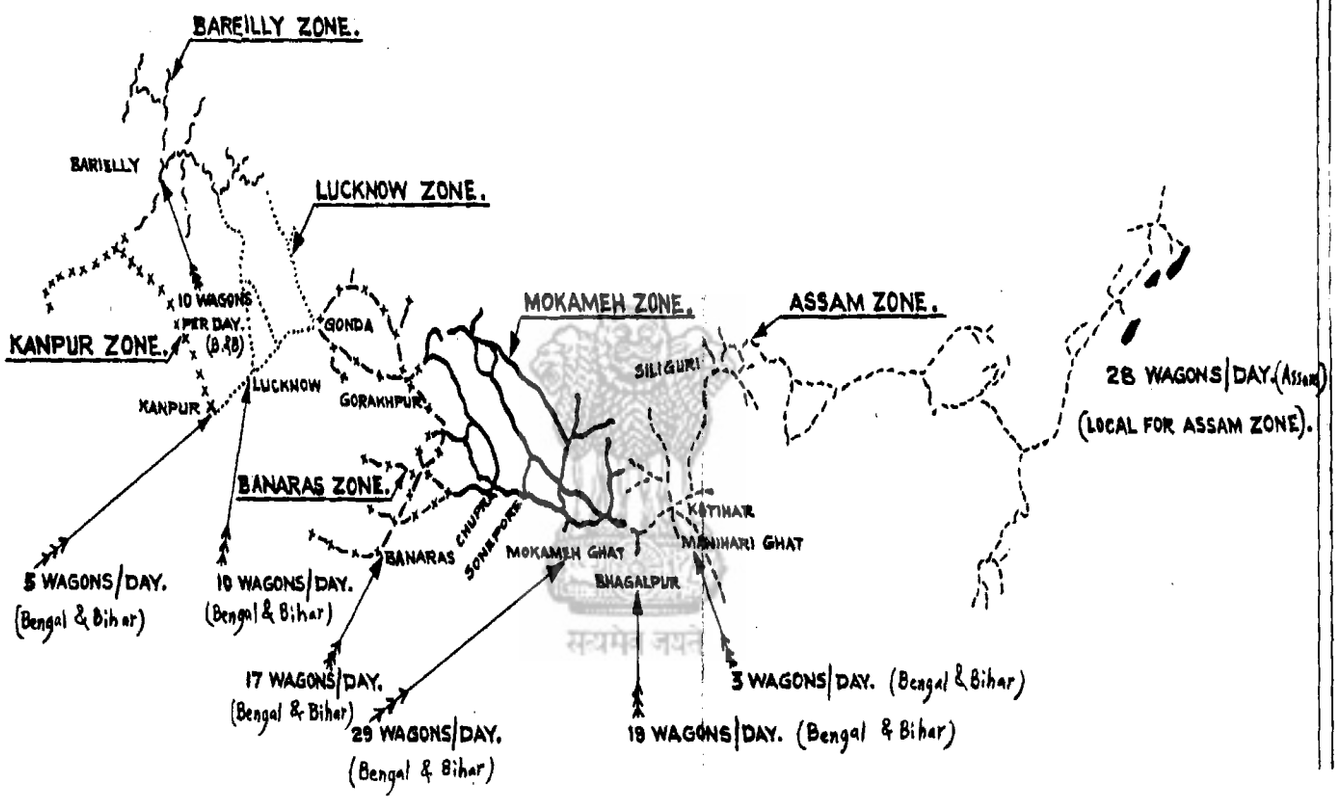
FIG. 12

APPENDIX ... 13-C
(CHAPTER IX).

RFEEC.

S.T.A. 13/2/53

PLAN FOR SUPPLY OF COAL TO NORTH-EASTERN RAILWAY.

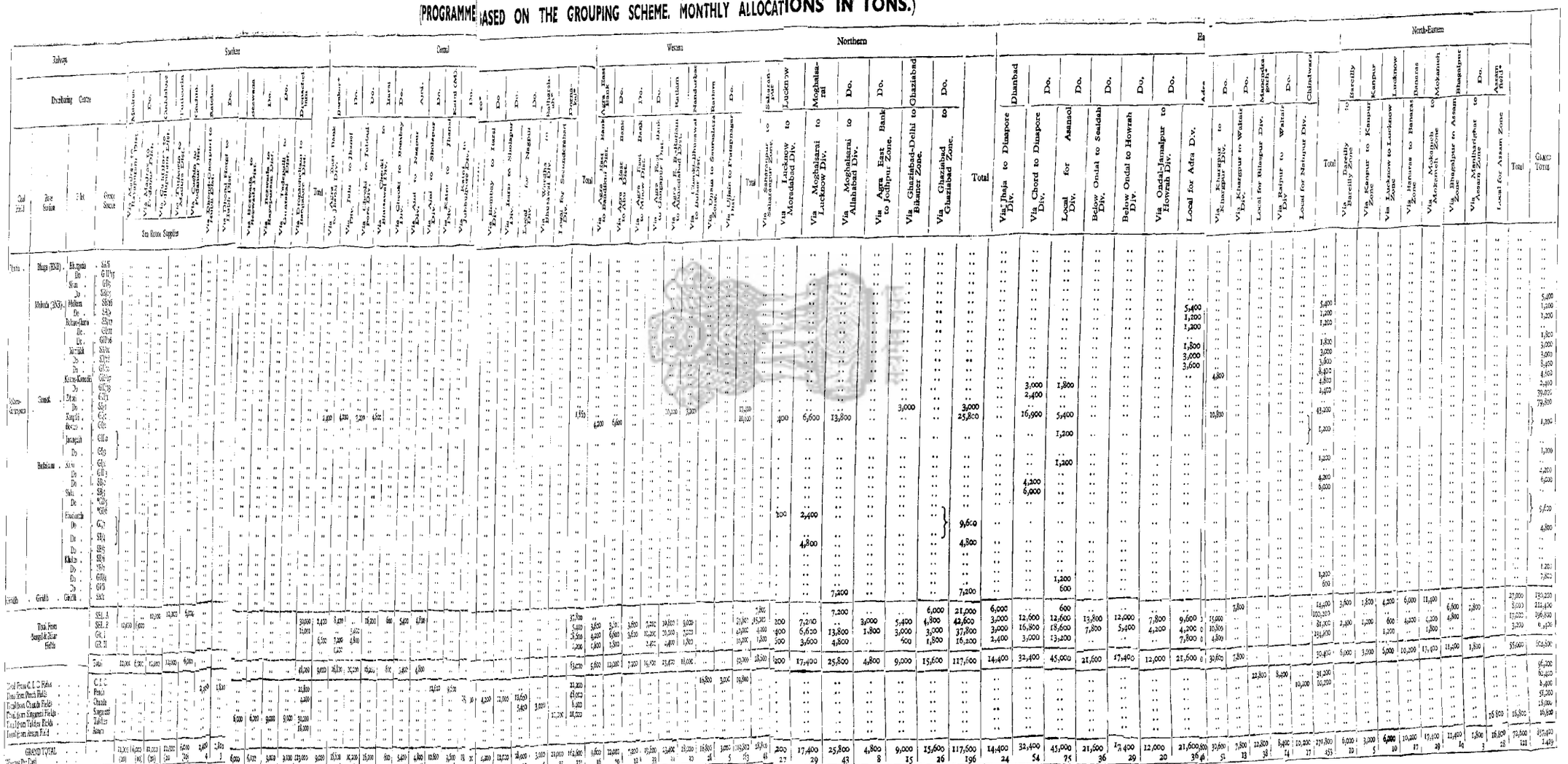


No.	ZONE.	COAL REQR WAGONS PER DAY.	DISTRIBUTING CENTRE.	SUPPLY ARRANGEMENTS.				
				COAL FIELD.	WAGONS PER DAY.	POINT OF INTAKE	ROUTE FOLLOWED.	TRANSHIPMENT POINTS.
1.	KANPUR	5	KANPUR	BENGAL & BIHAR	5	KANPUR	VIA. ALLAHABAD	KANPUR
2.	BAREILLY	10	BAREILLY	"	10	BAREILLY	VIA. LUCKNOW	BAREILLY
3.	LUCKNOW	10	LUCKNOW	"	10	LUCKNOW	"	LUCKNOW
4.	BANARAS	17	BANARAS	"	17	BANARAS	VIA. BANARAS	BANARAS
5.	MOKAMEH	29	MOKAMEH	"	29	MOKAMEH	VIA JHAJHA	MOKAMEH
6.	ASSAM	50	BHAGALPUR	"	22	BHAGALPUR & MANIHARI GHAT	VIA. BHAGALPUR	19 – BHAGALPUR 3 – MANIHARI GHAT
			—	ASSAM	28	(LOCAL)	(LOCAL)	—
TOTAL		121	—	—	121	—	—	—

FIG. 13 - APPENDIX ... 13-C (CHAPTER IX)

PLAN FOR SUPPLY AND DISTRIBUTION OF LOCO COAL

(PROGRAMME BASED ON THE GROUPING SCHEME. MONTHLY ALLOCATIONS IN TONS.)

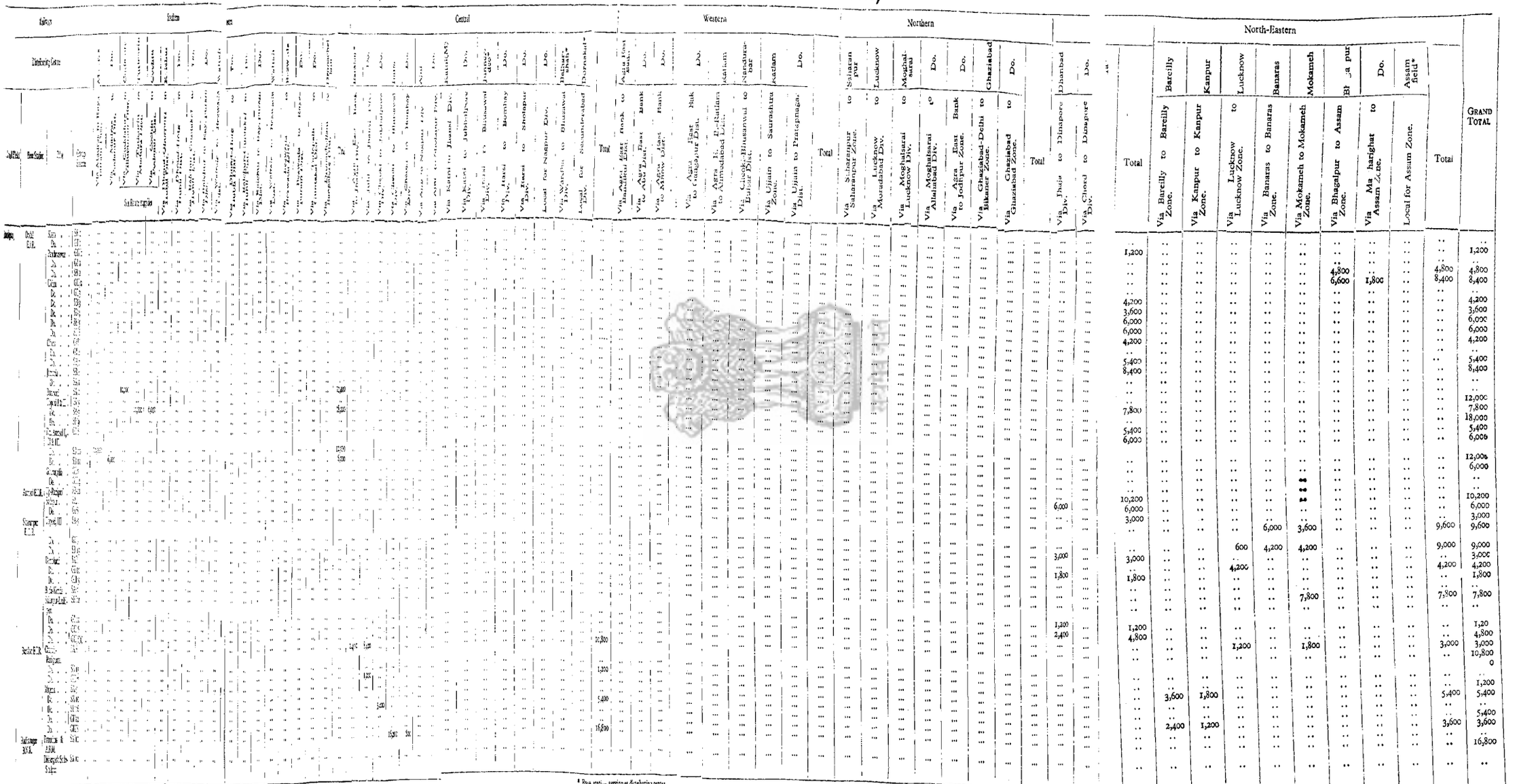


*Base Station Serving as Distributing Centre

PLAN FOR SUPPLY AND DISTRIBUTION OF LOCO COAL

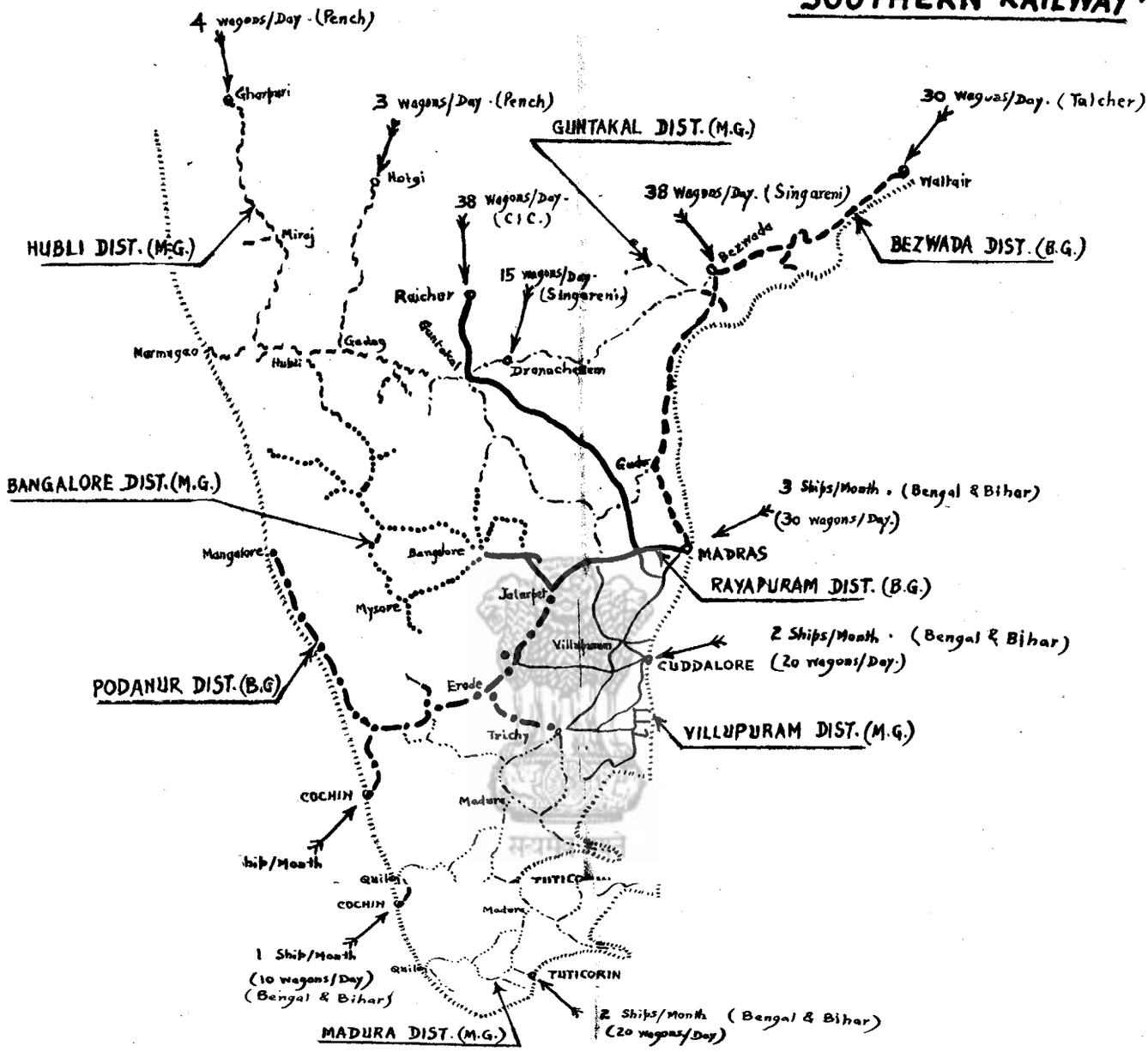
(PROGRAMME BASED ON THE GROUPING SCHEME. MONTHLY ALLOCATIONS IN TONS)

APPENDIX 13-a
(CHAPTER IX)
Sheet No. 1.



* Base station serving as distributing centre.

1ST PHASE OF THE PLAN FOR SUPPLY OF COAL TO SOUTHERN RAILWAY.



No.	District	Coal Reqds Wagons/Day	Distributing centre	Supply Arrangements: Coal field	Wagons/Day	Point of Intake	Route followed	Transhipment points
1	BEZWADA	40	Waltair & Bezwada	Talcher Singareni	30 10	Waltair Bezwada	Via Waltair Via Bezwada	– –
2	RAYAPURAM	45	Madras, Bezwada & Raichur	Bengal & Bihar Singareni C.I.C.	20 10 15	Madras Bezwada Raichur	Rail Cum Sea Via Bezwada Via Balharshah	– – –
3	PODANUR	20	Madras & Cochin	Bengal & Bihar	10 10	Madras Cochin	Rail Cum Sea "	– –
4	VILLUPURAM	20	Cuddalore	"	20	Cuddalore	"	–
5	MADURA	20	Tuticorin	"	20	Tuticorin	"	–
6	HUBLI	30	Raichur	C.I.C. Pench "	23 4 3	Raichur Ghorpuri Hotgi	Via Balharshah Via Dhond "	Guntakal Ghorpuri Hotgi
7	BANGALORE	15	Dronachellam	Singareni	15	Dronachellam	Via Secunderabad	Secunderabad
8	GUNTAKAL	15	Bezwada	"	15	Bezwada	Via Bezwada	Tadepalli
	TOTAL	205			205			

FIG. 8 ... APPENDIX 13-C (Chapter IX)

MAP SHOWING
BOTTLENECKS
IN RESPECT OF COAL MOVEMENTS.

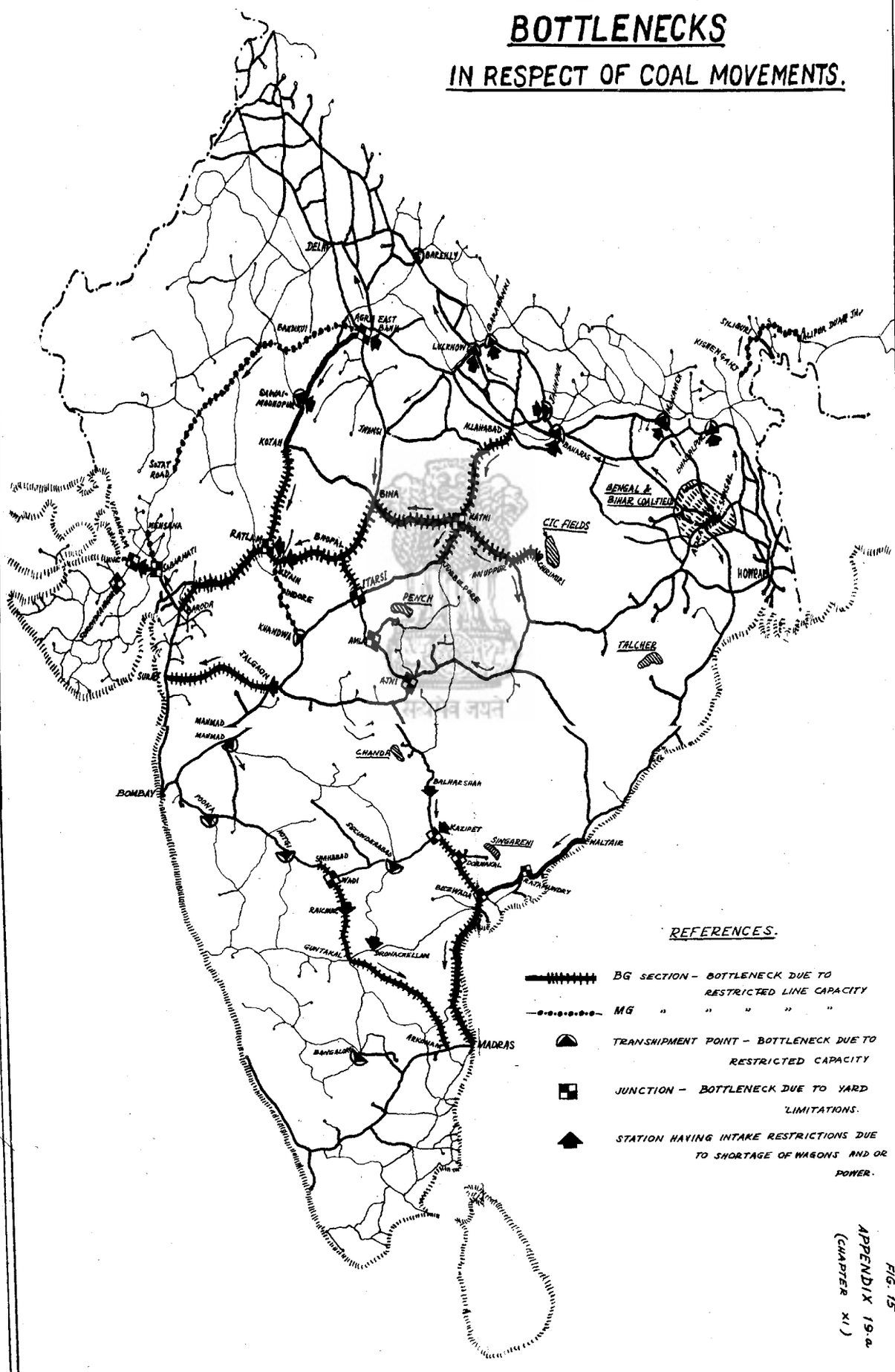
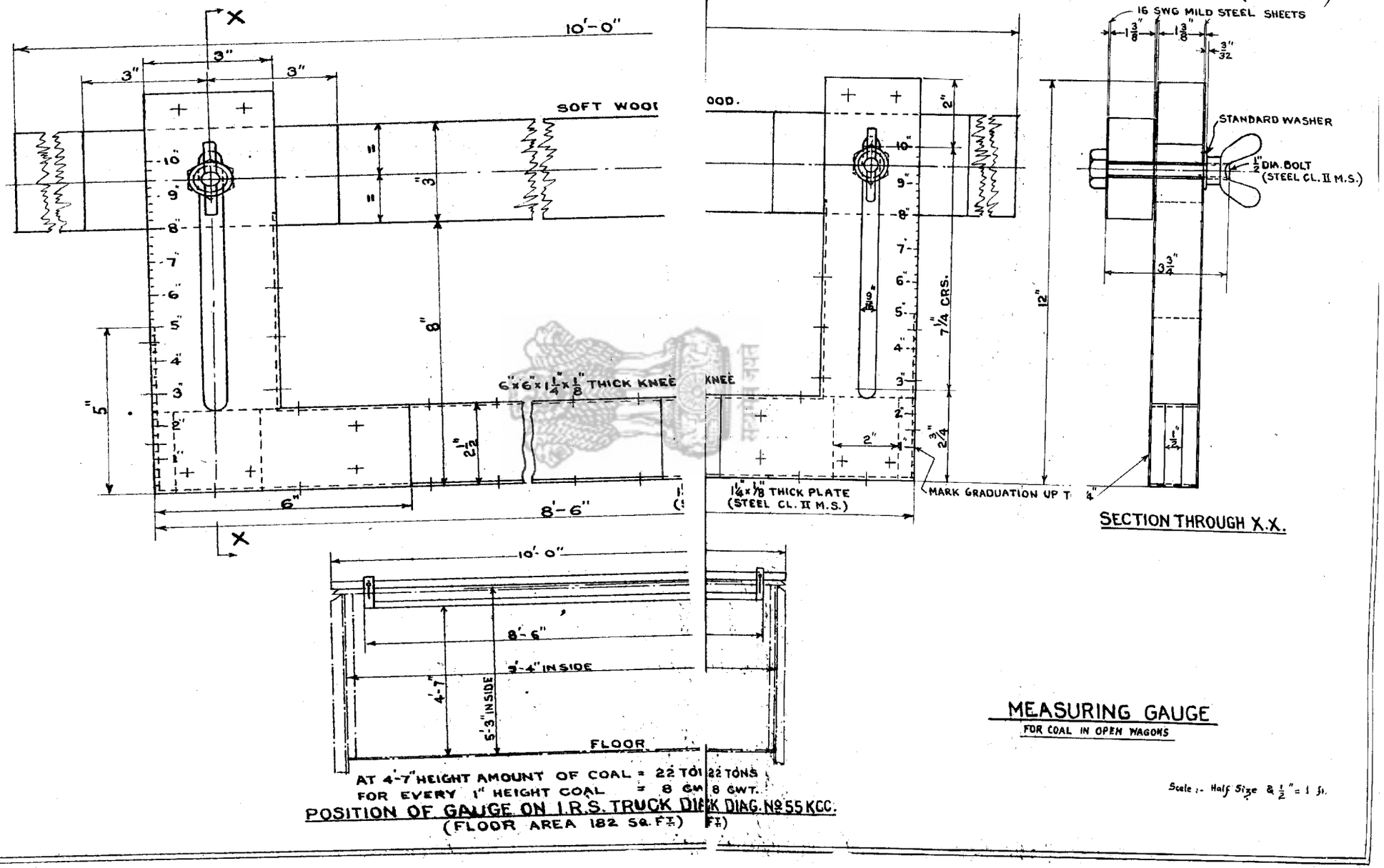


FIG. 15
APPENDIX 19-A
(CHAPTER XI)

FIG. 16 APPENDIX 20
(CHAPTER XI)



AT 4'-7" HEIGHT AMOUNT OF COAL = 22 TO 22 TONS
FOR EVERY 1" HEIGHT COAL = 8 CWT. 8 CWT.

POSITION OF GAUGE ON I.R.S. TRUCK DIAG. No 55 KCC.
(FLOOR AREA 182 Sq. Ft.)

MEASURING GAUGE
FOR COAL IN OPEN WAGONS

Scale :- Half Size & 1/2" = 1 ft.

Section Head 14/3/63
S.T.R.R

RFEEC.

DAILY AND WEEKLY FLUCTUATIONS IN WAGON ALLOTMENTS
OCT. 1951 – SEPT. 1952
E.I.R. SECTION OF THE BENGAL & BIHAR FIELDS.

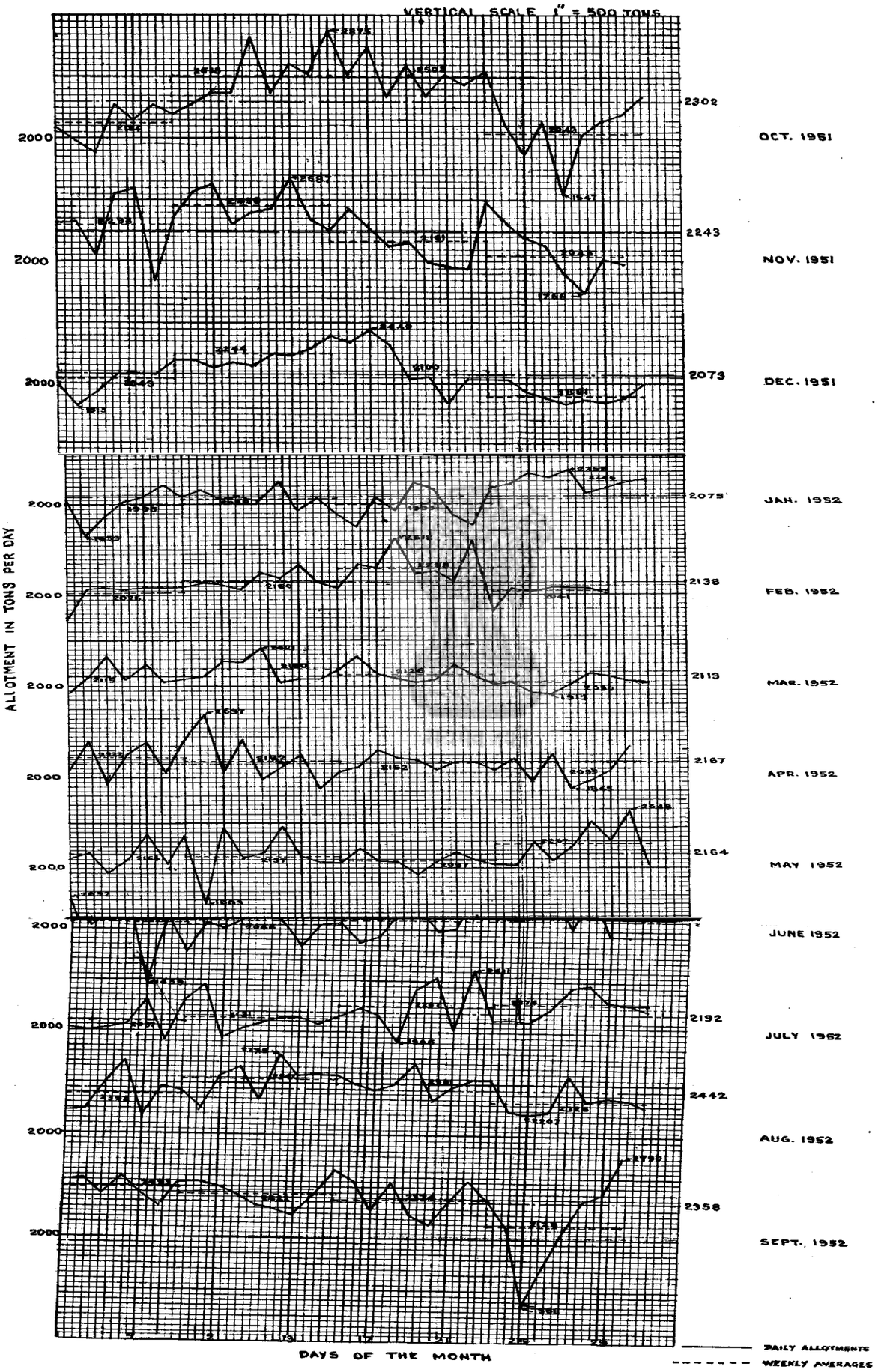


Fig. 17 APPENDIX – 22 (Chapter XI)

DAILY AND WEEKLY FLUCTUATIONS IN WAGON ALLOTMENTS
OCT. 1951 - SEPT. 1952
B.N.R. SECTION OF THE BENGAL & BIHAR FIELDS.

VERTICAL SCALE : 1" = 200 TONS

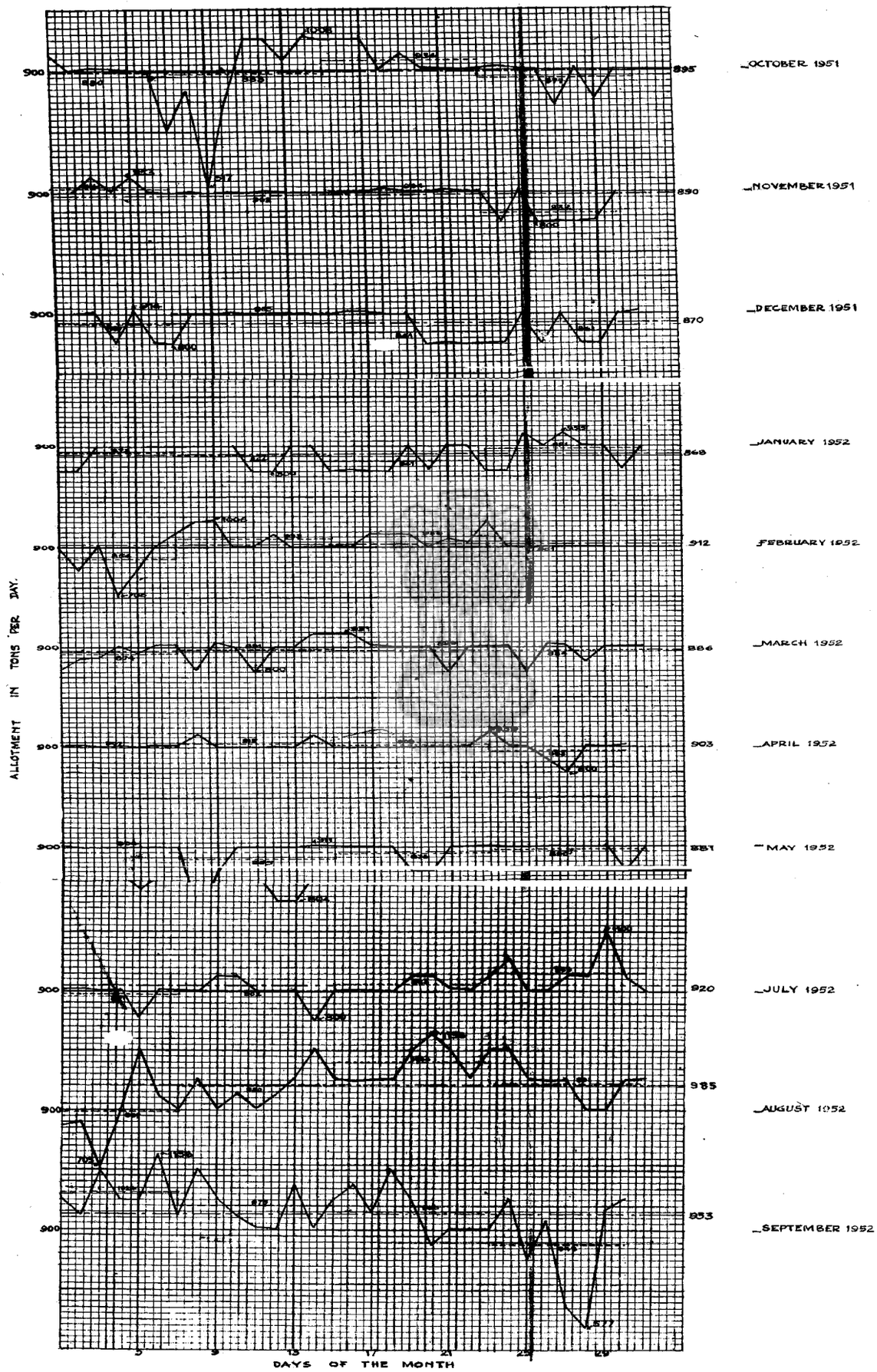


Fig. 18 - APPENDIX - 22 (Chapter XI)

COAL CONSUMPTION RELATING TO (1) LIGHTING UP (2) BANKING FIRE & (3) 'STAND BY LOSSES'.

TYPE OF LOCO.		GRATE AREA (SQ FEET)	COAL CONSUMPTION IN LIGHTING UP FIRE (LB.)	STAND BY LOSSES (LB/HR.)	BANKING UP FIRE (LB./HR.)
LATEST IRS.	WP	46	1700	280	170
	WG	46	1700	280	170
	WM	24	800	170	100
EARLIER IRS.	XA	32	1100	210	125
	XB	45	1660	275	165
	XC	51	1950	305	185
	XD	45	1660	275	165
	XE	60	2440	350	210
	XT	14	500	120	70
AMERICAN	AWE	63	2600	365	220
	A/CWD	47	1750	285	170
BESA	GSM	32	1100	210	125
	HPS	32	1100	210	125
	3/4, 1/4	32	1100	210	125
	SGS	27	900	185	110

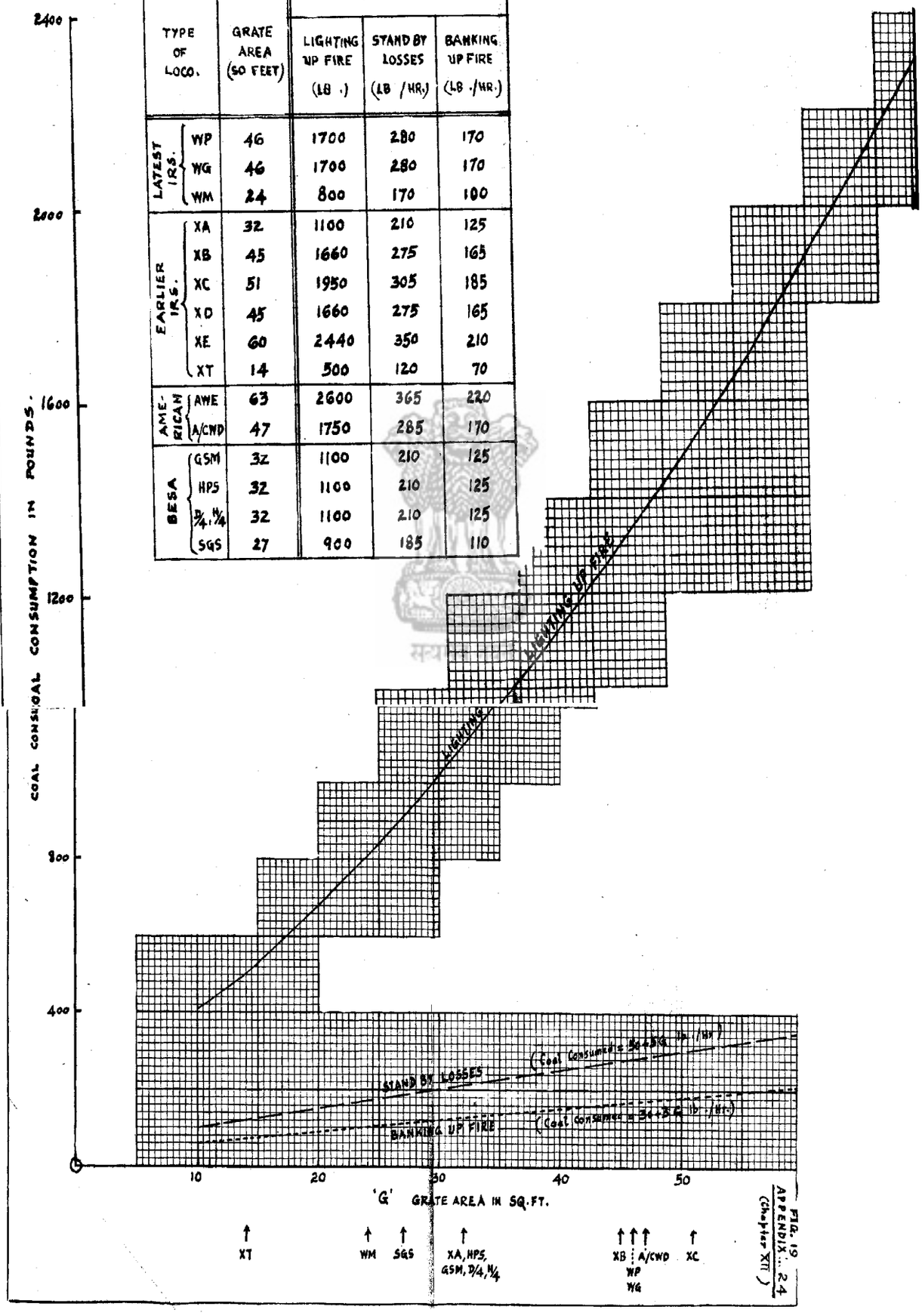


FIG. 19 APPENDIX ... 24 (Chapter XII)

ANALYSIS OF BOILER PERFORMANCES AND COAL PRICING & GRADING

DENOTE WORKING RANGE

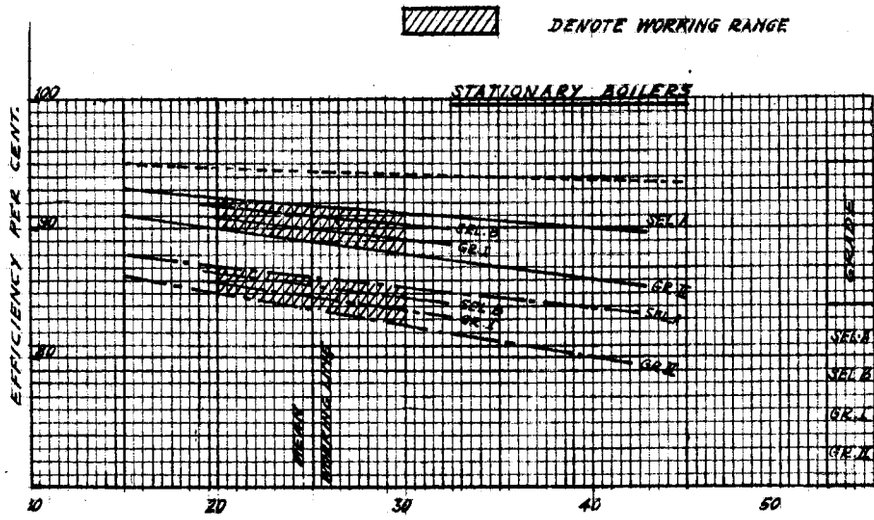


TABLE I

GRADE	STATIONARY BOILER PERFORMANCE			USEFUL BTU BASED ON		CONSUMPTION BASED ON	
	BOILER EFFY.	HEAT ABS. EFFY.	COMB. EFFY.	(B.P.) COMB. EFFY.	FORMULA ※	BOILER PERFORMANCE	FORMULA
SEL.A	86.3	94.1	91.8	11700	12000	100.0	100.0
SEL.B	85.6	94.1	91.0	11100	11500	105.2	104.5
GR.I	84.6	94.1	90.0	10500	10850	111.3	110.5
GR.II	83.8	94.1	89.0	9620	10000	122.0	120.0

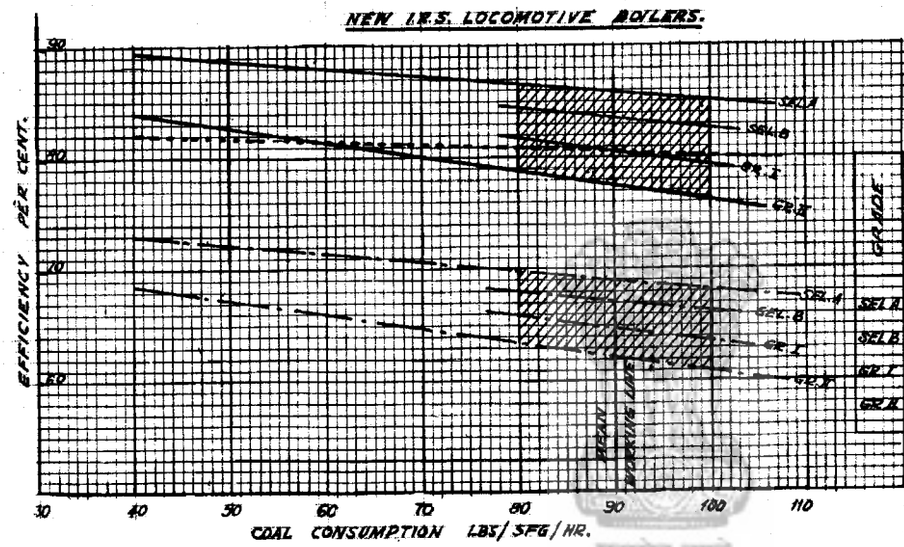


TABLE II

GRADE	LOCO. BOILER PERFORMANCE			USEFUL BTU BASED ON		CONSUM.N BASED ON	
	BOILER EFFY.	HEAT ABS. EFFY.	COMB. EFFY.	(B.P.) COMB. EFFY	FORMULA ※	BOILER PERFORMANCE	FORMULA
SEL.A	68.9	80.2	85.8	10900	10800	100.0	100.0
SEL.B	67.0	80.2	83.5	10200	10200	106.9	106.0
GR.I	64.6	80.2	80.5	9400	9300	116.1	116.2
GR.II	62.0	80.2	77.3	8350	8100	130.8	133.5

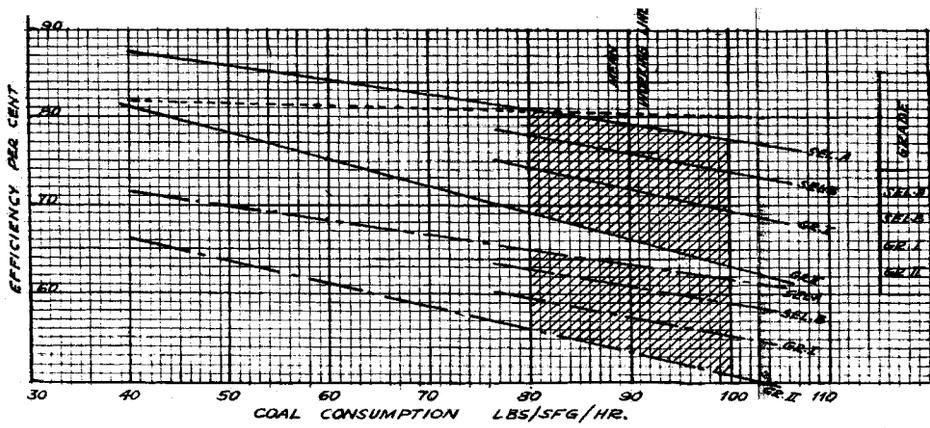


TABLE III

GRADE	LOCO. BOILER PERFORMANCE			USEFUL BTU BASED ON		CONSUM.N BASED ON	
	BOILER EFFY.	HEAT ABS. EFFY.	COMB. EFFY.	(B.P.) COMB. EFFY.	FORMULA ※	BOILER PERF. ORMANCE	FORMULA
SEL.A	63.0	80.2	78.7	10000	9700	100.0	100.0
SEL.B	60.5	80.2	75.5	9280	8920	107.5	108.5
GR.I	57.2	80.2	71.4	8350	7750	120.0	125.0
GR.II	53.0	80.2	66.0	7120	6200	140.5	156.0

※ FORMULAE USED :—

TABLE I : $H_u = \frac{B_u \times (100 - 1\frac{1}{2} A_d)}{100}$

TABLE II : $H_u = \frac{B_u \times (100 - 2 A_d)}{100}$

TABLE III : $H_u = \frac{B_u \times (100 - 2\frac{1}{2} A_d)}{100}$

WHERE
H_u = USEFUL HEAT IN BTU.
B_u = CAL. VALUE IN BTU/LB OF PURE DRY COAL
A_d = PER CENTAGE OF ASN IN DRY COAL

GRADE	REPRESENTATIVE CAL. VALUE BTU/LB.		
	LOWER LIMIT	UPPER LIMIT	AVERAGE
SEL. A	12200	13300	12750
SEL. B	11800	12600	12200
GR. I	11200	12200	11700
GR. II	10200	11400	10800

REFERENCE :—

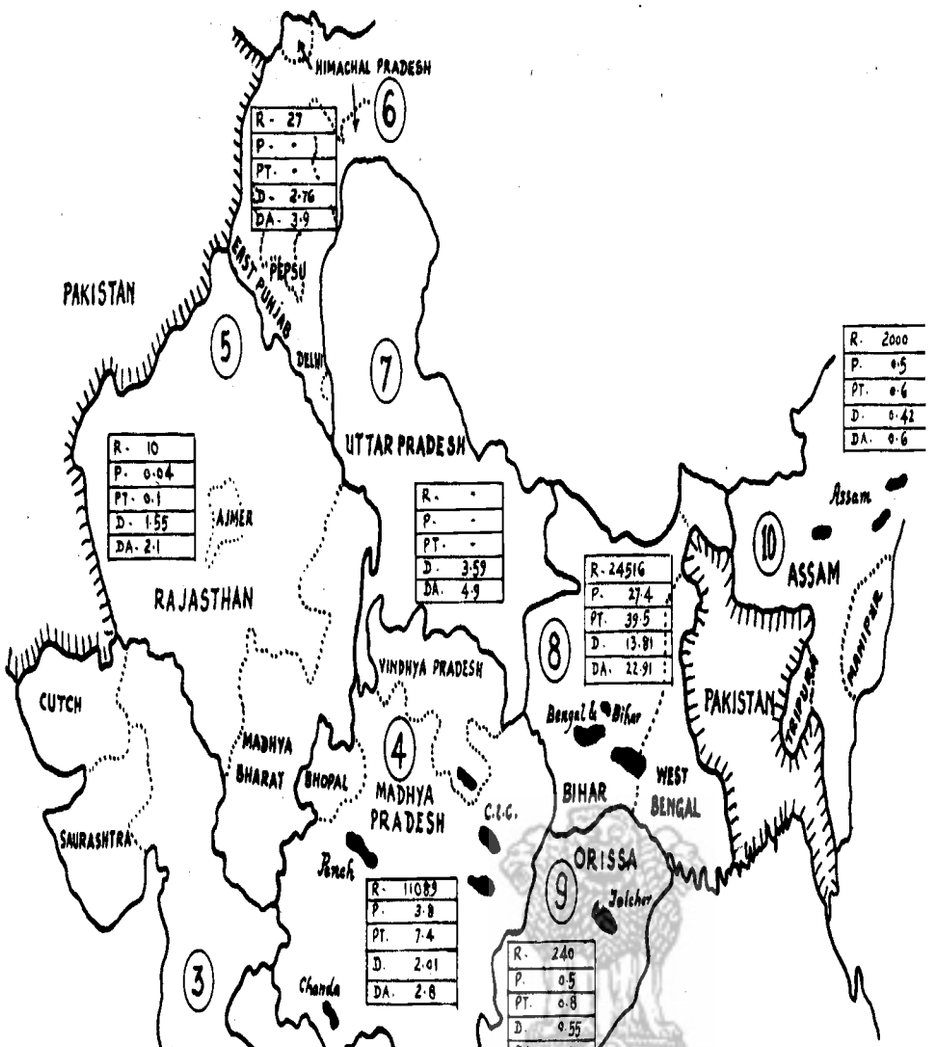
HEAT ABSORPTION EFFICIENCY CURVES ----------

COMBUSTION EFFICIENCY CURVES ——————

BOILER EFFICIENCY CURVES ——— - ——— - —

FIG. 2
APPENDIX 6
(CHAPTER IV)

MAP SHOWING ZONAL RESERVES, PRODUCTION & DEMANDS OF COAL IN INDIA



REFERENCES :-

NUMBER IN CIRCLE REPRESENTS ZONE NUMBER.
R - RESERVES (MILLION TONS)
P - PRODUCTION IN 1952 (MILLION TONS / ANNUM)
PT - PRODUCTION TARGET IN 1961 (MILLION TONS/ANNUM)
D - DEMAND IN 1951 (MILLION TONS / ANNUM)
DA - DEMAND ANTICIPATED IN 1961 (MILLION TONS/ANNUM)

ZONE No.	STATES COMPRISING A ZONE	RESERVES OF COAL - MILLION TONS			RESERVES OF COAL - MILLION TONS							PRODUCTION OF COAL - MILLION TONS/ANNUM						ZONAL DEMAND OF COAL MILLION TONS/ANNUM			ANTICIPATED ZONAL DEMAND	ZONAL PRODUCTION TARGET
		CAKING			CAKING			NON-CAKING				CAKING			NON-CAKING			FOR DOMESTIC	FOR INDUSTRY	TOTAL	IN 1961	IN 1961
		METALLURGICAL	NON-METALLURGICAL	TOTAL	COAL	INTERMEDIATE	TOTAL	COAL	LIGNITE	TOTAL	GRAND TOTAL	METALLURGICAL	NON-METALLURGICAL	TOTAL	COAL	LIGNITE	TOTAL	GRAND TOTAL				MILLION TONS PER ANNUM	MILLION TONS PER ANNUM
1	MADRAS, MYSORE, TRAV.-COCHIN & COORG.	-	-	-	-	-	-	(2000)	(2000)	-	-	-	-	-	-	-	-	-	1·46	1·28	2·44	3·1	1·2
2	HYDERABAD.	-	-	-	-	-	-	4042	4042	-	-	-	-	-	1·2	1·2	0·89	0·56	0·35	0·5	2·4
3	BOMBAY, SAURASHTRA, & CUTCH.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2·37	1·67	4·04	5·5	-
4	MADHYA PRADESH, V.-PRADESH, & BHOPAL.	-	-	-	-	-	-	11089	11089	-	-	-	-	-	3·8	3·8	0·86	1·15	2·01	2·8	7·4
5	MADHYA BHARAT, RAJASTHAN & AJMER.	-	-	-	-	-	-	(10)	(10)	-	-	-	-	-	0·04	0·04	1·96	0·69	1·65	2·1	0·1
6	E.PUNJAB, PEPSU, DELHI, KASHMIR & H.PRADESH.	-	-	-	-	-	-	(27)	(27)	-	-	-	-	-	-	-	2·15	0·61	2·76	3·9	-
7	UTTAR PRADESH.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2·13	1·40	3·53	4·9	-
8	BENGAL & BIHAR.	1311	1462	2773	311	1462	2773	21183	24456	7·3	5·3	12·6	14·8	27·4	17·88	2·93	13·81	23·9	39·5
9	ORISSA.	-	-	-	-	-	-	240	240	-	-	-	0·5	0·5	0·77	0·38	0·55	0·7	0·9
10	ASSAM, MANIPUR, & TRIPURA.	-	-	-	-	-	-	(2000)	(2000)	-	-	-	0·5	0·5	0·15	0·27	0·42	0·6	0·6
	TOTAL.	1311	1462	2773	311	1462	2773	40671	43844	7·3	5·3	12·6	20·8	35·44	20·81	11·64	31·52	47·0	-
	DEMAND FOR BUNKER & EXPORT																	3·0	5·0	-
	GRAND TOTAL																	34·52	52·0	52·0

NOTE :- FIGURES IN BRACKETS SHOW LIGNITE (IT'S SHOW LIGNITE OR LIGNITOUS (TERTIARY) COAL RESERVES.

S.T.A.

RFEEC.

FIG. 2.0 - APPENDIX .. 25
(Chapter. XII)

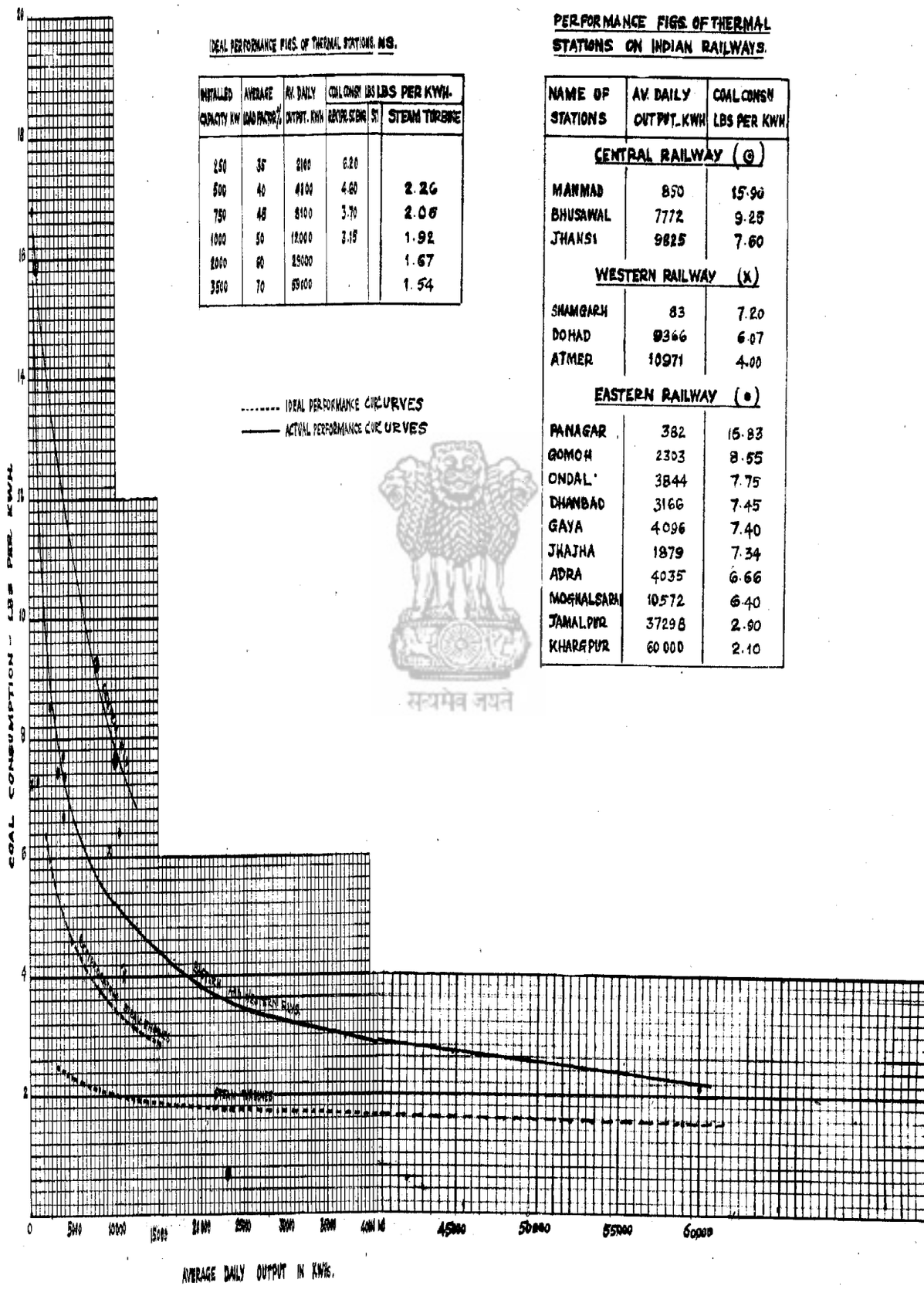
COMPARISON OF PERFORMANCES OF THERMAL STATIONS ON INDIAN RAILWAYS WITH IDEAL PERFORMANCE FIGURES

IDEAL PERFORMANCE FIGS. OF THERMAL STATIONS. NS.

INSTALLED CAPACITY KW	AVERAGE LOAD FACTOR %	AV. DAILY OUTPUT. KWH	COAL CONSN LBS PER KWH. RECIPR. STEAM	ST.	STEAM TURBINE
250	35	2100	6.20		
500	40	4100	4.60		2.26
750	48	8100	3.70		2.06
1000	50	12000	3.15		1.92
2000	60	29000			1.67
3500	70	59100			1.54

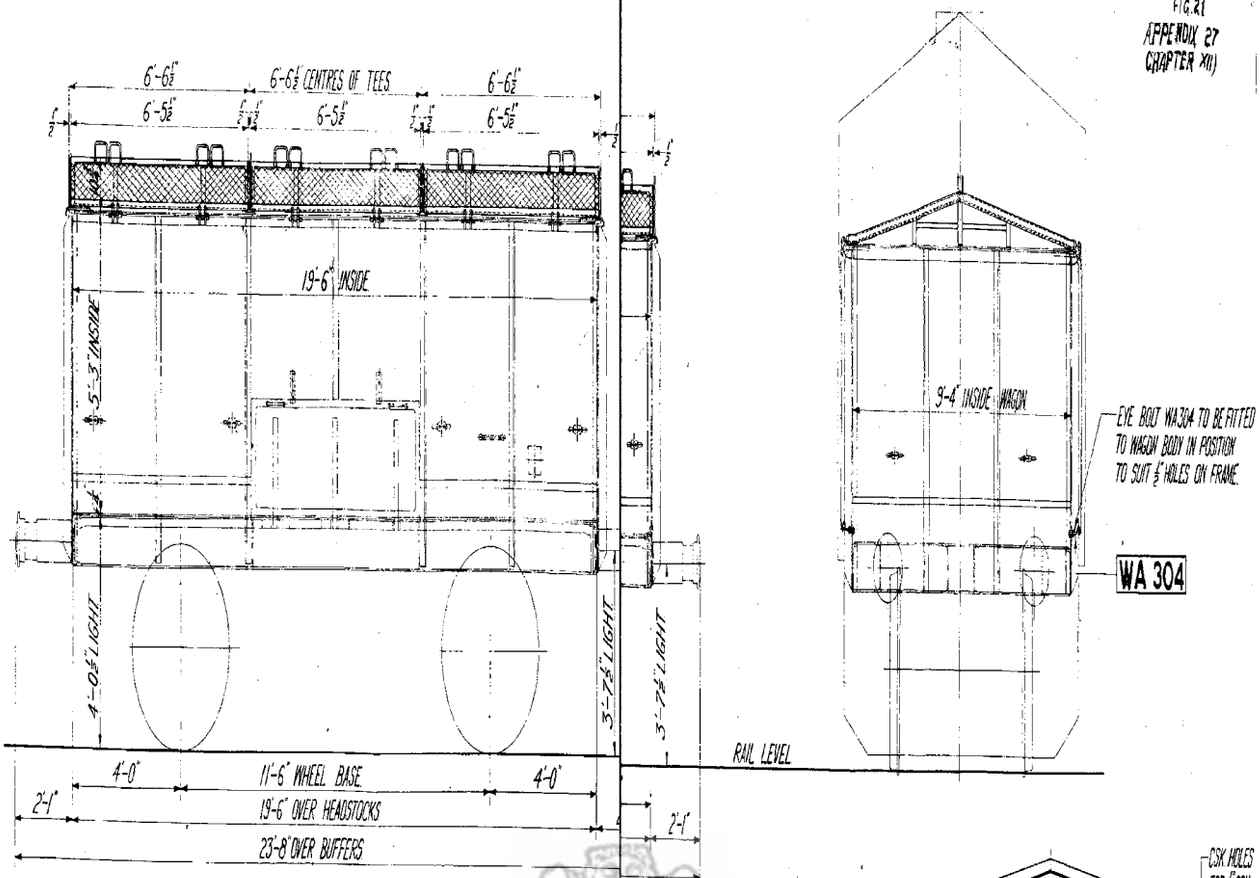
PERFORMANCE FIGS. OF THERMAL STATIONS ON INDIAN RAILWAYS.

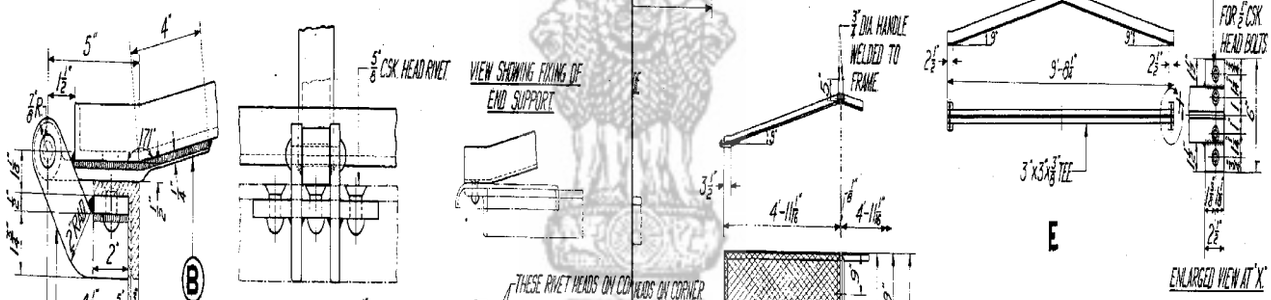
NAME OF STATIONS	AV. DAILY OUTPUT. KWH	COAL CONSN LBS PER KWH
CENTRAL RAILWAY (C)		
MANMAD	850	15.90
BHUSAWAL	7772	9.25
JHANSI	9825	7.60
WESTERN RAILWAY (X)		
SHAMGARH	83	7.20
DOHAD	9366	6.07
ATMER	10971	4.00
EASTERN RAILWAY (•)		
PANAGAR	382	15.83
GOMOH	2303	8.55
ONDAL	3844	7.75
DHANBAD	3166	7.45
GAYA	4096	7.40
JHAJHA	1879	7.34
ADRA	4035	6.66
MOGHALSARAI	10572	6.40
JAMALPUR	37298	2.90
KHARAPUR	60000	2.10

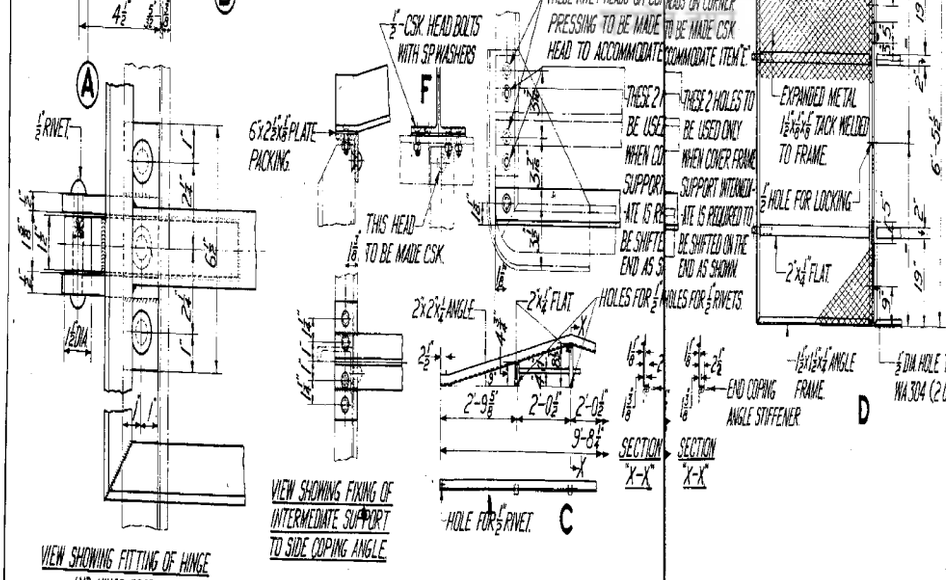


..... IDEAL PERFORMANCE CURVES
—— ACTUAL PERFORMANCE CURVES

FIG. 21
APPENDIX 27
CHAPTER XII)







TOTAL WEIGHT OF FRAME AND FITTINGS = 1000 LBS. (APPROX)

LETTING	DESCRIPTION	PER VEHICLE	Q. OF L.	MTL. & SPECN.
F	½" DIA CSK. HEAD BOLTS 1¼" LONG WITH SPRING WASHERS.	12	-	
E	COVER FRAME SUPPORT INTERMEDIATE	2	-	ST. CL. 2 M5
D	COVER	6	-	" " "
C	COVER FRAME SUPPORT END	2	-	" " "
B	HINGE	12	-	" " M3
A	HINGE FOOT	12	-	" " M5

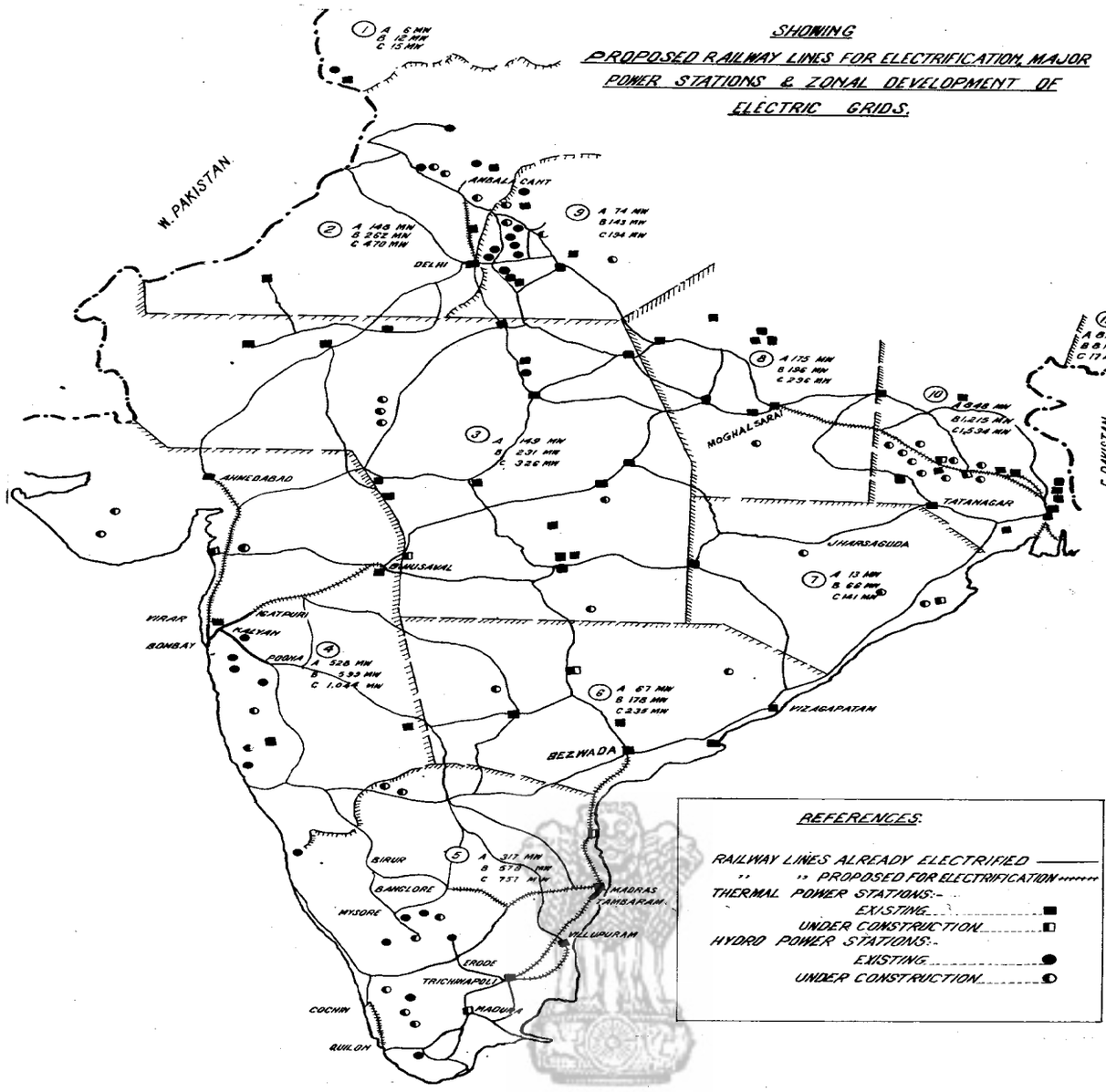
REFERENCE:-

ALT.	LETT.	AUTHY.	DESCRIPTION	DATE

B. G.

EXPANDED METAL COVER FOR "O" TY "O" TYPE WAGONS.

CSW 1028



ZONE No.	PARTICULARS OF AREA COVERED	PRESENT INSTALLED CAPACITY (1951) MW A	ANTICIPATED CAPACITY (1955) MW B	ANTICIPATED CAPACITY (1960) MW C	B-A	C-A	RAILWAY DEMAND OF POWER MW	(8)/(7) x 100 (%)	RAILWAY DEMAND INCREASED TWO TIMES MW	(10)/7 x 100 (%)
1	2	3	4	5	6	7	8	9	10	11
1	JAMMU & KASHMIR STATE	6	12	15	6	9	-	-	-	-
2	PUNJAB DELHI & PART OF RAJASTHAN	148	252	470	114	322	2·0	0·6	4·0	1·2
3	PART OF M.P. & RAJASTHAN	149	231	326	82	177	-	-	-	-
4	BOMBAY & PART OF HYDERABAD	528	699	1,044	171	516	34·5	6·7	69·0	13·4
5	S. INDIA EXCLUDING COASTAL ANDHRA DESHA	317	578	757	261	440	28·3	6·4	56·6	12·8
6	COASTAL ANDHRA DESHA PARTS OF HYDERABAD ORISSA M.P.	67	178	235	111	168	3·7	2·2	7·4	4·4
7	AREA UNDER MAHANADI VALLEY DEVELOPMENT	13	66	141	53	128	-	-	-	-
8	AREA UNDER RIHAND PROJECTS & CENTRAL REGIONS OF U.P.	175	196	296	21	121	13·0	10·7	26·0	21·4
9	WESTERN DISTRICTS OF U.P.	74	143	194	69	120	-	-	-	-
10	CALCUTTA & DAMODAR VALLEY	948	1,215	1,534	267	586	53·0	9·0	106·0	18·0
11	ASSAM	8	8	17	-	9	-	-	-	-
	TOTAL	2433	3588	5029	1155	2596 (2153)	134·5	6·2	269·0	12·4

FIGURE IN BRACKETS GIVES THE TOTAL POWER INCREMENT IN THE AREAS WHERE ELECTRIFICATION OF RAILWAYS IS CONSIDERED & PERCENTAGES ON TOTAL VIZ: 6·2 & 12·4 ARE CALCULATED ON THIS FIGURE.

APPENDIX-35 (CHAPTER No. XIV)

FIG. 28 - PAGE 155

COMPARATIVE OPERATING COSTS FOR STEAM, DIESEL & GAS TURBINE LOCOMOTIVE.

FIG. 23 - APPENDIX (CHAPTER

'S' = STEAM.

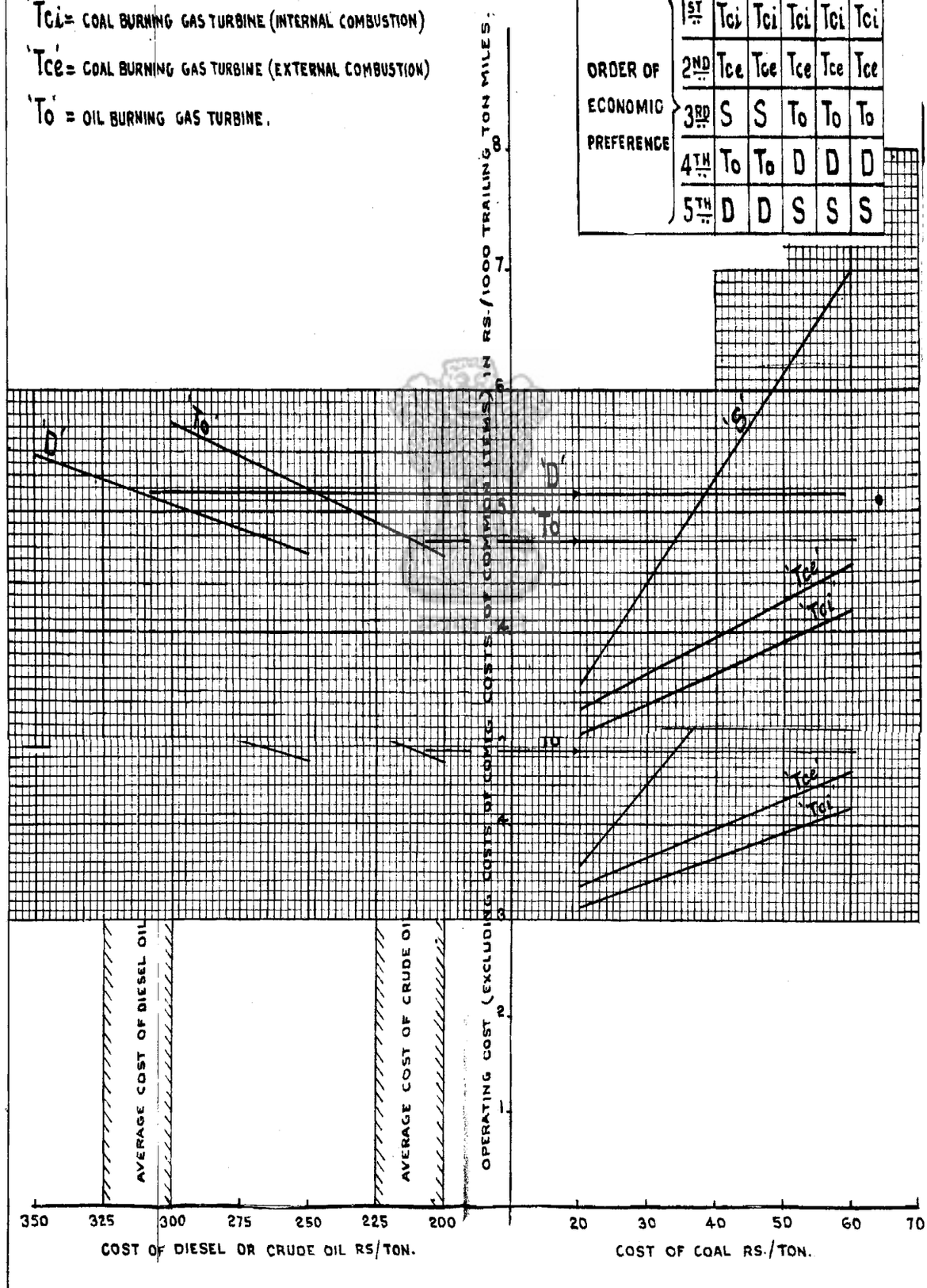
'D' = DIESEL.

'Tci' = COAL BURNING GAS TURBINE (INTERNAL COMBUSTION)

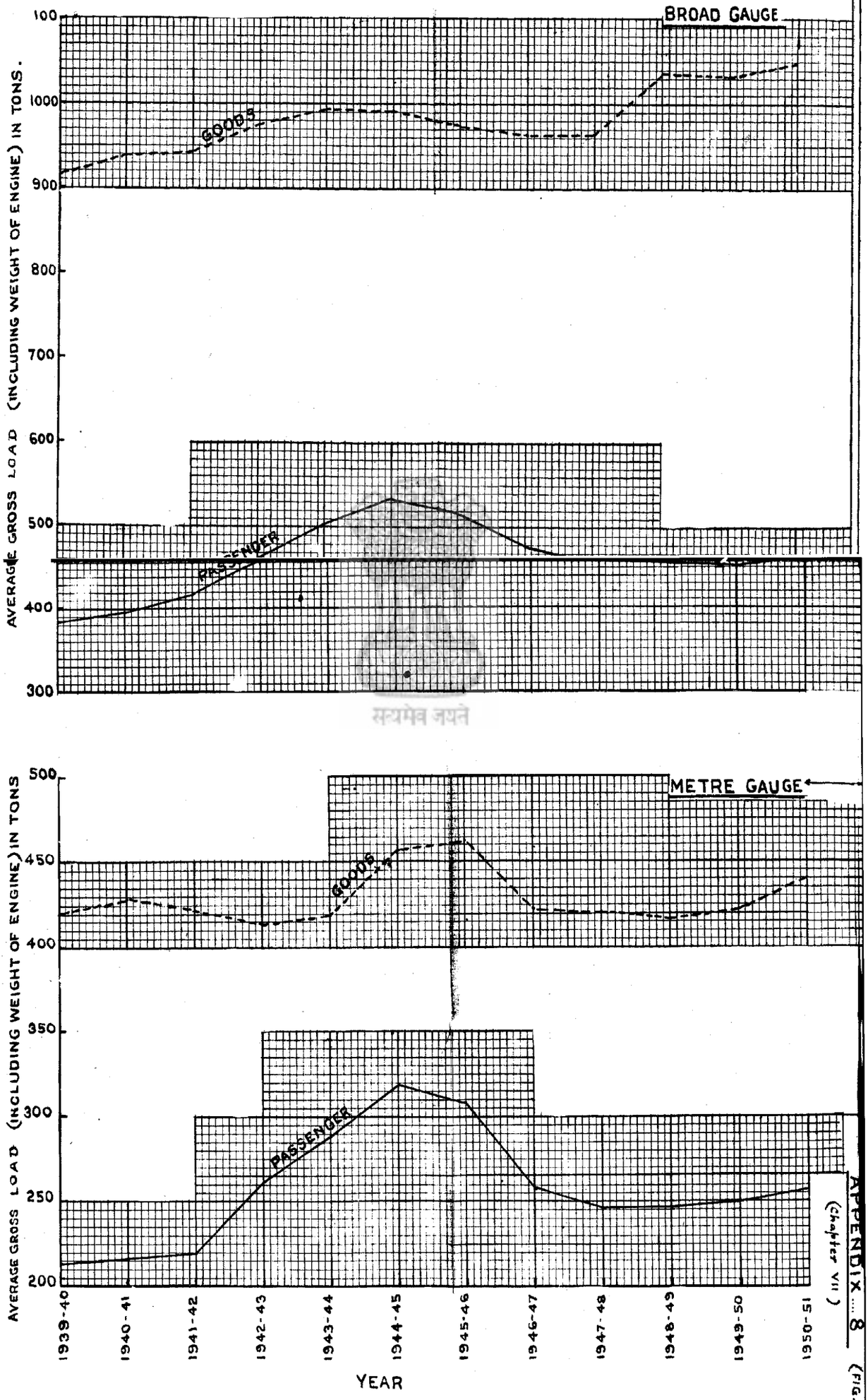
'Tce' = COAL BURNING GAS TURBINE (EXTERNAL COMBUSTION)

'To' = OIL BURNING GAS TURBINE.

PRICE OF COAL Rs/TON		20	30	40	50	60
ORDER OF ECONOMIC PREFERENCE	1ST	Tci	Tci	Tci	Tci	Tci
	2ND	Tce	Tce	Tce	Tce	Tce
	3RD	S	S	To	To	To
	4TH	To	To	D	D	D
	5TH	D	D	S	S	S



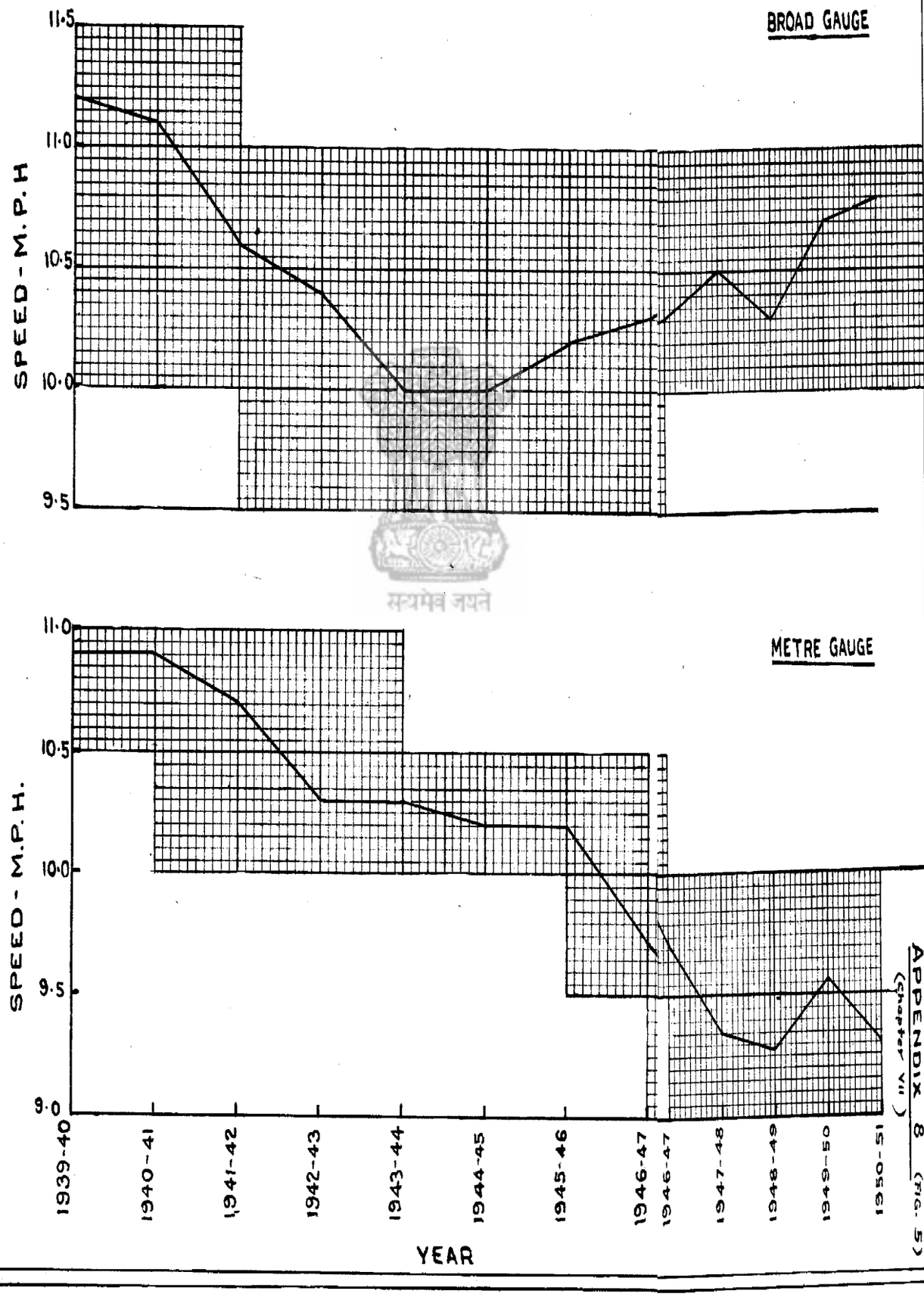
TREND OF AVERAGE LOAD PER TRAIN.



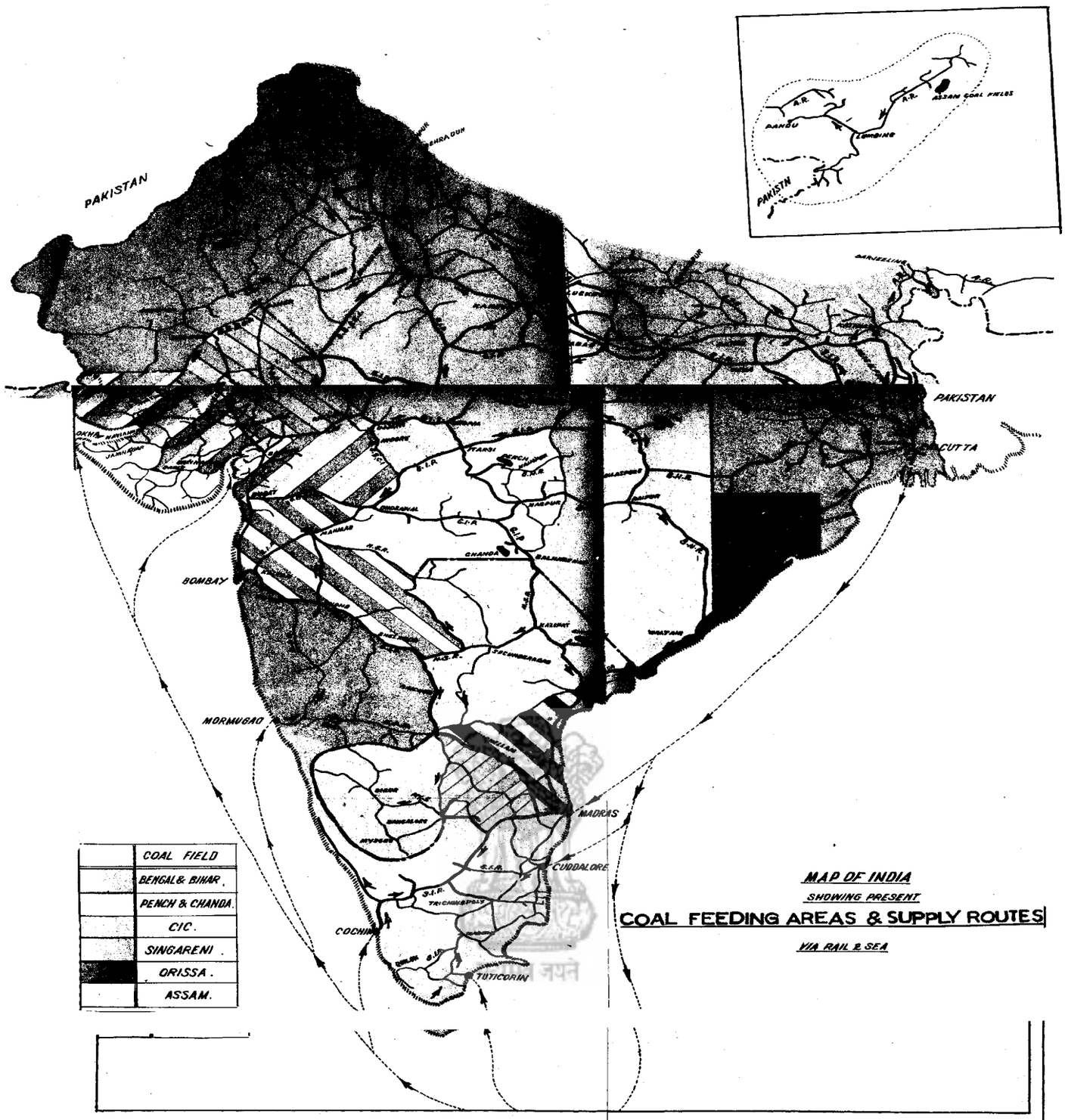
APPENDIX ... 8 (Chapter VII)

(FIG.

TREND OF AVERAGE SPEED OF GOODS TTRAINS



APPENDIX 8 (FIG. 5)
(Chapter VII)



MAP OF INDIA

SHOWING PRESENT

COAL FEEDING AREAS & SUPPLY ROUTES

VIA RAIL & SEA

TABLE -----I

RAISINGS OF INDIAN COAL FIELDS & ALLOCATION OF SUPPLIES TO INDIAN RAILWAYS

COAL FIELD	BENGAL & BIHAR	PENCH & CHANDA	C.I.C.	SINGARENI	ORISSA	ASSAM	TOTAL
AVERAGE MONTHLY RAISINGS IN TONS (MAY 51)	2447,000	179,000	161,000	100,000	41,000	42,000	2970,000
(%)	(82.4)	(6.0)	(5.4)	(3.4)	(1.4)	(1.4)	(100%)
AVERAGE MONTHLY ALLOCATIOS TO RAILWAYS IN TONS (MAY 51)	640,000	62,000	98,000	42,000	24,000	15,000	881,000
(%)	(72.7)	(7.0)	(11.1)	(4.8)	(2.7)	(1.7)	(100%)
REMAINING MONTHLY SUPPLIES TO INDUSTRIES BUNKER, EXPORT, ETC. IN TONS	1807,000	117,000	63,000	58,000	17,000	27,000	2088,000
(%)	(86.4)	(5.6)	(3.0)	(2.8)	(0.8)	(1.3)	(100%)

TABLE-----II

COAL COMM'S MONTHLY COAL ALLOTMENTS TO RAILWAYS (APRIL - JUNE 1951)

COAL FIELD / RAILWAY	BENGAL & BIHAR	PENCH & CHANDA	C.I.C	SINGARENI	ORISSA	ASSAM	TOTAL (TONS)
E.I.	100 %	–	–	–	–	–	(202,000)
B.N.	60.5 %	5.5 %	27.0 %	–	7.0 %	–	(128,000)
G.I.P.	53.6 %	33.8 %	12.6 %	–	–		(135,000)
B.B. & C.I.	69.1 %	3.4 %	27.5 %	–	–	–	(87,000)
E.P.	100 %	–	–	–	–	–	(47,000)
M.S.M. RAIL	45.3 %	–	25.2 %	11.1 %	18.4 %	–	(81,000)
M.S.M. SEA							
S.I. RAIL	100 %	–	–	–	–	–	(43,000)
S.I. SEA							
N.S.	–	6.0 %	–	94.0 %	–	–	(25,000)
ASSAM	55-0 %	–	–	–	–	45.0 %	(34,000)
O.T.	100 %	–	–	–	–	–	(51,000)
My.S	–	–	–	100 %	–	–	(10,000)
BIK.S	100 %	–	–	–	–	–	(5,000)
J.R.	100 %	–	–	–	–	–	(7,200)
SAURASHTRA RAIL	30.3 %	19.4 %	7.7. %	–	–	–	(26,000)
SAURASHTRA SEA	42.6 %						

TABLE ---- III

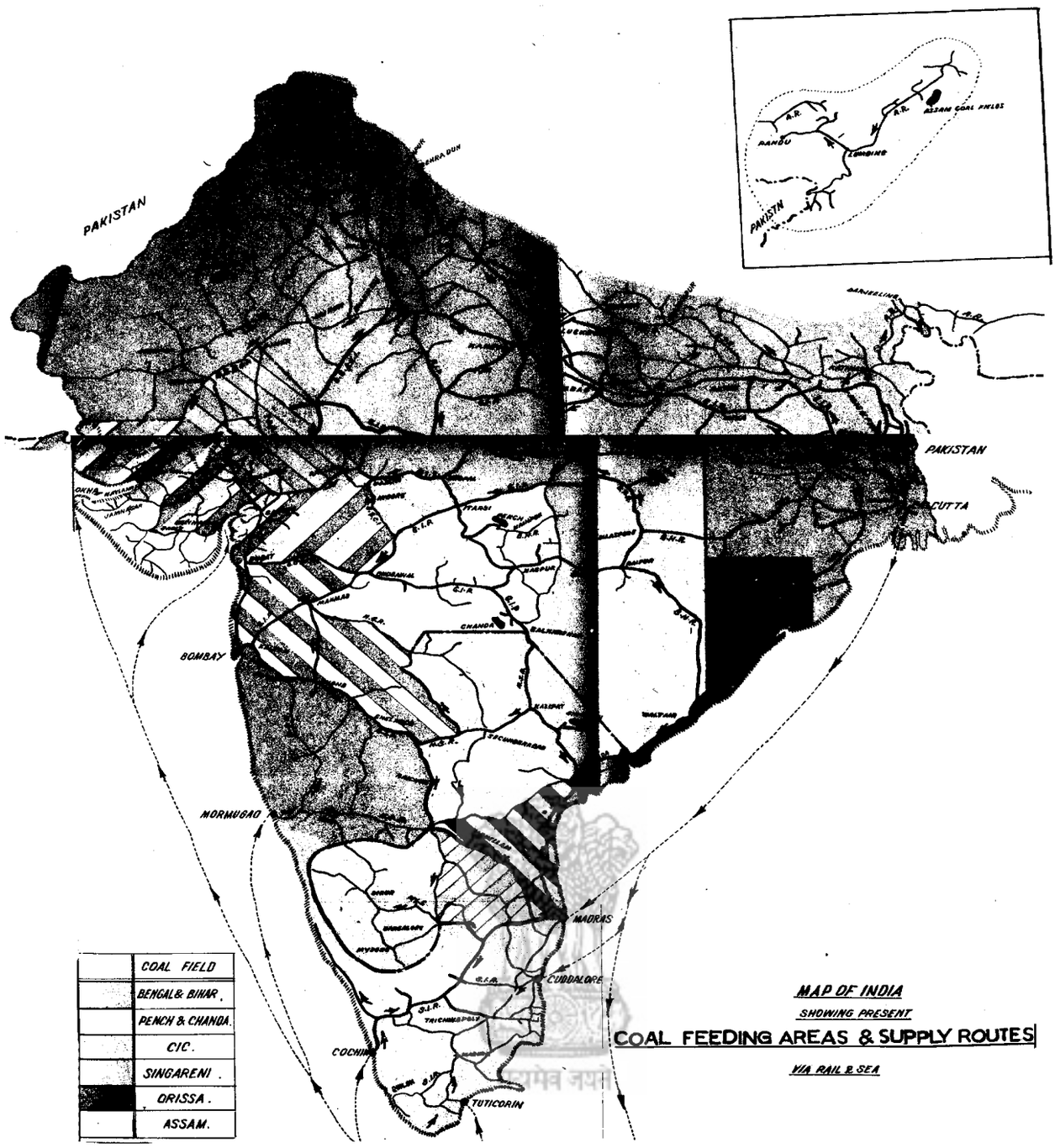
COAL PRICES AT PITHEAD (1951)

COAL FIELD	BENGAL & BIHAR					PENCH & CHANDA	C.I.C.	SINGARENI	ORISSA	ASSAM
	SEL.A	SEL.B	GR.I	GR.II	AVERAGE					
PRICE Rs:/TON	16/4	15/4	14/6	14/-	15/3	15/8 (Oct 48)	15/8 (Oct 48)	25/- (APPOX)	15/16 (Oct 48)	26/4 (Oct 48)

AVERAGE COST OF COAL PER TON (INCLUDING FREIGHT) ON INDIAN RAILWAYS (1949 - 50)

RAILWAY	E.I.	B.N.	G.I.P.	B.B&C.I.	E.P.	M.S.M.	S.I.	N.S.	ASSAM	O.T.	My.S.	BIK.S	J.R.	SAUR
COST Rs. TON	21.8	22.4	28.3	34.4 B.G. / 28.9 M.G.	31.1	48.8 B.G. / 60.9 M.G.	61.0 B.G. / 61.0 M.G.	28.9 B.G. / 32.7 M.G.	39.0	25.5	30.0	31.0	30.9	NOT AVAILABLE

APPEN



MAP OF INDIA
SHOWING PRESENT
COAL FEEDING AREAS & SUPPLY ROUTES
VIA RAIL & SEA

TABLE ----- I

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COAL FIELD	BENGAL & BIHAR	PENCH & CHANDA	C.I.C.	SINGARENI	ORISSA	ASSAM	TOTAL
AVERAGE MONTHLY RAISINGS IN TONS (MAY 51)	2447,000	179,000	161,000	100,000	41,000	42,000	2970,000
(%)	(82.4)	(6.0)	(5.4)	(3.4)	(1.4)	(1.4)	(100%)
AVERAGE MONTHLY ALLOCATIOS TO RAILWAYS IN TONS (MAY 51)	640,000	62,000	98,000	42,000	24,000	15,000	881,000
(%)	(72.7)	(7.0)	(11.1)	(4.8)	(2.7)	(1.7)	(100%)
REMAINING MONTHLY SUPPLIES TO INDUSTRIES, BUNKER, EXPORT, ETC. IN TONS	1807,000	117,000	63,000	58,000	17,000	27,000	2088,000
(%)	(86.4)	(5.6)	(3.0)	(2.5)	(10.8)	(1.3)	(100%)

TABLE ---- II

COAL COMM'S MONTHLY COAL ALLOTMENTS TO RAILWAYS (APRIL - JUNE 1951)

COAL FIELD / RAILWAY		BENGAL & BIHAR	PENCH & CHANDA	C.I.C	SINGARENI	ORISSA	ASSAM	TOTAL (TONS)
E.I.		100 %	–	–	–	–	–	(202,000)
B.N.		60.6 %	5.5 %	27.0 %	–	7.0 %	–	(128,000)
G.I.P.		53.6 %	33.8 %	12.6 %	–	–		(155,000)
B.B.&C.I.		69.1 %	3.4 %	27.5 %	–	–	–	(87,000)
E.P.		100 %	–	–	–	–	–	(47,000)
M.S.M.	RAIL	–	–	25.2 %	11.1 %	18.4 %	–	(81,000)
	SEA	45.3 %						
S.I.	RAIL	100 %	–	–	–	–	–	(43,000)
	SEA							
N.S.		–	6.0 %	–	94.0 %	–	–	(25,000)
ASSAM		55-0 %	–	–	–	–	45.0 %	(34,000)
O.T.		100 %	–	–	–	–	–	(51,000)
My.S		–	–	–	100 %	–	–	(10,000)
BIK.S		100 %	–	–	–	–	–	(5,000)
J.R.		100 %	–	–	–	–	–	(7,000)
SAURASHTRA	RAIL	30.3 %	19.4 %	7.7 %	–	–	–	(26,000)
	SEA	42.6 %						

TABLE ---- III

COAL PRICES AT PITHEAD (1951)

COAL FIELD	BENGAL & BIHAR					PENCH & CHANDA	C.I.C.	SINGARENI	ORISSA	ASSAM
	SEL.A	SEL.B	GR.I	GR.II	AVERAGE					
PRICE Rs./TON	16/4	15/4	14/6	14/-	15/3	15/8 (Oct 48)	15/9 (Oct 48)	25/- (APPOX)	15/18 (Oct. 48)	26/4 (Oct. 48)

AVERAGE COST OF COAL PER TON (INCLUDING FREIGHT) ON INDIAN RAILWAYS (1949 - 50)

RAILWAY	E.I.	B.N.	G.I.P.	B.B.&C.I.	E.P.	M.S.M.	S.I.	N.S.	ASSAM	O.T.	My.S.	BIK.S	J.R.	SAUR.
COST Rs. TON	21.8	22.4	28.3	34.4 B.G. 29.9 M.G.	31.1	48.6 B.G. 60.9 M.G.	61.0 B.G. 61.0 M.G.	28.9 B.G. 32.7 M.G.	32.0	25.5	30.0	31.0	30.9	NOT AVAILABLE

ANNEXURE 5

TABLE SHOWING

GRADEWISE SUPPLY OF LOCO COAL FROM VARIOUS BASE STATIONS TO INDIAN RAILWAYS.

(BG. WAGONS/DAY)

Coal Field	Base Station	Southern Rly. A	B	I	II	OF	Total	Central Rly. A	B	I	II	OF	Total	Western Rly. A	B	I	II	OF	Total
Raniganj	Ondal	50	30				80						-						-
	Asansol						-						-						-
	Sitarampur						-						-						-
	Barakar						-	18	9		2		29						-
	Radhanagar						-	28					28						-
	Chaurasi						-	17					17						-
Jharia	Patherdih						-						-						-
	Kusunda						-						-		51	23	11		85
	Katrasgarh						-						-		12		6		18
	Bhojudih						-						-						-
	Bhaga						-						-						-
	Mahuda						-						-						-
Bokaro & Karanpura	Gomoh						-			31			31			47			47
	Barkakana						-						-						-
Giridih	Giridih						-						-						-
Totals - Bengal & Bihar		50	30				80	63	9	31	2		105		63	70	17		150
" C.I.C. fields						38	38					37	37					33	33
" Pench "						7	7					80	80						-
" Chanda "							-					14	14						-
" Singareni "						50	50					35	35						-
" Talcher "						30	30						-						-
" Assam "							-						-						-
GRAND TOTAL		50	30	-	-	125	205	63	9	31	2	166	271	-	63	70	17	33	183

Coal Field	Base Station	Northern Rly. A	B	I	II	OF	Total	Eastern Rly. A	B	I	II	OF	Total	North-Eastern Rly. A	B	I	II	OF	Total	Total A	B	I	II	OF	G. Total
Raniganj	Ondal						-		56	41			97		14	8			22	50	100	49			199
	Asansol						-	10	17	5			32						-	10	17	5			32
	Sitarampur						-		5	5	8		18	36		15	5		56	36	5	20	13		74
	Barakar						-						-	9		6			15	27	9	6	2		44
	Radhanagar						-						-						-	28					28
	Chaurasi						-	13					13						-	30					30
Jharia	Patherdih	23	42	12	7		84		4	3	16		23						-	23	46	15	23		107
	Kusunda						-						-						-		51	23	11		85
	Katrasgarh		5	3	20		28						-						-		17	3	26		46
	Bhojudih						-		27				27						-		27				27
	Bhaga						-		25				25						-		25				25
	Mahuda						-		12	7	22		41						-		12	7	22		41
Bokaro & Karanpura	Gomoh			48			48		4	72	10		86						-		4	198	10		212
	Barkakana		24				24		17	2	2		21						-		41	2	2		45
Giridih	Giridih	12					12	1					1						-	13					13
Totals - Bengal & Bihar		35	71	63	27		196	24	167	135	58		384	45	14	29	5		93	217	354	328	109		1008
" C.I.C. fields							-					52	52						-					160	160
" Pench "							-					17	17						-					104	104
" Chanda "							-						-						-					14	14
" Singareni "							-						-						-					85	85
" Talcher "							-						-						-					30	30
" Assam "							-						-					28	28					28	28
GRAND TOTAL		35	71	63	27	-	196	24	167	135	58	69	453	45	14	29	5	28	121	217	354	328	109	421	1429

WAGON BASIS :- 20 TONS PER WAGON

Fig. 7

APPENDIX (3) (Chapter XI)

Coal Field	Base Station	Via Madras (Sea-Route)	Via Cuddalore (Supplies via K.P. Docks)	Via Tuticorin	Via Cochin	Via Dhond-Gharpuri	" " -Hotgi	Via Balharshah-Wadi-Raichur	Via Dronachellam	Via Bezwada-Tadepalli	Via " -Madras	Via Waltair	TOTAL
Raniganj	Ondal	30	20	20	10								80
	Asansol												-
	Sitarampur												-
	Barakar												-
	Radhanagar												-
	Chaurasi												-
Jharia	Patherdih												-
	Kusunda												-
	Katrasgarh												-
	Bhojudih												-
	Bhaga												-
	Mahuda												-
Bokaro & Karanpura	Gomoh												-
	Barkakana												-
Giridih	Giridih												-
Total for Bengal & Bihar fields	Sel. A		20	20	10								50
	Sel. B	30											30
	Gr. I												-
	Gr. II												-
	Total	30	20	20	10	-	-	-	-	-	-	-	80
Total for CIC fields								38					38
" " Pench "						4	3						7
" " Chanda "													-
" " Singareni "									15	15	20	-	50
" " Talcher "												30	30
" " Assam "													-
GRAND TOTAL		30	20	20	10	4	3	38	15	15	20	30	205

Coal Field	Base Station		Via Agra East Bank	Via Jhansi	Via Cheoki	Via Ajni	Via Katni Murwara	Via Itarsi	Via Badnera-Bhusawal	Local for Nagpur div.	" Secunderabad Div.	TOTAL
Raniganj	Ondal											-
	Asansol											-
	Sitarampur											-
	Barakar		4	16	9							29
	Radhanagar				28							28
	Chaurasi					17						17
Jharia	Patherdih											-
	Kusunda											-
	Katrasgarh											-
	Bhojudih											-
	Bhaga											-
	Mahuda											-
Bokaro & Karanpura	Gomoh		11	12	8							31
	Barkakana											-
Giridih	Giridih											-
Total for Bengal & Bihar fields	Sel. A		4	14	28	17						63
	Sel. B				9							9
	Gr. I		11	12	8							31
	Gr. II			2								2
	Total		15	28	45	17	-	-	-	-	-	105
Total for CIC fields							37					37
" " Pench "								59		21		80
" " Chanda "									5	9		14
" " Singareni "											35	35
" " Talcher "												-
" " Assam "												-
GRAND TOTAL			15	28	45	17	37	59	5	30	35	271

Coal Field	Base Station	Via Agra East Bank (M.G.)	" " (B.G.)	Via Cheoki-Bhusawal	Via Katni-Ujjain	TOTAL	Via Saharanpur	Local for Moradabad Div.	" Lucknow "	" Allahabad "	Via Agra East Bank (M.G.)	Via Ghaziabad	" -Delhi-S.R.	TOTAL
Raniganj	Ondal					-								-
	Asansol					-								-
	Sitarampur					-								-
	Barakar					-								-
	Radhanagar					-								-
	Chaurasi					-								-
Jharia	Patherdih					-	48					26	10	84
	Kusunda	3	44	18		85								-
	Katrasgarh	10	8			18		6	6	8	8			28
	Bhojudih					-								-
	Bhaga					-								-
	Mahuda					-								-
Bokaro & Karanpura	Gomoh	9	26	12		47		9	11	23			5	48
	Barkakana					-		12	12					24
Giridih	Giridih					-				12				12
Total for Bengal & Bihar fields	Sel. A					-	13			12		10		35
	Sel. B	9	39	15		63	25	12	12		5	8	9	71
	Gr. I	10	48	12		70	7	9	11	23	3	5	5	63
	Gr. II	3	11	3		17	3	6	6	8		3	1	27
	Total	22	98	30	-	150	48	27	29	43	8	26	15	196
Total for CIC fields					33	33								-
" " Pench "						-								-
" " Chanda "						-								-
" " Singareni "						-								-
" " Talcher "						-								-
" " Assam "						-								-
GRAND TOTAL		22	98	30	33	183	48	27	29	43	8	26	15	196

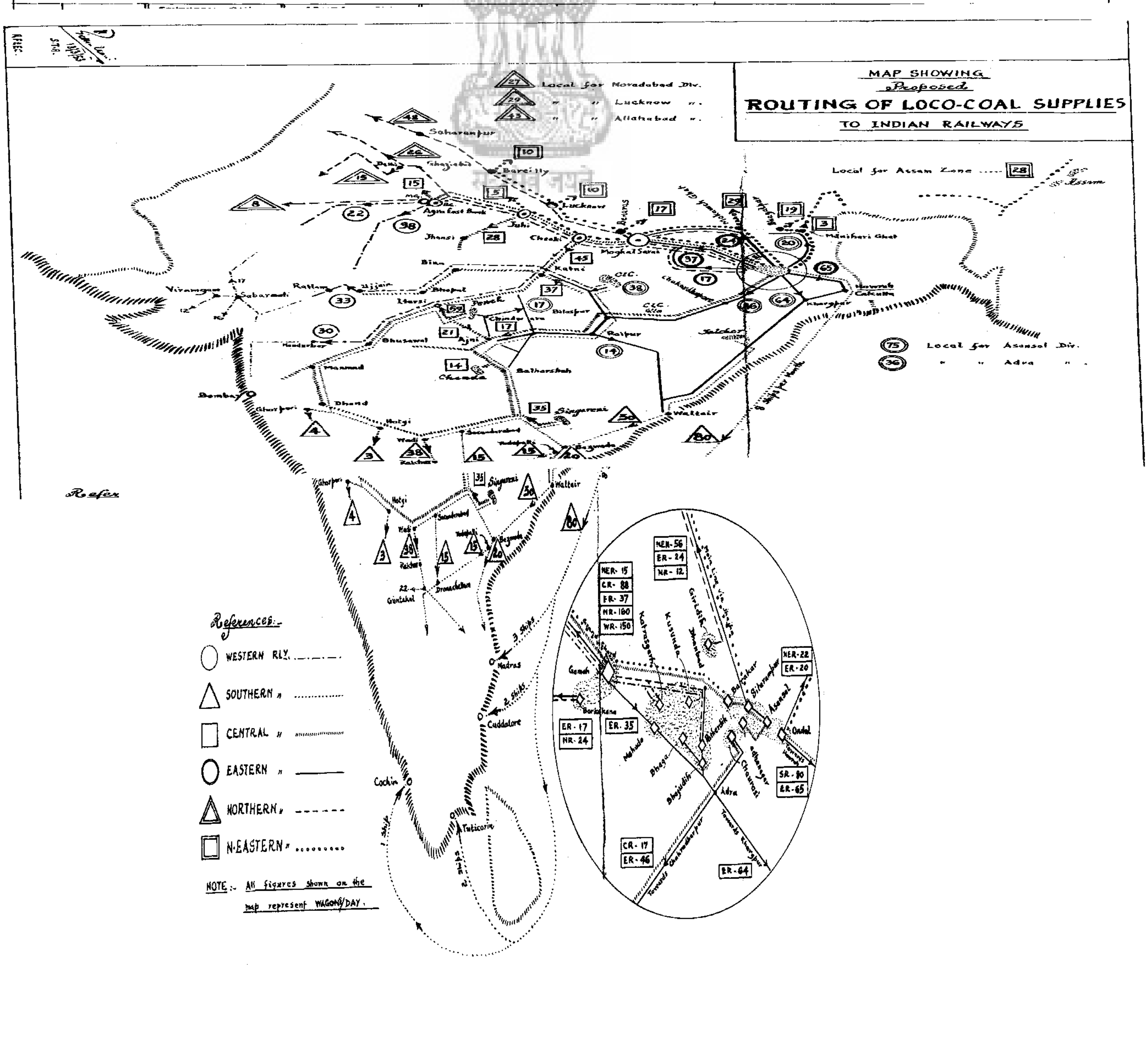
Coal Field	Base Station	Local for Dinapore Div. Via Jhajha	" " Via Gidhaur	" " Asansol Div.	From Ondal towards Calcutta	" " Jamalpur	Local for Adra Div.	Below Adra Via Chakradharpur	" " Kharagpur	Local for Bilaspur Div.	Via Raipur towards Waltair	Local for Nagpur (N.G.) Div.	TOTAL
Raniganj	Ondal			12	65	20							97
	Asansol	10		22									32
	Sitarampur	14		4									18
	Barakar												-
	Radhanagar												-
	Chaurasi								13				13
Jharia	Patherdih			18			5						23
	Kusunda												-
	Katrasgarh												-
	Bhojudih						4	23					27
	Bhaga								25				25
	Mahuda						27	6	8				41
Bokaro & Karanpura	Gomoh		37	14				17	18				86
	Barkakana		17	4									21
Giridih	Giridih			1									1
Total for Bengal & Bihar fields	Sel. A	10		1					13				24
	Sel. B	5	21	21	43	13	16	23	25				167
	Gr. I	5	28	31	22	7	7	17	18				135
	Gr. II	4	5	22			13	6	8				58
	Total	24	54	75	65	20	36	46	64	-	-	-	384
Total for CIC fields										38	14		52
" " Pench "												17	17
" " Chanda "													-
" " Singareni "													-
" " Talcher "													-
" " Assam "													-
GRAND TOTAL		24	54	75	65	20	36	46	64	38	14	17	453

Coal Field	Base Station	Via Bareilly	Via Jhansi (Kanpur)	Via Lucknow	Via Benares	Via Mokameh Ghat	Via Bhagalpur	Via Manihari Ghat	Local for Assam Zone	TOTAL	Grand Total
Raniganj	Ondal						19	3		22	199
	Asansol									-	32
	Sitarampur			10	17	29				56	74
	Barakar	10	5							15	44
	Radhanagar									-	28
	Chaurasi									-	30
Jharia	Patherdih									-	107
	Kusunda									-	85
	Katrasgarh									-	46
	Bhojudih									-	27
	Bhaga									-	25
	Mahuda									-	41
Bokaro & Karanpura	Gomoh									-	212
	Barkakana									-	45
Giridih	Giridih									-	13
Total for Bengal & Bihar fields	Sel. A	6	3	7	10	19				45	217
	Sel. B						11	3		14	354
	Gr. I	4	2	1	7	7	8			29	328
	Gr. II			2		3				5	109
	Total	10	5	10	17	29	19	3	-	93	1008
Total for CIC fields										-	160
" " Pench "										-	104
" " Chanda "										-	14
" " Singareni "										-	85
" " Talcher "										-	30
" " Assam "									28	28	28
GRAND TOTAL		10	5	10	17	29	19	3	28	121	1429

TABLE SHOWING

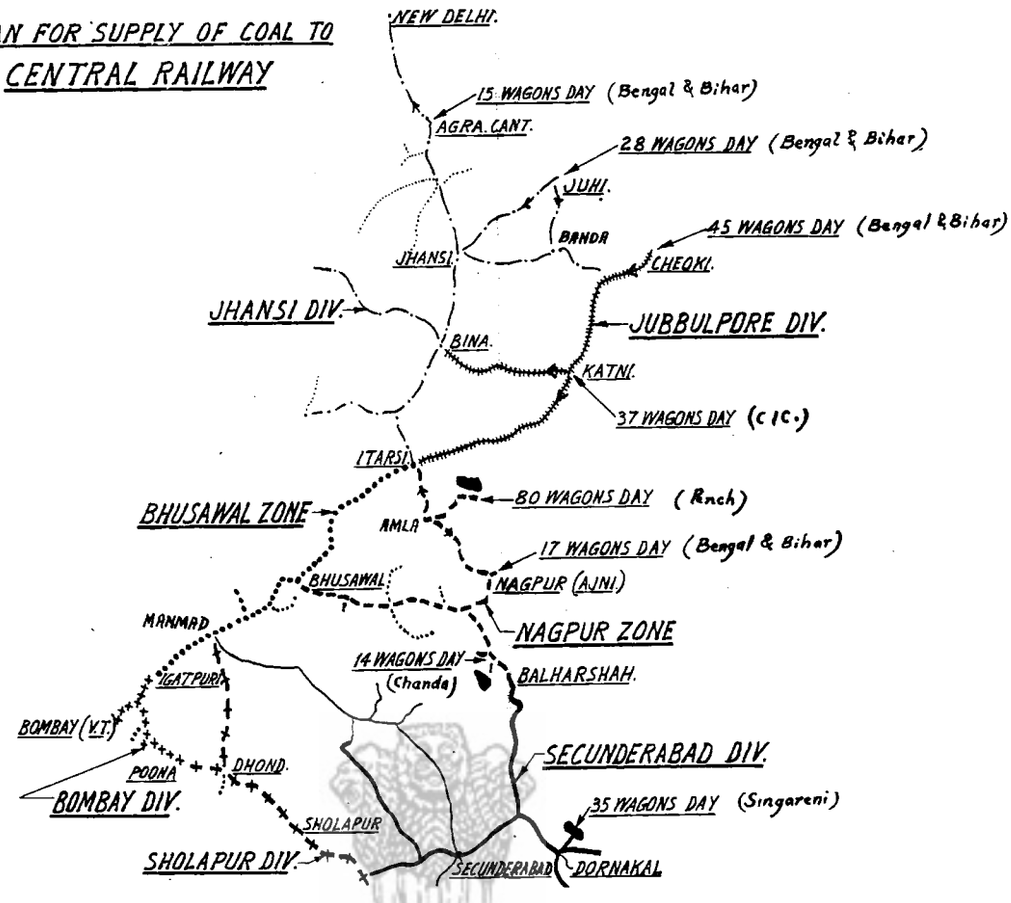
GRADEWISE SUPPLY OF LOCO COAL FROM VARIOUS BASE STATIONS TO INDIAN RAILWAYS.

(BG. WAGONS/DAY)



REREC.

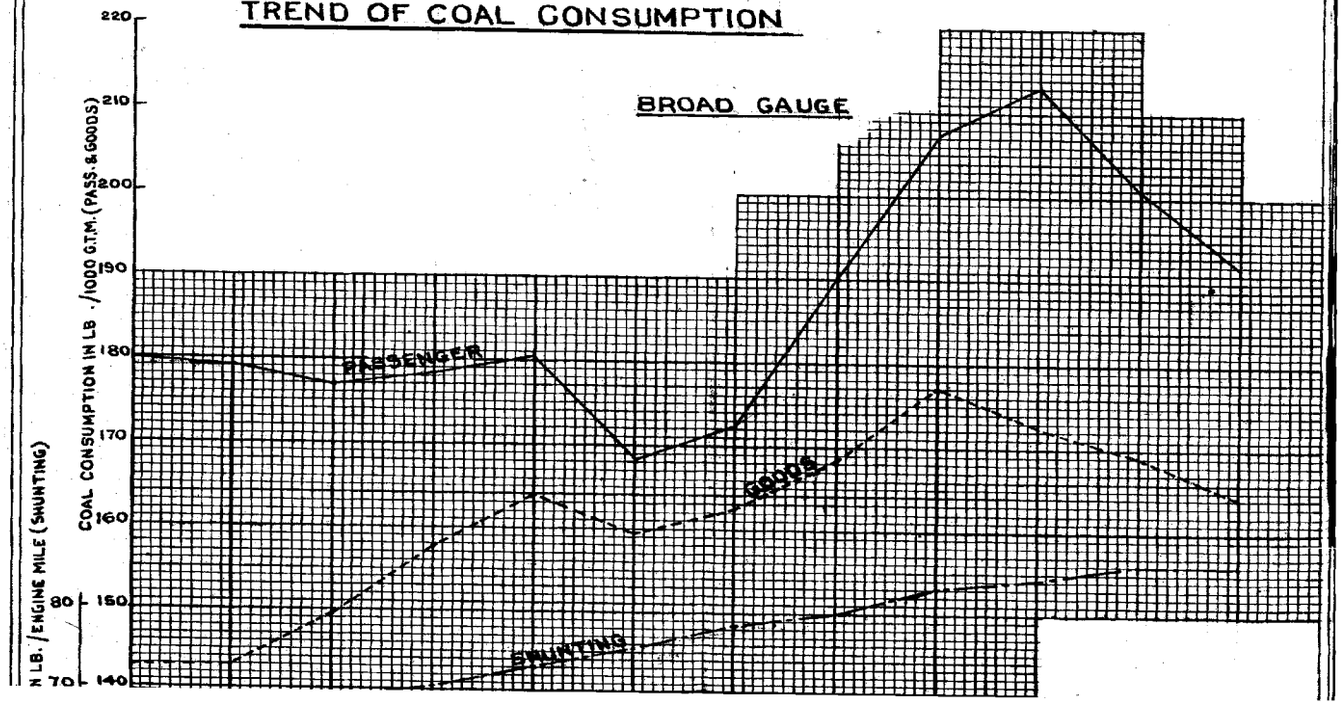
PLAN FOR SUPPLY OF COAL TO CENTRAL RAILWAY

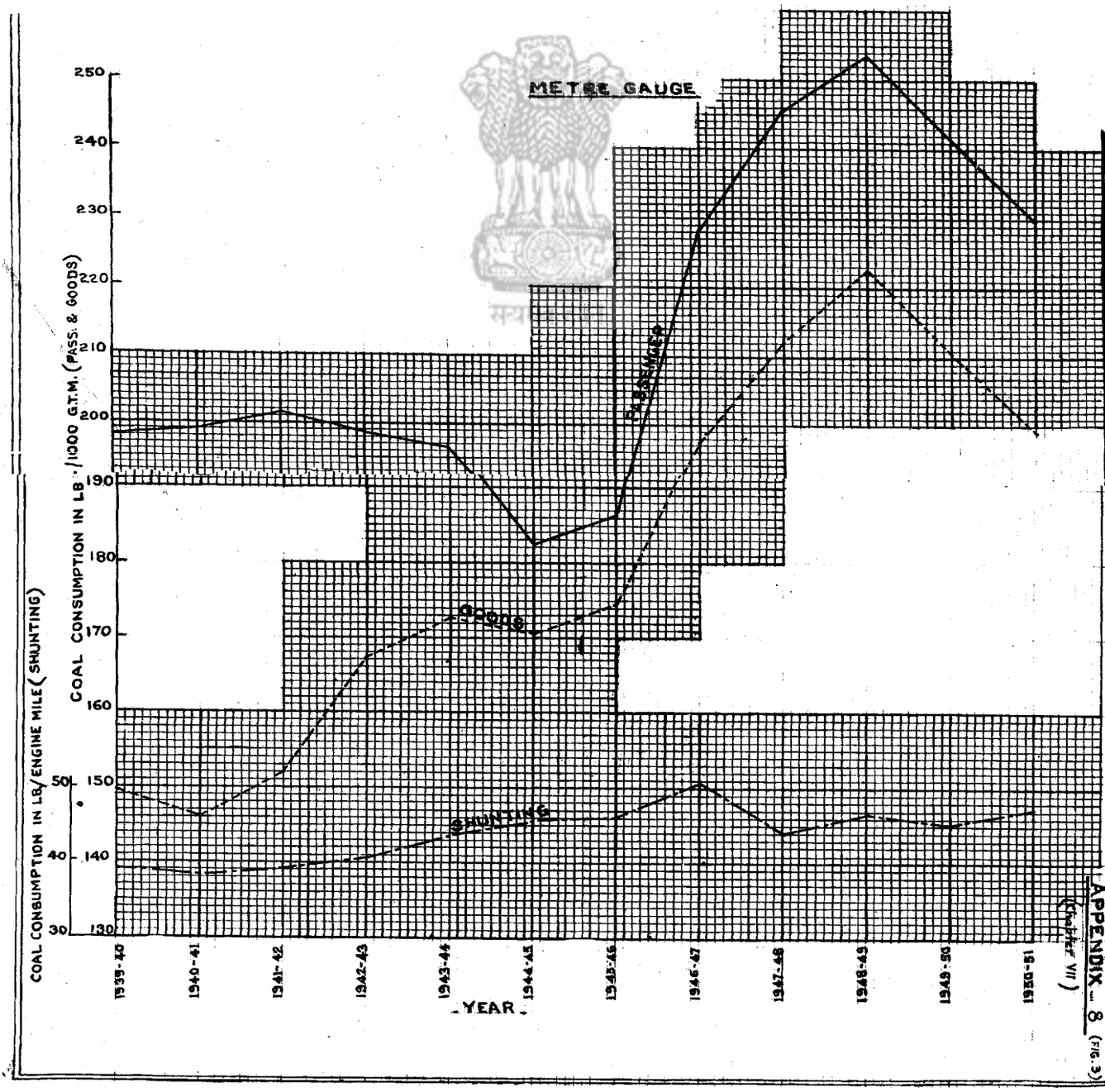


No	DIVISION OR ZONE	COAL REGD. WAGONS PER DAY	DISTRIBUTING CENTRE	SUPPLY ARRANGEMENT			
				COAL FIELD	WAGONS PER DAY	POINT OF INTAKE	ROUTE FOLLOWED
1	JHANSI	64	BARAKAR	BENGAL & BIHAR	43	JUHI (28) AEB (15)	VIA. KANPUR
			KATNI M.	※ CIC	21	KATNI	VIA. KATNI MURWARA
2	JUBBULPORE	33	BARAKAR	BENGAL & BIHAR	17	CHEOKI	VIA. CHEOKI
			KATNI M.	※ CIC	16	KATNI	VIA. KATNI MURWARA
3	BHUSAWAL	64	ITARSI	BENGAL & BIHAR	27	CHEOKI	VIA. CHEOKI
			JUNNERDEO	※ PENCH	32	-	VIA. ITARSI
			BALHARSHAH	※ CHANDA	5	-	VIA. BADNERA
4	BOMBAY	8	ITARSI	BENGAL & BIHAR	1	CHEOKI	VIA. CHEOKI
			JUNNERDEO	※ PENCH	7	-	VIA. ITARSI
5	SHOLAPUR	28	AJNI	BENGAL & BIHAR	8	AJNI	VIA. AJNI
			JUNNERDEO	※ PENCH	20	-	VIA. ITARSI
6	NAGPUR	39	AJNI	BENGAL & BIHAR	9	AJNI	VIA. AJNI.
			JUNNERDEO	※ PENCH	21	-	VIA. AJNI.
			BALHARSHAH	※ CHANDA	9	-	VIA. WARDHA.
7	SECUNDERABAD	35	DORNAKAL	SINGARENI	35	-	VIA. DORNAKAL
TOTAL		271	-	-	271	-	-

※ ALL CIC. COALS TO BE DISTRIBUTED AT KATNI MURWARA.
" PENCH " " " " " JUNNERDEO.
" CHANDA " " " " " BALHARSHAH.

TREND OF COAL CONSUMPTION





APPENDIX — 8 (FIG. 3)
(Chapter VII)