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STAFF APPRAISAL REPORT

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT I

October 26, 1982

Power and Transportation Division  
South Asia Projects Department

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CURRENCY EQUIVALENTS

|               |   |              |
|---------------|---|--------------|
| Currency Unit | = | Rupee (Rs)   |
| US\$1.00      | = | Rs 9.00      |
| US\$0.1111    | = | Rs 1.00      |
| US\$111,111   | = | Rs 1,000,000 |

SYSTEM OF WEIGHTS AND MEASURES: METRIC

| <u>Metric</u>                    |   | <u>British/US System</u> |
|----------------------------------|---|--------------------------|
| 1 meter (m)                      | = | 3.281 feet               |
| 1 square meter (m <sup>2</sup> ) | = | 10.760 square feet       |
| 1 kilometer (km)                 | = | 0.621 mile               |
| 1 ton-km                         | = | 0.621 ton-mile           |
| 1 passenger-km (pass-km)         | = | 0.621 pass-mile          |

ACRONYMS AND ABBREVIATIONS

|       |   |  |
|-------|---|--|
| AC    | - | Alternating Current  |
| BG    | - | Broad Gauge (1.676 m)  |
| cif   | - | cost, insurance, freight                                     |
| CLW   | - | Chittaranjan Locomotive Works                                |
| DC    | - | Direct Current   |
| DCW   | - | Diesel Component Works                                       |
| DF    | - | Development Fund   |
| DLW   | - | Diesel Locomotive Works                                      |
| DRF   | - | Depreciation Reserve Fund                                    |
| DSP   | - | Durgapur Steel Plant   |
| EMU   | - | Electric Multiple Unit                                       |
| ER    | - | Economic Return  |
| GOI   | - | Government of India  |
| hp    | - | horsepower   |
| hz    | - | herz or cycles per second                                    |
| ICB   | - | International Competitive Bidding                            |
| ICF   | - | Integral Coach Factory                                       |
| IR    | - | Indian Railways  |
| IRWA  | - | Indian Railways Wheel and Axle Plant                         |
| JPC   | - | Joint Plant Committee  |
| km/h  | - | kilometres per hour  |
| KV    | - | Kilovolt   |
| kwh   | - | kilowatt per hour  |
| MG    | - | Metre Gauge  |
| MW    | - | Megawatt   |
| NG    | - | Narrow Gauge (0.762 m and 0.610 m)                           |
| NTPC  | - | National Transport Policy Committee                          |
| OIS   | - | Operating Information System                                 |
| PF    | - | Pension Fund   |
| POH   | - | Periodical Overhaul  |
| RACF  | - | Railway Accident Compensation Fund                           |
| RDSO  | - | Research, Designs and Standards Organization Indian Railways |
| RITES | - | Rail India Technical and Economic Services                   |
| RRF   | - | Revenue Reserve Fund   |
| RTEC  | - | Rail Tariff Enquiry Committee                                |
| SFYP  | - | Sixth Five Year Plan   |
| TISCO | - | Tata Iron and Steel Company                                  |
| UNDP  | - | United Nations Development Program                           |
| v     | - | volt   |

GOVERNMENT OF INDIA FISCAL YEAR

April 1 - March 31



INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

STAFF APPRAISAL REPORT

Table of Contents

|   | <u>Page No.</u> |
|---|-----------------|
| I. BACKGROUND.....                                  | 1               |
| A. Economic Setting and Transport Sector.....       | 1               |
| B. Transport Planning and Coordination.....         | 3               |
| C. Transport Policy and Investment Allocations..... | 4               |
| II. INDIAN RAILWAYS.....                            | 6               |
| A. Organization, Management and Staff.....          | 6               |
| B. Training.....                                    | 6               |
| C. Infrastructure.....                              | 6               |
| D. Motive Power.....                                | 7               |
| E. Rolling Stock.....                               | 9               |
| F. Workshops.....                                   | 10              |
| G. Manufacturing Units.....                         | 11              |
| H. Operating Performance.....                       | 11              |
| I. Traffic.....                                     | 15              |
| J. Railway Planning.....                            | 16              |
| K. Railway Investment Plan.....                     | 17              |
| L. Performance Under Previous Projects.....         | 18              |
| III. THE PROJECT.....                               | 19              |
| A. Background.....                                  | 19              |
| B. Objectives.....                                  | 20              |
| C. Description.....                                 | 20              |
| D. Cost Estimates.....                              | 29              |
| E. Financing.....                                   | 31              |
| F. Implementation.....                              | 31              |
| G. Procurement.....                                 | 32              |
| H. Disbursements.....                               | 33              |
| IV. ECONOMIC EVALUATION.....                        | 33              |
| A. General.....                                     | 33              |
| B. Diesel Component Works (DCW).....                | 34              |
| C. Unit Exchange System.....                        | 35              |
| D. High Capacity Wagons.....                        | 36              |
| E. Other Items.....                                 | 36              |

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|     |   |    |
|-----|---|----|
| F.  | Overall Evaluation.....                         | 37 |
| G.  | Risks.....                                      | 37 |
| V.  | FINANCE AND EARNINGS.....                       | 37 |
| A.  | Introduction.....                               | 37 |
| B.  | Recent Changes in Financial Policies.....       | 38 |
| C.  | Rates and Fares.....                            | 40 |
| D.  | Past Performance.....                           | 40 |
| E.  | Future Prospects.....                           | 42 |
| F.  | Financing Plan.....                             | 44 |
| G.  | Financial Aspects of Diesel Component Works.. . | 45 |
| VI. | AGREEMENTS REACHED AND RECOMMENDATIONS.....     | 45 |

TABLES

|     |  |
|-----|--|
| 1.  | Age Inventory of Rolling Stock, March 31 1981  |
| 2.  | Summary of Operating Statistics 1973/74-1981/82  |
| 3.  | Freight and Passenger Traffic 1950/51-1981/82  |
| 4.  | Freight Traffic by Major Commodities 1969/70-1981/82   |
| 5.  | Freight Traffic Forecasts by Major Commodities 1981/82-1990/91   |
| 6.  | IR's Investment Program 1980/81-1984/85  |
| 7.  | Summary of Financial Cost Estimates - DCW  |
| 8.  | Investment Schedule - DCW 1982/83-1986/87  |
| 9.  | Indigenous Production and Import of Wheels, Tyres and Axles 1963/64-1981/82  |
| 10. | IR Wheel, Tyre and Axle Requirements, Present Manufacturing Capacity, and Projected Production and Shortfall 1982/83-1986/87 |
| 11. | Schedule of Training of Officers and Supervisors for DCW   |
| 12. | Estimated Schedule of Disbursements  |
| 13. | Summary of the Economic Cost and Benefit Streams of the Project  |
| 14. | IR Revenue and Expenditure Accounts 1976/77 to 1980/81   |
| 15. | IR Balance Sheet March 31, 1981  |
| 16. | Distribution of Key Revenue Expenditure Items as a Percentage of Total Revenues  |
| 17. | Changes in Average Fare and Freight Rates in Relation to Prices of Major Inputs of IR's Costs 1970/71-1981/82                |
| 18. | IR Revenue and Expenditure 1981/82 to 1986/87  |
| 19. | IR Forecast Balance Sheet as of March 31, 1982 to 1987   |
| 20. | IR Forecast Source and Application of Funds 1981/82 to 1986/87   |

ANNEXES

- Annex A Selected Documents Available in Project File
- Annex B Summary Timetable for Preparation of Operating Information System
- Annex C Railway Tariff Forecasts
- Annex D Principal Items Included in the Project
- Annex E Details of Economic Evaluation

CHARTS

- IBRD 18812 - Indian Railways Organization
- IBRD 22870 - Diesel Component Works (DCW), Proposed Layout
- IBRD 22871 - Project Implementation Organization (DCW)
- IBRD 24329 - Implementation Schedule

MAPS

- IBRD 13489R1- Railways
- IBRD 13490R1- Railways Depots, Sheds, Workshops, Manufacturing  
and Remanufacturing Units

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This report is based on information provided by the Government of India, and on the findings of various preparatory and appraisal missions in 1979, 1980, 1981 and 1982 consisting of Messrs. M. Alikhan (Financial Analyst), R. Auzmendi (Economist), N.E. Krough-Poulsen (Economist) M. Melrose (Railway Engineer), E. Pogson (Financial Analyst), A. Sabeti (Railway Specialist), T. Shima (Railway Engineer), A. Soto (Economist) and consultants D. Burns (Mechanical Engineer), G. Fisher (Electrical/Traction Specialist), D. Rowe (Manufacturing Management Specialist) and P. Voss (Electrical/Overhead Equipment Specialist). Messrs. M. Collins (PMD) and J. Griffith (Loan Officer) assisted in the appraisal. Reports and data related to the project available in the Association are listed in Annex A.



## INDIA

### RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

#### STAFF APPRAISAL REPORT

##### I. BACKGROUND

###### A. Economic Setting and Transport Sector

1.01 India covers an area of about 3.3 million square kilometres and includes parts of the Himalayan mountain system, the Indo-Gangetic plain, and the Deccan plateau of peninsular India. Total population is about 684 million with 23.7% living in urban areas (1981 census) and the remainder in small villages located mainly in the Indo-Gangetic plain, in the basins and deltas of other main river systems, and along the coast. The principal centres of population and economic activity are Calcutta, Bombay, Delhi and Madras. Other main centres are Hyderabad, Bangalore, Ahmedabad and Kanpur. The main agricultural areas are located in the Indo-Gangetic plain. The main coal and iron ore deposits are found in the eastern part of the Gangetic plain, where the majority of steel manufacturing and heavy engineering industries are also located.

1.02 Deliberate government policy, combined with the concentration of manufacturing and trading activities in a limited number of centres and the dispersal of the majority of the population in a large number of small villages, has resulted in rail and road transport becoming the dominant modes of transport, with the railway system providing mainly trunk services and the highway system functioning mainly as a feeder system to the railways. The roles of the various transport modes in India's motorized traffic in 1965 and 1981 are indicated below. The data are rough estimates, but suffice to indicate the main features of the system. Traffic figures are rounded to the nearest billion.

| <u>Mode</u> | <u>Billion Ton-km</u> |                | <u>Billion Pass-km</u> |                | <u>Annual Growth %</u> |                |
|-------------|-----------------------|----------------|------------------------|----------------|------------------------|----------------|
|             | <u>1964/65</u>        | <u>1981/82</u> | <u>1964/65</u>         | <u>1980/81</u> | <u>Ton-km</u>          | <u>Pass-km</u> |
| Rail        | 107                   | 174            | 93                     | 229            | 2.9                    | 5.2            |
| Road        | 31                    | 92             | 76                     | 331            | 6.6                    | 8.3            |
| Other       | <u>12</u>             | <u>12</u>      | <u>2</u>               | <u>2</u>       | <u>0.0</u>             | <u>0.0</u>     |
| TOTAL       | 150                   | 278            | 171                    | 542            | 3.7                    | 7.5            |

Agricultural and mineral products account for an estimated 70% of the total revenue freight transport volume. A large part of agricultural production and most mineral freight and manufacturing production has origin or destination in Northern India with its concentration of population and heavy industries. The

major part of foreign trade is channelled through the ports of Bombay, Calcutta and Madras.

1.03 For a country with the size and diversified economic structure of India, transport plays a vital role. It must provide efficient and reliable transport services, and, given the scarcity of financial resources in the economy, it must accomplish these objectives at a minimum cost. It is of paramount importance, therefore, to ensure that the vital production activities of the economy are not hindered by lack of transportation.

1.04 Traditionally transport kept pace with economic development in the country. During the late seventies, however, the discipline and morale of labor in transport agencies and their freight users alike markedly decreased, while investments in transport infrastructure and facilities were given lower priority than those for sectors such as agriculture, energy and industry. Other factors such as substantial changes in the volume as well as in origin and destination of traffic flows, further compounded the problem. As a result, ports (particularly Bombay) and railways, the backbone of the country's transport system, were unable to adequately meet traffic demand. And the road transport system, never designed to carry such traffic, had difficulty covering the railway transport shortfall and did so only at high cost to the economy. All this resulted in supply shortages of vital commodities such as coal, cement and fertilizer, which brought about stoppages and dislocations to critical economic sectors. However, in 1980-82, the general situation in the sector, and specifically in railways and ports, has substantially improved as a result of better railway and port management. Waiting time in the port of Bombay has dropped from 30-40 days for bulk cargo ships in mid-1980 to almost none in mid-1982. The improvement in railway performance is illustrated in Table 2.

1.05 The railways have traditionally been the main mode of motorized transport in India and retained their relative position more or less unchanged up to the beginning of the 1950's, when the railway share of motorized land transport was estimated at 90% of total ton-km and 75% of total pass-km. Over the following two decades, highway freight and passenger transport increased rapidly while the railways' share declined to 65% of total freight traffic and 40% of total passenger traffic, with a corresponding increase in the share of road transport. With respect to freight, this development was due to the increasing market for high-value goods moving over short and medium distances, where highway transport has inherent advantages over railway transport. With respect to passenger traffic, the main reason for the reduced railway share is that long-distance passenger traffic has tended to increase at a slower rate than short-distance commuter traffic, which can generally be carried more economically by road except for large and dense population centres such as Bombay, Calcutta and Madras.

1.06 Compared with railways and highway transport, the other modes of transport are at present of minor importance as general goods and passenger carriers: coastal shipping and pipelines each carry about 3% of the total freight traffic in terms of ton-km; air transport carries about 1% of total pass-km. These modes are, however, important within their specialized areas, and there is scope for considerable expansion within each mode because of the

size of the country and its geographical features. Consequently, projects for expansion of coastal shipping of coal and pipelines for transport of crude oil, gas and petroleum products are currently being undertaken by the Government.

#### B. Transport Planning and Coordination

1.07 The Indian transport sector is under the jurisdiction of various ministries: ports, shipping and roads are under the Ministry of Shipping and Transport; railways are under the Ministry of Railways; civil aviation under the Ministry of Tourism and Civil Aviation; and pipelines under the Ministry of Petroleum. Planning and coordination is undertaken within the context of overall national and regional plans.

1.08 The present institutional arrangements for transport and coordination at the Central Government level consist of: (a) a Cabinet Committee on Transport and Tourism; (b) a Secretaries' Committee on Transport, Tourism and Aviation; (c) a Transport Development Council and an Inland Water Transport Board, which coordinates policies between the Centre and the States; and (d) an Interstate Transport Committee which regulates interstate road transport. The committees described under (a) and (b) above are standing committees which are not concerned with the day-to-day process of planning. They provide a forum for discussion and their recommendations are not binding. While railways are exclusively under the Central Government, highways and road transport, minor ports and inland water transport are under the jurisdiction of Central and State Governments.

1.09 This organizational set up, which has resulted in insufficient coordination within the transport sector, was a matter of concern and of frequent exchange of views between GOI and the Bank Group for several years. In view of the increasing importance of addressing on a sectoral basis issues such as the high share (63% in 1979/80) of the transport sector's oil consumption in the country's oil bill, and of formulating investment, pricing and operating policies aimed at minimizing the resource cost to the economy of the transport sector's services, a special study group, the National Transport Policy Committee (NTPC), was created in April 1978. The NTPC, with the assistance of experts provided by UNDP, carried out a study which was presented to GOI in 1980. A review by the Bank indicates that the study's suggestions and recommendations are basically sound and that they will provide a framework for better development of the country's transport sector. GOI approved most of NTPC recommendations in a cabinet resolution of March 1982. The country is in the process of starting the implementation, and in such a vast country with a complex government structure, each transport policy change will have undoubtedly to overcome all sorts of difficulties to be finally implemented.

1.10 For national transport investments, the Planning Commission assesses and approves for inclusion in the national plan, the investment proposals emanating from the transport sector. The national plan thus formulated by the Planning Commission must subsequently be approved by the Government and the National Development Council.

1.11 For transport pricing, the overall responsibility lies with the Central Government, except in the case of road transport where the responsibility is shared by the Central, State and local authorities. As a result, the type, level and structure of taxes and road user charges vary considerably from one state to another. A number of studies 1/ have recommended improvements to make the system more efficient, less costly in terms of time and requirements to fulfill and geared to a more uniform cost-based structure. Some of these recommendations have been partially implemented by a few states, but a general application has proved difficult to attain. In the case of railways, as mentioned in paras 5.04 and 5.05, a committee convened by Government has studied the rail transport's rate structure and has recommended a number of measures to improve, inter alia, the tariff structure. Some measures have already been taken by Indian Railways with the final objective of achieving a fully distributed cost-based tariff structure, which currently is not true for some segments of traffic.

### C. Transport Policy and Investment Allocations

1.12 The Government's economic objectives were stated in the Sixth Five-Year Plan 1980-85. The Plan represents an attempt at realizing high average growth in the economy by increased emphasis on irrigation, rural development and power. India's current long-term policy for the transport sector generally aims at the further development of a transport system which can efficiently meet the increased transport demand resulting from growth in the economy. This policy would be implemented through increased support of the highway sector with particular emphasis on facilitating transport in rural areas; encouragement of increased efficiency of railway transport operations; and discouragement of growth in and decongestion of the central business districts of large metropolitan regions. Of the total public investment in the Five-Year Plan, Rs 101.6 billion or 10.4% would be allocated to transportation. Transport investment outlays are shown below (1951-78 representing outlays in current prices and 1980-85 planned outlays in 1979-80 prices):

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1/ Motor Vehicle Taxation Enquiry Committee (1950), Wankhede Study Group (1971), National Transport Policy Committee (1980).

Rs Million

| <u>Plan Period</u>        | <u>Total Plan</u> | <u>Transport</u> | <u>Percent Transport</u> |
|---------------------------|-------------------|------------------|--------------------------|
| 1951-56 (First)           | 19,600            | 4,340            | 22                       |
| 1956-61 (Second)          | 46,720            | 11,040           | 24                       |
| 1961-66 (Third)           | 85,770            | 19,810           | 23                       |
| 1966-69 (Inter)           | 66,250            | 10,320           | 16                       |
| 1969-74 (Fourth)          | 150,020           | 25,180           | 16                       |
| 1974-78 <u>a/</u> (Fifth) | 289,910           | 41,370           | 14                       |
| 1980-85 (Sixth)           | 975,000           | 101,620          | 10.4                     |

a/ The 1974-1979 Five-Year Plan was cut short by the defeat of the Congress Government in 1978.

1.13 The relative allocation of public transport investment funds between the various modes of transport, with the exception of pipelines, is shown below, 1951-78 representing actual allocations and 1980-85 planned allocations (in percent):

|         | <u>Rail</u> | <u>Roads</u> | <u>RTCs <u>a/</u></u> | <u>Ports</u> | <u>Ships</u> | <u>Aviation</u> |
|---------|-------------|--------------|-----------------------|--------------|--------------|-----------------|
| 1951-56 | 50          | 34           | 0                     | 7            | 4            | 5               |
| 1956-61 | 65          | 20           | 2                     | 3            | 5            | 5               |
| 1961-66 | 67          | 22           | 1                     | 5            | 2            | 3               |
| 1966-69 | 50          | 30           | 5                     | 6            | 3            | 6               |
| 1969-74 | 37          | 34           | 5                     | 11           | 6            | 7               |
| 1974-78 | 38          | 28           | 9                     | 11           | 9            | 5               |
| 1980-85 | <u>42</u>   | <u>28</u>    | <u>10</u>             | <u>6</u>     | <u>6</u>     | <u>8</u>        |
| Average | 50          | 28           | 4                     | 7            | 5            | 6               |

a/ Public Sector Road Transport Corporations, mainly for passenger transport.

1.14 The railway and road transport sectors have together received more than 80% of the public investment funds for transport over the past three decades. While railways used to get on the average 60% more than roads and road transport, the relative balance has changed, in line with the rapidly expanding role of road transport. The large port investment allocations during the period 1969-78 reflect an expansion program on the east coast which is substantially completed. The Sixth Plan port allocation includes only a nominal amount for the construction of a new port at Nhava Sheva, which was approved by GOI in early 1982. The inclusion of this project would substantially change the indicated percentages.

## II. INDIAN RAILWAYS

### A. Organization, Management and Staff

2.01 The network of Indian Railways (IR) is owned and managed by GOI. Its operations are controlled and directed by a Board of five members headed by a Chairman who is ex-officio a Principal Secretary to the Government of India reporting to the Minister of Railways. One board member, the Financial Commissioner, has discretionary powers to report directly to the Minister of Finance on financial matters. The Board, therefore, performs the dual functions of a Secretariat to the Ministry of Railways and of an executive body responsible for railway operations. In financial matters the Government of India, through Parliament, oversees implementation of recommendations made by the Railway Convention Committee and other parliamentary committees.

2.02 IR is the nation's largest single undertaking, with a capital investment of some Rs 75 billion and a total staff strength of about 1.67 million. There are nine Zonal Railways, each of which is under the control of a General Manager, and each zone is a large system on its own account. The quality of senior staff at Central and Zonal Headquarters is high and their knowledge of modern railway technology is good. IR also has three factories engaged in the manufacture of locomotives and rolling stock. A new factory is under construction for production of wheels and axles, partly financed under Credit 844-IN. IR's organization is illustrated in Chart IBRD 18812.

### B. Training

2.03 Training of staff is given high priority and is considered crucial by IR management in maintaining a high standard of operations, providing for staff development, and in keeping abreast of rapid technological changes. The training for particular jobs is done in the field at Zonal Training Schools in each zone. All schools have well equipped facilities.

2.04 In addition to the Zonal Training Schools, there are four Central Training Institutes where IR offers courses to its own personnel, as well as to personnel from African and Asian Railways: Sudan, Korea, Zambia, Nigeria, Bangladesh and others.

### C. Infrastructure

2.05 IR operates over 60,000 route-km, of which about 13,000 km have multiple track. IR's trackage is shown below by gauge and category (in km):

| <u>Gauge</u> | <u>Running Track</u> | <u>Sidings Yards</u> | <u>Total</u> | <u>Of which Electrified</u> |
|--------------|----------------------|----------------------|--------------|-----------------------------|
| Broad        | 45,167               | 20,269               | 65,436       | 13,114                      |
| Metre        | 26,447               | 7,815                | 34,262       | 329                         |
| Narrow       | 4,246                | 534                  | 4,780        | 0                           |
| Total        | 75,860               | 28,618               | 104,478      | 13,443                      |

Source: IR, Annual Statistical Statements 1980-81.

About 63% of total track is broad gauge (BG), 33% is metre gauge (MG), and the remaining 4% is narrow gauge (NG). About 20% of BG and 1% of MG track are electrified. Of total BG running track, 24,000 km or 15,000 route-km constitutes the heavy density lines over which average traffic density exceeds 20 million gross ton-km per year.

#### D. Motive Power

2.06 IR's traction policy has been under continuous review in the last two decades. The two most important studies on traction policy, before the energy crisis of 1973, were a "Study of Electrification and Dieselization on Indian Railways" in 1963 (known as the Sahai Committee Report), and the National Council of Applied Economic Research Study of 1970. These studies set the policy for a moderate pace of electrification of railway lines in the country coupled with a very rapid replacement of steam traction by diesel and electric. In view, however, of the huge increase in the price of petroleum derivatives after 1973, higher priority has been given to electrification and phasing out steam. To this effect, various studies have been recently carried out by GOI/IR, all of which are listed in Annex A and included in the Project File.

2.07 As of March 1981, there were 2,403 diesel electric and diesel hydraulic locomotives, 1,051 electric locomotives and 7,393 steam locomotives on IR (details of type and age group of IR's traction are shown in Table 1). Reexamination of IR's traction policy confirms the need to hasten the pace of steam traction replacement. Also, the recent studies conclude that, because of rapid oil price increases, the electrification in relative terms is becoming progressively more economical. In order to obtain maximum benefits from diesel and electric traction, however, it is essential to improve the performance of locomotives, to reduce their operating and maintenance costs, which are at present higher than those of the comparable diesel and electric locomotives in developed countries, and to provide a better flexibility in train operation.

2.08 In the 1960's, IR began manufacturing diesel electric, diesel hydraulic, AC and DC electric locomotives in order to reduce dependence on steam traction and reduce foreign exchange requirements for motive power modernization. At the Diesel Locomotive Works (DLW), located in Varanasi,

manufacture of diesel electric locomotives was set up in collaboration with ALCO, United States; at the Chittaranjan Locomotive Works (CLW), the diesel hydraulic locomotive manufacture was set up in collaboration with MAK, Federal Republic of Germany, and the AC electric locomotive manufacture was also set up in collaboration with the 50Hz Group (France, Germany, Switzerland and Belgium). At CLW, IR also manufactures a limited number of DC electric locomotives for replacement of DC traction around Bombay, which has the oldest electrified section of the Railways and the only DC section in India.

2.09 Since the acquisition of designs and start up of manufacture of locomotives in India, considerable improvements and innovations have taken place elsewhere in diesel and electric traction technology which have resulted in reduced manufacturing, operation and maintenance costs; and improved operating performance. These improvements have yet to be incorporated into locomotives manufactured by IR.

#### Diesel Electric Locomotives

2.10 Considerable potential exists for improving the reliability and efficiency of diesel electric locomotives manufactured by IR. The ongoing railway modernization and maintenance project, Credit 844-IN, provides support for engine testing, building of facilities for such testing and acquisition of proven new design parts and components for the purpose of adapting them to the Indian operating environment. Progress on this element of Credit 844-IN has been very difficult, mainly due to unwillingness of reputable manufacturers to part with their know-how. With manufacturers not willing to assist in advancing IR's basic knowledge quickly, the Railway has had to greatly increase the scope of testing facilities, instrumentation, and thus the implementation time, in order to carry out the required work for improving the locomotives.

2.11 The continued increase in IR's need for imported diesel fuel and rising costs have made it even more important for the Railways to improve the efficiency of its motive power in general and diesel locomotives in particular. There is significant potential for improved fuel efficiency of the existing fleet of DLW-built diesel engines. Under the project, improved fuel efficiency and consumption will be addressed (paras. 3.07 and 3.34-3.39). In addition, IR requires a medium range horsepower main line diesel electric locomotive for work train, branch line operation and other light duties in order to eliminate steam traction completely from trunk routes. During negotiations, an understanding was reached with GOI/IR regarding the timetable for introducing the medium range locomotive into operation.

#### Electric Locomotives

2.12 The present AC electric locomotive manufactured in India, designated the WAM4, was derived by IR's own Research, Design and Standards Organization (RDSO) from an Alsthom design of the 50 Hz Group and is approximately 27 years old. The only major change made to the design was the replacement of the original mono-motor bogie by a three-axle bogie with the same axle-hung motors of the WDM2 diesel electric locomotive manufactured by IR. When the WAM4 locomotive was first introduced, there were numerous performance problems.

Although problems of the traction motors have been gradually eliminated, the electrical controls and transformer are still unable to provide adequate power for the motors. Obsolescence of WAM4 design and features has resulted in lower availability and higher operating and maintenance costs than experienced with modern electric locomotives used by other railways. While a more versatile locomotive is required by IR to allow full utilization of electrified routes in the future, it is important to continue improving the 1,051 electric locomotives now operating on the system (para. 2.14).

2.13 A geographically specific problem of electric traction occurs at the major industrial centre and port of Bombay which is connected to the rest of the IR network by two 1,500 V DC electrified lines. These two lines are Bombay-Igatpuri on the northeast section and Bombay-Pune on the southeast section. The northeast approach to Bombay includes a heavy-graded 14-km section, known in India as ghat section of 1 in 37 (uncompensated) and a 67-km hilly section with a gradient of 1 in 87.5 (compensated). The southeast approach has a 28 km ghat section with a gradient of 1 in 37 (uncompensated). The present classes of locomotives manufactured by IR and used on the ghat sections have proved unsatisfactory for the specific requirements of banking duties, causing frequent wheel slips, stalls and partings of trains. In addition, due to inadequate capability of the existing locomotives, the train load limits on the DC graded sections are lower than load limits on adjacent AC electrified sections. Thus, the train loads have to be reduced prior to entering the DC ghat sections. As a result, operating costs and line-capacity utilization are adversely affected, indicating a need for special duty DC electric banking locomotives or partial conversion to AC traction for these sections.

2.14 Under the ongoing project, Credit 844-IN, the Association provided support for IR to improve the technology of its existing mainline AC and the DC banking locomotives. The project supported import of thyristor control/transformer sets to be tested on three groups of the present AC electric locomotives and complete electricals for developing prototype modern DC banking locomotives. The thyristor control transformer scheme has made some progress and two locomotives modified by local manufacturers have begun their testing period. Further, a contract has been finalized for ten thyristor sets to be supplied by a foreign manufacturer (Brown Boveri Company, Switzerland). These actions will considerably enhance the operating efficiency of the existing AC and DC locomotive fleet. It is, however, indispensable to try and update India's technology in electric locomotives as a pre-requisite to the stepped up electrification program envisaged in the Sixth Five-Year Plan. Accordingly, under the project, modern AC mainline locomotives are to be imported and tested for choosing the new generation of IR electric locomotives (paras. 3.25-3.27).

#### E. Rolling Stock

2.15 The current passenger stock includes 70 diesel rail cars, 2,361 electric multiple units (EMU); and 34,475 coaches. Details of passenger stock and their age group are given in Table 1. The present fleet of freight wagons

is about 402,000 units, equivalent to 541,000 four-wheeler wagons, IR's standard measure of freight capacity. Details of IR's rolling stock fleet by type and age group are also given in Table 1.

#### F. Workshops

2.16 IR's maintenance workshops were set up and equipped in the latter half of the nineteenth and early twentieth century by the then State and Company Railways. At the time of integration of the Railways in 1952, there were 41 workshops dealing with the overhaul of rolling stock and motive power. The size of these workshops varied from 150 to 15,000 employees. The workload and product mix in these units were governed by the need for self-sufficiency of each individual State/Company Railway, resulting in a proliferation of diverse activities for different types of rolling stock in individual workshops, which continues today.

2.17 While workshops mainly undertake periodical (programmed) overhauls and manufacture and remanufacture of parts and components, running repairs are performed in a large number of locomotive sheds and carriage and wagon depots dispersed through the country. These small repair units so far have been provided with limited machinery and plant, mainly through transfer of old machines from workshops.

2.18 The last 25 years of planned development on the IR has brought about extensive changes in the mode of traction from steam to diesel and electric. About 3,000 diesel and electric locomotives introduced since 1960 now carry about 80% of the total freight traffic. During the same period, the number of freight wagons in the fleet has grown two and a half times and the passenger stock has doubled. About 7,500 steam locomotives remain in service.

2.19 In spite of substantial increases in equipment holdings, complexity of technology and diversity of product mix since integration, IR's investment in workshops has been considerably lower than that required to sustain an adequate maintenance level. In the past 25 years, investment in workshops has averaged only 3.5% of the investment made in rolling stock and motive power, instead of the normal 7% to 11%. Besides, about 45% of investment in workshop machinery and plant has been exclusively for the manufacturing units: DLW, CLW and ICF. A 1977 detailed survey showed that of a total of 24,546 machines, 77% of those in mechanical workshops, 53% in production units and 46% in diesel and electric locomotive sheds and repair lines were over 15 years old. The gap between maintenance facilities and requirements has been widening rapidly. At the same time, the level of parts and components available for maintenance in the past has been substantially lower than required by the Railways. The result has been low out-turn and quality of maintenance, low availability of spare parts and components, and more importantly, decrease in reliability of motive power and rolling stock. This situation is aggravated because a large percentage of IR's rolling stock and motive power is reaching the age group for which heavy repair and overhaul are required.

2.20 Under the on-going Railway Modernization and Maintenance Project, Credit 844-IN, the Association provided support for the first phase of IR's program for improving its maintenance organization, facilities and procedures. The proposed project will provide further assistance in improving IR's maintenance capability and quality (paras. 3.07-3.24).

#### G. Manufacturing Units

2.21 IR's main manufacturing units are the Chittaranjan Locomotive Works (CLW) at Chittaranjan, the Diesel Locomotive Works (DLW) at Varanasi, and the Integral Coach Factory (ICF) at Madras. The CLW was set up in 1950/51 for the manufacture of steam locomotives. Production in this shop was diversified in the mid-1960's, and by 1972 this unit had switched entirely to the manufacture of electric locomotives, diesel hydraulic shunters and a variety of components for diesel electric locomotives and other equipment. The ICF commenced production of coaches in 1955/56 and later added electric multiple units to its product line. The DLW began production of diesel electric locomotives in 1964/65. A large proportion of the original equipment installed in the three production units has already served its useful economic life.

2.22 Under on-going Credit 844-IN, assistance is provided for modernization of CLW and DLW. Construction and equipping of a wheel and axle plant is also included in this on-going project (para. 3.24). In addition, GOI/IR are studying the coach manufacturing in India and ways to meet future needs, improvement of technology and augmentation of capacity.

2.23 IR's manufacturing, remanufacturing and maintenance activities are growing and rapidly becoming more complex. A need to strengthen IR's organization and management to adequately cover these expanding activities has become evident and has been the subject of extensive discussions between IR and the Bank. Accordingly, IR has agreed that an in-depth study for the preparation of a corporate plan covering present and future manufacturing activities and for the evaluation of alternative management and administrative approaches to its production operations would be carried out in the future. During negotiations an understanding was reached on the terms of reference of the study, timetable for completion of the study and for implementation of mutually accepted recommendations arising from this study.

#### H. Operating Performance

2.24 IR's operating performance for the period 1972/73 to 1981/82 is given in Table 2. The best performance level for the most significant operating indicators during the nine year period has been underlined in Table 2 for easy reference. The overall performance of IR compared to other railway systems in developing countries remains generally satisfactory. While the 1981/82 results show definite upswings in many of these indicators, a number of them, especially in motive power and equipment, are still faltering. The Bank and IR have been in the process of formulating a project to address these problems and, in the project now under consideration, a first step will be taken through

the import and testing in service of modern AC locomotive prototypes, and to improve reliability and efficiency of the diesel electric fleet.

2.25 The reasons for the somewhat disappointing results in recent years can be classified into three general categories: (i) factors external to IR and over which the railways have little, if any, control; (ii) events external to IR but to which the railways should be able to adapt smoothly and with reasonable promptness; and (iii) problems largely within the realm of IR's management to resolve. The first group includes a deterioration of law and order in the country, a reduction in efficiency of major railway users, port congestion, and an insufficient level of investment in maintenance and renewals in recent years, resulting from reduced priority for railway funds in recent five-year plans. The second group comprises changes in traffic patterns. The last category includes a drop in productivity of railway staff; insufficient attention to reducing costs; and the need to increase operating efficiency, improve railway technology, and delays in adopting or introducing modern management tools which would considerably enhance IR's ability to cope with these problems.

#### External Changes Largely Beyond IR's Control

2.26 As seen in paras. 1.12 and 1.13, the share of transport investment in the national plan and the proportion of this share allocated to railway investment have decreased since 1966 in spite of continuously increasing traffic and a rapidly rising need for renewal and modernization of rolling stock and maintenance equipment and facilities. The general deterioration of law and order since early 1978, which has resulted in damage to railway installations and rolling stock and in theft of railway property and materials, has also had adverse effects on railway operations.

2.27 The efficiency of major railway users such as steel plants, coal mines, power houses and the Food Corporation of India, has also deteriorated since 1976/77, with adverse effects on IR. Steel plants are currently holding 10% to 15% more wagons compared to the past, and average detention of rolling stock at the plants has increased sharply. Similarly, wagons loaded with foodgrain traffic for unloading by the Food Corporation of India have suffered long detentions, particularly in the eastern sector, including the Calcutta terminals. Despite coal stocks at power plants being generally low, long delays have been caused by unduly slow unloading of coal rakes by several power plants and by using railway rolling stock as storage. Some thermal plants have complained of coal shortage but have been slow to release coal wagons placed in their sidings, thereby holding up other loaded stock awaiting placement. The major ports of Bombay, Madras and Calcutta/Haldia have also faced low labor productivity, with the result that, in addition to port congestion and detentions of ships and railway stock, an increasing number of ships are being diverted to minor ports where adequate facilities for handling them are not available. This also results in a major shift in rail operations from well-established routes and services to the limited capacity routes serving minor ports. In recent months, however, there is a general trend towards improvement in most of these fronts, which supports the belief that the general decline in efficiency of ports and rail users has been halted.

2.28 A special study of terminal operations to be carried out by IR under the proposed project (para. 2.31), will search for appropriate methods of improving operations and reducing the detention time of IR's wagons. In search of a solution to the port congestion problem, meanwhile, GOI has launched a new port development at Nhava Sheva, while the Bombay Port Trust is preparing interim measures to improve container handling at the existing port of Bombay.

#### External Changes to Which IR Should Adapt Promptly

2.29 Developments affecting several of IR's main users have changed the traffic pattern and average travel distances of a number of IR's main commodities after 1976/77. One of the most important changes is the cessation of foodgrain imports into the country. Before this occurred, the foodgrain requirements in the hinterland of each port were being met mostly from imports through the port. Now all the deficit areas, including the south, are supplied from surplus northern states such as Haryana, Punjab and Uttar Pradesh. This has resulted in sharply increasing haul distances of foodgrain from about 940 km in 1976/77 to 1307 km in 1981/82. Similarly, due to the port congestion problem mentioned above, aggravated by stepped up volumes of fertilizer imports, average travel distance of fertilizer traffic increased from 926 km in 1976/77 to 1,092 km in 1980/81. In the past, cement produced in the western part of the country was exported. With a shortage of cement in recent years, it is now being imported and distributed internally by the railways. Furthermore, disturbances in the northeast, which lasted until early 1981, completely dislocated the pattern of flow of petroleum products in several areas of the country, resulting in the need for major west to east cross-country flows of crude oil. The average haul for steel traffic has also increased substantially in recent years. Given the size and complexity of IR's internal structure and the lack of a real-time information system, all these major changes considerably strain IR's managerial resources and have heavy repercussions on its operations. A more flexible and dynamic marketing and operating techniques added to a modern information and telecommunications system would permit adequate advance planning of those changes which can be reasonably foreseen and would greatly reduce the lag time elapsed between a major shift in demand and IR's adequate response to it.

#### Areas Largely Within IR's Control

2.30 After 1976/77 there was a perceptible drop in the efficiency and productivity of railway staff. From 1977/78 onwards, there were frequent agitations by staff, particularly in the eastern sector, which is the hub of activity on Indian Railways. Strikes and lockouts and general lack of cooperation and poor productivity seriously impaired the railways capacity to adequately meet transport demand. IR is trying to improve its labor relations. This has already resulted in less time lost due to strikes and agitations.

2.31 Equally important is an increasing emphasis towards improving railway operating efficiency. To improve utilization of rolling stock, IR management has already taken steps to improve the current loading performance, primarily by isolating the coal wagon fleet and forming them into blocks of about 44

units each and running them as unit trains, cutting out intermediate shunting operations and yard detentions. Major gains have thus been achieved in the movement of bulk commodities. During 1979/80, 100% of iron ore and manganese for export, 92% of petroleum products, 72% of coal and 24% of all other goods were moved in block trains. This implied that about 60% of the total revenue-earning traffic was moved in block trains. However, considering that bulk commodities make up about 85% of the total revenue-earning traffic it is clearly possible to increase the scope and number of block and unit trains. Further, the productivity increases derived from unit train operations have sometimes been offset by longer terminal detentions for loadings and unloadings, generally due to inefficient or deteriorating operations of railway users, beyond IR's control. The matter deserves, therefore, careful scrutiny. Accordingly, during negotiations it was confirmed that the Borrower will ensure that IR and the main public sector agencies served by unit trains, would jointly study the best techniques and the cost-sharing and demurrage arrangements for efficient loading and unloading of unit and block trains carrying the commodities for which they are responsible.

2.32 Cost reduction is also an important objective for the railways. IR urgently requires modern management tools to adequately run its operations. As experience has proven in other complex railways, adoption of a real-time operating information system and of a modern communication capability, would, inter alia, immensely help reduce traffic congestion, considerably improve rolling stock and motive power utilization and facilitate maintenance of motive power and rolling stock, and enable IR to quickly adjust to changing traffic patterns all of which will reduce operating and capital costs of the Railways.

2.33 Adoption of a real time Operating Information System (OIS) which would help resolve most of the problems described above has been under consideration by IR for several years. The Bank Group's audit of the Eleventh and Twelfth Railway projects also recommended the use of computers to provide immediate up-to-date information on freight carrying capacity and its optimum utilization.

2.34 The IR Board appointed a seven-member task force in the Spring of 1979 to study operating information systems used by railways and airlines outside India. The task group issued its report entitled "Real Time Computer Systems for Freight Operations Control and Passenger Reservations" in August 1979. As follow-up in November/December 1981 a multi-disciplinary team visited and studied rail operations control systems in UK, France, Federal Republic of Germany, USA and Canada with the view to evaluating and assessing the possibilities of applicability/adoption of a system in India.

2.35 GOI has fully accepted the need for and approved introduction of an online/real time computer based OIS for freight operations and management on the Indian Railways and the related telecommunication and data transmission network. The basic configuration of the integrated computer based freight OIS would be a combination of centralized and decentralized functions. The core functions, like control of wagons locomotives, train movements, routing of traffic and empty wagon distribution, will be performed centrally and to perform this central function a system operating on Canadian Railways System or

British Railways System will be adapted and implemented to suit the needs and conditions of the Indian Railways. Other functions like terminal and yard management, locomotives and wagon repairs, crew and fuel management and accounting, will be done on a distributed basis at the regional or zonal level and would be developed and implemented indigenously to cover initially Northern, Southern and South Eastern Railways.

2.36 Preparation of a project for implementation of OIS and related telecommunication network is being worked out between various Government agencies. Specifically, the Department of Electronics and the Department of Atomic Energy clearances are needed for implementation because, given the size of IR and operation system needs, the importation of high powered computers, software, and modern telecommunication equipment is required. These two GOI agencies would have preferred to develop IR's needs indigenously, an approach which would have set back the establishment of this high priority system several years. This matter has been resolved by GOI's recent decision described in para 2.35 above. During the negotiations, understanding was reached on a timetable for preparation of an OIS and related telecommunication network (Annex B).

2.37 Despite the multiple reasons behind the deteriorating capacity and inferior performance of the railways in the late 1970s, improved management measures to ensure effective functioning of its full labor force and resources have restored most of the tonnage lost and arrested deteriorating operating and financial trends of recent years. The promising results attained since late 1980 through a sustained increase in traffic after months of continuous decline, point in the right direction. These short-term improvements should not, however, detract attention from the basic problem, namely that sustained expansion of capacity to adequately meet the expected growth in traffic, demands a substantial improvement in technology, management and operating procedures and a stepped up investment effort in critical areas. The proposed project addresses these issues.

## I. Traffic

2.38 IR's freight and passenger traffic statistics from 1950/51 to 1981/82 are shown in Table 3. In the last 31 years, railway freight traffic has increased at an average annual rate of 3.1% in terms of total tonnage and 4.5% in terms of ton-kilometres. The corresponding growth ratios for inter-city passenger traffic are 2.3% and 3.7%. These long-term trends reflect, however, gradually changing--and diverging--patterns of growth. While the annual rate of growth of inter-city passenger traffic has accelerated from 0.5% (for passengers) and 1.0% (for passenger-kilometres) between 1950/51 and 1960/61 to 3.3% and 6.1%, respectively, between 1970/71 and 1981/82, the rate for freight traffic has decreased from 5.3% (tons) and 7.1% (ton-kilometres) between 1950/51 and 1960/61 to 2.0% and 2.9%, respectively, between 1970/71 and 1981/82. While total tonnage, moderately increased from 237 to 245 million tons or about 0.8% per annum during the last four years, ton kilometres increased by 1.7% per annum (from 163 to 174 billion) due to a continuing rise

in average haul of freight. Suburban traffic, meanwhile, has grown at a sustained rate of 5.4% for passengers and 6.3% for passenger-kilometres during the last 31 years. Growth has levelled off in the last four years, however, due mainly to shortage of rail equipment and terminal facilities. Traditionally, seven groups of commodities have made up the bulk of railway transport in India. In 1981/82 these seven commodities (coal, inputs and production of steel plants, iron ore for export, foodgrains, petroleum products, cement and fertilizers) comprised about 80% of net revenue earning traffic in terms of tons moved and 75% in terms of ton-kilometres (see Table 4).

2.39 Details of freight traffic forecasts are provided in Table 5 and in Annex C. Three different alternatives have been analyzed and commodity-wise projections show that a total rail traffic ranging from 186 to 198 billion ton-kilometres, with a medium forecast of 191 billion ton-kilometres can be expected by the end of the Sixth Plan in 1984/85. In addition, by 1990/91, total traffic would range between 212 and 258 billion ton-kilometres. Passenger traffic, moreover, is expected to reach between 246 and 292 billion passenger-kilometres by 1984/85 and from 307 to 444 billion passenger kilometres in 1990/91. The freight traffic forecasts are less than the Sixth Plan estimate of 220 billion ton-kilometres of total freight traffic in 1984/85. However, as indicated in para.2.39, the limitations of the Sixth Year Plan are such that even assuming an efficiency similar to the 1981/82 level, the Plan allocations would be generally insufficient to cover the needs of the railways.

#### J. Railway Planning

2.40 Under Credit 280-IN (Eleventh Railway Project), a corporate planning exercise was initiated by IR with the objective of ensuring adequate provision of rail transport services for both passenger and freight in areas in which railways could confer optimum benefit to the economy. The exercise was completed in 1976 and resulted in a Corporate Plan for the total railway system, consolidating the corporate plans of the individual zonal railways on which IR is based. The Plan outlines a proposed development strategy for IR for the period 1977/78 to 1988/89 and covers passenger and freight traffic, traction and rolling stock, line capacity, yards and terminals, shops, production units, research and development, management and manpower and financial aspects. The Corporate Plan also provides the framework for the modernization efforts supported by the proposed project.

2.41 IR's management, recognizing the changing transport environment in the country, particularly the pattern of traffic, has begun revising the Corporate Plan and updating it to cover a period up to 1994/95. In this endeavor, much will be drawn from recent experiences in operations and from recommendations made in the National Transport Policy Committee and the Rail Tariff Enquiry Committee (RTEC).

2.42 The planning, evaluation and project sanctioning system applied by IR is defined in the various railway codes and policy directives. IR's internal planning is mainly undertaken for the preparation of annual investment and

works programs. Planning has improved in recent years and comprehensive economic studies are undertaken for major new works such as gauge conversion, electrification schemes and new lines. The various components included in the proposed project were each subjected to comprehensive technical and economic studies by IR in accordance with terms of reference agreed between IR and the Bank Group.

#### K. Railway Investment Plan

2.43 To support projected traffic growth and finance asset replacement, IR's approved investment for the Sixth Five-Year Plan (SFYP) period 1980/81 to 1984/85 totals Rs 51,000 million, including Rs 3,050 million for metropolitan transport projects and investment in road services. The broad features of the Plan are responsive to the country's needs although improvements are possible. Investment of Rs 51,000 million is a minimum to meet urgent needs of asset replacements and to sustain momentum of modernization. The plan allocations are particularly short in telecommunications and in replacement of motive power and rolling stock. The amount allocated for telecommunications excludes the investment needed to implement an operating information system (para. 2.32). Similarly the replacement of motive power and rolling stock is not adequately covered, especially when considering the importance of phasing out steam traction to improve IR's maintenance and operations and to optimize the use of coal; and the age and condition of a sizeable portion of the freight wagons and coaches. Even if IR's efficiency is maintained--as expected--to the 1981/82 best historical levels, there would be little safety margin when compared with the conservative estimates of future traffic growth presented in para.2.35, not to mention the need to reduce operating expenses by phasing out obsolete motive power and rolling stock. Detailed investment is presented in Table 6 and is summarized below:

#### Sixth Plan Outlay for Railways, 1980/81-1984/85

|  | <u>Rs Million</u> | <u>%</u>   |
|--|-------------------|------------|
| Rolling Stock                            | 21,000            | 41         |
| Track Renewal                            | 5,000             | 10         |
| Traffic Facilities                       | 4,800             | 10         |
| Electrification                          | 4,500             | 9          |
| Workshops and Sheds                      | 2,800             | 5          |
| Machinery and Plant                      | 2,300             | 4          |
| Bridge Works                             | 900               | 2          |
| Signalization and Telecommunication      | 900               | 2          |
| Metropolitan Projects, New Lines, Others | 8,800             | 17         |
| <u>Total</u>                             | <u>51,000</u>     | <u>100</u> |

Source: Sixth Five-Year Plan

2.44 The railway motive power and rolling stock production, based on available resources and manufacturing capacity, has been estimated by IR as follows:

| <u>Item</u>             | <u>1981/82</u> | <u>1982/83</u> | <u>1983/84</u> | <u>1984/85</u> |
|-------------------------|----------------|----------------|----------------|----------------|
| Diesel Locomotives      | 99             | 92             | 37             | 30             |
| Diesel Shunters         | 12             | 10             | 58             | 60             |
| Electric Locomotives    | 66             | 66             | 74             | 84             |
| Electric Multiple Units | 188            | 67             | -              | -              |
| Coaches                 | 1,050          | 1,125          | 1,150          | 1,172          |
| Wagons <u>a/</u>        | 18,000         | 20,000         | 25,000         | 25,000         |
| Diesel Power Packs      | 20             | 20             | 20             | 20             |

a/ In terms of four wheelers.

#### L. Performance Under Previous Projects

2.45 In the past 32 years, the Bank has approved six loans and eight credits for IR, totalling US\$1,086.5 million. Implementation of the projects, including the ongoing Credit 844-IN, has generally been satisfactory and on time. Project audits have been carried out for Credits 280-IN and 448-IN (Eleventh and Twelfth Railway Projects) and the findings are contained in the Project Performance Audit Report Number 1658 of June 30, 1977. A project completion and draft Project Performance Audit Report have also been prepared on the Thirteenth Railway Project.

2.46 The Project Performance Audit Report concluded that the Bank Group's contribution to the country's development through its involvement in railway projects has been substantial. Bank Group assistance provided the foreign exchange resources without which IR's replacement and expansion programs would have been very difficult to carry out. The report also pointed out the need to: (a) improve the planning, both at the sectoral level and within the railways; (b) introduce a better reporting system of the results of Bank Group financed projects; and (c) use computers to provide immediate information to optimize the utilization of its carrying capacity. Additionally, the report mentions IR's difficulties in paying the full dividend on Capital-at-Charge which IR owes annually to GOI (para. 5.01).

2.47 The issues listed under (a) in para. 2.42 have already been addressed by GOI as mentioned in paras. 1.09 and 2.37-2.38. Additionally, starting with Credit 844-IN, a thorough and adequate reporting and monitoring system was introduced and has been functioning satisfactorily. A first step towards resolving issue (c) this issue has been addressed by GOI/IR as described in paras. 2.33-2.36. Regarding the dividend problem, although IR has met the full dividend payment to GOI between 1976/77 and 1978/79, it has run into difficulties in meeting this financial requirement. In this regard, changes have been introduced recently in IR's financial responsibilities, and further changes are

under consideration by GOI/IR, in line with recommendations of the Rail Tariff Enquiry Committee. This subject has also been addressed under the proposed project as explained in paras. 5.03-5.06 and 5.09-5.11.

### III. THE PROJECT

#### A. Background

3.01 Through six loans and seven credits approved between 1949 and 1975 (excluding Credit 844-IN), Bank Group assistance to IR totalled US\$896.5 million. The main objective of the assistance consisted of the rehabilitation and subsequent modernization of railway infrastructure, motive power and rolling stock and the improvement of operating efficiency, administration and planning. These loans and credits were based on one to three-year slices of IR investment programs and covered foreign exchange for acquisition of:

- (a) materials, parts and components for manufacture and maintenance of motive power and rolling stock;
- (b) machinery and plant for IR manufacturing units; and
- (c) materials and equipment for line improvement works and telecommunications.

In the 32 years that passed since the first Bank loan to IR, the main railway infrastructure has been substantially improved, and domestic production of diesel and electric locomotives and coaches and wagons, which the Bank loans and credits supported, resulted in an improved motive power and rolling stock fleet.

3.02 With a rapidly growing number of diesel and electric locomotives nearing their mid-lives and in need of major overhaul, IR has acknowledged the immediate need for a change in investment priorities in favor of modernization of maintenance facilities and motive power and rolling stock design, as well as local manufacture of critical standard items such as wheels and axles, which can be more cheaply produced domestically. In support of IR's move in these new directions, the Association approved the first Railway Modernization and Maintenance Project, Credit 844-IN, in July 1978, for an amount of US\$190 million equivalent.

3.03 Under Credit 844-IN, IR began tackling its most pressing and long overdue issues: maintenance organization, level and procedures; and technological design obsolescence of its motive power and rolling stock. In addition, IR continued the examination of its long term management and administration needs and its economic and financial viability. The major issues addressed in the past three years by IR are as follows:

- (a) a master plan study for modernization and rationalization of workshops;

- (b) relative economics of diesel and electric motive power;
- (c) railways motive power plan, medium and long range;
- (d) railways passenger vehicle technology and requirements;
- (e) unit exchange spares and maintenance system for diesel electric locomotives;
- (f) modernization of 1,500V DC Banking Locomotive;
- (g) railways real time information need for freight operation and passenger reservation;
- (h) accelerated electrification; and
- (i) the revision of the Corporate Plan based on changes in IR's operating and traffic environment.

3.04 The Bank Group has been involved in development, preparation and review of the work mentioned above. Bank Group missions to IR have been supplemented by consultants in such fields as heavy engineering, electric and diesel traction technology, maintenance, telecommunications, organization and operating information systems and intermodal transport. Also, arrangements were made at various times for IR officers and those of other Government agencies to visit transport and industrial organizations outside India. Findings and preparation of the various subjects have been extensively discussed with IR and GOI, especially the Ministries of Finance and Heavy Industries, and the Planning Commission. These findings and discussions form the basis for the formulation of a number of projects by IR, including the proposed project.

#### B. Objectives

3.05 The objectives of the proposed project are: (a) modernization and improvement of diesel electric locomotive maintenance and reliability; (b) improvement of technology and performance of the AC mainline electric locomotive; and (c) improvement of technology, design and operation of heavy bulk movements. GOI has requested the Bank Group to support IR in attaining these objectives.

#### C. Description

3.06 The proposed loan/credit would support the construction and equipping of a shop for the remanufacture of diesel electric locomotives and parts and components; the extension of the unit exchange maintenance system which began under Credit 844-IN; modernization of AC traction technology; and construction of high capacity wagons for bulk freight movement. The project is estimated to

cost about US\$1,216 million equivalent, of which US\$400 million equivalent is proposed for Bank Group financing. The project consists of:

- (a) maintenance improvement consisting of:
  - (i) the establishment at Patiala, in Punjab State, of a facility for reclamation of diesel electric locomotive components and assemblies (paras. 3.07-3.21); and
  - (ii) acquisition of parts and components for the unit exchange system in the workshops and running repair facilities (paras. 3.22-3.24);
- (b) acquisition of complete modern AC prototype locomotives for testing in Indian environment and operating conditions (paras. 3.25-3.27);
- (c) acquisition of components and material for construction of 11,300 high capacity wagons (paras. 3.28-3.30); and
- (d) acquisition of test equipment, technical advisory services and staff training for remanufacturing, quality control, and design personnel required to achieve the project objectives and know-how, technical advisory services, and training for IR improved train operations and fuel efficiency (paras. 3.31-3.39).

(a) Maintenance Improvements

(i) Diesel Component Works (DCW)

3.07 Depending on the horsepower and utilization, the economic life of a locomotive is generally regarded to be 15 to 20 years. At this age the mechanical components - trucks, engines, pumps, etc., - are either in need of a major overhaul or are obsolete. More important, however, is the fact that the electrical wiring has by this time deteriorated to the point that electrical circuit failures are the most common reason for locomotive failures. Many of the world's major railways have determined that it is economically worthwhile rebuilding (or more specifically remanufacturing) locomotives to get another 15 to 20 years life out of them. In the remanufacturing process, it is possible to update the locomotive by applying many of the latest technological developments to the locomotive. Therefore, the locomotive is not only more reliable due to the remanufacturing, but is also of a more advanced design.

3.08 The proposed DCW has been designed to remanufacture diesel electric locomotives at the third periodic overhaul (POH). This entails overhauling all of the various components that make up the locomotive. Since the component overhaul processes will be the same as required for other repairs to the locomotive fleet, it is proposed that DCW be sized and equipped to supply the railways in Northern, Central and Western India with unit exchange of major

components and all of IR with a number of critical new spare parts. The major components and subassemblies for the Southern and Southeastern part of the Railways will be supplied by the Golden Rock shop near Madras, currently being modernized. At present, locomotive components such as power assemblies, traction motors and pumps are overhauled by various IR shops around the country. These shops generally lack the specialized equipment to clean, repair and inspect the components; thus, there is a lack of quality control over the components used to repair the locomotive fleet.

3.09 The proposed DCW was subject to a technical and economic study, including location, plant capacity and product mix and existing indigenous capacity. The study was carried out by the consultants Rail India Technical and Economic Services Limited (RITES); and assisted by several railways and remanufacturers outside India, according to the Terms of Reference agreed to in Credit 844-IN. The consultants' report was comprehensive on remanufacture of major assemblies and manufacture of spare parts. In addition, the Railway Board appointed a team to prepare a report on a project that would have, as priority objectives:

- (a) remanufacture of various assemblies to support the unit exchange maintenance system; and
- (b) locomotive remanufacturing at the 3rd POH stage (about 15-20 years of age).

The Bank Group and the consultants retained by the Bank Group have found the project preparation satisfactory.

3.10 The proposed location for the plant is about three kilometres north of Patiala, in the Punjab State, between a Broad Gauge railway line and a highway linking Rajpura-Patiala. The site, which has already been acquired, is recommended from among five possible locations. Major attractions of the proposed site, in addition to availability of water, power and roads, are two housing estates which have been already developed by the State Government extending over 500 acres each. These estates have not proved as popular as expected; consequently, a very large number of plots for construction of houses are available. The proposed plant is to be located a few kilometres from either estate and the suitability of the site allow room for future expansion of activities that will follow the elimination of steam traction, increased traffic requirements, and the extension of electrification. The proposed plant design also makes possible the remanufacturing of electric locomotive components such as traction motors, transformers, traction gears, pinions, etc., and is an integral part of IR's overall workshop master plan.

3.11 The critical elements of remanufacturing and component overhaul are cleaning, inspection before and after overhaul, specialized repair machinery, material handling and quality control. These elements have been addressed in detail and are summarized below:

3.12 Cleaning: Through use, locomotives accumulate many types of fouling material, ranging from brake shoe dust to baked-on carbon. The traditional way

of cleaning is with the use of chemicals. Much of the fouling material, however, if washed in new specialized ways, can be removed with water and without the use of expensive and polluting chemicals. If chemicals are not used, the water can easily be filtered and reused. Therefore, each of the component groups will have its own specialized cleaning equipment and will minimize the use of chemicals.

3.13 Inspection Before and After Overhaul: It is important that the condition of a component be initially assessed to determine what type of repairs are required. For example, it is often not necessary to rewind a traction motor armature when overhauling it, provided it can be fully tested beforehand. Inspection is also required for various small "components" during overhaul. At the present time most of the repair shops lack the necessary equipment, and as a result the component frequently fails soon after installed in a locomotive.

3.14 Specialized Repair Machinery: With many locomotive components, it is possible to build-up worn surfaces by welding, spray metallizing or plating and machining the part back to standard or new dimensions. Other components, such as armatures for example, can be rewound. It is therefore necessary to have a range of machine tools that are capable of performing these specialized build-up and machinery operations.

3.15 Quality Control: At present, almost all component overhaul work is performed by various running repair sheds and workshops. In order to ensure quality in using the sophisticated equipment required as well as standardized procedures and sound criteria for overhaul, precision equipment for inspection and testing and appropriate skills are required, which for economic and practical reasons, are not and cannot be duplicated in every maintenance facility. The result of poor quality control has been very costly. Quality control, therefore, is given very high priority in design, equipment and training needs at DCW.

3.16 Other Features: The proposed unit will occupy approximately 50 hectares. The unit, as presently proposed, is shown in Chart IBRD 22870 and will have the following features:

|                  |  |                   |
|------------------|--|-------------------|
| Major facilities | - Locomotive remanufacturing shop                  |                   |
|                  | - Traction machines remanufacturing shop           |                   |
|                  | - Power pack remanufacturing shop                  |                   |
|                  | - Cylinder liner and crankshaft manufacturing shop |                   |
|                  | - Engine block remanufacturing shop                |                   |
| Covered area     | - Workshop buildings                               | 18,000 sq. metres |
|                  | - Ancillaries/Services                             | 6,000 sq. metres  |
|                  | - Offices  | 3,200 sq. metres  |
| Manpower         | - Officers   | 105               |
|                  | - Supervisory                                      | 350               |
|                  | - Artisans   | 1,588             |
|                  | - Unskilled  | 620               |

3.17 The layout and the process flows were based on final engineering plans furnished by consultants (RITES, India). Detailed final process engineering for the shop has been completed by an IR design team in consultation with various railways and will entail possible technical collaborators outside India. Ancillary service facilities such as stores, sheds, laboratory and training schools will also be provided. IR is preparing a final project report to include detailed process engineering. The date for completion of the final project report has been confirmed during negotiations.

3.18 The total DCW peak load power requirement is estimated at 5 MW. The Punjab Electricity Board has agreed to supply power to the plant as per phased requirements indicated to them. Also, the Punjab State Government has assured a reliable water supply, and no water problem is expected since the shop's daily estimated consumption is low.

3.19 The project has been designed with due regard to environmental and worker safety aspects. A Punjab State law for environmental and pollution control stipulates that all industrial enterprises must conform to environmental standards specified in the legislation relevant to the industry concerned. The DCW meets these standards, and no significant adverse environmental impact is expected from the project.

3.20 The DCW will require a total labor force and staff of about 2,600 employees, of which about 2,000 will be directly involved in locomotive remanufacturing, component overhaul, manufacturing, plant engineering, quality control and materials management. The remainder will be general management, colony and security staff. The plant will generally work in two shifts. The labor force and the number of shifts in the plant are adequate for efficient operations. Project implementation and organization are treated in paras. 3.43-3.48.

3.21 The proposed DCW is estimated to cost about Rs 1,073 million (US\$119.2 million equivalent) with a foreign exchange component of some Rs 498 million (US\$55 million). A summary of the plant's fixed capital cost is shown in Table 7 and its investment schedule is shown in Table 8. In addition, the

technical advisory services and training for this project component is estimated to cost about Rs 12.6 million as described in paras. 3.31-3.32.

(ii) Unit Exchange System

3.22 Shortage of foreign exchange, lack of ancillary industries (especially for low off-take items), and priority given to manufacturing of new motive power and rolling stock, have all culminated in a serious shortage of spare parts and components for repair and overhaul of motive power and rolling stock. As a result, even the scheduled repairs of motive power and rolling stock are held up until a defective part or assembly is repaired. As practiced world-wide and proven by a small-scale unit exchange program for diesel electric locomotives at IR's Kharagpur workshops, the maintenance downtime can be reduced by over 50% through implementation of a unit exchange system whereby the defective part is replaced and the locomotive or other unit returns to service while repairs or remanufacturing of the part takes place.

3.23 The ongoing Credit 844-IN provided US\$30 million for procurement of critical components for the unit exchange maintenance system. Under the proposed project, in the next three years (1983/84-1985/86), a further working capital investment of about Rs 2,365 million (US\$263 million equivalent) in a rotating pool of parts and components is envisaged in order to further expand the unit exchange maintenance program. The unit exchange pool will continue to build up and, for diesel electric locomotive, will reach the required level upon completion of ongoing projects at Golden Rock shop and the proposed DCW. For electric locomotives, the component pool will reach adequate levels for traction motors and some of the electrical components with the completion of an ongoing workshop project at Nasik, near Bhusaval; and the proposed DCW.

3.24 The shortage of wheels and axles continues to be a major obstacle in improving availability of IR's rolling stock. As shown in Tables 9 and 10, domestic production of wheels and axles has deteriorated in the past three years, increasing IR's dependence on imports. This situation is only expected to begin improving in 1984/85 when the wheel and axle plant, being constructed under ongoing Credit 844-IN, is expected to become fully operational. The proposed project will provide for three years' import (1983/84 to 1985/86) of wheels and axles to meet IR's requirement for manufacture and maintenance, out of which the Bank Group would finance about 32%. This portion is estimated to be required for the unit exchange maintenance pool. This project component is estimated to cost Rs 2,195 (US\$244 million equivalent) with a foreign exchange component of Rs 1,568 obtained (US\$174 million equivalent). During negotiations, agreement was reached with GOI that IR will maintain and expand the unit exchange component pool as required by its maintenance needs.

(b) AC Electric Locomotive Testing

3.25 In addition to the need for improving and updating locomotive technology (paras. 2.12-2.14) in the light of future operating and service requirements, it is necessary to introduce a modern design, high adhesion locomotive capable of hauling trains consisting of 4,500 tons on all IR 25 KV electrified lines. With the accelerated pace of electrification envisaged in the SFYP,

domestic development of a new locomotive will delay the high benefits to be obtained from introducing a modern and proven locomotive. Thus the project will support the importation of up to 20 prototype AC electric locomotives of up to four different types for testing in Indian operating condition.

3.26 The present generation of electric locomotives available from leading manufacturers of high performance, rugged, low maintenance locomotives have evolved from integrated designs in which the mechanical part, the electrical part and the power control circuitry are finely tuned to each other to achieve maximum performance and reliability. IR intends to invite leading manufacturers to propose the locomotive configuration from their designs and production models that will best suit Indian Railways' operational requirements. Only certain necessary features such as braking systems, safety equipment and certain dimensions, pantograph, speed limits, etc., will be specified. To ensure adequate hauling capacity for heavy train operations, the locomotive must be capable of operating in Multiple-Unit (MU) configuration and therefore a standard MU control system must be equipped on locomotives of each manufacturer.

3.27 This project component is estimated to cost a total of Rs 608 million (US\$67.5 million equivalent) with a foreign exchange component of Rs 405 million (US\$45 million equivalent).

(c) High Capacity Wagons

3.28 The present open wagon design used by IR is an eight-wheeler wagon (Box) with a plate-fabricated bogie and an over-buffers length of 13.73 metres and a net capacity of 56 tons. With the existing loop length on IR, this wagon design limits the maximum gross tonnage of the freight trains to 3,495 tons and a net of 2,400 tons on the Broad Gauge. Tests have shown that with a cast bogie, presently manufactured in India in a limited number, and equipped with cartridge-type tapered roller bearings, the capacity of the open top wagon can be increased to 58 net tons with an over-buffers length of 10.71 metres. This new higher-capacity design has been labelled by IR, Box N wagon. The use of this type of wagon would increase the gross train loads to about 4,500 tons with 3,200 net tons within the existing loop length. In addition, since such wagons will be put into dedicated unit train operation for major users, they will be equipped with air brakes. This will enable to increase the allowable speed of Box N wagons to 100 kmph without increasing the braking distance, as compared to IR's present fleet equipped with vacuum brake with a maximum allowable speed of 72 kmph, creating potential for increased line capacity and service improvements to the users. Furthermore, use of corrosion-resistant steel for highly susceptible parts (i.e., body sides, floor, end plates and door panels) will permit higher utilization of the rolling stock as it will reduce the down-time for maintenance.

3.29 The traffic development for bulk commodities, especially minerals, requires greater efficiency of transport to reduce costs. Therefore IR has decided, as part of its investment for replacement of overaged stock during the Sixth Plan period, to order the manufacture of about 21,000 high capacity wagons. The domestic manufacturing capacity of cast bogies is limited, and

corrosion-resistant steel production is nil. Under the proposed project, support will be provided to import bogie, and corrosion-resistant steel for manufacturing of about 11,300 wagons. This number of wagon is based on the Bank's assessment of estimated capability of domestic fabricators in 1984-85 for the type wagons envisaged.

3.30 This project component is estimated to cost about Rs 4,520 million (US\$502 million equivalent) with a foreign exchange component of Rs 1,305 million (US\$145 million equivalent).

(d) Technical Assistance and Training

3.31 Training of DCW staff and work force in respect of specialized technologies required for operation and maintenance of the plant would be carried out in the remanufacturing, manufacturing and training facilities of the machinery suppliers, foreign railways with similar facilities or service facilities of the type to be set up at Patiala, and IR's own facilities such as DLW. The details of estimated training program for DCW are shown in Table 11. The chrome plating of cylinder liners and crankshafts and the manufacture of rubber components will be initiated under licensing or technical collaboration agreement with a manufacturer or service company which would include the specific training needed. A total of 2,045 man-months of training for DCW is provided under the project out of which 114 man-months would be overseas. Total cost of training under the project is estimated at US\$810,000 equivalent, of which US\$500,000 equivalent would be foreign exchange.

3.32 Technical advisory services for DCW under the project will include assistance during the detailed process engineering, preparation of specifications, plant construction, commissioning and start-up amounting to an estimated 48 man-months at about US\$11,000 equivalent per man-month, including transportation and subsistence. The total cost is estimated at US\$590,000 equivalent of which US\$430,000 equivalent is estimated to be foreign exchange.

3.33 Bogie Testing: The tests carried out by IR in the past in the area of bogie design have been mainly aimed at improving the load carrying capacity of the general purpose box wagons which are the backbone of the railway's long distance bulk commodity traffic. With the advent of developments in the domestic and international traffic, such as containers, technological developments in design, construction, maintenance and operation of track and rolling stock, rapid increases in fuel and material costs, IR needs to increase its research efforts in the area of vehicle design and standards. As a major step in this area, IR recently adopted smaller wheel diameter for freight wagons. Although technically sound and widely practiced internationally, this change will have effects on IR's rail life. Therefore a group was set up to measure the effects and recommend improvements needed in quality of rail used by IR and any other changes to be made in permanent way structure maintenance practices simultaneous with the introduction of smaller wheel size. To undertake this, the project will support bogie acquisition and tests for evaluations needed as a basic input for the future rolling stock design and rail standards. This project component is estimated to cost US\$3.4 million equivalent of which US\$2.0 million equivalent is foreign exchange.

3.34 Fuel Conservation and Train Operation Improvement: Locomotive diesel fuel oil and lubricant cost increases in recent years indicate a clear need for additional fuel efficiency and conservation on IR. Experience has shown that the greatest potential for fuel savings rest in the hands of the well-trained locomotive driver. A systems approach to locomotive turn around, train make-up, train operations and motive power and wagon design is another potential for fuel efficiency as well as improved plant and equipment utilization. IR requires vastly expanded and improved driver training programs, and development of optimum operating techniques.

3.35 Driver training programs, which incorporate a train simulator, are producing encouraging results in a number of railways. Some of these railways report fuel savings of up to 25% for individual drivers and overall system savings of 2% to 5%. The simulator is a simple computer with input from a locomotive control stand and an instructor's control unit integrated with a software program which contains basic train and roadway profile data, all aimed at producing train response details resulting from driver's actions.

3.36 In addition to motive power and equipment design improvements discussed in paras. 2.10 - 2.14, 3.28 - 3.30 and 3.33, improvements are needed in facilities and procedures for locomotive turn around. Modern fuelling equipment is needed to prevent spillage and to reduce locomotive servicing delays. Strict monitoring and testing of use and condition of engine oil with the help of modern techniques and equipment are another area for improving locomotive performance and conservation.

3.37 An often overlooked potential for improved fuel efficiency in railways is the reduction of tare weight of freight wagon equipment through the use of modern design and materials. Freight wagon wheels in use on IR are unnecessarily large and heavy. IR has recognized that there exists major potential benefit from reducing the nominal maximum rolling stock wheel size. The benefits of IR's new wheel size policy will be demonstrated along with lighter design bogies, made possible with smaller wheels, discussed in paras. 3.28-3.30 and para. 3.33.

3.38 To develop the system of programs, facilities, and procedures for improved train operation, fuel efficiency and conservation, a pilot program at Moghalsarai, the western terminus of the "Grand Chord" is envisaged. The Grand Chord is a section of IR's Broad Gauge System from Gomoh in the east to Gaya and from Gaya to Moghalsarai in the west on the New Delhi - Calcutta corridor, 380 km in all. This section is a serious bottleneck in that the traffic is heavy - about 33 trains each way - and the terrain is difficult - grades to 1 in 80. IR has a major effort under way to deal with the numerous problems which grow out of this bottleneck on a large part of the system. The proposed fuel efficiency and train operation improvement pilot program will contribute to solution of these problems.

3.39 The fuel conservation and train operation improvement component of the project is estimated to cost Rs 110 (US\$12.3 million equivalent) with a foreign exchange component of about Rs 57 million (US\$6.3 million equivalent).

D. Cost Estimates

3.40 Items included in the project were chosen from IR's investment plan 1980/81-1984/85 totalling Rs 51,000 million (US\$5,667 million equivalent). Principal items included in the proposed project are detailed in Annex C. The project is estimated to cost about Rs 10,942 million (US\$1,216 million equivalent) with a foreign exchange component of some Rs 4,628 million (US\$514 million equivalent). However, the local manufacturers of machinery to be procured through ICB under the project could win up to US\$20 million equivalent, thus reducing the most likely foreign exchange component to US\$494 million equivalent.

3.41 The cost estimates are based on prices of January 1982. They are based on ex-factory prices for similar items manufactured in India and on recent prices of imported equipment. A physical contingency allowance of 10% has been incorporated in the cost of civil works for DCW. This is satisfactory, since very little earthwork is required; architectural designs are relatively simple for buildings and preliminary industrial engineering is complete. Also, a physical contingency of 7.5% for machinery and equipment is included for DCW, which is reasonable. Price contingencies for all project items have been included to cover expected price increases until contracts are awarded as well as price escalation during implementation and commissioning of DCW. The price contingencies for all items in the project are based on an annual average rate of 8% for local costs and 8.5% for foreign costs. The foreign exchange rate was assumed to be US\$1 = Rs 9. During negotiations, the cost estimates were discussed and confirmed. The cost estimates are summarized below:

| Project Item  | -----Rs Million----- |                |                 | -----US\$ Million----- |              |                | Loan/<br>Credit |
|---|----------------------|----------------|-----------------|------------------------|--------------|----------------|-----------------|
|   | Local                | Foreign        | Total           | Local                  | Foreign      | Total          |                 |
| <b>a. Maintenance Improvements</b>                      |                      |                |                 |                        |              |                |                 |
| Diesel Component  |                      |                |                 |                        |              |                |                 |
| Works (DCW)   | 575.5                | 497.7          | 1,073.2         | 63.9                   | 55.3         | 119.2          | 55.0            |
| Unit Exchange:  |                      |                |                 |                        |              |                |                 |
| Locomotive Components                                   | 1,622.7              | 742.5          | 2,365.2         | 180.3                  | 82.5         | 262.8          | 82.5            |
| Wheels and Axles  | 627.3                | 1,567.8        | 2,195.1         | 69.7                   | 174.2        | 243.9          | 56.0            |
| Subtotal  | <u>2,825.5</u>       | <u>2,808.0</u> | <u>5,633.5</u>  | <u>313.9</u>           | <u>312.0</u> | <u>625.9</u>   | <u>193.5</u>    |
| <b>b. Prototype AC Locomotives<br/>  for Testing a/</b> | <u>202.5</u>         | <u>405.0</u>   | <u>607.5</u>    | <u>22.5</u>            | <u>45.0</u>  | <u>67.5</u>    | <u>45.0</u>     |
| <b>c. High Capacity<br/>  Wagons Manufacturing</b>      |                      |                |                 |                        |              |                |                 |
| Components  | 1,051.2              | 1,305.0        | 2,356.2         | 116.8                  | 145.0        | 261.8          | 145.0           |
| Fabrication & Misc.                                     | <u>2,163.8</u>       | -              | <u>2,163.8</u>  | <u>240.4</u>           | -            | <u>240.4</u>   | -               |
| Subtotal  | <u>3,215.0</u>       | <u>1,305.0</u> | <u>4,520.0</u>  | <u>357.2</u>           | <u>145.0</u> | <u>502.2</u>   | <u>145.0</u>    |
| <b>d. Technical Assistance<br/>  and Training</b>       |                      |                |                 |                        |              |                |                 |
| DCW   | 4.5                  | 8.1            | 12.6            | 0.5                    | 0.9          | 1.4            | 1.2             |
| Bogie Testing   | 12.6                 | 18.0           | 30.6            | 1.4                    | 2.0          | 3.4            | 3.0             |
| Fuel Conservation & Train<br>Operation Improvement      | <u>54.0</u>          | <u>56.7</u>    | <u>110.7</u>    | <u>6.0</u>             | <u>6.3</u>   | <u>12.3</u>    | <u>9.3</u>      |
| Subtotal  | <u>71.1</u>          | <u>82.8</u>    | <u>153.9</u>    | <u>7.9</u>             | <u>9.2</u>   | <u>17.1</u>    | <u>13.5</u>     |
| Total Project Cost                                      | <u>6,314.1</u>       | <u>4,600.8</u> | <u>10,914.9</u> | <u>701.5</u>           | <u>511.2</u> | <u>1,212.7</u> | <u>397.0</u>    |
| Front-end Fee on<br>Bank Loan                           | -                    | 27.0           | 27.0            | -                      | 3.0          | 3.0            | 3.0             |
| GRAND TOTAL   | <u>6,314.1</u>       | <u>4,627.8</u> | <u>10,941.9</u> | <u>701.5</u>           | <u>514.2</u> | <u>1,215.7</u> | <u>400.0</u>    |

a/ Includes test equipment where required

b/ Includes Rs 1,800 million in taxes and duties

### E. Financing

3.42 Total foreign exchange component of the project amounts to about US\$514 million equivalent. The Bank Group would finance the foreign exchange component of all items except the wheel, axles and tyres, of which only a portion, related to the Unit Exchange Pool Component under the project, is included in the proposed credit. Thus the proposed loan/credit is US\$400 million equivalent representing about 39% of the project costs not including taxes and duties. During the negotiations, GOI agreed to finance the remaining US\$816 million equivalent including US\$114 million equivalent in foreign exchange, and release funds in a timely manner and in accordance with the implementation schedule. An amount of up to US\$5.0 million is proposed to be retroactively financed under the loan/credit for expenditures after November 1, 1981, to meet some of IR's costs of final process engineering required for preparation of the DCW, preparation for testing of AC electric locomotives and other project related costs.

### F. Implementation

3.43 IR will be responsible for the implementation of the project as part of its ongoing works and manufacturing program. It has the necessary capability and competence to carry out the project. A time-phased implementation schedule is shown in Chart IBRD 24329. This schedule, as well as progress reporting arrangements, including GOI preparation of a final report upon completion of the project, was discussed and agreed to during negotiations.

3.44 DCW Detailed engineering and design of the project is complete. Final processes engineering started on May 15, 1982 and will be completed by end September 1982. Civil work was started in January 1982. Machinery and plant procurement is to start in January 1983 and be completed by October 1984. Procurement, delivery and construction schedules are considered reasonable. The 1984/85 production is to be about 40% of gross rated annual capacity and at least 70% in 1986/87 and at least 90% thereafter. During negotiations, agreement was reached with GOI that these production targets will be met and that IR will receive such budget allocations as will be sufficient to allow DCW management to procure, as required, up to 48 man-months of technical support services from suppliers of the plant technology to assist in installation of equipment, start-up and monitoring of operations.

3.45 The DCW Project Management Team (mostly in place already) will have primary responsibility for project implementation. The organizational set-up for project implementation is shown in Chart IBRD 22871. During negotiations, agreement was reached with GOI that DCW will be adequately staffed at all times with competent managerial and technical personnel and that any changes in management staff will be minimal and not detrimental to implementation and operation.

3.46 AC Locomotive During the appraisal, a schedule for acquiring the locomotives and testing them was agreed upon with IR. This schedule was discussed and confirmed during negotiations.

3.47 High Capacity Wagons During the appraisal, a schedule for procurement of material and components and contracting for fabrication of the Box N wagons was drawn up and is shown in Chart IBRD 24329. During negotiations, this schedule was confirmed.

3.48 Technical Assistance and Training During negotiations, the technical advisory services needed for DCW and details of the training program, the terms of reference and timetable for testing of bogies were discussed and agreed.

#### G. Procurement

3.49 Items financed by the Bank Group will be procured by IR through international competitive bidding in accordance with Bank/IDA guidelines except for:

- (a) proprietary items which IR procures from particular sources because of the need for procurement under license or for continued standardization of equipment;
- (b) electric locomotives for the test and trails, which would be procured by soliciting proposals from leading manufacturers and evaluating them on the basis of technical and economic merits to select up to four but no less than two most advantageous types; and
- (c) contracts of US\$100,000 equivalent or less, where the advantage of ICB would be clearly outweighed by the administrative burden thereof.

Local manufacturers are expected to bid for items under the project and a domestic preference of 15% or the import duty, whichever is less, would be applied in bid evaluation. During negotiations, assurances were obtained from GOI that, when the lowest evaluated bidder is a foreign manufacturer, permission to import will be forthcoming immediately and no further review by any agency of the Government will be made.

3.50 The proprietary items to be financed under the project are estimated to cost about US\$5 million equivalent or less than 1% of the proposed credit. These items will be used for a unit exchange maintenance system for existing locomotives. GOI and IR have made and are making considerable efforts to encourage indigenous production, but quality and other considerations make it appropriate to continue to import some of those items. During negotiations, the final list of proprietary items to be financed under the project was discussed and agreed to with IR.

3.51 The total amount of contracts less than US\$100,000 equivalent not covered by ICB is estimated to represent a very small portion (less than US\$10 million equivalent) of the proposed loan.

#### H. Disbursements

3.52 Subject to review and agreement with the Bank Group, savings in any category of the proceeds will be available to cover increases in any other category except proprietary items. Disbursements are expected to be completed by June 30, 1987; but to allow time for possible late payments, the closing date will be September 30, 1987. Disbursements under the project would be made against:

- (a) 100% of the c.i.f. cost of imported items;
- (b) 100% of the ex-factory cost of items procured from domestic suppliers; and
- (c) 100% of the foreign exchange cost of training, technical advisory services and installation and inspection of equipment requiring foreign expertise.

A schedule of disbursements is shown in Table 12. The estimated disbursements are about one year ahead of disbursement profiles for Bank Group loans/credits in India. This divergence is a result of taking into account the experience of previous IR projects and the nature of goods to be financed under the proposed credit. During negotiations the disbursement schedule was discussed and agreed to with IR.

### IV. ECONOMIC EVALUATION

#### A. General

4.01 Since the early sixties, IR has concentrated on improving railway infrastructure and expanding the motive power and rolling stock fleet to carry ever increasing traffic volumes. Concurrently with this expansion, IR moved from steam to diesel and electric traction. Partly due to the relatively young age of the diesel and electric locomotive fleet and partly due to foreign exchange constraints, the workshop system had received relatively little attention during the last two decades, with the result that about 80% of machinery and plant in the workshops is overaged and annual periodic overhaul (POH) capacity was increasingly insufficient to meet requirements.

4.02 To correct this situation, IR launched a program aimed at modernizing and improving the maintenance and manufacture of diesel and electric locomotives and rolling stock, supported by the First Railway Modernization and Maintenance Project (Credit 844-IN of July 1978). The proposed project is a logical follow up of the previous one in that the rationalization of repair shops is complemented by the construction and equipping of DCW. Further, the

unit exchange maintenance concept, introduced under the previous project, is expanded under the proposed one to a size commensurable with the needs of the railways. This expansion is achieved both through the establishment of DCW and through the acquisition of locomotive components and wheels and axles. The ongoing project also contains an element in support of research and development activities aimed at improving motive power, in line with similar efforts financed under Credit 844-IN.

4.03 Additionally, two areas not directly supported by the previous project have been included in the proposed one: the manufacturing of high capacity wagons for bulk handling and the technical assistance required to carry out bogie testing, fuel conservation and train operation improvement.

4.04 The economic case for the proposed project rests, therefore, on a reduction in maintenance and operating costs of motive power and rolling stock throughout the system, as well as on a more efficient handling of heavy bulk (coal, iron ore and other minerals) which constitutes one of IR's principal commodity groups. With the project, IR will be able to make better use of its assets and to accelerate its improvement in performance in order to allow it to meet the increasing demands of the Sixth and Seventh Year Plans, while avoiding a larger share of long haul goods from being diverted to the more costly road transport system.

4.05 All the major physical components of the project have been evaluated individually to assess their benefits: (i) the construction and operation of the DCW, including the technical assistance and training required (accounting for 9.9% of total project financial costs); (ii) the procurement of locomotive components and wheels and axles for the unit exchange system (41.87%); and (iii) the purchase of critical parts for the manufacture of high capacity wagons (41.4%). No separate economic evaluation has been carried out for the research and development investment in prototype locomotives, fuel conservation and train operation improvement nor in bogie testing, all of which amount to 6.9% of total project costs. However, these costs were included, without quantifying their benefits, in the calculation of the economic return for the entire project.

#### B. Diesel Component Works (DCW)

4.06 DCW will produce or remanufacture parts, assemblies and subassemblies which are currently either manufactured or repaired at other existing facilities in the country, or else imported into the country. DCW will supply the locomotive fleet in Northern, Central and Western India with unit exchange components and the entire national system with a number of spare parts. DCW will also remanufacture locomotives at their third scheduled periodic overhaul (POH), estimated to take place around 15 to 20 years after the original commissioning of the locomotive. As a result of this third POH, the locomotive improves in reliability and performance due to substantial technological improvements (para. 3.07) and its economic life is lengthened by about 20 years.

4.07 The economic cost of establishing the plant has been obtained by adding the technical assistance and training input (Rs 12.6 million) to the total financial cost of building and equipping the plant (Rs 1072.8 million) and deducting import duties and price contingencies. Moreover, the foreign cost has been shadow-priced at US\$1 = Rs 10. This results in an economic cost of Rs 853.1 million. A residual value of 10% has been assumed after an economic life of the plant of 20 years. To obtain economic production costs, financial data have been adjusted by correcting costs for customs duties, excise duties and sales taxes which, for most materials consumed by DCW, gives a reasonable approximation of world prices. Since the production of DCW is not traded in the market but a transfer price is assigned to it, border prices have been estimated for all items. In the case of the POH of locomotives, the benefits have been assessed at 70% of the avoided c.i.f. cost of purchasing a new locomotive, in line with the commercial practice for remanufactured locomotives in the world market (see Annex E). Naturally, the parts and components produced by DCW which are incorporated into the remanufacturing of locomotives have been excluded from the benefits attributed to the production of the plant, thus avoiding a double counting of benefits. Under these circumstances, DCW is well justified with an economic rate of return of about 22%. Moreover, a sensitivity analysis indicates that if the benefits go down by 20%, the economic rate of return comes down to about 12%; if the costs were to increase by 15%, the return would be reduced to about 16% and if both elements change in adverse directions but in realistic combinations (e.g. (i) benefits go down by 15% and costs go up by 10%, ER = 11%; (ii) benefits go down by 10% and costs go up by 20%, ER = 10%) the rate of return would still be acceptable.

### C. Unit Exchange System

4.08 The unit exchange maintenance system was a concept established in IR through the workshop modernization program partly financed under the ongoing Credit 844-IN. Although the concept has been successfully introduced, the potential for sizeable savings in maintenance costs and in improved reliability and utilization of motive power and rolling stock has not been tapped due to the limited size of the original pool of parts and components. The proposed project, therefore, will considerably expand the system by the acquisition of locomotive components and wheels and axles, thus enhancing the benefits of the system.

4.09 The economic cost of this element of the project would amount to Rs 3,356 million, after deducting import duties and price contingencies and assuming an economic cost of foreign exchange of US\$1 = Rs 10. It has been estimated that the proposed project will reduce the idle time of locomotives and rolling stock awaiting repairs, both for normal maintenance and during POH, resulting in savings in the number of locomotives, coaches and wagons needed to carry the ever increasing traffic and to replace existing fleet. Moreover, the reliability of locomotives will substantially increase, leading to further savings in motive power and rolling stock because of better utilization of existing equipment. It is difficult, however, to estimate the magnitude of the benefits generated by this project element. The concept of unit exchange has been introduced too recently in India to have meaningful results and the same

type of benefits can be generated by other elements of the ongoing First Modernization Project or the proposed one. Accordingly, the current evaluation is based on minimum expected results and the resulting rate of return must be regarded as a basic level of reference. For this reason, no sensitivity test was carried out for the economic evaluation of this component. Assuming a reduction of only two days per year in the average down time of locomotives and one day per year for rolling stock and an average overall improvement in utilization of rolling stock of about 4% and of motive power of 1%, the investment is well justified. Based on an investment period of three years, an assumed economic life of assets of ten years on average (it varies, depending on the component, from about 7-15 years) and a salvage value at the end of this period of 20% (for some items it is as high as 50%), this project element would yield an economic return of not less than 23%.

#### D. High Capacity Wagons

4.10 Three main benefits would stem from the manufacturing and utilization of the 11,300 high capacity wagons to be partly financed under the proposed project: (i) there would be a net increase in payload per train, with a much less-than-proportional increase in transport costs, resulting in net savings in transport costs of bulk goods; (ii) there would be a faster turnaround of unit trains comprising the high capacity wagons because of the use of air brakes which would allow for higher average speeds; and (iii) there would be a decrease in the maintenance cost of wagons due to the use of corrosion-resistant steel.

4.11 Assuming a period of investment of three years, an economic life of the rolling stock of 20 years and a salvage value of 10% of the capital cost, the total economic investment of Rs 3,600 million would yield an economic return of about 30%. A reduction in benefits of 20% would yield an economic rate of return of 23%, while an increase in costs of 20% would yield a return of 24%. The project, however, is more sensitive to variations in the turnaround time of the unit train. The average haul has been estimated at 650 km with a turnaround time of five days. Should the turnaround increase to seven days on the average, the rate of return on the proposed investment would decrease to a still acceptable 20%.

#### E. Other Items

4.12 Up to 20 new electric locomotives will be purchased under the project to be tested under normal operating conditions prevailing in India. They will operate on the broad gauge in main line haulage of passenger and freight trains. The normal acquisition of more efficient electric locomotives than those currently manufactured in the country will generate considerable benefits in terms of reduced maintenance costs, increased availability and hence, fewer new locomotives required in the long run. The current acquisition is, however, of an experimental nature designed mainly as a test of new technology in terms of overall performance, operating and maintenance costs, rather than normal

full operation. Accordingly, no separate economic return was calculated for this project component.

4.13 Likewise, no separate economic return has been estimated either for the bogie testing, or for fuel conservation and train operation improvement.

#### F. Overall Evaluation

4.14 The project's overall economic return is 24%, including the cost of components not separately evaluated. A sensitivity analysis indicates that a decrease in benefits of 20% would reduce the rate of return to 17%; an increase in costs of 20% would bring down the rate of return to 18%; and an unlikely combination of the two variations would yield a rate of return of 13%. Moreover, a lag of one year in project implementation combined with 20% increase in costs would bring the project's return down to 15%, while a lag of two years (again with 20% increase in costs), an unlikely situation, would yield a return of 12%.

4.15 The foregoing economic evaluation is considerably conservative, since benefits for passengers have not been included, and results of investment in unit exchange systems in other countries suggest higher rates of return for this component than those presented in this report.

4.16 The main beneficiaries of the project are the power, industrial and agricultural sectors, particularly the main public and private industrial enterprises, and inter-city passengers. Through the power and agricultural sectors, a large proportion of small industries and rural population will also benefit from the proposed investment.

#### G. Risks

4.17 All project components involve proven technology, except for the testing and research elements for which technology is well established in other parts of the world; technological risks connected with the project are therefore small. Additionally, in the past IR has successfully implemented similar projects in a timely manner, and has built up competent managerial and technical expertise. Risks from inadequate project implementation are therefore negligible.

### V. FINANCE AND EARNINGS

#### A. Introduction

5.01 GOI's financial policy towards IR is designed to allow it to earn net revenues sufficient to cover all expenses including depreciation and a dividend to GOI. Funds for capital expenditure, which do not pertain to replacement of assets, are provided by GOI and are added to a Capital-at-Charge

account, which is a liability of IR in perpetuity and on which IR is expected to pay a dividend of about 6% per annum. The dividend, in reality, is more like an interest payment as IR is expected to meet this obligation whether or not it generates sufficient net revenues. IR finances capital expenditure for asset replacement by a charge against revenues through the Depreciation Reserve Fund (DRF). GOI generally grants rates and fares increases to IR at the beginning of a fiscal year based on IR's resources and forecast of traffic to be carried by IR in the ensuing year. The assumption is that the rates and fares set at the traffic level forecasted would result in revenues sufficient to meet the financial policy. As IR is a departmental undertaking of GOI, the commercial freedom allowed IR is constrained by Government policy.

5.02 Financial arrangements with the Government and audit procedures are, with some improvements noted later, the same as when the first IR Modernization Project was appraised in 1978. The accounting function is efficient, well organized and well staffed with satisfactory budget control and operating systems. A formal traffic costing function has been established recently and IR is continually making improvements to this important activity. In addition to a large and efficient internal audit, an exhaustive statutory audit is conducted under the direction of the Comptroller and Auditor General of India, who reports to the Parliament through the Public Accounts Committee. Audit arrangements are thorough and satisfactory. Audit financial statements are finalized within eight months of year end and presented to Parliament within ten months. At the same time, IR's revised estimates for the current year and budget estimates for the following year are presented to Parliament for approval. IR has under previous credits consistently provided IDA with interim and completed (audited) accounts. Thus, a specific covenant is not needed. IR also provides reports of project expenditure in a timely manner and to the satisfaction of IDA, as mentioned in para.2.43.

#### B. Recent Changes in Financial Policies

5.03 Some beneficial changes in financial practices have been made in recent years and GOI is now considering measures which would give IR greater commercial freedom and set performance targets. The most important recent change relates to IR's obligation to pay a dividend to GOI in years when its earnings are insufficient to generate a net surplus. Prior to 1979 IR was required to take interest bearing loans from GOI to pay dividend, but at present, amount of dividend unpaid is carried forward as a deferred dividend liability without interest. This change is sound and removes an unnecessary financial burden placed on IR. Accordingly, accumulated interest on loans for payment of dividends to March 31, 1978, was written off and the balance of outstanding loans amounting to Rs 1,222 million was converted to a deferred dividend liability.

5.04 In 1977, the Government convened a high level independent committee - The Rail Tariff Enquiry Committee (RTEC) to review IR's freight rates, passenger fares and IR's operational efficiency. The Committee issued its reports

in June 1980, and as part of its overall review, also covered areas of Government policy and practices, made comparisons of IR's operations with both Western Railways and those of the USSR and China. The report is of an excellent standard and reflects a rigorous intellectual and professional examination of IR's operations. It contains 386 recommendations and suggestions.

5.05 Key recommendations of RTEC include: (a) IR be allowed to earn a 10% rate of return on investment and the excess over 6% due GOI as dividend be used by IR for development purposes; (b) provision for repairs and maintenance in the past has been inadequate and IR should be allowed to catch up on arrears and more funds from now on should be provided for this critical activity; (c) funds for the Depreciation Reserve Fund (DRF) have been under-provided and should be substantially increased based on IR's needs and an expert group be appointed to recommend the appropriate methodology for calculation of depreciation; (d) tariff increases, rather than being assessed on "cost plus" basis, should be related to efficiency. A formula is suggested which uses 1976/77, being the most efficient year of railways operations, as a yard-stick. Tariff fares would be increased annually by indexing the increase to the change in prices of the major inputs of IR's costs, including labor, fuel and steel; (e) tariff rates should be set to cover the total costs attributable to that stream of traffic; cross subsidization, from freight to passenger, should not be allowed; (f) cost of social burdens such as lines built for strategic purposes, should be eliminated and IR be fully compensated when a decision is made for IR to provide a service which it would not normally do on commercial grounds; (g) other recommended reforms in operational, personnel, costing and marketing activities; and (h) IR's management structure and promotion practices should be reviewed and changed to support a greater degree of commercial freedom. The recommendations envisage financial reforms which provide a framework within which IR would be able to operate more like a commercial entity.

5.06 IR has already taken action on key RTEC recommendations, especially in the area of finance. Consecutively for the three years 1980/81 - 1982/83 rates and fares have been adjusted upwards exceeding percentage targets recommended by RTEC and resulting in estimated total additional revenues to IR of Rs 1,040 million with about 70% accruing from freight and 30% from passenger respectively. The number of commodities, which were exempted from various supplementary charges has been drastically reduced. Consequently, losses on these commodities are expected to decline from Rs 1,335 million in 1980/81 to Rs 643 million in 1982/83. Passenger operations losses, while increasing in quantum, are declining in percentage terms over previous years losses and in percentage terms to total revenue. Season tickets in terms of single journey tickets have been adjusted to levels recommended in the RTEC report. Details of tariff adjustments are on project file. Appropriations to DRF have been significantly stepped up to a more adequate level (see para. 5.16), and more intensive use of costing techniques are being made by IR. These actions with record traffic carried by IR in 1981/82 have meant that overall performance level of 1976/77 has been met and is expected to surpass in 1982/83. The result has been improvement in IR's ability to generate internally financial resources necessary for capital and maintenance requirements. RTEC recommendations on organizational changes have wider implications and GOI has appointed a

Railway Reforms Committee in May 1981 to examine them in depth and to recommend appropriate action to be taken by the Government. This Committee will also examine IR's depreciation policy and is expected to issue its report in 1983. RTEC recommendations are complex and would take time to implement. Accordingly, during negotiations discussions were held on key RTEC recommendations and assurances were obtained that the Bank Group will be informed on further progress being made and on decisions taken by GOI/IR on implementation of key RTEC recommendations.

#### C. Rates and Fares

5.07 GOI has, in the past, applied a tariff policy which has tended to subsidize large segments of freight (essential basic commodities) and passenger traffic (second class ordinary). Traffic costing is an integral part of tariff formulation and continual refinements to the traffic costing techniques are being made. No direct subsidies are involved, but GOI exempts IR from payment of dividend in respect of the capital invested in strategic lines, unremunerative branch lines and on construction of certain new lines. Most subsidies on freight traffic are being eliminated, but passenger service is still subsidized. Thus, cross-subsidization is in the main from freight to passenger service. Some measures have been effected by IR towards the objective of achieving fully distributed cost based tariff structure (para. 5.06).

#### D. Past Performance

5.08 IR's actual revenue and expenditure accounts for the period FY77 to FY81 are summarized below and detailed in Table 14. The balance sheet as of March 31, 1981 is shown in Table 15.

| <u>Account Head</u>                                    | <u>Actual</u>           |                |                |                |                |
|--|-------------------------|----------------|----------------|----------------|----------------|
|  | <u>1976/77</u>          | <u>1977/78</u> | <u>1978/79</u> | <u>1979/80</u> | <u>1980/81</u> |
|  | (in Current Rs Million) |                |                |                |                |
| <u>Total Revenues</u>                                  | 20,361                  | 21,234         | 21,510         | 23,378         | 26,240         |
| <u>Total Working Expenses</u>                          | 15,490                  | 15,706         | 16,540         | 18,607         | 22,162         |
| Appropriation to DRF <u>a/</u>                         | 1,350                   | 1,400          | 1,450          | 2,000          | 2,200          |
| Appropriation to PF <u>a/</u>                          | 350                     | 393            | 678            | 817            | 1,003          |
| <u>Total Operating Expenses</u>                        | 17,190                  | 17,499         | 18,668         | 21,424         | 25,365         |
| <u>Net Revenue from Operations</u>                     | 3,171                   | 3,735          | 2,842          | 1,954          | 875            |
| Net Miscellaneous Expenditure                          | 208                     | 207            | 234            | 241            | 399*           |
| <u>Net Revenues</u>                                    | <u>2,963</u>            | <u>3,528</u>   | <u>2,608</u>   | <u>1,713</u>   | <u>1,274</u>   |
| Dividend on Capital-at-Charge <u>b/</u>                | 2,091                   | 2,266          | 2,241          | 2,375          | 3,252          |
| <u>Net Surplus (Deficit)</u>                           | 872                     | 1,262          | 367            | (662)          | (1,978)        |
| Operating Ratio  | 84.4%                   | 82.4%          | 86.7%          | 91.6%          | 96.6%          |
| Ratio of Net Operating Revenue<br>to Capital-at-Charge | 6.5%                    | 7.4%           | 5.2%           | 4.1%           | 2.1%           |

a/ Depreciation Reserve Fund (DRF); Pension Fund (PF)

b/ See Note 2 on Table 14

\* Credit figure

5.09 IR has earned revenues which are greater than its total operating expenses, which include depreciation. However, IR has not always been able to meet its full dividend liability. IR had its best results in FY78, generating a large surplus. The increase in revenues subsequent to FY78 was mainly attributable to tariff increases. The total working expenses, as a percentage of total revenues, increased from 76.1% in FY77 to 84.5% in FY81. Fuel as a percentage of total working expenses increased from 18.6% in FY77 to 22.1% in FY81, while other costs remained more or less at the same level (see Table 16). Considerable increase in appropriation to DRF in FY81 was made over FY79; Rs 2,200 million compared to Rs 1,450 million respectively (an increase of over 50%).

5.10 For the reasons stated above and because the traffic carried fell short of the forecast, IR was not able to pay the full dividend in FY80 and FY81 as required by GOI policy and in agreement for Credit 844-IN. The basic shortcoming in IR's financial arrangement is dependence on an annual decision by GOI notably on the level of tariff (limitation of administrative prices) and capital investments. This, however, is being looked into by the Government in its consideration of the RTEC recommendations and by the Railway Reforms Committee (para. 5.06).

5.11 Historically, GOI has kept tariffs at levels much below the increases in the cost of IR's inputs or changes in general price levels (Table 17). In addition, IR has to absorb losses on such services as suburban and short distance travel, and unremunerative lines, etc. These are termed as "social burden" costs by IR and during FY80 and FY81 were estimated at Rs 2,400 million and Rs 4,200 million, respectively (about 10% and 16% of revenues, respectively). Had IR been compensated for these costs, it would have generated a

large profit to cover the dividend payment for FY80 and FY81 and had a surplus of about Rs 1,700 million and Rs 2,200 million, respectively.

E. Future Prospects

5.12 IR has prepared financial statement estimates for the period FY82 to FY87 based on its freight traffic forecasts which appear high, and without provision for price increases and tariff changes. IR's financial statement estimates show that for FY82 it would be able to cover its full dividend and generate about Rs 500 million surplus. This is encouraging considering that IR incurred losses in previous two years. For the subsequent period FY83 to FY87 IR estimates show that at present (April 1982) tariff rates, it would cover its full dividend obligation but would partially cover its dividend obligations for FY86 and FY87. IR contends that GOI policy of granting tariff increases in advance of the forthcoming year will continue and hence IR will be provided with sufficient annual tariff increases to cover all its obligations.

5.13 IDA forecasts have been made using the conservative traffic forecast of 'Scenario II' (see paras. 2.34 and 2.35). IDA forecast for FY83 to FY87 at tariff levels in effect at April 1, 1982, are summarized below and shown in detail in Table 18. Balance sheets are shown in Table 19.

| <u>Account Head</u>                     | IR's Revised<br>Estimate | -----Bank Group Forecast-----<br>(in Current Rs Million) |                |                |                |                |
|---|--------------------------|--|----------------|----------------|----------------|----------------|
|   |                          | <u>1981-82</u>   | <u>1982-83</u> | <u>1983-84</u> | <u>1984-85</u> | <u>1985-86</u> |
| <u>Total Revenues</u>                   | 35,418                   | 41,120   | 42,039         | 42,952         | 43,953         | 44,923         |
| <u>Total Working Expenses</u>           | 27,146                   | 30,100   | 30,620         | 31,149         | 31,687         | 32,234         |
| Appropriation to DRF <u>a/</u>          | 3,500                    | 5,000  | 5,000          | 5,300          | 6,500          | 6,800          |
| Appropriation to PF <u>a/</u>           | 985                      | 1,480  | 1,750          | 1,900          | 2,150          | 2,300          |
| <u>Total Operating Expenses</u>         | 31,631                   | 36,580   | 37,370         | 38,349         | 40,337         | 41,334         |
| <u>Net Revenues from Operations</u>     | 3,787                    | 4,540  | 4,669          | 4,603          | 3,616          | 3,589          |
| Net Miscellaneous Credits               | 433                      | 400  | 450            | 500            | 205            | 311            |
| <u>Net Revenues</u>                     | 4,220                    | 4,940  | 5,119          | 5,103          | 3,821          | 3,900          |
| Dividend on Capital-at-charge <u>b/</u> | 3,702                    | 4,051  | 4,290          | 4,430          | 4,660          | 5,010          |
| <u>Net Surplus (Deficit)</u>            | 518                      | 889  | 829            | 673            | (839)          | (1,110)        |
| Operating Ratio                         | 89.3%                    | 88.9%  | 88.9%          | 89.2%          | 91.7%          | 92.0%          |

a/ Depreciation Reserve Fund (DRF); Pension Fund (PF).

b/ See Note 1 on Table 18.

5.14 Bank Group's revenue and expenditure account estimates for the period FY83 to FY87 have been projected using prices, rates, fares and expenses at April 1982 levels. Conservative assumptions on improvements in operating efficiency resulting from the proposed project have been included. The forecasts do not include any provision for increase in tariffs, changes in the financial policies of GOI, or allowances for inflation. On these assumptions and using "Scenario II" traffic level, the above table indicates that tariff increases would need to be raised for FY86 and FY87 to generate revenues high enough to meet full dividend payment--and meet the covenant of the existing and proposed Bank Group projects. During negotiations, it was agreed that GOI would maintain passenger fares and freight rates and take all other actions as may be necessary or appropriate, so as to provide to the Railways net revenue sufficient to enable the Railways to meet out of internally generated resources all operating expenses (including depreciation) and dividend payments on Capital-at-Charge.

5.15 By FY87 revenues are projected to increase by about 26.9% over FY82 as a result of tariff increases granted April 1, 1982 and traffic increases. Total working expenses are expected to increase by about 18.7% because of the high proportion of variable costs. Total operating expenses are expected to register a higher increase (about 30.7%) mainly because of increased allocations to depreciation (DRF). The likely levels of annual tariff revenue increases needed to pay full dividend with traffic at Scenario II levels for the period FY83 to FY87 have been estimated as follows:

|                                      | <u>FY83</u> | <u>FY84</u> | <u>FY85</u> | <u>FY86</u> | <u>FY87</u> |
|--------------------------------------|-------------|-------------|-------------|-------------|-------------|
| (i) Without allowance for inflation  | -           | -           | -           | 2%          | 1%          |
| (ii) With inflation at 10% per annum | 5%          | 8%          | 9%          | 13%         | 11%         |

5.16 The DRF in IR is in effect a renewal and replacement fund and not a depreciation provision in the normal accounting sense. Over the years, contribution of funds to DRF has proved to be insufficient to take care of need-based replacements as it has been determined on an annual, almost ad-hoc basis, depending on IR's financial situation, physical constraints in the form of productive capacity in the country (e.g., how many wagons can be manufactured) and the complexities in ascertaining the exact timing of replacements. This has led to a situation where IR is burdened with a high percentage of overaged and obsolete assets which are a restraint on capacity and produce high costs. In the recent past DRF annual allocation has averaged 2.7% of the fixed assets (see Table 15, page 2, item 1). Experience elsewhere suggests that a contribution of about 5% of fixed assets would be more appropriate and a rate of this order should be provided on a regular annual basis and not be allowed to fluctuate because of other constraints. This would give some semblance of "true depreciation". The increased allocation would permit more rapid replacement of old and obsolete assets, which would in turn improve operational efficiency (increase revenue) and would result in reduction of maintenance costs, which now constitute about 40% of working expenses. The DRF allocations proposed by IR for FY83 to FY87 (and used in Table in para. 5.13) represents a 5% contribution which is acceptable. During negotiations it was agreed that appropriations to the DRF of the Railways shall be not less than Rs 21,000 million in aggregate as provided in the Sixth Five-Year Plan of India for the period from April 1, 1980 to March 31, 1985. Of the total amount (Rs 21,000

million) of the Plan, Rs 10,700 has already been appropriated to DRF of IR during the period 1980/81 - 1982/83 and the balance of Rs 10,300 million is to be appropriated during remaining two years (1983/84 and 1984/85) of the Plan period.

5.17 A sensitivity analysis using the alternative traffic forecasts Scenario I and III and at current tariff levels indicates that IR would be able to cover all of its operating expenses, but would not be able to fully meet its dividend obligation in latter years FY86 and FY87.

#### F. Financing Plan

5.18 Table 20 shows the Source and Application of Funds for the five-year period FY83 to FY87, in which the proceeds of the proposed credit will be utilized, the funds required by IR and the anticipated source of such funds are summarized as follows:

|   | <u>Rs Million</u> | <u>US\$ Million</u> | <u>%</u>   |
|---|-------------------|---------------------|------------|
| <u>Required Funds</u>                       |                   |                     |            |
| A. <u>For Investment Program:</u>           |                   |                     |            |
| Capital Expenditure                         | 60,315            | 6,701               | 98         |
| Inventories                                 | 1,418             | 158                 | 2          |
|   | <u>61,733</u>     | <u>6,859</u>        | <u>100</u> |
| B. <u>For Other Purposes</u>                |                   |                     |            |
| Dividend Paid                               | 20,492            | 2,277               | 95         |
| Repayment of Temporary Loans                | 200               | 22                  | 1          |
| Interest on Temporary Loans                 | 784               | 87                  | 4          |
|   | <u>21,476</u>     | <u>2,386</u>        | <u>100</u> |
| Required Funds - Total                      | <u>83,209</u>     | <u>9,245</u>        |            |
| <u>Sources of Funds:</u>                    |                   |                     |            |
| A. <u>For Investment Program:</u>           |                   |                     |            |
| IR Internal Cash Generation                 | 33,215            | 3,690               | 53         |
| Government Funds <u>a/</u>                  | 26,750            | 2,972               | 44         |
| Government Temporary Loans <u>b/</u>        | 1,768             | 197                 | 3          |
|   | <u>61,733</u>     | <u>6,859</u>        | <u>100</u> |
| B. <u>For Other Purposes:</u>               |                   |                     |            |
| IR Internal Cash Generation<br>for Dividend | 20,492            | 2,277               | 95         |
| IR Internal Cash Generation for other       | 984               | 109                 | 5          |
|   | <u>21,476</u>     | <u>2,386</u>        | <u>100</u> |
| Sources of Funds - Total                    | <u>83,209</u>     | <u>9,245</u>        |            |

a/ Of which the proposed Bank Group would finance Rs 3,600 million (US\$400 million equivalent for this proposed project).

b/ To finance Development Fund (DF) requirements.

5.19 It is estimated that IR would be able to finance over 50% of its total investment requirements out of internally generated funds. The balance to be provided by the Government results in an increase in the Capital-at-Charge. Forecast financial statements have been prepared on the basis of IR's preliminary estimates of planned investment for the period FY83 to FY87.

#### G. Financial Aspects of Diesel Components Works

5.20 The DCW is estimated to cost about Rs 1,072.8 million, including taxes and contingencies, with an additional amount of Rs 12.6 million for technical assistance, making a total of Rs 1,085.4 million. The amount required for construction will be included in the railway budget presented annually to the Parliament. The funds provided by GOI for the workshop will be added to the Capital-at-Charge of IR.

5.21 Estimates of the operating costs for the workshop have been calculated with costs developed from IR's experience in remanufacturing some of the components in the Zonal Workshops and in manufacturing components at their electric and diesel locomotive plants at Chittaranjan and Varanasi respectively. These estimates are reasonable. Transfer prices for parts and assemblies delivered to the Zonal Railways will be set to recover all the operating costs of the workshop including overheads and depreciation.

5.22 IR has developed a new Management Information System (MIS) for production units which includes a cost accounting system. A team has been established at the Integral Coach Factory (ICF) at Perambur to develop the System which will be introduced and tested there and then installed at the Diesel Loco Works at Varanasi (DLW) and Chittaranjan (CLW) and the Wheel and Axle plant under construction at Yelahanka, which is being financed under the ongoing Credit 844-IN. The design of the system has been reviewed and it would be appropriate, with small modifications, for use at the DCW. This will provide an effective costing system for determining transfer prices and cost control. During negotiations assurances were obtained that concurrently with the start of operations of the DCW in 1985, an adequate management information system will be installed therein.

#### VI. AGREEMENTS REACHED AND RECOMMENDATIONS

6.01 During the negotiations, agreements were reached with GOI on the following principal matters:

- (a) IR will maintain and expand the unit exchange component pool as required by its maintenance needs (para. 3.24);
- (b) IR will ensure that production and remanufacture of parts and components as a portion of gross rated annual capacity of DCW will be at least 40% in 1984/85, 70% in 1986/87 and no less than 90% thereafter (para. 3.44);

- (c) IR will ensure that at all times DCW is adequately staffed with competent managerial, supervisory and technical personnel and that any changes in managerial staff will not be detrimental to plant operation (para. 3.45);
- (d) GOI will ensure that when the lowest evaluated bidder is a foreign manufacturer, permission to import will be forthcoming immediately and no further review by any agency of the Government will be made (para. 3.49);
- (e) GOI will maintain passenger fares and freight rates and shall take all other actions as may be necessary or appropriate so as to provide to the Railways net revenue sufficient to enable the Railways to meet out of internally generated resources all operating expenses and dividend on Capital-at-Charge (para. 5.14);
- (f) Appropriations to the DRF will be not less than Rs 10,300 million in the aggregate for FY84 and FY85 (para. 5.16); and

6.02 Subject to agreements reached on the foregoing, the project constitutes a suitable basis for a Bank Loan/IDA Credit of US\$400 million equivalent.

## INDIA

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

## Age Inventory of Rolling Stock - March 31, 1981

(Units)

|                             | <u>1 to 5 yrs.</u> | <u>6 to 10 yrs.</u> | <u>11 to 15 yrs.</u> | <u>16 to 20 yrs.</u> | <u>21 to 25 yrs.</u> | <u>26 to 30 yrs.</u> | <u>31 to 35 yrs.</u> | <u>Above 35 yrs.</u> | <u>TOTAL</u> |
|-----------------------------|--------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------|
| <u>Diesel Locomotives</u>   |                    |                     |                      |                      |                      |                      |                      |                      |              |
| <u>(Main Line)</u>          |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 407                | 337                 | 297                  | 361                  | 96                   | -                    | -                    | -                    | 1,498        |
| Metre Gauge                 | 63                 | 135                 | 89                   | 148                  | -                    | -                    | -                    | -                    | 435          |
| Narrow Gauge                | 20                 | 2                   | 10                   | 25                   | 10                   | -                    | -                    | -                    | 67           |
| <u>Diesel Shunters</u>      |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 122                | 139                 | 64                   | 7                    | -                    | 29                   | 2                    | 10                   | 373          |
| Metre Gauge                 | -                  | 2                   | -                    | -                    | 7                    | 13                   | 7                    | 1                    | 30           |
| Narrow Gauge                | -                  | -                   | -                    | -                    | -                    | -                    | -                    | -                    | -            |
| <u>Electric Locomotives</u> |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 312                | 263                 | 161                  | 203                  | 66                   | -                    | -                    | -                    | 1,031        |
| Metre Gauge                 | -                  | -                   | 2                    | 18                   | -                    | -                    | -                    | -                    | 20           |
| Narrow Gauge                | -                  | -                   | -                    | -                    | -                    | -                    | -                    | -                    | -            |
| <u>Rail Cars</u>            |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | -                  | -                   | -                    | -                    | 21                   | -                    | 1                    | -                    | 22           |
| Metre Gauge                 | -                  | 5                   | 4                    | 2                    | 8                    | 6                    | 2                    | 3                    | 30           |
| Narrow Gauge                | -                  | -                   | 4                    | -                    | -                    | -                    | 4                    | 10                   | 18           |
| <u>EMU (Motor Coaches)</u>  |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 190                | 202                 | 120                  | 125                  | 61                   | 20                   | -                    | -                    | 718          |
| Metre Gauge                 | -                  | -                   | 20                   | 25                   | -                    | -                    | -                    | -                    | 45           |
| <u>EMU (Trailers)</u>       |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 200                | 390                 | 412                  | 321                  | 67                   | 60                   | 1                    | -                    | 1,451        |
| Metre Gauge                 | 30                 | 36                  | 30                   | 27                   | 14                   | 10                   | -                    | -                    | 147          |
| <u>Coaches</u>              |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 3,610              | 4,008               | 3,644                | 3,724                | 3,856                | 1,496                | 368                  | 980                  | 21,686       |
| Metre Gauge                 | 899                | 1,392               | 1,867                | 2,544                | 2,462                | 1,224                | 154                  | 703                  | 11,245       |
| Narrow Gauge                | 86                 | 98                  | 70                   | 285                  | 188                  | 105                  | 9                    | 703                  | 1,544        |
| <u>Steam Locomotives</u>    |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | *26                | 6                   | 322                  | 790                  | 1,033                | 742                  | 774                  | 595                  | 4,288        |
| Metre Gauge                 | *20 1 21           | 41                  | 287                  | 326                  | 930                  | 503                  | 357                  | 298                  | 2,763        |
| Narrow Gauge                | -                  | -                   | -                    | -                    | 18                   | 93                   | 14                   | 217                  | 342          |
| <u>Freight Wagons</u>       |                    |                     |                      |                      |                      |                      |                      |                      |              |
| Broad Gauge                 | 44,248.5           | 49,300.5            | 66,811.5             | 115,306              | 69,848.5             | 31,613.5             | 20,733               | 27,031               | 424,891.5    |
| Metre Gauge                 | 8,022              | 4,027               | 18,123               | 20,112               | 28,794               | 23,510               | 1,345                | 11,261               | 115,194      |
| Narrow Gauge                | 868                | 228                 | -                    | 1,356                | 949                  | 864                  | 2                    | 4,325                | 8,386        |

Source: IR  
September 1982

## INDIA

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

## Summary of Operating Statistics 1/

|   | BROAD GAUGE |         |         |         |         |         |         |         |            |
|---|-------------|---------|---------|---------|---------|---------|---------|---------|------------|
|   | 1973/74     | 1974/75 | 1975/76 | 1976/77 | 1977/78 | 1978/79 | 1979/80 | 1980/81 | 1981/82 2/ |
| 1. Percentage of serviceable locomotives (%) 3/         |             |         |         |         |         |         |         |         |            |
| - Steam   | 84.91       | 84.39   | 85.63   | 86.61   | 85.88   | 84.77   | 84.52   | 83.6    | 83.5       |
| - Diesel  | 84.44       | 82.26   | 82.93   | 82.92   | 83.15   | 85.52   | 85.81   | 85.8    | 83.3       |
| - Electric - Total 4/                                   | 80.78       | 78.77   | 79.95   | 79.40   | N.A.    | N.A.    | 84.18   | 83.8    | 79.1       |
| - AC 4/   | N.A.        | N.A.    | N.A.    | N.A.    | 82.78   | 83.85   | 85.20   | 85.0    | 80.6       |
| - DC 4/   | N.A.        | N.A.    | N.A.    | N.A.    | 73.58   | 74.56   | 77.60   | 75.9    | 71.9       |
| 2. Percentage of serviceable passenger vehicles (%)     | 86.55       | 84.02   | 84.29   | 87.26   | 86.59   | 86.56   | 86.10   | 85.5    | 85.8       |
| 3. Percentage of serviceable wagons                     | 95.64       | 95.52   | 95.59   | 96.01   | 96.02   | 95.66   | 95.57   | 94.6    | 93.3       |
| 4. Engine - Km per day per engine in use (km)           |             |         |         |         |         |         |         |         |            |
| - Passenger   |             |         |         |         |         |         |         |         |            |
| - Steam   | 238         | 236     | 238     | 233     | 228     | 228     | 215     | 210     | 209        |
| - Diesel  | 694         | 652     | 641     | 721     | 735     | 628     | 630     | 610     | 683        |
| - Electric  | 408         | 408     | 450     | 697     | 636     | 459     | 452     | 453     | 506        |
| - Freight   |             |         |         |         |         |         |         |         |            |
| - Steam   | 108         | 112     | 114     | 114     | 111     | 100     | 94      | 89      | 88         |
| - Diesel  | 307         | 306     | 321     | 379     | 353     | 317     | 307     | 300     | 370        |
| - Electric - Total                                      | 372         | 296     | 331     | 445     | N.A.    | N.A.    | 289     | 274     | 339        |
| - AC  | N.A.        | N.A.    | N.A.    | N.A.    | 410     | 322     | 300     | 283     | 339        |
| - DC  | N.A.        | N.A.    | N.A.    | N.A.    | 337     | 171     | 175     | 160     | 169        |
| 5. Gross trailing load per freight train (ton)          | 1,528       | 1,563   | 1,577   | 1,607   | 1,638   | 1,648   | 1,694   | 1,721   | 1,798      |
| 6. Net Tonnage per freight train (ton)                  | 745         | 778     | 782     | 796     | 618     | 826     | 863     | 884     | 932        |
| 7. Wagon - km per day per wagon in use (km)             | 67.2        | 70.3    | 76.8    | 81.1    | 81.9    | 75.9    | 73.3    | 73.4    | 83.0       |
| 8. Net ton km per wagon per day                         | 837         | 907     | 982     | 1,019   | 1,045   | 976     | 972     | 896     | 1,130      |
| 9. Gross ton km per freight-train hour                  | 260.1       | 26,756  | 27,663  | 30,222  | 30,238  | 30,366  | 31,168  | 31,850  | 36,075     |
| 10. Net ton km per freight-train hour                   | 13,966      | 14,599  | 15,018  | 16,292  | 16,444  | 16,541  | 17,171  | 17,677  | 19,664     |
| 11. Percentage of passenger trains arriving on time (%) | 79.47       | 82.1    | 86.5    | 93.2    | 91.3    | 83.3    | 86.0    | 84.3    | 85.4       |
| 12. Average wagon load (ton)                            | 17.9        | 18.5    | 18.9    | 18.9    | 19.0    | 18.9    | 19.1    | 21.2    | 21.6       |
| 13. Locomotive utilization (%) 5/                       |             |         |         |         |         |         |         |         |            |
| - Steam   | 47.9        | 46.7    | 48.3    | 45.8    | 47.9    | 45.8    | 45.0    | 47.1    | 43.3       |
| - Diesel  | 75.0        | 76.7    | 80.0    | 80.0    | 79.2    | 76.7    | 76.7    | 73.3    | 75.0       |
| - Electric - Total                                      | 67.5        | 72.1    | 76.3    | 79.6    | 80.4    | 76.3    | 72.9    | 70.0    | 80.4       |
| - All Traction  | 53.8        | 54.2    | 56.7    | 55.4    | 57.9    | 56.3    | 55.8    | 57.1    | 56.7       |
| 14. Average speed of all freight trains (kmph)          |             |         |         |         |         |         |         |         |            |
| - Steam   | 11.8        | 12.0    | 11.8    | 11.9    | 11.5    | 11.2    | 10.8    | 10.2    | 9.59       |
| - Diesel  | 22.2        | 22.7    | 22.1    | 23.1    | 22.5    | 21.5    | 21.3    | 21.3    | 22.4       |
| - Electric - Total                                      | 22.5        | 22.4    | 23.5    | 25.2    | N.A.    | N.A.    | 23.5    | 22.8    | 23.1       |
| - AC  | N.A.        | N.A.    | N.A.    | N.A.    | 25.0    | 24.2    | 23.4    | 23.0    | 23.4       |
| - DC  | N.A.        | N.A.    | N.A.    | N.A.    | 20.6    | 19.3    | 18.7    | 18.0    | 17.4       |
| - All Traction  | 18.3        | 18.4    | 18.8    | 20.1    | 19.7    | 19.6    | 19.5    | 19.7    | 20.8       |
| 15. Average speed of through freight trains (kmph)      |             |         |         |         |         |         |         |         |            |
| - Steam   | 15.6        | 15.8    | 15.9    | 16.8    | 16.3    | 15.8    | 15.2    | 15.0    | 14.9       |
| - Diesel  | 22.4        | 22.3    | 22.3    | 23.3    | 23.3    | 21.9    | 21.4    | 21.5    | 22.7       |
| - Electric - Total                                      | 22.6        | 22.5    | 23.7    | 25.4    | N.A.    | N.A.    | 23.6    | 23.0    | 23.4       |
| - AC  | N.A.        | N.A.    | N.A.    | N.A.    | 25.1    | 24.3    | 23.9    | 23.2    | 23.7       |
| - DC  | N.A.        | N.A.    | N.A.    | N.A.    | 21.0    | 19.6    | 18.9    | 18.6    | 17.2       |
| - All Traction  | 21.1        | 21.0    | 21.6    | 23.2    | 22.3    | 22.1    | 21.7    | 21.7    | 22.7       |
| 16. Average lead of a ton of freight (km)               | 630         | 651     | 636     | 626     | 659     | 663     | 691     | 698     | -          |
| 17. Wagon turnaround (days)                             | 15.0        | 14.6    | 13.3    | 13.0    | 13.3    | 14.3    | 15.1    | 15.4    | 13.3       |

NOTES: Underscored figures represent the best performance during the nine year period.

1/ Wagons are based on standard 4-wheel equivalent, 22 tons for BG and 14-6 tons for MG.

2/ Provisional figures, based on operating documents for the first 11 months.

3/ Beginning in 1978/79 the method of calculating availability has been changed, thus the statistics are not comparable to the past. More importantly, percent availability does not reflect actual reliability and effectiveness of the locomotives.

4/ Until 1976/77 electric locomotive performance statistics were compiled for the entire locomotive fleet. Beginning in 1977/78, they have been separated into AC and DC type of locomotives to show their comparative merits.

5/ Numbers of hours engine available and worked per day.

## INDIA

Table 2  
Page 2 of 2

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

## Summary of Operating Statistics 1/

|   | METRE GAUGE |         |         |         |         |         |         |         |            |
|---|-------------|---------|---------|---------|---------|---------|---------|---------|------------|
|   | 1973/74     | 1974/75 | 1975/76 | 1976/77 | 1977/78 | 1978/79 | 1979/80 | 1980/81 | 1981/82 2/ |
| 1. Percentage of serviceable locomotives (%) 3/         |             |         |         |         |         |         |         |         |            |
| - Steam   | 85.28       | 85.28   | 84.45   | 86.37   | 86.42   | 85.88   | 85.83   | 83.8    | 83.2       |
| - Diesel  | 87.71       | 86.55   | 88.33   | 88.58   | 87.82   | 87.25   | 88.57   | 87.9    | 84.3       |
| - Electric  | 88.45       | 87.90   | 85.00   | 85.00   | 80.00   | 80.00   | 84.30   | 85.1    | 84.8       |
| 2. Percentage of serviceable passenger vehicles (%)     | 88.48       | 87.13   | 88.45   | 89.59   | 89.80   | 89.50   | 88.48   | 87.2    | 88.5       |
| 3. Percentage of serviceable wagons                     | 94.98       | 94.81   | 95.65   | 96.00   | 96.09   | 95.86   | 95.27   | 94.1    | 92.9       |
| 4. Engine - Km per day per engine in use (Km)           |             |         |         |         |         |         |         |         |            |
| - Passenger   |             |         |         |         |         |         |         |         |            |
| - Steam   | 214         | 205     | 215     | 215     | 215     | 206     | 200     | 200     | 180        |
| - Diesel  | 561         | 556     | 533     | 578     | 561     | 574     | 550     | 541     | 568        |
| - Electric  | 375         | 361     | 401     | 439     | 431     | 419     | 411     | 405     | 400        |
| - Freight   |             |         |         |         |         |         |         |         |            |
| - Steam   | 118         | 117     | 120     | 126     | 123     | 115     | 113     | 107     | 109        |
| - Diesel  | 259         | 272     | 286     | 344     | 305     | 285     | 277     | 277     | 334        |
| - Electric  | 248         | 232     | 225     | 242     | 211     | 211     | 207     | 206     | 215        |
| 5. Gross trailing load per freight train (ton)          | 785         | 800     | 800     | 785     | 800     | 835     | 849     | 871     | 891        |
| 6. Net Tonnage per freight train (ton)                  | 408         | 422     | 413     | 413     | 423     | 451     | 467     | 487     | 504        |
| 7. Wagon - km per day per wagon in use (km)             | 50.9        | 53.7    | 56.4    | 58.1    | 57.5    | 52.7    | 49.7    | 47.3    | 47.8       |
| 8. Net ton km per wagon per day                         | 482         | 528     | 545     | 570     | 570     | 543     | 534     | 522     | 534        |
| 9. Gross ton km per freight-train hour                  | 11,336      | 11,300  | 11,109  | 11,097  | 11,164  | 11,495  | 11,780  | 12,235  | 13,445     |
| 10. Net ton km per freight-train hour                   | 6,616       | 6,669   | 6,423   | 6,556   | 6,618   | 6,915   | 7,115   | 7,562   | 8,415      |
| 11. Percentage of passenger trains arriving on time (%) | 84.44       | 85.61   | 88.7    | 94.1    | 92.3    | 91.7    | 85.3    | 85.9    | 88.3       |
| 12. Average wagon load (ton)                            | 12.7        | 13.2    | 13.3    | 13.6    | 13.7    | 13.8    | 14.1    | 15.1    | 15.5       |
| 13. Locomotive utilization (%) 4/                       |             |         |         |         |         |         |         |         |            |
| - Steam   | 38.6        | 35.6    | 41.7    | 41.3    | 40.8    | 38.0    | 36.9    | 36.3    | 34.7       |
| - Diesel  | 66.3        | 68.8    | 74.2    | 74.6    | 72.9    | 72.1    | 70.8    | 72.1    | 76.3       |
| - Electric  | 47.5        | 45.0    | 53.3    | 58.3    | 61.7    | 59.2    | 55.8    | 56.3    | 53.3       |
| - All Traction  | 41.6        | 39.4    | 45.4    | 45.4    | 45.0    | 42.5    | 41.5    | 41.5    | 41.2       |
| 14. Average speed of all freight trains (kmph)          |             |         |         |         |         |         |         |         |            |
| - Steam   | 12.9        | 12.5    | 12.1    | 12.2    | 11.9    | 11.4    | 11.2    | 10.8    | 10.9       |
| - Diesel  | 19.0        | 18.7    | 18.5    | 19.1    | 18.8    | 18.4    | 18.3    | 18.4    | 18.7       |
| - Electric  | 21.3        | 22.5    | 20.0    | 19.4    | 16.8    | 17.1    | 18.0    | 16.8    | 17.8       |
| - All Traction  | 15.5        | 15.2    | 14.9    | 15.2    | 15.0    | 14.8    | 14.8    | 15.1    | 16.1       |
| 15. Average speed of through freight trains (kmph)      |             |         |         |         |         |         |         |         |            |
| - Steam   | 15.5        | 14.4    | 14.1    | 14.1    | 13.7    | 12.7    | 12.1    | 11.3    | 11.3       |
| - Diesel  | 19.3        | 19.0    | 18.8    | 19.2    | 19.0    | 18.6    | 18.5    | 19.5    | 19.1       |
| - Electric  | 21.3        | 22.5    | 20.0    | 19.4    | 16.8    | 17.1    | 18.0    | 16.8    | 17.8       |
| - All Traction  | 18.1        | 17.6    | 17.3    | 17.6    | 17.4    | 16.9    | 16.7    | 16.2    | 17.9       |
| 16. Average lead of a ton of freight (km)               | 462         | 512     | 499     | 458     | 473     | 507     | 521     | 536     | -          |
| 17. Wagon turnaround (days)                             | 12.5        | 12.0    | 11.6    | 11.1    | 11.5    | 12.8    | 14.1    | 15.2    | 14.1       |

NOTES: Underscored figures represent the best performance during the nine year period.

1/ Wagons are based on standard 4-wheel equivalent, 22 tons for BG and 14-6 tons for MG.

2/ Provisional figures, based on operating documents for the first 11 months.

3/ Beginning in 1978/79 the method of calculating availability has been changed, thus the statistics are not comparable to the past. More importantly, percent availability does not reflect actual reliability and effectiveness of the locomotives.

4/ Number of hours engine available and worked per day.

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

## Freight and Passenger Traffic

| Year       | Freight Traffic                     |                                 |                            | Passenger Traffic                 |                                 |                            |                                   |                                 |                            |
|------------|-------------------------------------|---------------------------------|----------------------------|-----------------------------------|---------------------------------|----------------------------|-----------------------------------|---------------------------------|----------------------------|
|            | Originating Tonnage<br>million tons | Total Ton-Kilometres<br>million | Average Lead<br>Kilometres | Non-Suburban Traffic              |                                 |                            | Suburban Traffic a/               |                                 |                            |
|            |                                     |                                 |                            | Passengers Originating<br>million | Passenger-Kilometres<br>million | Average Lead<br>Kilometres | Passengers Originating<br>million | Passenger-Kilometres<br>million | Average Lead<br>Kilometres |
| 1950/51    | 93.0                                | 44,117                          | 474                        | 867                               | 59,914                          | 69.1                       | 417                               | 6,603                           | 15.8                       |
| 1955/56    | 115.9                               | 59,576                          | 514                        | 776                               | 54,235                          | 69.9                       | 499                               | 8,165                           | 16.4                       |
| 1960/61    | 156.2                               | 87,680                          | 561                        | 909                               | 65,847                          | 72.4                       | 685                               | 11,818                          | 17.3                       |
| 1965/66    | 203.0                               | 116,936                         | 576                        | 1,057                             | 79,059                          | 74.8                       | 1,025                             | 17,235                          | 16.8                       |
| 1966/67    | 201.6                               | 116,607                         | 578                        | 1,111                             | 83,676                          | 75.3                       | 1,081                             | 18,469                          | 17.1                       |
| 1967/68    | 196.6                               | 118,860                         | 605                        | 1,153                             | 88,188                          | 76.5                       | 1,104                             | 18,975                          | 17.2                       |
| 1968/69    | 204.0                               | 125,140                         | 615                        | 1,129                             | 87,425                          | 77.4                       | 1,084                             | 19,515                          | 18.0                       |
| 1969/70    | 207.9                               | 127,248                         | 617                        | 1,180                             | 91,219                          | 77.3                       | 1,158                             | 22,163                          | 19.1                       |
| 1970/71    | 196.5                               | 127,358                         | 648                        | 1,204                             | 95,068                          | 79.0                       | 1,227                             | 23,052                          | 18.8                       |
| 1971/72    | 197.8                               | 133,265                         | 674                        | 1,261                             | 101,079                         | 80.2                       | 1,275                             | 24,250                          | 19.0                       |
| 1972/73    | 201.3                               | 136,531                         | 678                        | 1,268                             | 106,931                         | 84.3                       | 1,385                             | 26,596                          | 19.2                       |
| 1973/74    | 184.9                               | 122,354                         | 662                        | 1,217                             | 107,627                         | 88.5                       | 1,437                             | 28,037                          | 19.5                       |
| 1974/75    | 196.7                               | 134,304                         | 683                        | 1,056                             | 99,097                          | 93.8                       | 1,373                             | 27,157                          | 19.8                       |
| 1975/76    | 223.3                               | 148,219                         | 664                        | 1,306                             | 115,899                         | 88.7                       | 1,639                             | 32,862                          | 20.1                       |
| 1976/77    | 239.1                               | 156,756                         | 656                        | 1,498                             | 126,754                         | 84.6                       | 1,802                             | 37,082                          | 20.6                       |
| 1977/78    | 237.3                               | 162,687                         | 686                        | 1,575                             | 137,201                         | 87.1                       | 1,928                             | 39,433                          | 20.4                       |
| 1978/79    | 223.4                               | 154,824                         | 693                        | 1,606                             | 149,506                         | 93.1                       | 2,113                             | 43,439                          | 20.6                       |
| 1979/80    | 217.8                               | 155,995                         | 717                        | 1,602                             | 159,913                         | 99.8                       | 1,903                             | 38,730                          | 20.4                       |
| 1980/81    | 220.0                               | 158,474                         | 720                        | 1,612                             | 167,472                         | 103.9                      | 2,000                             | 41,086                          | 20.5                       |
| 1981/82 b/ | 244.7                               | 173,918                         | 711                        | 1,720                             | 183,352                         | 106.6                      | 2,100                             | 43,890                          | 20.9                       |

## Average Annual Growth Rates (%)

|              |      |      |     |      |     |     |      |      |      |
|--------------|------|------|-----|------|-----|-----|------|------|------|
| 1960/61 over |      |      |     |      |     |     |      |      |      |
| 1950/51      | 5.3  | 7.1  | 1.7 | 0.5  | 1.0 | 0.5 | 5.1  | 6.0  | 0.9  |
| 1970/71 over |      |      |     |      |     |     |      |      |      |
| 1960/61      | 2.3  | 3.8  | 1.5 | 2.8  | 3.7 | 0.9 | 6.0  | 6.9  | 0.9  |
| 1980/81 over |      |      |     |      |     |     |      |      |      |
| 1950/51      | 2.9  | 4.3  | 1.4 | 2.0  | 3.3 | 1.3 | 5.4  | 6.2  | 0.8  |
| 1980/81 over |      |      |     |      |     |     |      |      |      |
| 1970/71      | 1.1  | 2.1  | 1.1 | 2.5  | 5.3 | 2.6 | 5.0  | 5.8  | 0.8  |
| 1980/81 over |      |      |     |      |     |     |      |      |      |
| 1977/78      | -2.7 | -1.1 | 1.6 | -0.5 | 5.1 | 3.3 | 1.2  | 1.0  | -0.2 |
| 1981/82 over |      |      |     |      |     |     |      |      |      |
| 1950/51      | 3.0  | 4.5  | 1.6 | 3.2  | 6.6 | 1.8 | 13.0 | 18.2 | 1.0  |
| 1981/82 over |      |      |     |      |     |     |      |      |      |
| 1970/71      | 2.2  | 3.3  | 0.9 | 3.9  | 8.4 | 3.2 | 6.5  | 8.2  | 1.0  |
| 1981/82 over |      |      |     |      |     |     |      |      |      |
| 1977/78      | 0.8  | 1.7  | 0.9 | 2.3  | 8.4 | 5.6 | 2.2  | 2.8  | 0.6  |

a/ Passengers booked between stations within the metropolitan areas of Bombay, Calcutta, Madras and Secunderabad up to 1970-71. From 1971-72 onwards, these figures exclude Secunderabad.

b/ Provisional figures.

Source: Ministry of Railways

September 1982

INDIA  
RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II  
Freight Traffic by Major Commodities  
1969/70 - 1981/82

| Traffic Category      | 1969/70 |         | 1975/76 |         | 1976/77 |         | 1977/78 |         | 1978/79 |         | 1979/80 |         | 1980/81 |         | 1981/82 <sup>1/</sup> |         |
|-----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------------------|---------|
|                       | T       | TK      | T                     | TK      |
| Steel Plants          | 23.6    | 8,707   | 27.7    | 11,746  | 33.0    | 14,521  | 31.2    | 14,074  | 29.8    | 13,525  | 27.9    | 12,545  | 27.7    | 12,810  | 32.64                 | 15,167  |
| Coal                  | 53.0    | 31,026  | 64.3    | 37,654  | 67.4    | 38,756  | 69.1    | 40,552  | 64.1    | 36,318  | 62.0    | 35,340  | 64.1    | 36,373  | 75.80                 | 43,761  |
| Iron Ore for Export   | 8.8     | 5,276   | 11.3    | 7,171   | 10.0    | 6,408   | 10.6    | 7,057   | 10.3    | 6,871   | 9.3     | 6,188   | 11.1    | 7,293   | 11.18                 | 6,517   |
| Cement                | 10.7    | 6,265   | 11.6    | 8,627   | 13.7    | 9,170   | 13.6    | 9,200   | 12.3    | 8,911   | 10.0    | 7,442   | 9.6     | 7,189   | 10.79                 | 8,072   |
| Foodgrains            | 15.1    | 13,400  | 16.2    | 15,479  | 20.0    | 18,757  | 19.5    | 22,962  | 16.7    | 20,522  | 18.4    | 23,474  | 18.3    | 24,308  | 21.51                 | 28,111  |
| Fertilizers           | 4.6     | 3,760   | 7.2     | 6,158   | 7.8     | 7,225   | 8.2     | 8,135   | 8.6     | 8,901   | 8.2     | 9,240   | 8.1     | 8,922   | 9.56                  | 9,665   |
| Petroleum Products    | 8.8     | 4,958   | 11.7    | 7,051   | 12.4    | 7,552   | 13.1    | 8,238   | 14.3    | 9,988   | 14.3    | 10,397  | 14.9    | 11,660  | 16.55                 | 11,888  |
| Other Goods           | 49.2    | 37,443  | 46.8    | 40,988  | 48.3    | 41,641  | 45.5    | 40,032  | 43.5    | 38,834  | 43.0    | 39,933  | 42.1    | 39,097  | 43.16                 | 41,052  |
| Total Revenue Traffic | 173.8   | 110,826 | 196.8   | 134,874 | 212.6   | 144,030 | 210.8   | 150,250 | 199.6   | 143,870 | 193.1   | 144,559 | 195.9   | 147,652 | 221.19                | 164,233 |
| Non-Revenue Traffic   | 34.1    | 16,422  | 26.5    | 13,345  | 26.5    | 12,726  | 26.5    | 12,437  | 23.8    | 10,954  | 24.7    | 11,436  | 24.1    | 10,822  | 23.62                 | 9,685   |
| Total ALL Traffic     | 207.9   | 127,248 | 223.3   | 148,219 | 239.1   | 156,756 | 237.3   | 162,687 | 223.4   | 154,824 | 217.8   | 155,995 | 220.0   | 158,474 | 244.81                | 173,918 |

Notes: T = Metric tons (millions); TK = Metric Ton Kilometers (millions).

<sup>1/</sup> Provisional

Source: Indian Railways Year Books and IR estimates.  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Freight Traffic Forecasts by Major Commodities

1984/85 - 1990/91

| Traffic Category      | 1981/82 <sup>1/</sup> |       | 1984/85    |       |             |       |              |       | 1990/91    |       |             |       |              |       |
|-----------------------|-----------------------|-------|------------|-------|-------------|-------|--------------|-------|------------|-------|-------------|-------|--------------|-------|
|                       | T                     | TK    | Scenario I |       | Scenario II |       | Scenario III |       | Scenario I |       | Scenario II |       | Scenario III |       |
|                       |                       |       | T          | TK    | T           | TK    | T            | TK    | T          | TK    | T           | TK    | T            | TK    |
| Steel Plants          | 32.6                  | 15.2  | 35.8       | 16.5  | 36.1        | 10.8  | 37.7         | 17.5  | 40.4       | 18.5  | 41.8        | 19.6  | 45.2         | 20.5  |
| Coal                  | 75.8                  | 43.8  | 85.5       | 49.4  | 90.3        | 52.1  | 97.6         | 56.4  | 108.8      | 62.9  | 128.1       | 74.0  | 150.6        | 87.0  |
| Iron Ore for Export   | 11.2                  | 6.5   | 11.5       | 7.5   | 11.6        | 7.6   | 11.7         | 7.6   | 11.8       | 7.7   | 11.9        | 7.8   | 12.1         | 7.9   |
| Cement                | 10.8                  | 8.1   | 10.7       | 8.8   | 11.1        | 9.1   | 12.1         | 9.9   | 10.6       | 10.5  | 11.7        | 11.6  | 13.9         | 13.7  |
| Foodgrains            | 21.5                  | 28.1  | 22.8       | 29.8  | 23.0        | 30.0  | 23.1         | 30.2  | 25.7       | 33.5  | 26.2        | 34.3  | 26.8         | 35.1  |
| Fertilizers           | 9.6                   | 9.7   | 9.6        | 10.7  | 9.7         | 10.9  | 10.0         | 11.3  | 11.1       | 12.5  | 12.4        | 14.0  | 14.2         | 16.0  |
| Petroleum Products    | 16.5                  | 11.9  | 17.1       | 11.5  | 17.8        | 12.1  | 18.7         | 12.6  | 18.3       | 12.4  | 19.4        | 14.3  | 26.3         | 19.4  |
| Other Goods           | 43.2                  | 41.1  | 40.3       | 40.4  | 40.5        | 40.7  | 40.6         | 40.8  | 34.6       | 42.2  | 35.7        | 44.2  | 35.7         | 46.2  |
| Total Revenue Traffic | 221.2                 | 164.4 | 233.3      | 174.7 | 240.1       | 179.3 | 251.5        | 186.3 | 261.3      | 200.2 | 287.2       | 219.8 | 324.8        | 245.8 |
| Non-Revenue Traffic   | 23.5                  | 9.7   | 24.0       | 11.5  | 24.0        | 11.5  | 24.0         | 11.5  | 25.0       | 12.0  | 25.0        | 12.0  | 25.0         | 12.0  |
| Total All Traffic     | 244.7                 | 174.1 | 257.3      | 186.2 | 264.1       | 190.8 | 275.5        | 197.8 | 286.3      | 212.2 | 312.2       | 231.8 | 349.8        | 257.8 |

Notes: T = Metric Tons (millions); TK = Metric Ton Kilometers (billions)

The assumptions on which each scenario is based are explained in Annex C

<sup>1/</sup> Provisional

Source: IR estimates, modified by the Bank Group Mission

September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR's Investment Program 1980/81-1984/85 <sup>1/</sup>

(Rs Million)

| <u>Category</u>                      | <u>1980/81</u> | <u>1981/82</u> | <u>1982/83</u> | <u>1984/84</u> | <u>1984/85</u> | <u>Total</u><br><u>1980/81-1984/85</u> |
|--------------------------------------|----------------|----------------|----------------|----------------|----------------|--|
| 1. Rolling Stock                     | 3,400          | 3,500          | 4,700          | 4,700          | 4,700          | 21,000                                 |
| 2. Traffic Facilities                | 1,150          | 1,650          | 680            | 660            | 660            | 4,800                                  |
| 3. Track Renewals                    | 700            | 1,200          | 1,050          | 1,030          | 1,020          | 5,000                                  |
| 4. Electrification                   | 220            | 400            | 1,300          | 1,290          | 1,290          | 4,500                                  |
| 5. Machinery and Plant               | 170            | 250            | 580            | 580            | 570            | 2,150                                  |
| 6. Workshops and Sheds               | 380            | 850            | 580            | 570            | 570            | 2,950                                  |
| 7. Spare Parts                       | 80             | 200            | 40             | 40             | 40             | 400                                    |
| 8. Signalling and Telecommunications | 200            | 250            | 150            | 150            | 150            | 900                                    |
| 9. New Lines                         | 410            | 450            | 980            | 980            | 980            | 3,800                                  |
| 10. Other Civil and Electrical Works | 200            | 210            | 230            | 230            | 230            | 1,100                                  |
| 11. Other Investment                 | 220            | 260            | 300            | 300            | 270            | 1,350                                  |
| Subtotal                             | <u>7,130</u>   | <u>9,220</u>   | <u>10,590</u>  | <u>10,530</u>  | <u>10,480</u>  | <u>47,950</u>                          |
| 12. Metropolitan Transport Projects  | 250            | 500            | 600            | 600            | 600            | 2,550                                  |
| 13. Investment in Road Services      | 220            | 80             | 70             | 70             | 60             | 500                                    |
| Subtotal                             | <u>470</u>     | <u>580</u>     | <u>670</u>     | <u>670</u>     | <u>660</u>     | <u>3,050</u>                           |
| GRAND TOTAL                          | <u>7,600</u>   | <u>9,800</u>   | <u>11,260</u>  | <u>11,200</u>  | <u>11,140</u>  | <u>51,000</u>                          |

<sup>1/</sup> The Investment Program was prepared on the basis of January 1981 prices.

Source: IR and Mission Estimates

September 1982

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Diesel Component Works (DCW)

Summary of Financial Cost Estimates

| Facility                                      | -----Rs Million----- |                        |              |                | -----US\$ Million----- |              |               |
|---|----------------------|------------------------|--------------|----------------|------------------------|--------------|---------------|
|   | Local                | Taxes<br>and<br>Duties | Foreign      | Total          | Local                  | Foreign      | Total         |
| <b>1. Component Overhaul Shops</b>            |                      |                        |              |                |                        |              |               |
| Engine Shop                                   | 4.8                  | 4.7                    | 15.9         | 25.4           | 1.05                   | 1.77         | 2.82          |
| Auxillary Shop                                | 0.5                  | 0.7                    | 2.0          | 3.2            | 0.13                   | 0.22         | 0.35          |
| Air Brake Shop                                | 5.2                  | 3.3                    | 11.1         | 19.6           | 0.96                   | 1.23         | 2.19          |
| Traction Motor Shop                           | 6.4                  | 4.9                    | 16.1         | 27.4           | 1.25                   | 1.79         | 3.04          |
| Engine Block Shop                             | 2.8                  | 2.7                    | 9.5          | 15.0           | 0.62                   | 1.05         | 1.67          |
| Liner Chrome Plating Shop                     | 1.6                  | 1.4                    | 4.7          | 7.7            | 0.33                   | 0.52         | 0.85          |
| Crank Shaft, Camshaft<br>Remanufacturing Shop | <u>6.2</u>           | <u>5.2</u>             | <u>17.2</u>  | <u>28.6</u>    | <u>1.27</u>            | <u>1.91</u>  | <u>3.18</u>   |
| Subtotal                                      | 27.5                 | 22.9                   | 76.5         | 126.9          | 5.61                   | 8.49         | 14.10         |
| <b>2. Component Manufacturing Shops</b>       |                      |                        |              |                |                        |              |               |
| Machine Shop                                  | 18.2                 | 40.9                   | 137.2        | 196.3          | 6.57                   | 15.24        | 21.81         |
| Heat Treatment Shop                           | 2.9                  | 3.4                    | 11.8         | 18.1           | 0.70                   | 1.31         | 2.01          |
| Rubber Component Shop                         | <u>0.6</u>           | <u>0.8</u>             | <u>2.5</u>   | <u>3.9</u>     | <u>0.15</u>            | <u>0.28</u>  | <u>0.43</u>   |
| Subtotal                                      | 21.7                 | 45.1                   | 151.5        | 218.3          | 7.42                   | 16.83        | 24.25         |
| <b>3. Locomotive Remanufacturing Shops</b>    |                      |                        |              |                |                        |              |               |
| Locomotive Stripping and<br>Cleaning Shop     | 2.8                  | 3.6                    | 12.0         | 18.4           | 0.71                   | 1.33         | 2.04          |
| Locomotive Erecting Shop                      | 9.5                  | 4.5                    | 14.7         | 28.7           | 1.56                   | 1.63         | 3.19          |
| Bogi and Wheel Shop                           | <u>8.9</u>           | <u>5.5</u>             | <u>18.4</u>  | <u>32.8</u>    | <u>1.60</u>            | <u>2.04</u>  | <u>3.64</u>   |
| Subtotal                                      | 21.2                 | 13.6                   | 45.1         | 79.9           | 3.87                   | 5.00         | 8.87          |
| <b>4. Service Shops</b>                       |                      |                        |              |                |                        |              |               |
| Plant Maintenance & Tool Room                 | 4.0                  | 3.3                    | 10.4         | 17.7           | 0.81                   | 1.16         | 1.97          |
| Laboratory                                    | 0.4                  | 0.3                    | 1.1          | 1.8            | 0.08                   | 0.12         | 0.20          |
| Inspection Equipment                          | 0.1                  | 1.6                    | 4.3          | 6.0            | 0.16                   | 0.51         | 0.67          |
| Miscellaneous (Material<br>Handling, etc.)    | <u>5.1</u>           | <u>5.0</u>             | <u>16.7</u>  | <u>26.8</u>    | <u>1.12</u>            | <u>1.86</u>  | <u>2.98</u>   |
| Subtotal                                      | 9.6                  | 10.2                   | 32.5         | 52.3           | 2.17                   | 3.65         | 5.82          |
| <b>5. Construction and Start-Up</b>           |                      |                        |              |                |                        |              |               |
| Civil and Electrical                          | 200.0                | 0.0                    | 0.0          | 200.0          | 22.22                  | 0.0          | 22.22         |
| Project Implementation                        | 11.5                 | 0.0                    | 4.0          | 15.5           | 1.28                   | 0.44         | 1.72          |
| Technical Assistance                          | 1.4                  | 0.0                    | 3.9          | 5.3            | 0.16                   | 0.43         | 0.59          |
| Training                                      | 2.8                  | 0.0                    | 4.5          | 7.3            | 0.31                   | 0.50         | 0.81          |
| Initial Raw Material and<br>Working Capital   | <u>57.5</u>          | <u>25.0</u>            | <u>82.3</u>  | <u>164.8</u>   | <u>9.1</u>             | <u>9.14</u>  | <u>18.24</u>  |
| Subtotal                                      | 273.2                | 25.0                   | 94.7         | 392.9          | 33.07                  | 10.51        | 43.58         |
| Base Cost Estimate                            | 353.2                | 116.8                  | 400.3        | 870.3          | 52.14                  | 44.48        | 96.62         |
| <b>6. Physical Contingencies</b>              |                      |                        |              |                |                        |              |               |
| Machinery                                     | 5.9                  | 5.6                    | 18.7         | 30.2           | 1.28                   | 2.08         | 3.36          |
| Construction Start Up                         | 20.8                 | 1.7                    | 6.3          | 28.8           | 2.50                   | 0.70         | 3.20          |
| <b>7. Price Contingencies</b>                 |                      |                        |              |                |                        |              |               |
|   | <u>51.4</u>          | <u>24.1</u>            | <u>80.7</u>  | <u>156.2</u>   | <u>8.39</u>            | <u>8.97</u>  | <u>17.36</u>  |
| Total Project Cost 1/                         | <u>431.3</u>         | <u>148.2</u>           | <u>506.0</u> | <u>1,085.5</u> | <u>64.31</u>           | <u>56.23</u> | <u>120.54</u> |

**Notes:** Totals may not agree due to rounding errors.

1/ Includes technical assistance and training which is shown as a separate item in para. 3.38.

Source: IR and Mission Estimates  
September 1982

INDIA  
RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Diesel Component Works (DCW)

Investment Schedule

(Rs Million)

| Work Item                                       | 1982/83 |               |         |       | 1983/84 |               |         |       | 1984/85 |               |         |       | 1985/86 |               |         |       | 1986/87 |               |         |       |
|---|---------|---------------|---------|-------|---------|---------------|---------|-------|---------|---------------|---------|-------|---------|---------------|---------|-------|---------|---------------|---------|-------|
|   | Local   | Custom Duties | Foreign | Total | Local   | Custom Duties | Foreign | Total | Local   | Custom Duties | Foreign | Total | Local   | Custom Duties | Foreign | Total | Local   | Custom Duties | Foreign | Total |
| Machinery & Plant                               | 8.8     | -             | -       | 8.8   | 20.0    | 25.6          | 85.6    | 131.2 | 28.0    | 43.8          | 143.6   | 215.4 | 13.6    | 23.7          | 76.4    | 113.7 | 9.6     | -             | -       | 9.6   |
| Civil & Electrical Works                        | 42.0    | -             | -       | 42.0  | 52.0    | -             | -       | 52.0  | 56.0    | -             | -       | 56.0  | 26.0    | -             | -       | 26.0  | 24.0    | -             | -       | 24.0  |
| Implementation, Training & Technical Assistance | 2.4     | -             | -       | 2.4   | 2.8     | -             | 3.1     | 5.9   | 3.1     | -             | 3.1     | 6.2   | 4.2     | -             | 3.1     | 7.3   | 3.2     | -             | 3.1     | 6.3   |
| Initial Raw Material & Working Capital          | -       | -             | -       | -     | -       | -             | -       | -     | 8.6     | 6.0           | 20.5    | 35.1  | 20.1    | 8.5           | 28.8    | 57.4  | 29.4    | 10.5          | 33.0    | 72.9  |
| Subtotal  | 53.2    | -             | -       | 53.2  | 74.8    | 25.6          | 88.7    | 189.1 | 95.7    | 49.8          | 167.2   | 312.7 | 63.9    | 32.2          | 108.3   | 204.4 | 66.2    | 10.5          | 36.1    | 112.8 |
| <u>Physical Contingencies</u>                   |         |               |         |       |         |               |         |       |         |               |         |       |         |               |         |       |         |               |         |       |
| Machinery                                       | 0.6     | -             | -       | 0.6   | 1.5     | 1.5           | 5.2     | 8.2   | 2.1     | 2.7           | 9.0     | 13.8  | 1.1     | 1.4           | 4.5     | 7.0   | 0.6     | -             | -       | 0.6   |
| Construction & Start up                         | 3.7     | -             | -       | 3.7   | 4.6     | -             | 0.6     | 5.2   | 5.0     | 0.4           | 1.6     | 7.0   | 3.7     | 0.6           | 2.0     | 6.3   | 3.8     | 0.7           | 2.1     | 6.6   |
| Subtotal  | 4.3     | -             | -       | 4.3   | 6.1     | 1.5           | 5.8     | 13.4  | 7.1     | 3.1           | 10.6    | 20.8  | 4.8     | 2.0           | 6.5     | 13.3  | 4.4     | 0.7           | 2.1     | 7.2   |
| <u>Price Contingencies 1/</u>                   |         |               |         |       |         |               |         |       |         |               |         |       |         |               |         |       |         |               |         |       |
| Foreign Costs                                   | -       | -             | -       | -     | -       | -             | 10.5    | 10.5  | -       | -             | 32.2    | 32.2  | -       | -             | 27.4    | 27.4  | -       | -             | 10.6    | 10.6  |
| Local Costs                                     | 1.5     | -             | -       | 1.5   | 7.7     | 3.1           | -       | 10.8  | 14.4    | 10.1          | -       | 24.5  | 13.4    | 8.4           | -       | 21.8  | 14.4    | 2.5           | -       | 16.9  |
| Subtotal  | 1.5     | -             | -       | 1.5   | 7.7     | 3.1           | 10.5    | 21.3  | 14.4    | 10.1          | 32.2    | 56.7  | 13.4    | 8.4           | 27.4    | 49.2  | 14.4    | 2.5           | 10.6    | 27.5  |
| TOTAL   | 59.0    | -             | 3.5     | 59.0  | 88.6    | 30.2          | 105.0   | 223.8 | 117.2   | 63.0          | 210.0   | 390.2 | 82.1    | 42.6          | 142.2   | 266.9 | 85.0    | 13.7          | 48.8    | 147.5 |

Notes: Price Estimates as of May 1982

1/ Custom Duties are inflated at foreign rates

Source: IR and Mission  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Indigenous Production and Imports of Wheels  
Tyres and Axles 1963/64-1981/82

| Year    | Indigenous Production of<br>DSP and TISCO |        |                  | Import           |        |                  | DSP and TISCO Import |        |                  | Total 2/<br>Wheels/Tyres and Axles |        |
|---------|---|--------|------------------|------------------|--------|------------------|----------------------|--------|------------------|------------------------------------|--------|
|         | Wheels/<br>Tyres                          | Axles  | Wheel<br>Sets 1/ | Wheels/<br>Tyres | Axles  | Wheel<br>Sets 1/ | Wheels/<br>Tyres     | Axles  | Wheel<br>Sets 1/ | Wheels/<br>Tyres                   | Axles  |
| 1963/64 | 42,890                                    | 10,786 | 18,523           | 27,633           | 11,604 | 3,084            | 70,523               | 22,390 | 21,607           | 113,737                            | 43,997 |
| 1964/65 | 48,603                                    | 13,621 | 22,415           | 0                | 0      | 9,872            | 48,603               | 13,621 | 32,287           | 113,177                            | 45,908 |
| 1965/66 | 43,758                                    | 12,579 | 23,407           | 22,995           | 4,371  | 32,658           | 66,753               | 16,950 | 56,065           | 178,883                            | 73,015 |
| 1966/67 | 43,850                                    | 11,360 | 15,143           | 2,253            | 0      | 2,542            | 46,103               | 11,360 | 17,685           | 81,873                             | 29,045 |
| 1967/68 | 42,854                                    | 9,962  | 14,879           | 40,779           | 14,417 | 14,025           | 83,633               | 23,379 | 28,904           | 141,441                            | 52,283 |
| 1968/69 | 36,673                                    | 10,318 | 9,895            | 43,516           | 1,907  | 164              | 80,189               | 12,225 | 10,059           | 100,307                            | 22,284 |
| 1969/70 | 37,107                                    | 11,049 | 8,666            | 33,007           | 4,595  | 3,000            | 70,114               | 15,644 | 11,666           | 93,446                             | 27,310 |
| 1970/71 | 36,309                                    | 10,734 | 10,632           | 54,391           | 11,311 | 16,088           | 90,700               | 22,045 | 26,711           | 144,122                            | 48,756 |
| 1971/72 | 29,934                                    | 7,706  | 7,443            | 78,840           | 7,023  | 1,672            | 108,774              | 14,729 | 9,115            | 127,004                            | 23,844 |
| 1972/73 | 16,489                                    | 3,776  | 5,825            | 76,106           | 11,161 | 15,218           | 92,595               | 14,937 | 21,043           | 134,681                            | 35,980 |
| 1973/74 | 16,434                                    | 5,872  | 6,950            | 54,486           | 5,235  | 5,314            | 70,920               | 11,107 | 12,264           | 95,448                             | 23,371 |
| 1974/75 | 23,833                                    | 6,191  | 7,661            | 35,088           | 11,786 | 18,616           | 58,921               | 17,977 | 26,277           | 111,475                            | 44,254 |
| 1975/76 | 28,553                                    | 8,194  | 10,433           | 43,354           | 12,646 | 18,288           | 71,907               | 20,840 | 28,721           | 129,349                            | 49,561 |
| 1976/77 | 35,547                                    | 10,333 | 10,655           | 22,571           | 932    | NIL              | 58,118               | 11,265 | 10,655           | 79,428                             | 21,920 |
| 1977/78 | 41,960                                    | 12,200 | 11,413           | 28,084           | 1,896  | NIL              | 70,044               | 13,996 | 11,413           | 92,870                             | 25,409 |
| 1978/79 | 29,713                                    | 10,806 | 14,226           | 73,174           | 3,781  | 12,384           | 102,887              | 14,587 | 26,610           | 156,107                            | 41,197 |
| 1979/80 | 28,306                                    | 8,313  | 13,835           | 115,541          | 18,437 | 7,574            | 143,847              | 26,750 | 21,409           | 186,665                            | 48,159 |
| 1980/81 | 14,762                                    | 2,246  | 11,787           | 115,539          | 30,935 | 25,880           | 130,301              | 33,181 | 37,667           | 205,635                            | 70,848 |
| 1981/82 | 19,675                                    | 11,658 | 9,441            | 89,550           | 12,593 | 11,020           | 109,225              | 24,251 | 20,461           | 150,146                            | 44,712 |

1/ One wheel-set consists of two wheels and one axle fully assembled.

2/ Wheel-sets converted to wheels and axles.

Source: IR  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR Wheel, Tyre and Axle Requirements, Present Manufacturing Capacity,  
Projected Production and Shortfall 1982/83 - 1986/87

|   | <u>1982/83</u> | <u>1983/84</u> | <u>1984/85</u> | <u>1985/86</u> | <u>1986/87</u> |
|---|----------------|----------------|----------------|----------------|----------------|
| <u>WHEELS</u>                             |                |                |                |                |                |
| Total IR requirements                     | 82,083         | 112,500        | 128,600        | 141,000        | 141,000        |
| Domestic manufacturing capacity <u>1/</u> | 40,000         | 40,000         | 60,000         | 80,000         | 80,000         |
| Production                                | <u>24,361</u>  | <u>26,000</u>  | <u>35,000</u>  | <u>70,000</u>  | <u>70,000</u>  |
| Production shortfall                      | 57,722         | 86,500         | 93,600         | 71,000         | 71,000         |
| <u>TYRES</u>                              |                |                |                |                |                |
| Total IR requirements                     | 52,132         | 50,000         | 50,000         | 50,000         | 50,000         |
| Domestic manufacturing capacity           | 27,500         | 27,500         | 27,500         | 27,500         | 27,500         |
| Production                                | <u>16,000</u>  | <u>25,000</u>  | <u>25,000</u>  | <u>25,000</u>  | <u>25,000</u>  |
| Production shortfall                      | 36,132         | 25,000         | 25,000         | 25,000         | 25,000         |
| <u>AXLES</u>                              |                |                |                |                |                |
| Total IR requirements                     | 38,460         | 55,000         | 65,000         | 75,000         | 75,000         |
| Domestic manufacturing capacity <u>1/</u> | 20,000         | 20,000         | 25,000         | 40,000         | 40,000         |
| Production                                | <u>13,208</u>  | <u>15,000</u>  | <u>20,000</u>  | <u>39,000</u>  | <u>39,000</u>  |
| Production shortfall                      | 25,252         | 40,000         | 45,000         | 36,000         | 36,000         |

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1/ Domestic capacity of wheel reduced in 1982/83 because M/s TISCO has discontinued manufacture of wheels and axles. This will increase with the commissioning of wheels and axles plant.

Source: IR and Mission Estimates  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Schedule of Training of Officers and Supervisors for DCW

(In Weeks)

| Sl. No. | Category                               | Total No. of Staff | Orientation | D.L.W. | Railway Work-shop | Public Sector Under Taking | Indian Institute & Similar plants | Indian M/C Supplier | Foreign M/C Supplier | Foreign Institute Similar plant |
|---------|--|--------------------|-------------|--------|-------------------|----------------------------|-----------------------------------|---------------------|----------------------|---------------------------------|
| 1.      | Design & Quality Control               | 26                 | 4(all)      | 4(12)  | -                 | -                          | 4(4)                              | -                   | -                    | 8(2)                            |
| 2.      | Plant Engineering                      | 47                 | 4(all)      | 8(20)  | -                 | -                          | -                                 | 4(8)                | 8(2)                 | 8(2)                            |
| 3.      | Chemists                               | 20                 | 4(all)      | 4(8)   | -                 | 4(4)                       | 2(2)                              | 4(2)                | 6(2)                 | 4(2)                            |
| 4.      | Industrial Eng.                        | 27                 | 4(all)      | 4(10)  | -                 | -                          | 4(2)                              | -                   | -                    | 8(2)                            |
| 5.      | Manufacturing                          | 97                 | 4(all)      | 8(25)  | 8(40)             | 4(10)                      | 0                                 | 2(4)                | 8(2)*                | 12(2)                           |
| 6.      | Loco. and Bogie Stripping and Erection | 45                 | 4(all)      | 4(20)  | 4(20)             | -                          | -                                 | -                   | -                    | 12(4)                           |
| 7.      | Officers                               | 96                 | 4(32)       | 2(12)  | -                 | 4(20)                      | 4(20)                             | 4(25)               | 8(16)                | 8(16)                           |

Notes:

Figures in brackets indicate number of staff.

\* Majority of training included in purchase cost of machinery.

September 1982

**INDIA**

**RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II**

**Schedule of Artisan Staff Training for DCW**  
(In Weeks)

| Sl. No. | Category                                       | Total No. of Staff | Orientation | At D.L.W. | Other Rly. Work-shops | Public Sector under-taking | Indian Institute & similar Plant | Foreign M/C supplier | Foreign Institute similar Plant |
|---------|--|--------------------|-------------|-----------|-----------------------|----------------------------|----------------------------------|----------------------|---------------------------------|
| 1.      | Welder   | 34                 | 4(all)      | 8(20)     | 2(8)                  | -                          | 2(6)                             | -                    | 6(4)                            |
| 2.      | Machinist (General)                            | 64                 | 4(all)      | 8(32)     | -                     | -                          | -                                | -                    | -                               |
| 3.      | Machinist (Special)                            | 138                | 4(all)      | 8(60)     | -                     | 2(20)                      | 2(20)                            | 2(10)                | -                               |
| 4.      | Millwright fitters                             | 55                 | 4(all)      | 8(40)     | -                     | -                          | 2(10)                            | 4(10)                | -                               |
| 5.      | Fitters (elec.)                                | 128                | 4(all)      | 2(50)     | 4(50)                 | -                          | -                                | 3(4)                 | 4(10)                           |
| 6.      | Fitters (mach.)                                | 268                | 4(all)      | 8(150)    | 4(100)                | -                          | -                                | 3(8)                 | 4(20)                           |
| 7.      | C & M  | 11                 | 4(all)      | 8(11)     | -                     | -                          | 2(4)                             | -                    | -                               |
| 8.      | Armature Winder                                | 137                | 4(all)      | -         | 4(60)                 | 8(20)                      | 2(8)                             | -                    | 4(10)                           |
| 9.      | Heat Treatment                                 | 38                 | 4(all)      | 8(20)     | -                     | 4(10)                      | 2(4)                             | 4(2)                 | -                               |
| 10.     | Chrome Platers                                 | 14                 | 4(all)      | 24(14)    | -                     | -                          | 2(4)                             | 4(2)                 | -                               |
| 11.     | Rubber Moulder                                 | 8                  | 4(all)      | -         | -                     | -                          | 4(4)                             | 4(4)                 | -                               |
| 12.     | P.C.C.   | 26                 | 4(all)      | 24(15)    | -                     | -                          | -                                | -                    | -                               |
| 13.     | Transport                                      | 30                 | 2(all)      | 4(30)     | -                     | -                          | -                                | -                    | -                               |
| 14.     | Painters                                       | 10                 | 2(all)      | 4(10)     | 2(4)                  | -                          | -                                | -                    | -                               |
| 15.     | Loco erectors (elec. & mech.)<br>Bogie fitters | 260                | 2(all)      | 4(60)     | 2(80)                 | -                          | -                                | 2(8)                 | 4(20)                           |

**Note:** Figures in brackets indicate no. of staff.

Source: IR and the mission  
September 1982

Table 12

INDIARAILWAY MODERNIZATION AND MAINTENANCE PROJECT IIEstimated Schedule of Disbursements

|         | <u>IBRD Fiscal Year<br/>and Quarter</u> | <u>Cumulative Disbursements<br/>At the End of Quarter<br/>(US\$ Million Equivalent)</u> | <u>%</u> |
|---------|---|---|----------|
| 1982-83 | March 31, 1983                          | 6   | 1        |
|         | June 30, 1983                           | 7   | 1        |
| 1983-84 | September 30, 1983                      | 10  | 2        |
|         | December 31, 1983                       | 21  | 5        |
|         | March 31, 1984                          | 32  | 8        |
|         | June 30, 1984                           | 44  | 11       |
| 1984-85 | September 30, 1984                      | 66  | 16       |
|         | December 31, 1984                       | 100   | 24       |
|         | March 31, 1985                          | 126   | 30       |
|         | June 30, 1985                           | 156   | 38       |
| 1985-86 | September 30, 1985                      | 201   | 48       |
|         | December 31, 1985                       | 226   | 54       |
|         | March 31, 1986                          | 266   | 64       |
|         | June 30, 1986                           | 301   | 73       |
| 1986-87 | September 30, 1986                      | 341   | 82       |
|         | December 31, 1986                       | 375   | 94       |
|         | March 31, 1987                          | 385   | 96       |
|         | June 30, 1987                           | 390   | 98       |
| 1987-88 | September 30, 1987                      | 400   | 100      |

Closing Date: September 30, 1987

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Source: IR and Mission Estimates  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Summary of the Economic Cost and Benefit Streams of the Project

| Years   | -----Cost Streams----- |                  |                            |                |                  | -----Benefit Streams----- |                  |                            |                  | Net Benefits<br>Total Project |
|---------|------------------------|------------------|----------------------------|----------------|------------------|---------------------------|------------------|----------------------------|------------------|-------------------------------|
|         | DCW                    | Unit<br>Exchange | High<br>Capacity<br>Wagons | Other<br>Items | Total<br>Project | DCW                       | Unit<br>Exchange | High<br>Capacity<br>Wagons | Total<br>Project |                               |
| 1982/83 | 71.1                   | 0                | 0                          | 0              | 71.1             | 0                         | 0                | 0                          | 0                | - 71.1                        |
| 1983/84 | 203.8                  | 1122             | 865                        | 250            | 2440.8           | 0                         | 100              | 0                          | 100              | -2340.8                       |
| 1984/85 | 527.1                  | 1122             | 865                        | 250            | 2764.1           | 149.1                     | 300              | 350                        | 799.1            | -1965.0                       |
| 1985/86 | 529.1                  | 1122             | 865                        | 250            | 2766.1           | 378.0                     | 746              | 700                        | 1824             | - 942.1                       |
| 1986/87 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1987/88 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1988/89 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1989/90 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1990/91 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1991/92 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1992/93 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1993/94 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 746              | 700                        | 1966             | 1704.9                        |
| 1994/95 | 261.1                  | (673)            | 0                          | 0              | (411.9)          | 520.0                     | 746              | 700                        | 1966             | 2377.9                        |
| 1995/96 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 0                | 700                        | 1220             | 958.9                         |
| 1996/97 | 261.1                  | 0                | 0                          | 0              | 261.1            | 520.0                     | 0                | 700                        | 1220             | 958.9                         |
| 2006/07 | 175.9                  | 0                | (260)                      | (75.0)         | (159.1)          | 520.0                     | 0                | 700                        | 1220             | 1379.1                        |

Economic Rates of Return

|  |       |
|--|-------|
| 1. For DCW -----   | 24.0% |
| 2. For maintenance elements for the unit exchange system ----- | 23.3% |
| 3. For high capacity wagons -----                              | 30.3% |
| 4. For the entire project -----                                | 22.8% |

NOTE: Details on the economic evaluation of each project element are provided in Annex E.

September 1982

Table 14

## INDIA

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR Revenue and Expenditure Accounts - 1976/77 to 1980/81  
(In Current Rupees Million)

|   | 1976/77 | 1977/78 | 1978/79 | 1979/80 | 1980/81 |
|---|---------|---------|---------|---------|---------|
|   | Actual  | Actual  | Actual  | Actual  | Actual  |
| <u>Revenues</u>                                       |         |         |         |         |         |
| Passenger   | 5 693   | 6,217   | 6 728   | 7,388   | 8,274   |
| Other Coaching  | 869     | 901     | 915     | 987     | 1,158   |
| Goods   | 13,259  | 13,484  | 13,054  | 14,404  | 16,175  |
| Sundries  | 540     | 632     | 813     | 599     | 633     |
| <u>Total Revenues</u>                                 | 20,361  | 21,234  | 21,510  | 23,378  | 26,240  |
| <u>Working Expenses 1/</u>                            |         |         |         |         |         |
| Administration  | 1,528   | 1 536   | -       | -       | -       |
| Repairs and Maintenance                               | 5,956   | 6,087   | -       | -       | -       |
| Operating Staff                                       | 3 126   | 3 163   | -       | -       | -       |
| Fuel  | 2,883   | 2,992   | -       | -       | -       |
| Operating Other than Staff and Fuel                   | 872     | 880     | -       | -       | -       |
| Miscellaneous Expenses                                | 587     | 497     | -       | -       | -       |
| Staff Welfare   | 538     | 551     | -       | -       | -       |
| General Superintendence and Services                  | -       | -       | 1,139   | 1,242   | 1,415   |
| Repairs and Maintenance of<br>Permanent Way and Works | -       | -       | 1 788   | 2 069   | 2 390   |
| Repairs and Maintenance of Motive Power               | -       | -       | 1,637   | 1,769   | 2,046   |
| Repairs and Maintenance of Carriage<br>and Wagons     | -       | -       | 2 014   | 2 221   | 2 590   |
| Repairs and Maintenance of Plant<br>and Equipment     | -       | -       | 966     | 1,111   | 1,311   |
| Operating Expenses Rolling Stock<br>and Equipment     | -       | -       | 2,092   | 2,194   | 2 469   |
| Operating Expenses Traffic                            | -       | -       | 2,233   | 2,475   | 2,833   |
| Operating Expenses Fuel                               | -       | -       | 3 090   | 3,741   | 4 917   |
| Staff Welfare and Amenities                           | -       | -       | 697     | 798     | 942     |
| Miscellaneous Expenses                                | -       | -       | 884     | 987     | 1,248   |
| <u>Total Working Expenses</u>                         | 15,490  | 15,706  | 16,540  | 18,607  | 22,162  |
| Appropriation to Depreciation Reserve Fund            | 1,350   | 1,400   | 1,450   | 2,000   | 2,200   |
| Appropriation to Pension Fund                         | 350     | 393     | 678     | 817     | 1,003   |
| <u>Total Operating Expenses</u>                       | 17,190  | 17,499  | 18 668  | 21,424  | 25,364  |
| <u>Net Revenue from Operations</u>                    | 3 171   | 3,735   | 2,842   | 1,954   | 875     |
| <u>Charges to Revenues of Capital Nature</u>          |         |         |         |         |         |
| Open Line Works                                       | 84      | 76      | 78      | 74      | 97      |
| Miscellaneous Transaction                             | 124     | 131     | 156     | 167     | 302     |
| <u>Net Revenues</u>                                   | 2 963   | 3,528   | 2,608   | 1,713   | 1,274   |
| <u>Dividend of Capital-at-Charge 2/</u>               | 2,091   | 2,266   | 2,241   | 2,375   | 3,253   |
| <u>Net Surplus (Deficit)</u>                          | 872     | 1,262   | 367     | (662)   | (1,978) |
| Operating Ratio                                       | 84.4%   | 82.4%   | 86.7%   | 91.6%   | 96.6%   |
| Ratio of Net Revenues to Capital-at-Charge            | 6.5%    | 7.4%    | 5.2%    | 4.1%    | 2.1%    |
| Freight Traffic (tons originating) -<br>million tons  | 239     | 237     | 223     | 217     | 220     |

1/ Accounts classification was changed in 1978/79 and expenses were booked by function, resulting in a refinement from previous classification.

2/ Rate of Dividend on Capital-at-Charge. On capital provided by Government 5.5% to March 31, 1964; and 6.0% after March 31, 1964



IR - Notes to Balance Sheet March 31, 19811. Fixed Assets

The value of fixed assets shown in the balance sheet is based on their original costs. Additional cost of like-for-like replacements over their cost (the inflationary element) is charged against DRF, and has not been included in the figures in the balance sheet. Improvement element at the time of replacement has been included in the Fixed Asset account in the balance sheet.

2. Depreciation Reserve Fund

This balance in the fund represents cumulative contributions including interest earned to date less:

- (a) value of assets withdrawn from services, and
- (b) full cost of replacement.

3. Inventories

These are financed from Capital-at-Charge.

4. Investment Financed From Railway Sources

These are the published figures representing amounts the Railways provided from their own sources over the years towards the capital investment program.

Development Fund

Development Fund is created out of IR's net revenue surpluses after meeting dividend liability to GOI. In the last few years, IR revenues have not been sufficient to clear dividend liabilities in full and temporary loans were drawn to meet the expenditure chargeable to Development Fund. As of March 31, 1981, IR has an outstanding loan of Rs 2,242 million under the Development Fund. Because of the acceptance by the Government of the recommendations of the Committee on IR's Finances, there is no outstanding loan under the Revenue Reserve Fund, but there is undischarged dividend liability of Rs 3,793 million which has not been taken into account in the balance sheet. The year-to-year position of the outstanding loan under the Development Fund is as under.

| <u>Year</u> | <u>Loan Drawn</u> | <u>Rs million</u> |  |
|-------------|-------------------|-------------------|--|
|             |                   | <u>Repayments</u> | <u>Net Cumulative Outstanding Loan</u> |
| 1967/68     | 112               | -                 | 112                                    |
| 1968/69     | 141               | -                 | 253                                    |
| 1969/70     | 181               | -                 | 434                                    |
| 1970/71     | 216               | -                 | 650                                    |
| 1971/72     | 216               | -                 | 866                                    |
| 1972/73     | 157               | 167*              | 856                                    |
| 1973/74     | 227               | -                 | 1,083                                  |
| 1974/75     | 219               | -                 | 1,302                                  |
| 1975/76     | 223               | -                 | 1,525                                  |
| 1976/77     | -                 | -                 | 1,525                                  |
| 1977/78     | -                 | -                 | 1,525                                  |
| 1978/79     | 54                | -                 | 1,579                                  |
| 1979/80     | 316               | -                 | 1,895                                  |
| 1980/81     | 347               | -                 | 2,242                                  |

\* Repaid by application of dividend relief.

5. Development Fund: Finances expenditure of a capital nature for:

- (a) Operating improvements costing over Rs 300,000 each.
- (b) Users' amenities irrespective of their cost.
- (c) Staff amenities costing more than Rs 25,000 each.

6. Items Financed from Revenue are:

- (a) Operating improvements costing up to Rs 300,000 each.
- (b) Staff amenities costing up to Rs 25,000 each.

7. Provident Fund and Staff Benefit Fund

The balances as of March 31, 1981, Rs 9,020 million, are not shown in the above balance sheet since these funds are held in special deposit accounts, specifically for paying benefits to employees. Contributions to the Fund are charged to operating expenses.

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR - Distribution of Key Revenue Expenditure Items as Percentage of Total Revenues

|                            | <u>1976/77</u> | <u>1977/78</u> | <u>1978/79</u> | <u>1979/80</u> | <u>1980/81</u> | <u>1981/82*</u> |
|----------------------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| (a) Total Working Expenses | 76.1           | 74.0           | 76.9           | 79.6           | 85.0           | 76.6            |
| Depreciation Reserve Fund  | 6.6            | 6.6            | 6.7            | 8.5            | 8.4            | 9.8             |
| Pension Fund               | 1.7            | 1.8            | 2.3            | 2.7            | 3.2            | 2.7             |
| Dividend Paid              | 10.3           | 10.7           | 10.4           | 7.3            | 4.9            | 10.5            |
| Net Surplus (Deficit)      | 4.3            | 5.9            | 1.7            | (2.8)          | (7.5)          | 1.5             |

Distribution of Key Cost Items as Percentage of Total Working Expenses

|                               |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|
| (b) Total Working Expenses    | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Staff                         | 54.2  | 55.2  | 55.1  | 54.6  | 53.0  | 53.0  |
| Fuel                          | 18.6  | 19.0  | 18.4  | 19.9  | 21.5  | 21.5  |
| Material, Supplies and Stores | 27.2  | 25.8  | 26.5  | 25.5  | 25.5  | 25.5  |

\* Provisional

Source: Mission Estimate  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Changes in Average Fare and Freight Rates in Relation to Prices of Major Inputs of IR's Costs

1970/71 to 1981/82

|  | <u>1970/71</u> | <u>1971/72</u> | <u>1972/73</u> | <u>1973/74</u> | <u>1974/75</u> | <u>1975/76</u> | <u>1976/77</u> | <u>1977/78</u> | <u>1978/79</u> | <u>1979/80</u> | <u>1980/81</u> | <u>1981/82 1/</u> |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------------|
| Average rate per passenger km                                | 100            | 102.0          | 102.8          | 108.4          | 130.8          | 138.4          | 138.8          | 140.8          | 139.6          | 146.8          | 158.8          | 173.6             |
| Average rate per ton km                                      | 100            | 103.3          | 105.7          | 108.5          | 131.9          | 149.5          | 163.2          | 159.1          | 162.1          | 177.5          | 193.4          | 254.0             |
| Average annual cost per employee                             | 100            | 105.7          | 109.2          | 118.7          | 152.3          | 178.9          | 185.9          | 190.1          | 201.2          | 223.3          | 248.2          | 270.3             |
| <u>Index Number of wholesale prices<br/>based on 1970/71</u> |                |                |                |                |                |                |                |                |                |                |                |                   |
| Coal   | 100            | 102.2          | 110.8          | 121.7          | 143.0          | 184.2          | 197.6          | 198.8          | 212.2          | 293.6          | 340.6          | 424.4             |
| High speed Diesel  | 100            | 104.9          | 105.9          | 119.5          | 194.3          | 206.4          | 213.9          | 214.1          | 216.7          | 243.8          | 279.6          | 385.9             |
| Electricity  | 100            | 102.5          | 105.7          | 111.3          | 137.2          | 158.1          | 171.6          | 182.5          | 209.1          | 225/6          | 239.7          | 277.0             |
| Iron, Steel and Ferrous alloys                               | 100            | 105.8          | 117.6          | 142.6          | 171.3          | 184.5          | 186.9          | 188.2          | 212.5          | 258/2          | 272.4          | 318.1             |
| Cement, Lime and Plaster                                     | 100            | 105.4          | 109.5          | 112.3          | 147.8          | 170.7          | 173.5          | 176.6          | 196.2          | 229.1          | 232.6          | 261.7             |
| Machinery and Transport equipment                            | 100            | 105.3          | 112.1          | 122.7          | 156.4          | 172.6          | 170.1          | 172.6          | 183.9          | 215.9          | 238.8          | 257.6             |
| Foodgrains   | 100            | 103.4          | 119.5          | 141.9          | 195.8          | 174.1          | 152.7          | 170.4          | 172.6          | 185/4          | 216.6          | 237.4             |
| All commodities  | 100            | 105.6          | 116.2          | 139.7          | 174.9          | 173.0          | 176.6          | 185.8          | 185.8          | 217/6          | 256.9          | 280.5             |
| Cost of living index number<br>(working class)               | 100            | 103.2          | 111.3          | 134.4          | 170.4          | 168.3          | 161.8          | 174.2          | 178.0          | 193.6          | 215.6          | 242.5             |

1/ Provisional.

Source: IR  
September 1982

INDIA  
RAILWAY MODERNIZATION AND MAINTENANCE PROJECT  
IR REVENUE AND EXPENDITURE 1981-82 TO 1986-87  
SCENARIO II

|                               | IR's 1981-1982<br>(Revised<br>Estimate) | (Figures in Current Rupees Million) |               |               |               |               |
|-------------------------------|---|-------------------------------------|---------------|---------------|---------------|---------------|
|                               |   | BANK GROUP FORECAST                 |               |               |               |               |
|                               |   | 1982-83                             | 1983-84       | 1984-85       | 1985-86       | 1986-87       |
| <u>REVENUES</u>               |   |                                     |               |               |               |               |
| Passengers                    | 9,840                                   | 11,942                              | 12,320        | 12,730        | 13,140        | 13,550        |
| Other Coaching                | 1,279                                   | 1,398                               | 1,440         | 1,440         | 1,520         | 1,560         |
| Goods                         | 23,448                                  | 26,904                              | 27,369        | 27,842        | 28,323        | 28,813        |
| Sundry                        | 851                                     | 876                                 | 910           | 940           | 970           | 1,000         |
| Total Revenues:               | <u>35,418</u>                           | <u>41,120</u>                       | <u>42,039</u> | <u>42,952</u> | <u>43,953</u> | <u>44,923</u> |
| <u>WORKING EXPENSES</u>       |   |                                     |               |               |               |               |
| Personnel                     | 14,388                                  | 15,953                              | 16,229        | 16,509        | 16,794        | 17,084        |
| Fuel                          | 5,836                                   | 6,472                               | 6,584         | 6,697         | 6,813         | 6,930         |
| Stores                        | <u>6,922</u>                            | <u>7,675</u>                        | <u>7,807</u>  | <u>7,943</u>  | <u>8,080</u>  | <u>8,220</u>  |
| Total Working Expenses:       | <u>27,146</u>                           | <u>30,100</u>                       | <u>30,620</u> | <u>31,149</u> | <u>31,687</u> | <u>32,234</u> |
| Appropriation to DRF          | 3,500                                   | 5,000                               | 5,000         | 5,300         | 6,500         | 6,800         |
| Appropriation to PF           | <u>985</u>                              | <u>1,480</u>                        | <u>1,750</u>  | <u>1,900</u>  | <u>2,150</u>  | <u>2,300</u>  |
| Total Operating Expenses:     | <u>31,631</u>                           | <u>36,580</u>                       | <u>37,370</u> | <u>38,349</u> | <u>40,337</u> | <u>41,334</u> |
| Net Operating Revenues        | 3,787                                   | 4,540                               | 4,669         | 4,603         | 3,616         | 3,589         |
| Net Miscellaneous Credits     | <u>433</u>                              | <u>400</u>                          | <u>450</u>    | <u>500</u>    | <u>205</u>    | <u>311</u>    |
| Net Revenue:                  | <u>4,220</u>                            | <u>4,940</u>                        | <u>5,119</u>  | <u>5,103</u>  | <u>3,821</u>  | <u>3,900</u>  |
| Dividend on Capital-at-Charge | 3,702                                   | 4,051                               | 4,290         | 4,430         | 4,660         | 5,010         |
| Net Surplus/(Deficit)         | 518                                     | 889                                 | 829           | 673           | (839)         | (1,110)       |

Note: Rate of Dividend on Capital-at-Charge: Or Capital provided by the Government 5.5% to March 31, 1964; and 6.0% after March 31, 1964.

Source: 1981-82 IR's Estimate; 1982-83 to 1986-87 Mission Estimate.

September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR and Revenue and Expenditure Forecasts - Assumptions

1981-82 to 1986-87

1. The FY82 figures represent IR's revised estimates. Subsequent years FY83 to FY87 are Bank Group estimates based on the higher freight rates as proposed in the Railway Budget for FY83 presented to Parliament on February 23, 1982, and on traffic levels forecasted (by the Bank Group) in paragraph 2.35 'Scenario II'. Correspondingly it is assumed that small improvements in operational efficiency as a result of the proposed project would be achieved and is reflected in the total working expenses. Further breakdown and assumptions used in forecasting revenues and expenditures are discussed in subsequent paragraphs.

2. The estimates, therefore, take a-count of the three major influences which have occurred since the appraisal of the First Modernization Project in 1978 that is over the past three years:

- (a) the revision of tariffs which resulted in increases in both freight rates and passenger fares during the period 1979-82, and the increase allowed from April 1, 1982;
- (b) increased costs of fuel and coal, repairs and maintenance and consumable stores; and
- (c) the wage awards and dearness allowances sanctioned by GOI, the latest being effective from April, 1982, and the productivity-linked-bonus allowed to the railway staff for the year 1979-80 onwards.

3. Revenue forecasts for 1982-83 onward reflect the increase in traffic anticipated during the period (para 2.35 Scenario II), but do not take into account any further adjustment in tariff and fare levels, though further upward adjustments are expected to take place in view of the recommendations of the Rail Tariff Enquiry Committee.

4. The total working expenses are based on the detailed analysis of the current costs, related to freight and passenger traffic forecasts. The ratios between the three main elements of the costs are as under:

|                        |       |
|------------------------|-------|
| Personnel              | 53.0% |
| Fuel                   | 21.5% |
| Other costs and stores | 25.5% |

5. Provision for Appropriation to Depreciation Reserve Fund for the years 1981-82 and 1982-83 are based on the interim recommendations of the Railway Convention Committee, and provisions for subsequent years are provisional as the final recommendations in this regard have yet to be given by the Railway Convention Committee.

6. Appropriation for Pension Fund are based on estimated expenditure on this account.

7. Total revenues are projected to increase by 26.9% during the period 1981-82 to 1986-87, increasing from Rs 35,418 million to Rs 44,923 million. Total working expenses are expected to increase from Rs 27,416 million in 1981-82 to Rs 32,234 million in 1986-87 which in percentage terms is about 18.7%. This points to high level of variable costs and the need to further adjust the freight rates and passenger fares. Total operating expenses are anticipated to increase from Rs 31,631 million in 1981-82 to Rs 41,334 million registering an increase of 30.7%. The higher rate of increase in expenditure is due to step up in appropriation for depreciation.

8. For the year 1981-82, average receipt per ton km of freight is anticipated to be paise 13.2 and average receipt per pass.km is anticipated to be paise 4.42.

9. The revenue and expenditure forecast is based on IR's preliminary estimate of investment plan for the period 1982-83 to 1986-87.

Source: IR and Mission Estimate  
September 1982

## INDIA

Table 19

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

IR Forecast Balance Sheet as of March 31, 1982-87

(Figures in Current Millions of Rupees)

|  | IR's Revised     | -----Bank Group Forecast----- |                |                |                |                |
|--|------------------|-------------------------------|----------------|----------------|----------------|----------------|
|  | Estimate<br>1982 | 1983                          | 1984           | 1985           | 1986           | 1987           |
| <b>Assets</b>  |                  |                               |                |                |                |                |
| Fixed Assets   | 76,987           | 83,145                        | 89,650         | 96,802         | 102,117        | 106,677        |
| Floating Assets  | 4,200            | 4,536                         | 4,854          | 5,145          | 5,402          | 5,618          |
|  | 81,187           | 87,681                        | 94,504         | 101,947        | 107,519        | 112,295        |
| Receivables  | 4,818            | 4,866                         | 4,916          | 4,967          | 5,025          | 5,087          |
| <b>Cash and Deposits with Government</b>                 |                  |                               |                |                |                |                |
| Cash   | 1,231            | 1,231                         | 1,231          | 1,231          | 1,231          | 1,231          |
| Deposits   | 5,454            | 6,019                         | 6,761          | 7,349          | 5,868          | 4,603          |
| <b>Total Assets</b>                                      | <b>92,690</b>    | <b>99,797</b>                 | <b>107,412</b> | <b>115,494</b> | <b>119,643</b> | <b>123,216</b> |
| <b>Capital and Reserve Fund</b>                          |                  |                               |                |                |                |                |
| Investment financed from<br>Government Capital-at-Charge | 66,400           | 72,780                        | 76,465         | 80,150         | 86,650         | 93,150         |
| Temporary Loan Government - DF                           | 2,242            | 2,242                         | 2,242          | 2,242          | 3,052          | 3,913          |
|  | 68,642           | 75,022                        | 78,707         | 82,392         | 89,702         | 97,063         |
| <b>Railway Sources</b>                                   |                  |                               |                |                |                |                |
| Depreciation Reserve Fund                                | 6,216            | 7,716                         | 7,716          | 8,016          | 10,216         | 10,216         |
| Development Fund   | 6,255            | 6,245                         | 6,375          | 6,475          | 7,175          | 7,175          |
| Open Line Works  | 2,632            | 2,642                         | 2,682          | 2,725          | 2,735          | 2,735          |
| Accident Compensation Fund                               | 398              | 398                           | 398            | 408            | 428            | 428            |
| Less Financed from Temporary<br>Loan from Government     | (2,242)          | (2,242)                       | (2,242)        | (2,242)        | (3,052)        | (3,913)        |
|  | 81,901           | 89,781                        | 93,636         | 97,774         | 107,204        | 113,704        |
| <b>Railway Funds</b>                                     |                  |                               |                |                |                |                |
| Depreciation Reserve Fund                                | 1,527            | 1,631                         | 1,766          | 1,931          | 52             | (1,700)        |
| Development Fund   | -                | -                             | -              | -              | -              | -              |
| Revenue Reserve Fund                                     | 4                | 4                             | 4              | 4              | 5              | 5              |
| Pension Fund   | 3,492            | 3,894                         | 4,440          | 4,825          | 5,275          | 5,825          |
| Accident Compensation Fund                               | 431              | 490                           | 551            | 589            | 536            | 473            |
|  | 5,454            | 6,019                         | 6,761          | 7,349          | 5,868          | 4,603          |
| <b>Current Liabilities</b>                               | <b>5,335</b>     | <b>3,997</b>                  | <b>7,015</b>   | <b>10,371</b>  | <b>6,571</b>   | <b>4,909</b>   |
| <b>Total Capital and Reserves</b>                        | <b>92,690</b>    | <b>99,797</b>                 | <b>107,412</b> | <b>115,494</b> | <b>119,643</b> | <b>123,216</b> |

Source: IR and Mission Estimates  
September 1982

Table 20

INDIA  
RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II  
IR Forecast Source and Application of Funds 1981-82 to 1986-87

(Figures in Current Millions of Rupees)

|  | -----Forecast----- |               |               |               |               | Total         |
|--|--------------------|---------------|---------------|---------------|---------------|---------------|
|  | 1982-83            | 1983-84       | 1984-85       | 1985-86       | 1986-87       |               |
| <u>Source of Funds</u>                                     |                    |               |               |               |               |               |
| Net Revenue  | 4,940              | 5,119         | 5,103         | 3,821         | 3,900         | 22,883        |
| Less Dividend on Capital-at-Charge                         | 4,051              | 4,290         | 4,430         | 4,660         | 5,010         | 22,441        |
| Surplus/Shortfall  | 889                | 829           | 673           | ( 839)        | (1,110)       | 442           |
| Contribution to DRF  | 5,000              | 5,000         | 5,300         | 6,500         | 6,800         | 28,600        |
| Capital Works Charged to Revenue                           | 110                | 150           | 193           | 200           | 200           | 853           |
| Increase in Pension Fund Excluding Interest                | 170                | 280           | 340           | 200           | 210           | 1,200         |
| Accident Compensation, Safety and Passenger Amenities Fund | 86                 | 87            | 87            | 80            | 74            | 414           |
| Interest on Fund Balances                                  | 388                | 387           | 512           | 248           | 305           | 1,840         |
| Railway Cash Generation                                    | 6,643              | 6,733         | 7,105         | 6,389         | 6,479         | 33,349        |
| Capital Funds Received from Government                     | 6,380              | 3,685         | 3,685         | 6,500         | 6,500         | 26,750        |
| Temporary Loans from Government - DF                       | -                  | -             | -             | 795           | 973           | 1,768         |
| <u>Total Sources of Funds</u>                              | <u>13,023</u>      | <u>10,418</u> | <u>10,790</u> | <u>13,684</u> | <u>13,952</u> | <u>61,867</u> |
| <u>Application of Funds</u>                                |                    |               |               |               |               |               |
| Capital Works Charged to Revenue                           | 110                | 150           | 193           | 200           | 200           | 853           |
| Replacement Work DRF                                       | 5,230              | 5,000         | 5,591         | 7,500         | 7,500         | 30,821        |
| Works Charged to DF  | 320                | 450           | 455           | 650           | 650           | 2,525         |
| Works Charged to RACF                                      | 170                | 170           | 144           | 150           | 150           | 784           |
| Additions Charged to Capital                               | 6,044              | 3,367         | 3,394         | 6,243         | 6,284         | 25,332        |
| <u>Total Capital Expenditure</u>                           | <u>11,874</u>      | <u>9,137</u>  | <u>9,777</u>  | <u>14,743</u> | <u>14,784</u> | <u>60,315</u> |
| Increase (Decrease) in Inventories                         | 336                | 318           | 291           | 257           | 216           | 1,418         |
| Repayment of Temporary Loans - RRF                         | -                  | -             | -             | -             | -             | -             |
| - DF   | 113                | 87            | -             | -             | -             | 200           |
| Interest on Temporary Loans - DRF                          | -                  | -             | -             | -             | -             | -             |
| - DF   | 134                | 134           | 134           | 165           | 217           | 784           |
| Increase (Decrease) in Fund Balance                        | 12,457             | 9,676         | 10,202        | 15,165        | 15,217        | 62,717        |
|  | 566                | 742           | 588           | (1,481)       | (1,265)       | ( 850)        |
| <u>Total Application of Funds</u>                          | <u>13,023</u>      | <u>10,418</u> | <u>10,790</u> | <u>13,684</u> | <u>13,952</u> | <u>61,867</u> |
| <u>Funds Flow</u>  |                    |               |               |               |               |               |
| Opening Balance  | 5,450              | 6,016         | 6,758         | 7,346         | 5,865         |               |
| Closing Balance  | 6,016              | 6,758         | 7,346         | 5,865         | 4,600         |               |
| Increase (Decrease) in Fund Balance - DRF                  | 104                | 135           | 165           | (1,879)       | (1,752)       |               |
| - Pension  | 403                | 546           | 385           | 450           | 550           |               |
| - DF   | -                  | -             | -             | 1             | -             |               |
| - RRF  | -                  | -             | -             | -             | -             |               |
| - ACSPPF   | 59                 | 61            | 38            | (53)          | (63)          |               |
| <u>Temporary Loan</u>                                      |                    |               |               |               |               |               |
| Temporary Loans Balances                                   |                    |               |               |               |               |               |
| Outstanding - RRF  | -                  | -             | -             | -             | -             |               |
| - DF   | 2,129              | 2,042         | 2,042         | 2,837         | 3,810         |               |
| <u>Dividend Liability</u>                                  |                    |               |               |               |               |               |
| Balance Outstanding Dividend                               |                    |               |               |               |               |               |
| Liability at Beginning of Year                             | 3,736              | 3,128         | 2,753         | 2,626         | 3,465         |               |
| Dividend due for the Year                                  | 4,051              | 4,290         | 4,430         | 4,660         | 5,010         |               |
| Less Dividend paid during the Year                         | 4,051              | 4,290         | 4,430         | 3,821         | 3,900         | 20,492        |
| Deferred Dividend paid during the Year                     | 608                | 375           | 127           | -             | -             |               |
| Balance Outstanding Dividend                               |                    |               |               |               |               |               |
| Liability at End of the Year                               | 3,128              | 2,753         | 2,626         | 3,465         | 4,575         |               |

Source: IR and Mission Estimates  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Selected Documents Available in the Project File 1/

Transport and Railways

1. Report of the National Transport Policy Committee, Planning Commission. GOI, May 1980
2. The Main Report of the Rail Tariff Enquiry Committee (Five Volumes). GOI, June 1980

Motive Power

3. Study of the Relative Economics of Diesel and Electric Traction on Indian Railways. IR, June 1978
4. Report of the Committee on Motive Power. IR, December 1978
5. Modernization Project for 1500V DC Banking Locomotive. IR, June 1979

Rolling Stock

6. Report of the Committee on Capacity Augmentation for Coach Production. IR, January 1979
7. Interim Report on Techno Economic Study of New Coach Building Factory. IR (ICF), October 1979
8. Project Report of Box "N" Wagon. IR, January 1981

Workshops and Maintenance

9. Master Plan Study for Workshops. Inception Report. RITES, April 1980

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1/ Additional documents pertaining to most components of this project are available in the Project File for Credit 844-IN and are listed in Annex A of Report No. 2020-IN (SAR dated July 24, 1980).

10. Master Plan Study for Workshops: Volume I, POH System; Volume II, MRUE and Related Systems; Volume III, Inventory of Facilities and Activities. RITES, November 1980

Remanufacturing

11. Detailed Project Report for a Diesel Loco Remanufacturing and Component Works (Three Volumes). RITES, May 1979. Supplementary Report. RITES, July 1979
12. Review of the Project Report for a Diesel Loco Remanufacturing and Component Works. IR, November 1980
13. Project Report for Diesel Component Works, Patiala. IR, January 1981. Supplementary Report. IR, April 1981

Management Information System

14. Real Time Computer System for Freight Operations Control and Passenger Reservations. IR, August 1979
15. Installing Operating Information and Telecommunication System on Indian Railways. Robert McAfee and John Albertson (Consultants), May 1980
16. Freight Operations Management System. IR, March 1982

Rail Tariff Enquiry Committee

17. Estimates of Financial Impact Arising from Implementation of RTEC Recommendations.
18. Schedule Showing Adjustment of Freight Effectuated Compared to Recommended Freight in RTEC Report.

INDIARAILWAY MODERNIZATION AND MAINTENANCE PROJECT IISummary Timetable for Preparation of Operating Information  
System and Related Telecommunications

During the negotiations, the need and implementation of an operating information system (OIS) and related telecommunication network was discussed. A schedule for preparation of a project to achieve the agreed upon objective has been prepared as shown below. GOI has confirmed that steps 1 through 3 will be accomplished by the dates indicated in the schedule. Steps 4 through 9 represented best estimates of these dates.

| <u>Tasks</u>  | <u>Target Completion Dates</u> |
|---|--------------------------------|
| 1. Completion of preliminary OIS and telecommunications feasibility studies by CANAC and TRANSMARK.                             | January 1983                   |
| 2. Select OIS Collaborator.   | April 1983                     |
| 3. Develop integrated OIS and Telecommunications Project Plan (i.e., implementation strategies, schedules, staffing and costs). | June 1983                      |
| 4. Develop CPU specifications.  | July 1983                      |
| 5. Identify reporting stations and make reporting volume estimates.   | September 1983                 |
| 6. Develop computer terminal specifications.  | September 1983                 |
| 7. Develop communications control centre equipment specifications.  | September 1983                 |
| 8. Complete microwave network specifications.   | December 1983                  |
| 9. Complete detailed OIS Study, including identification of and detailed plans for:   | December 1983                  |
| a. application program modifications;   |                                |
| b. system program modifications;  |                                |
| c. required changes to IR coding systems; and   |                                |
| d. detailed training and implementation schedules and staffing requirements.  |                                |

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September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

RAILWAY TRAFFIC FORECASTS

I. Macroeconomic Considerations

1.01 The growth of the country's economy during the Fourth Year Plan (1968/69-1973/74) was slower than predicted. Instead of the targetted 5.5%, GDP grew at a real rate of about 3.4% per annum. The end of the Plan period was marked by a number of adverse events, internal (the 1972/73 drought) as well as external (the Bangladesh conflict and the steep rise in world grain and petroleum prices of 1973). After a period of difficult adjustment, however, the GDP (at factor cost) grew at an annual average rate of 5.3% between 1975/76 and 1978/79. This performance was slightly below the Fifth Year Plan's target of 5.5% p.a., 1/ but it compares very favorably with a long-term trend of growth rate of GDP at 3.7% p.a. from 1950/51 to 1978/79.

1.02 1979/80 was a year of serious economic decline, underscored by a severe drought which produced a fall of about 16% in agricultural production, and by a deterioration of industrial production, which registered a decline of 1.4% after four years with an average rate of growth of about 7%. The decline in industrial production was largely due to shortfalls in the production of major inputs such as coal, steel and cement, as well as constraints in the provision of infrastructure, notably power and transportation. GDP declined by about 5%. As a consequence of these developments, the remarkable price stability that characterized the Indian economy after 1975 gave way to a sudden rise in the level of prices after 1979/80.

1.03 During 1980/81, the economy started to recover. Weather was normal, which allowed a recovery in agricultural production, which rose by more than 15%. Close attention to the performance of infrastructural services and the availability of basic goods improved their supply beginning in the middle of the year, resulting in a growth in industrial production by 4%; GDP rose by 7.5%.

1.04 During 1981/82, the economy largely completed the recovery phase, resulting in a year of solid growth on top of the rebound of 1980/81. Even though the 1981 monsoon withdrew early and foodgrain production was only 2%-3% higher than in 1980/81, production of other crops was better.

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1/ The Fifth Plan was originally envisaged to cover the period 1974/75-1979/80, but it was cut short by the defeat of the Congress party during the elections of 1978.

The total agricultural output grew by about 4%. Industrial output continued to recover from the supply problems which earlier had constrained the economy and grew by over 8%. GDP grew by around 5.5%. Inflation is clearly decelerating as wholesale prices rose by about 10% on average annual basis, compared to 17% in 1979/80, and 18% in 1980/81.

1.05 In the 1980's, the country's economy is shifting from a situation of resource surplus which characterized the last half of the 1970's, to one of resource scarcity. The economy is facing basic infrastructural and supply constraints whose relaxation requires substantial domestic investments and an unprecedented mobilization of foreign resources. In the current Sixth Five Year Plan (1980-85) the GOI gives high priority to expansion of irrigation and rural development and to investments in the energy sector. The share of investment in the transport sector dropped from 14% of the total in the Fifth Plan to 12.7% in the Sixth. The financing of this ambitious Plan relies heavily on raising the domestic savings rate from its already high level and in reducing a rapidly rising import bill while boosting the traditionally weak export sector. To attain these targets, India must avoid imports that can be produced economically at home, must accelerate exports, mobilize and then utilize aid at a faster rate than hitherto and borrow more on non-concessional terms.

1.06 The final size of the public sector outlay under the Plan has been fixed at Rs 975 billion (US\$108.3 billion equivalent) at 1979/80 prices but this figure could be raised during the mid-term Plan review). This is, in real terms, 80% higher than the outlay in the Fifth Year Plan. The mobilization of the large volume of domestic and foreign resources required to finance this plan will no doubt take some time to materialize. The Plan advocates an average annual growth rate in GDP of 5.3% between 1980/81 and 1984/85. The Bank Group's Economic Report <sup>1/</sup> projects a real growth rate of 6% in 1981/82, followed by a 5% per year for the period 1982/83 to 1984/85.

## II. Traffic Forecasts

### (a) Freight

2.01 Railways and road transport account for about 96% of India's freight traffic. Traffic carried by these modes increased from 50 to 269 billion ton-kms between 1950/51 and 1979/80, or by 5.4 times during this

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<sup>1/</sup> Economic Situation and Prospects of India, Report No. 3872-IN. April 7, 1982; Table 2.4. For brevity, this report will be referred to as WB's Economic Report in the rest of this Annex.

period. The change in the share of each of the two main transport modes in the total and the comparison of their growth with that of GDP at factor cost (at 1970/71 prices) is shown below:

| Year<br><u>/a</u> | Land Freight Traffic (Billion TKms) |                |                   |                |                    | GDP in<br>billion Rs<br><u>/g</u> | TKms per<br>Unit GDP (f-g)<br><u>/h</u> |
|-------------------|-------------------------------------|----------------|-------------------|----------------|--------------------|-----------------------------------|---|
|                   | Rail<br><u>/b</u>                   | %<br><u>/c</u> | Road<br><u>/d</u> | %<br><u>/e</u> | Total<br><u>/f</u> |                                   |   |
| 1950/51           | 44.1                                | 89             | 5.5               | 11             | 49.6               | 175.36                            | 0.28                                    |
| 1955/56           | 59.6                                | 87             | 8.9               | 13             | 68.5               | 208.70                            | 0.33                                    |
| 1960/61           | 87.7                                | 71             | 35.0              | 29             | 122.7              | 255.34                            | 0.48                                    |
| 1965/66           | 116.9                               | 68             | 55.0              | 32             | 171.9              | 290.23                            | 0.59                                    |
| 1970/71           | 127.4                               | 66             | 66.9              | 34             | 193.4              | 367.36                            | 0.53                                    |
| 1975/76           | 148.2                               | 67             | 73.0              | 33             | 221.3              | 426.33                            | 0.52                                    |
| 1976/77           | 156.8                               | 67             | 76.0              | 33             | 232.8              | 432.48                            | 0.54                                    |
| 1977/78           | 162.7                               | 68             | 77.0              | 32             | 239.7              | 469.73                            | 0.51                                    |
| 1978/79           | 154.8                               | 62             | 93.6              | 38             | 248.4              | 497.23                            | 0.50                                    |
| 1979/80           | 156.0                               | 61             | 101.0             | 39             | 257.0              | 469.48                            | 0.54                                    |
| 1980/81           | 158.5                               |                |                   |                |                    | 504.80                            |   |
| 1981/82           | 174.0                               |                |                   |                |                    | 533.26                            |   |

Sources: 1950/51-1977/78 traffic figures: Report of the National Transport Policy Committee, Planning Commission, May 1980. Table 2.2.  
1978/79-1979/80 traffic figures: Indian Railways and Planning Commission. GDP figures: WB's Economic Report, Table 2.1(b).

2.02 As has long been established, there is a close correlation between growth of ton-km and GDP for most countries. In the case of India, the ratio of ton-km to GDP shows considerable stability over time, particularly after 1965/66. This indicator of the link between economic development and the transport sector has been used as a criterion to establish a boundary to expected future growth in railway traffic. This criterion is used in this analysis as one of the guidelines in establishing expected rail traffic.

2.03 Given the uncertainty which traffic forecasts entail, and particularly bearing in mind the state of transition of the country's economy, three scenarios have been tested to obtain estimates for the Eighties. The first one assumes an economic rate of growth of 3.7% p.a., in line with the historical trend. The second scenario assumes an annual rate of growth of GDP of 4.5%, as expected in WB's Economic Report (see para 1.06 above), but extended to cover the period 1980/81 to 1990/91. The third alternative contemplates an annual growth of GDP in accordance with the Sixth Plan (5.2% p.a.), also used as an average for the entire decade. Basic assumptions used to establish an upper boundary in traffic volumes are that: (i) the share of rail traffic in the transport sector

would be around 60%, prevalent value for the last few years (energy conservation policy and latest improvements in operations support the assumption of no further decline of railway share); and (ii) the ratio of ton-km to GDP (at 1970/71 prices) would remain at 0.53, the average for the period 1965/66-1979/80. Given these assumptions, the forecast of total overland and railway traffic would vary as follows:

| Year    | Estimated GDP in billion 1970/71 Rs |        |        | Total Overland Transport (BTKMs) /a |       |       | %    | Rail Traffic Share BTKMs /a |     |       |
|---------|-------------------------------------|--------|--------|-------------------------------------|-------|-------|------|-----------------------------|-----|-------|
|         | S1                                  | S2     | S3     | S1                                  | S2    | S3    |      | S1                          | S2  | S3    |
| 1981/82 | 533.26                              | 533.26 | 533.26 | 282.6                               | 282.6 | 282.6 | 61.0 | 173                         | 173 | 173/b |
| 1982/83 | 553.0                               | 557.3  | 561.0  | 293.1                               | 295.4 | 297.3 | 61.0 | 179                         | 180 | 181   |
| 1983/84 | 573.5                               | 582.3  | 590.2  | 304.0                               | 308.6 | 312.8 | 61.0 | 185                         | 188 | 191   |
| 1984/85 | 594.7                               | 608.5  | 620.9  | 315.2                               | 322.5 | 329.7 | 61.0 | 192                         | 197 | 201   |
| 1990/91 | 739.5                               | 792.5  | 841.6  | 391.9                               | 420.0 | 445.7 | 61.0 | 239                         | 256 | 272   |

Notes: S1 = Scenario 1; S2 = Scenario 2; S3 = Scenario 3.

/a BTKms = Billion ton-kms. In this Annex the analysis has been focused on this parameter as the relevant unit of traffic rather than originating tons, or equivalent four-wheeler wagons or other similar units used by IR.

/b Provisional value given by IR for 1981/82.

2.04 Since 1965/66 until 1977/78, the railway share of traffic has been almost invariably around 67%. After that, (see Section H of Chapter II) IR has had several problems that severely affected its production with a consequent drop in its traffic share at the level of about 60%, but in the last two years the recovery has been significant. The NTPC report forecasted a possible share of railways in the order of 70%, but this figure seems to be optimistic. The assumed 61% seems to be realistic, possibly on the conservative side.

2.05 A more accurate forecast, of course, entails a detailed examination of growth estimates for the main commodity groups moved by the railways. As indicated by Table 4, in 1981/82 seven groups of commodities made up 80.4% of revenue tonnage and 75.0% of revenue ton-kms. These commodities are coal, steel inputs and products, foodgrains, POL, iron ore for export, cement and fertilizers. A detailed forecast per commodity group follows.

(i) Coal

2.06 Coal constitutes the main domestic source of commercial energy in India. The country's potential for hydroelectricity is estimated to be 100,000 MW of which 70,000 MW is economically exploitable. Only about 11,000 MW is currently developed. Production of coal kept pace with

planned targets and was well ahead of demand between 1973/74 and 1975/76. However, output increases could not be sustained after 1976/77 and coal production stagnated around 100 million tons for the next three years, falling behind the reduced demand for these years. During 1979/80 coal production increased by 2% to 104 million tons and in 1980/81 the total production was 114 million, a significant 10% annual growth. In 1981/82 the production is estimated to be about 124 million.

2.07 WB's Economic Report finds GOI coal demand estimates generally sound, although the assumed production targets, especially for steel and cement, appear optimistic. GOI's estimates indicate an average annual growth of demand of 10.1% for the period 1980/81-1985/86 and of 7.9% for the whole period 1980/81-1989/90. On the supply side, GOI's coal production targets assume a 12.5% average annual growth during the 1980/81-1984/85 period (from 112.71 to 179.19 million tons) and 9.7% between 1984/85-1989/90 (up to 260.45 million tons). These production targets are also deemed to be ambitious, particularly for the 1980/81-1984/85 period. IDA's Economic Report forecasts that for the coal sector as a whole, output in 1984/85 should be in the region of 160-165 million tons <sup>1/</sup> which represents an annual growth of 8.8% as compared with 1980/81 production. Accordingly, it has been conservatively assumed that coal availability would yearly grow by about 4.1%, 6.0% and 8.8% until 1984/85 and 7.5% thereafter during the period 1981/82 to 1990/91, and that the railway share would remain fairly constant, taking into consideration IR plans to increase the number of high capacity wagons (see para 3.29) (historical growth from 1970/71 to 1979/80).

2.08 Average haul distances are expected to increase during the Sixth Plan period due to the location of some new mines which are expected to come into operation in the next few years, and the location and tonnage of additional users, particularly the new cement and power plants in western India, several of which are expected to be operating by 1984/85. However, towards the end of the decade, the new high-power thermal stations are expected to be in operation. Since they will be located closer to the coal fields than previous ones, the average lead for coal will decrease. Future traffic has been estimated to range between 49.4 and 56.4 billion ton-kms in 1984/85 and between 62.9 and 87.0 billion ton-kms by the year 1990/91 (see Table 5).

(ii) Steel Plant Traffic

2.09 From 1970/71 to 1979/80 the average increase in output of both ingot and saleable steel was over 3% per annum. However, the variations

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<sup>1/</sup> See para.5.90 of WB's Economic Report.

in production throughout the decade were erratic with a very low increase between 1970/71 and 1974/75 (1.1% for ingot and 2.1% for saleable steel) followed by an upsurge in 1974/75-1976/77 of 16.0% and 19.2% annual rates of growth for ingot and saleable steel, respectively, which gave way to a decline of 5.1% p.a. for ingot and 13.5% p.a. for saleable steel between 1977/78 and 1979/80. Production tonnages of pig iron, ingot and saleable steel stood at 1.1 million, 8.0 million and 6.0 million, respectively, during 1979/80. Current indications are that overall output for 1980/81 remained at about the 1979/80 level but a significant annual growth of about 14% is expected for 1981/82. Consumption of finished steel during the seventies grew faster than production, at a rate of about 5.5% p.a., the deficit being compensated by curtailing exports (India has been a net exporter on and off for a number of years) and stepping up imports.

2.10 Total ingot steel capacity in integrated plants (the public sector accounts for about 82% of large plant capacity in India) is expected to be raised from 11.4 million tons in 1979/80 to 14.6 million tons in 1984/85 and 22.6 million tons in 1989/90. The growth during the Sixth Plan period would be from expansion, modernization and rehabilitation of existing plants, while growth in the second half of the decade would stem mostly from the addition of two new plants of 3.5 million tons and 3.0 million tons at Vishakapatnam and Paradip, respectively. WB's Economic Report (paras 3.39-3.40), however, considers these production targets difficult to achieve in view of the constraints of power shortages and decline in the quality of coking coal in India, combined with a number of technical difficulties relating to the quality of raw materials and the choice of production processes, all of which affect productivity. As a result, it is likely that net imports of steel will be required through the end of the Eighties.

2.11 The transport requirements for steel plants comprise raw materials and finished products. Coal used for steel production process has already been analyzed in paras 2.06-2.08 of this Annex. Iron ore for steel production is included in the present analysis, while iron ore for export is discussed in para 2.18 below. The average haul for raw materials has remained fairly constant, while that for finished products has increased gradually in the last two decades. Until the new plants begin operations towards the end of the eighties, however, no major variations are expected in average haul. The transportation requirement of the import/export trade of finished steel has also been taken into account; assuming, however, that a major portion of the imported steel would be destined for the urban centers and industrial areas around the main ports (Bombay, Calcutta and Madras), which would be transported by road. Further, it has been assumed that modal shares for steel plants would remain fairly stable. Based on these assumptions, the traffic estimates for 1984/85 range between 16.5 and 17.5 billion ton-kms, and for 1990/91 between 18.5 and 20.5 billion ton-kms, respectively.

(iii) Foodgrains

2.12 Agriculture is the mainstay of India's economy, employing over two-thirds of the labor force. Foodgrains, in turn, dominate the country's agriculture. The supply/demand balance of foodgrains in recent years suggests a reduced and possibly eliminated need to import large quantities of foodgrains, and if present trends continue, India could become a significant foodgrain exporter. These developments have already had a profound effect on the country's transport sector, mainly by lengthening the average haul distances.

2.13 Production of foodgrains between 1967/68, a year of high yields, and 1977/78, an unusually good year, grew at 2.37% per year. A longer term trend (1960/61-1978/79) indicates an annual growth of 2.74%. The Sixth Plan targets imply a substantial acceleration of the growth rate to about 3.8% per annum. Assuming that the export/import element in the foodgrain global picture continues shrinking gradually, average haul distances are expected to continue growing faster than total tonnages due to a combination of long hauls from the production centers in the North to all deficit areas including the South, and to a larger proportion of short to medium loads being captured by road transport. If, as it is also assumed here, the policy of self-sufficiency for the various regions continues to meet with success, a reversing trend would occur towards the second half of the decade--average travel distances would tend to decrease due to self-sufficiency at regional and national levels, while export of foodgrains in significant volumes of diversification of agricultural production, or both, may take place. As a consequence, total traffic volumes are expected to stagnate. Accordingly, assuming a growth in foodgrain production ranging from 2.5% to 3.0% p.a., traffic projections (assuming a decrease in railway share of about 0.5 percentage points per year) lead to estimated traffic volumes varying from 29.8 to 30.2 billion ton-kms in 1984/85 and from 33.5 to 35.1 billion ton-kms in 1990/91.

(iv) Petroleum Products (POL)

2.14 Demand for petroleum products rose quite rapidly in India (8.9% p.a.) between 1950 and 1973, the time of the oil price hike. A substantial increase in the real domestic price of POL after 1973 has moderated the growth in demand to an average annual rate of 5.1%, between 1973/74 and 1979/80. In 1980/81, consumption was constrained by the labor petroleum in Assam, which resulted in a loss of production of about 3.5 million tons of crude. During 1981/82 demand grew by about 7%. Estimating future demand, however, is uncertain because, as individuals and firms adjust their habits of POL consumption, historical relationships no longer apply. On the other hand, it is difficult to sharply reduce demand in the near future because most POL products are used as intermediate products.

World Bank estimates a growth of about 7.6% p.a. between 1979/80 and 1984/85.

2.15 The transport picture is also going to be affected by the structure and regional pattern of production and supply and by the availability of alternative transport modes. India is largely unexplored regarding hydrocarbons. The exploration activity undertaken during the Seventies, however, paid off in the discovery of one giant oil and gas offshore field (Bombay High) and several smaller commercial fields, both offshore and onshore. The number of good prospective areas exceeds the number that the state-owned organizations can reasonably explore during the next five years; therefore, the Government has recently decided to open selective prospective areas to foreign exploration firms under production-sharing contracts. These arrangements will considerably accelerate exploration of hydrocarbons, although exploitation of any commercial reserves is not likely to happen until the second half of the eighties at the earliest.

2.16 Crude production in 1981/82 was about 16.4 million tons which represents a little less than one-half of Indian POL demand. India's refining capacity, on the other hand, was of 31.8 million tons of through-put capacity (mttc) in 1980. This is enough to process about 29 million tons of crude into 27 million tons of petroleum at 90% capacity utilization and 93% outturn of products from crude. There is a new refinery under construction at Mathura, which should be operating in 1981, adding 6 mttc. Moreover, the Government plans to meet the growing demand both by expanding existing refineries and by building new ones. The new refineries would be located at Mangalore (6 mttc) and Karnal (3 mttc). Altogether, India is expected to have 13 mttc more than at present by 1984/85.

2.17 Concerning transport facilities, in addition to road transport and existing pipelines, a new pipeline is expected to be commissioned in the near future, from Bombay High to Mathura, and more pipelines are planned to be built during the sixties. The share of POL by rail will thus be reduced, and fairly moderate increases in transport volumes are estimated, except in the third alternative, where, in addition to an annual rate of growth of demand of about 7.6% p.a., a smaller reduction in the share of the railways is assumed. Traffic forecasts range between 11.5 and 12.6 billion ton-kms in 1984/85 and between 12.4 and 19.4 billion ton-kms by 1990/91.

(v) Iron Ore for Export

2.18 Despite occasional surges in export volumes in a few years in response to world market conditions, iron ore has presented a stable pattern of traffic with relatively minor fluctuations from one year to the next. After experiencing a world-wide slump in demand of iron ore, the

market is beginning to recover. On the supply side, a switch of production has been completed from lumps to fines to better suit the world market. Accordingly, a moderate traffic increase has been estimated, ranging from 7.5 to 7.6 billion ton-kms in 1984/85 and from 7.7 to 7.9 billion ton-kms in 1990/91.

(vi) Cement

2.19 During the past 20 years, India has suffered an almost chronic shortage of cement. As a result, cement is rationed administratively. The annual rate of growth of installed capacity averaged about 8.9% during 1950/51-1971/72 and declined to about 2.1% between 1971/72-1978/79 due to restrictive Government pricing and licensing policies. Production growth, meanwhile, averaged about 3.7% per year as a result of increases in capacity utilization between 1971/72 and 1977/78. Thenceforth, capacity utilization declined, however, from 88% in 1977/78 to less than 75% in 1979/80 and 1980/81. The most critical constraints on the operation of cement plants were coal and power shortages. In 1981/82 the total production was 21.5 million tons an increase of 15% over the previous year.

2.20 India is planning a major expansion of its cement industry from 32.7 million tons of installed capacity in 1981/82 to about 42.5 million tons in 1984/85. About 80% of the additional capacity will be in new production units and the remaining 20% will result from expansion of existing plants. If the investment targets are met, the planned expansion would roughly meet the projected demand for cement in the next four years, although shortages are likely to continue for some time.

2.21 These shortages, combined with the necessity to supplement the domestic production through imports, the concentration of consumption in the country's northern region, and an increasingly rapid erosion of traffic in the shorter distances, are expected to continue aiding to the average haul of cement by the railways. Of the three alternatives tested, the first two (with growth/rates of 3.0% p.a. and 4.0% p.a.) straddle the average growth in production of cement during the 1971/72-1977/78 period. The third alternative assumes a jump in production of 7% p.a. between 1980/81-1984/85, followed by 5.5% p.a. through the end of the decade. Assuming a decrease in railway share of tonnages of about 3% per year, the total traffic moved by the railways is expected to range from 8.8 billion ton-kms to 9.9 billion ton-kms in 1984/85 and from 10.5 to 13.7 billion ton-kms in 1990/91.

(vii) Fertilizer

2.22 The consumption of nitrogenous fertilizers in India increased at an average annual rate of 22% in the decade 1962-72. In the next three

years, consumption declined. However, as a result of improved agricultural conditions and a reduction in the price of nitrogen, consumption picked up again, resulting in a growth of about 15% p.a. between 1975 and 1980. Phosphatic and potassic fertilizers followed a consumption pattern similar to nitrogenous fertilizers, but did not begin to recover until 1976/77. By 1981/82, India's total fertilizer consumption was 5.9 million nutrient tons, of which 67% was nitrogen, 22% phosphates and 11% potash.

2.23 India produces nitrogenous and phosphatic fertilizers. Installed capacity has grown from 0.15 million nutrient tons per year in 1952 to about 6.8 million in 1981/82. The utilization of available capacity has been relatively low, however. Although it showed substantial improvements between 1974/75 and 1978/79, it has declined sharply in 1979/80 and 1980/81, largely as the result of shortages of power, fuel oil and naphtha, coupled with equipment and operating problems, particularly in several of the older public sector plants. In 1981/82 the utilization improved but the level is still low about 60% of installed capacity. In 1981/82, India produced 3.1 million tons of nitrogenous fertilizers and 0.9 million tons of phosphatic fertilizers.

2.24 The high rates of growth in consumption of fertilizers of recent years are not sustainable in the long run. Consumption in 1980/81 increased at a more moderate rate of about 6% as a result of price increases. The installed capacity is expected to increase from 6.9 million tons in 1981/82 to 8.5 million tons in 1984/85. Additionally, the Government is placing considerable emphasis on measures to increase capacity utilization of existing plants. Even after taking into consideration the large projects underway at Thal and Hazira and those firmly planned, fertilizer consumption is expected to exceed domestic output significantly. To estimate future transport demand, fertilizer consumption has been estimated to grow at annual rates of 8.5%, 10.1% and 12.5% in line with the analysis provided in connection with the Hazira Fertilizer Project. 1/

2.25 Bearing in mind the location of existing and projected plants, and assuming that the railways' share would continue decreasing by about 3% annually as the main inter-regional flows are concentrated along the principal railway corridors, while road transport handles intra-regional distribution flows, in line with the modal-point transport strategy being developed by GOI/IR, 2/ railway traffic volumes are projected to reach

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1/ Staff Appraisal Report, March 6, 1981. Para.4.08.

2/ Under the Fertilizer Industry Credit, financed partly by IDA, Rail India Technical and Economic Services Ltd. has carried out a study to optimize rail fertilizer movements.

between 10.7 and 11.3 billion ton-kms in 1984/85 and from 12.5 to 16.0 billion ton-kms by 1990/91.

(viii) Other Commodities

2.26 In line with a historical pattern of concentration of railway traffic in the main seven commodities discussed above, the remaining traffic is estimated to continue decreasing in tonnage. As road transport continues capturing the shorter distance traffic in these other commodities, however, the average haul will increase, leading to a stagnation or even a small decrease in ton-kms from 41.1 billion in 1980/81 to a range between 38.0 and 38.3 billion in 1984/85 and their growth between 39.6 and 43.4 billion by 1990/91.

(b) Passengers

(1) Suburban

2.27 The following table summarizes the growth in population and in suburban railway passenger traffic for the three largest urban centers in India. 1/

| Year          | Population<br>(Million) |      |      |       | Passengers<br>(Billion) |      |      |      | Pass-Km<br>(Billion) |       |      |       |
|---------------|-------------------------|------|------|-------|-------------------------|------|------|------|----------------------|-------|------|-------|
|               | B                       | C    | M    | T     | B                       | C    | M    | T    | B                    | C     | M    | T     |
| 1951/<br>1952 | 3.11                    | 3.30 | 1.82 | 8.23  | 0.28                    | 0.09 | 0.04 | 0.41 | 3.96                 | 2.42  | 0.45 | 6.83  |
| 1960/<br>1961 | 4.15                    | 4.83 | 2.32 | 11.30 | 0.42                    | 0.20 | 0.06 | 0.68 | 6.36                 | 4.61  | 0.80 | 11.77 |
| 1970/<br>1971 | 5.97                    | 7.03 | 3.17 | 16.17 | 0.85                    | 0.27 | 0.10 | 1.22 | 15.12                | 6.44  | 1.42 | 22.98 |
| 1977/<br>1978 | 7.87                    | 8.19 | 3.92 | 19.98 | 1.32                    | 0.45 | 0.16 | 1.93 | 25.77                | 11.29 | 2.37 | 39.43 |

Note: B = Bombay; C = Calcutta; M = Madras; and T = Total.

Source: Rail Tariff Enquiry Committee, Ministry of Railways. April, 1980. Main Report, Volume IV. Statement (Appendix) 6.1.

1/ These statistics, regarding passenger traffic, must be viewed with some caution since ticketless passengers are not included and their proportion varies from one city to another and through time, as law and order deteriorated, particularly in Calcutta.

2.28 As shown above, while the population of Bombay, Calcutta and Madras grew by 3.5% annually between 1951/52 and 1977/78, the total suburban traffic moved by the railways in the three cities increased by 6.1% per year in terms of number of passengers and by 7.0% annually in terms of passenger-kms. When analyzed decade by decade, the traffic in passengers and passenger-kms grew by 5.8% p.a. and by 6.2% p.a. in the fifties, by 6.0% p.a and 6.9% p.a. in the Sixties and by 3.1% p.a. and 8.0% p.a. between 1970/71 and 1977/78. In 1979/80 the traffic decreased by 10% (passengers) and 11% (passenger-kms) in the face of fare increases, which took place in July 1980. The fare increases included a raise of 5% on passenger traffic up to 100 kms and of 15% on quarterly and monthly season tickets. Preliminary estimates for 1980/81 indicate a recovery of traffic growth of about 5% in number of passengers and of 4.8% in passenger-kms (see Table 3 for total traffic statistics after 1977/78).

2.29 As a result of the spread of urban centers, average lead for the three cities has increased from 17.3 kms in 1960/61 to 17.8 kms in 1970/71 and then to 20.4 kms in 1977/78. A careful study of the various parameters having a bearing on suburban passenger traffic (urban population, service sectors, land use pattern, per capita income and prices for railway services) was carried out by the Rail Traffic Enquiry Committee and they concluded--based principally on urban population growth--with a projected rate of growth of about 5.8% annually between 1977/78 and 1999/2000, which would increase to around 6.7% annually if the population increase in the three cities continues growing at the average rate of the Seventies. Assuming a gradual increase in average lead from 20.4 kms in 1977/78 to 25.1 kms in 1999/2000, the study concludes that the growth in traffic demand in terms of pass-kms would range from 6.8% annually to 7.9% annually throughout this period.

2.30 A closer look at the price elasticity of suburban passenger travel, based on the 1980 experience, suggests that the high growth in demand could be dampened, by implementing a gradual increase in fares. Alternatively, it would be necessary to limit the available capacity on the main suburban corridors, to avoid excessively large investments. Assuming either of the two solutions, growth in suburban passenger traffic has been estimated at about 4.5% per year in terms of passengers or 5.1% per year in terms of passenger-kms, during the period 1980/81-1990/91. This would generate a total number of around 2,380 million passengers in 1984/85 and 3,100 million passengers in 1990/91 and of 49.5 billion pass-kms in 1984/85 and 66.8 billion pass-kms in 1990/91.

(ii) Inter-urban

2.31 Inter-urban passenger traffic has grown at an average of about 2.0% per year (in terms of number of passengers) and at 3.3% per year (in

passenger-kms) during the last three decades. The rate, however, has increased gradually, decade after decade. Thus, in the Fifties total number of passengers and passenger-kms increased by 0.5% p.a. and 1.0% p.a., respectively; in the sixties they went up by 2.8% p.a. and 3.7% p.a.; and in the seventies by 2.5% p.a. and 5.3% p.a., respectively. Hence, only the growth in the total number of passengers decreased somewhat from the sixties (2.8% p.a.) to the Seventies (2.5% p.a.). This increasing trend reflects mainly the increase in the country's population throughout the period (the population roughly doubled from about 360 million to some 644 million in these 30 years), the increased economic activity of the various regions and of the country in general (growth in GNP) and the ratio of increases in income per capita to increases in passenger fares. Of all these variables, the Rail Tariff Enquiry Committee (RTEC) found the best correlation in the case of population and the service sector.

2.32 Using the population projections for India presented in Table A.9 of previous WB Economic Report, which assume a net reproduction rate of one in the year 2000, and using the growth rate relationships established by the RTEC (Appendix 6.7 to Volume IV), the following estimates of population and inter-urban traffic levels are obtained:

Inter-Urban Passenger Traffic Volumes

| Year    | Population<br>(millions) | Million Passengers |        |        | Billion Pass-Kms |      |      |
|---------|--------------------------|--------------------|--------|--------|------------------|------|------|
|         |                          | S1                 | S2     | S3     | S1               | S2   | S3   |
| 1980/81 | 672                      | 1,550*             | 1,550* | 1,550* | 159*             | 159* | 159* |
| 1984/85 | 739                      | 1,720              | 1,833  | 1,946  | 187              | 202  | 224  |
| 1990/91 | 803                      | 1,884              | 2,124  | 2,377  | 215              | 249  | 303  |

S1 = Scenario 1; assumes a growth rate relationship based on 1950/51 to 1977/78 long term trends.

S2 = Scenario 2; assumes a growth rate relationship based on 1970/71 to 1977/78 trends.

S3 = Scenario 3; assumes a growth rate relationship based on actual increase in the relation between 1960/61-1970/71 and 1970/71-1977/78.

\* Provisional figures.

2.33 The figures in the preceding table represent an annual rate of growth which ranges from 2.6% to 5.9% for total number of passengers and from 4.2% to 8.9% for passenger kilometers between 1980/81 and 1984/85. For the entire decade (1980/81-1990/91) these annual rates would vary from

2.0% to 4.4% for passengers and from 3.1% to 6.6% for passenger kilometers.

### III. Summary and Conclusions

3.01 Different studies carried out in India in recent years have arrived at various railway traffic forecasts. As shown in Table B-1, concerning freight, the 1984/85 World Bank estimates are lower than previous ones, although not significantly lower than IR's own estimates. The railway traffic forecast based on macroeconomic considerations (paras. 2.01 to 2.04) is somewhat higher, but as indicated before, the results of applying that methodology are not so accurate. In any case they represent a small increase in the order of 1-3%.

3.02 Comparing with the upper boundaries suggested by expected GDP growth (see table in para. 2.03 of this Annex C), the Bank's estimates vary within reasonable limits. The resulting annual rates of growth in terms of ton-kms range from 2.3 for the low, to 3.1 for the medium and to 4.4 for the high alternative, between 1981/82 and 1984/85. Between 1981/82 and 1990/91, the corresponding annual rates of growth are 2.2%, 3.3% and 4.4%.

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Comparative Projections of Rail Freight Traffic

(Billion Revenue Metric Ton Kilometers)

| <u>Reports Prepared For</u>            | <u>1982/83</u>        | <u>1984/85</u>        | <u>1987/88</u> | <u>1990/91</u> <sup>3/</sup> | <u>1992/93</u> | <u>1999/2000</u>      |
|--|-----------------------|-----------------------|----------------|------------------------------|----------------|-----------------------|
| 1. Energy Policy Working Group         | 200                   | 215 <sup>1/</sup>     | 240            | -                            | 300            | 410                   |
| 2. National Transport Policy Committee | 206-222               | 226-243 <sup>1/</sup> | 260-279        | -                            | 320-344        | 435-468               |
| 3. Railway Corporate Plan              | 205-210 <sup>2/</sup> | 211-216 <sup>1/</sup> | 235-240        | -                            | -              | -                     |
| 4. Operating Research Group            | -                     | -                     | -              | -                            | -              | 368-903 <sup>3/</sup> |
| 5. Rail Tariff Enquiry Committee       | 195                   | 214 <sup>1/</sup>     | 247            | -                            | 295            | 406                   |
| 6. Sixth Five Year Plan                | -                     | 220                   | -              | -                            | -              | -                     |
| 7. Indian Railways                     | -                     | 203                   | -              | 258                          | -              | 380                   |
| 8. World Bank: Scenario I              | -                     | 175                   | -              | 200                          | -              | -                     |
| Scenario II                            | -                     | 179                   | -              | 220                          | -              | -                     |
| Scenario III                           | -                     | 186                   | -              | 246                          | -              | -                     |

Source: Figures from the report numbers one to five above were taken from the Rail Tariff Enquiry Committee, Main Report, Volume IV, Statement (Appendix) 6.16; April 1980. All these sources based their analyses on traffic data before 1978/79. Reports six and seven based their forecasts on more recent information.

Notes: <sup>1/</sup> These figures have been interpolated to facilitate the comparison.

<sup>2/</sup> Relates to 1989/90.

<sup>3/</sup> The ORG prepared two alternatives, each consisting of four scenarios. The figures in the table indicate the maximum spread.

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Cost Estimates and Principal Items  
Included in the Project and Credit

Principal items included in the project and credit and their estimated costs are summarized in Table D-1 to this Annex. For details of all cost estimates, types and number of machinery and plant, material and components, see reports in project files as listed in Annex A. Additional cost details for DCW are provided in Tables 7 and 8.

## INDIA

## RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

## Summary of Project Cost Estimates

|   | -----Rs Million----- |                |                 | -----US\$ Million----- |              |                | Proposed<br>Credit |
|---|----------------------|----------------|-----------------|------------------------|--------------|----------------|--------------------|
|   | Local 1/             | Foreign        | Total           | Local                  | Foreign      | Total          |                    |
| <b>Maintenance Improvements</b>                               |                      |                |                 |                        |              |                |                    |
| <b>I. Diesel Component Works</b>                              |                      |                |                 |                        |              |                |                    |
| (a) Component Overhaul Shops                                  | 50.4                 | 76.5           | 126.9           | 5.6                    | 8.5          | 14.1           | 8.5                |
| (b) Component Manufacturing Shops                             | 66.8                 | 151.5          | 218.3           | 7.4                    | 16.8         | 24.2           | 16.8               |
| (c) Locomotive Remanufacturing Shops                          | 35.1                 | 45.0           | 80.1            | 3.9                    | 5.0          | 8.9            | 5.0                |
| (d) Service Shops   | 19.6                 | 32.4           | 52.0            | 2.2                    | 3.6          | 5.8            | 3.6                |
| (e) Construction and Start-up                                 | 211.5                | 4.0            | 215.5           | 23.5                   | 0.4          | 23.9           | 0.4                |
| (f) Working Capital   | 82.5                 | 82.3           | 164.8           | 9.1                    | 9.1          | 18.2           | 9.1                |
| (g) Technical Assistance and<br>Training                      | 4.2                  | 8.4            | 12.6            | 0.5                    | 0.9          | 1.4            | 1.0                |
| (h) Contingencies   |                      |                |                 |                        |              |                |                    |
| Physical  | 34.0                 | 25.0           | 59.0            | 3.8                    | 2.8          | 6.6            | 2.8                |
| Price   | 75.5                 | 80.7           | 156.2           | 8.4                    | 9.0          | 17.4           | 9.0                |
| Subtotal I  | 579.6                | 505.8          | 1,085.4         | 64.4                   | 56.1         | 120.5          | 56.2               |
| <b>II. Unit Exchange Components</b>                           |                      |                |                 |                        |              |                |                    |
| (a) Locomotive Components                                     | 1,417.5              | 632.7          | 2,050.2         | 157.5                  | 70.3         | 227.8          | 70.3               |
| (b) Wheels and Axles  | 562.5                | 1,340.1        | 1,902.6         | 62.5                   | 148.9        | 211.4          | 47.7               |
| (c) Price Contingencies                                       | 270.0                | 337.5          | 607.5           | 30.0                   | 37.5         | 67.5           | 20.5               |
| Subtotal II   | 2,250.0              | 2,310.3        | 4,560.3         | 250.0                  | 256.7        | 506.7          | 138.5              |
| <b>III. AC Locomotive Testing</b>                             |                      |                |                 |                        |              |                |                    |
| Subtotal III  | 202.5                | 405.0          | 607.5           | 22.5                   | 45.0         | 67.5           | 45.0               |
| <b>IV. High Capacity Wagons</b>                               |                      |                |                 |                        |              |                |                    |
| (a) Material and Components                                   | 940.4                | 1,122.3        | 2,062.7         | 104.5                  | 124.7        | 229.2          | 124.7              |
| (b) Fabrication   | 1,888.8              | -              | 1,888.8         | 209.9                  | -            | 209.9          | -                  |
| (c) Price Contingencies                                       | 385.8                | 182.7          | 568.5           | 42.8                   | 20.3         | 63.1           | 20.3               |
| Subtotal  | 3,215.0              | 1,305.0        | 4,520.0         | 357.2                  | 145.0        | 502.2          | 145.0              |
| <b>V. Technical Assistance<br/>and Training</b>               |                      |                |                 |                        |              |                |                    |
| (a) Bogie Testing   | 12.6                 | 18.0           | 30.6            | 1.4                    | 2.0          | 3.4            | 2.4                |
| (b) Fuel Conservation and Train<br>and Operation Improvements | 54.0                 | 56.7           | 110.7           | 6.0                    | 6.3          | 12.3           | 9.9                |
| Subtotal V  | 66.6                 | 74.7           | 141.3           | 7.4                    | 8.3          | 15.7           | 12.3               |
| <b>Total Project Cost</b>                                     | <b>6,313.7</b>       | <b>4,600.8</b> | <b>10,914.5</b> | <b>701.5</b>           | <b>511.2</b> | <b>1,212.7</b> | <b>397.0</b>       |
| Front-end Fee on Bank Loan                                    | -                    | 27.0           | 27.0            | -                      | 3.0          | 3.0            | 3.0                |
| <b>GRAND TOTAL</b>  | <b>6,313.7</b>       | <b>4,627.8</b> | <b>10,941.5</b> | <b>701.5</b>           | <b>514.2</b> | <b>1,215.7</b> | <b>400.0</b>       |

1/ Taxes and Duties of about Rs 1,800 million (US\$200 million) are included in local costs.

Source: IR and Mission Estimates  
September 1982

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

DETAILS OF ECONOMIC EVALUATION

A. DCW

The capital and production financial costs have been adjusted by excluding from the former, custom duties and price contingencies and by deducting excise duties and sales taxes from the production costs. Also, foreign costs have been estimated using a rate of exchange of US\$1 = Rs 10. These adjustments represent a reduction of 21.5% in capital costs and 11.2% in production costs.

The economic benefits were derived by determining the CIF value of equivalent imported parts and components to those which will be produced by DCW with two adjustments: (i) about one-third of DCW's total production, in value, has not been thus valued, since it will be used as input into the remanufacturing of diesel locomotives; and (ii) the operating efficiency of the plant in producing parts and components has been conservatively assumed to be about 40% in the first year of operation, 60% in the second year and 85% thereafter. A separate computation was carried out to measure the benefits of locomotive remanufacturing. In this case, it was estimated that the remanufactured locomotive would have a cost equivalent to 70% of the border price of a new one. As explained in Table D-1, this cost is lower than the price at which US remanufacturers sell their locomotives (recent market quotations range around 80% of the price of a new one). It is noteworthy that a remanufactured locomotive incorporates new technological improvements and it is normally guaranteed by the remanufacturer as if it were new. Further, it was assumed that DCW's operating efficiency in loco remanufacturing would reach 20% the first year, 60% the second year and 85% over the remainder of the economic life of the plant.

B. Unit Exchange System

The economic costs of this project have been determined by excluding custom duties and price contingencies from the financial costs. Also, foreign costs have been estimated using a rate of exchange of US\$1 = Rs 10. This entails a reduction of 27% in total costs. Further, a salvage value of 20% has been assumed at the end of the economic life of main assets (10 years).

Although the nature of economic benefits to be expected from this project element is relatively simple to establish, the magnitude of such benefits is considerably more difficult to estimate. The concept of unit exchange system has been introduced too recently to have reliable results. Moreover, similar benefits can be obtained through better management of maintenance and operations and through more advanced design of motive

power and rolling stock, all of which are expected to improve under ongoing projects, including the proposed one. Accordingly, in the present analysis, minimum improvements in maintenance and operations are assumed, to obtain a base estimate of the economic merits of this project component. The rate of return thus obtained is, therefore, an indication of the minimum return which could be reasonably expected from from this investment.

Benefits have been classified into three major categories: (i) reduction in maintenance time of locomotives and rolling stock; (ii) increased reliability of motive power; and (iii) better utilization of rolling stock. The benefits due to increased availability of locomotives and rolling stock have been based on an improvement of only two days per year for locos and one day per year for rolling stock. Benefits due to increased reliability would result in a average overhaul improvement in utilization of rolling stock of about 4% and of motive power of 1%.

#### C. High Capacity Wagons

The economic costs were obtained by deducting customs duties and price contingencies from the financial estimates. As in all other cases, the foreign cost was estimated using an exchange rate of US\$1 = Rs 10. These adjustments result in an economic cost about 23% less than the financial cost.

The main benefits consists of savings in total transport costs of minerals owned by unit train. According to the information supplied by IR and the updated economic cost data regarding transportation of coal and other minerals, contained in the May 1980 Report of the National Transport Policy Committee, the transport costs per ton-km without the project (e.g. using the existing box wagons) would amount to about 19.0 Paise (USc 2.11), while economic costs per ton-km using the new high capacity wagons would be about 15.21 Paise (USc 1.69). Furthermore, savings in faster turnaround and decreased maintenance of wagons have also been incorporated. In this regard, it has been assumed that unit trains using the new equipment would be assigned to the longer runs (650 km average lead) and that turnaround time would be reduced to five days on average, from the present seven to nine days.

INDIA

RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II

Cost/Benefit Streams For Economic Rate of Return of DCW

(Rs Million)

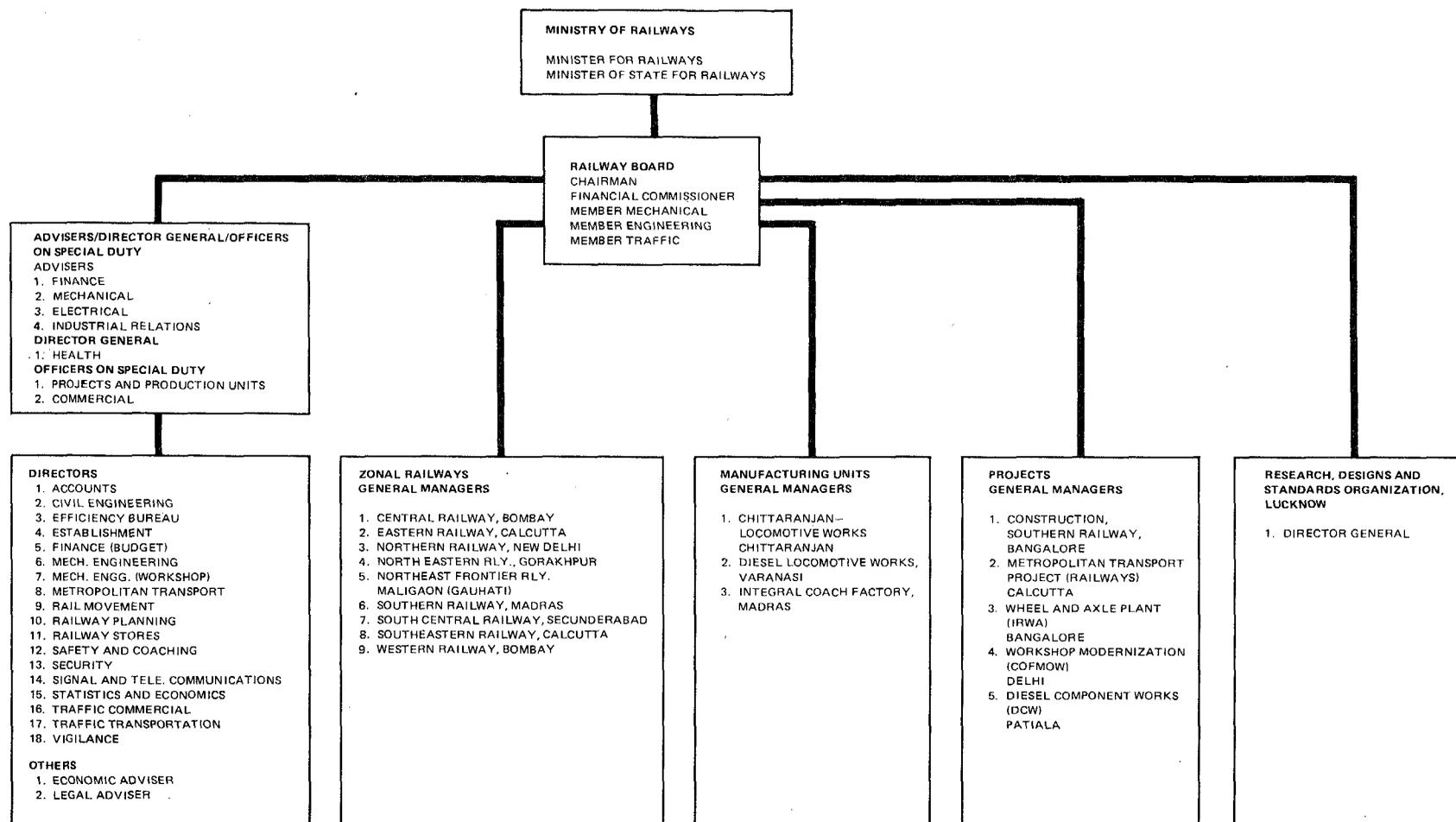
| YEARS   | CAPITAL COST   |             |               | PRODUCTION COST |                |               | ECONOMIC BENEFITS   |                            | TOTAL COSTS | ECONOMIC BENEFITS | NET BENEFIT STREAM |
|---------|----------------|-------------|---------------|-----------------|----------------|---------------|---------------------|----------------------------|-------------|-------------------|--------------------|
|         | Financial Cost | Adjustments | Adjusted Cost | Financial Cost  | Taxes & Duties | Adjusted Cost | Spares & Assemblies | Remanufactured Locomotives |             |                   |                    |
| 1982/83 | 74.3           | 3.2         | 71.1          | 0               | 0              | 0             | 0                   | 0                          | 71.1        | 0                 | -71.1              |
| 1983/84 | 244.1          | 40.3        | 203.8         | 0               | 0              | 0             | 0                   | 0                          | 203.8       | 0                 | -203.8             |
| 1984/85 | 434.0          | 124.5       | 309.5         | 245.0           | 27.4           | 217.6         | 75.2                | 73.9                       | 527.1       | 149.1             | -378               |
| 1985/86 | 333.1          | 65.1        | 268           | 294.0           | 32.9           | 261.1         | 100.8               | 277.2                      | 529.1       | 378.0             | -151.1             |
| 1986/87 | 0              | 0           | 0             | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 261.1       | 520.0             | 258.9              |
| 1987/88 | 0              | 0           | 0             | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 261.1       | 520.0             | 258.9              |
| 1988/89 | 0              | 0           | 0             | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 261.1       | 520.0             | 258.9              |
| 1989/90 | 0              | 0           | 0             | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 261.1       | 520.0             | 258.9              |
| 1990/06 | 0              | 0           | 0             | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 261.1       | 520.0             | 258.9              |
| 2006/07 |                |             | (85.2)        | 294.0           | 32.9           | 261.1         | 150.4               | 369.6                      | 175.9       | 520.0             | 344.1              |

Economic Rate of Return: 24.0%

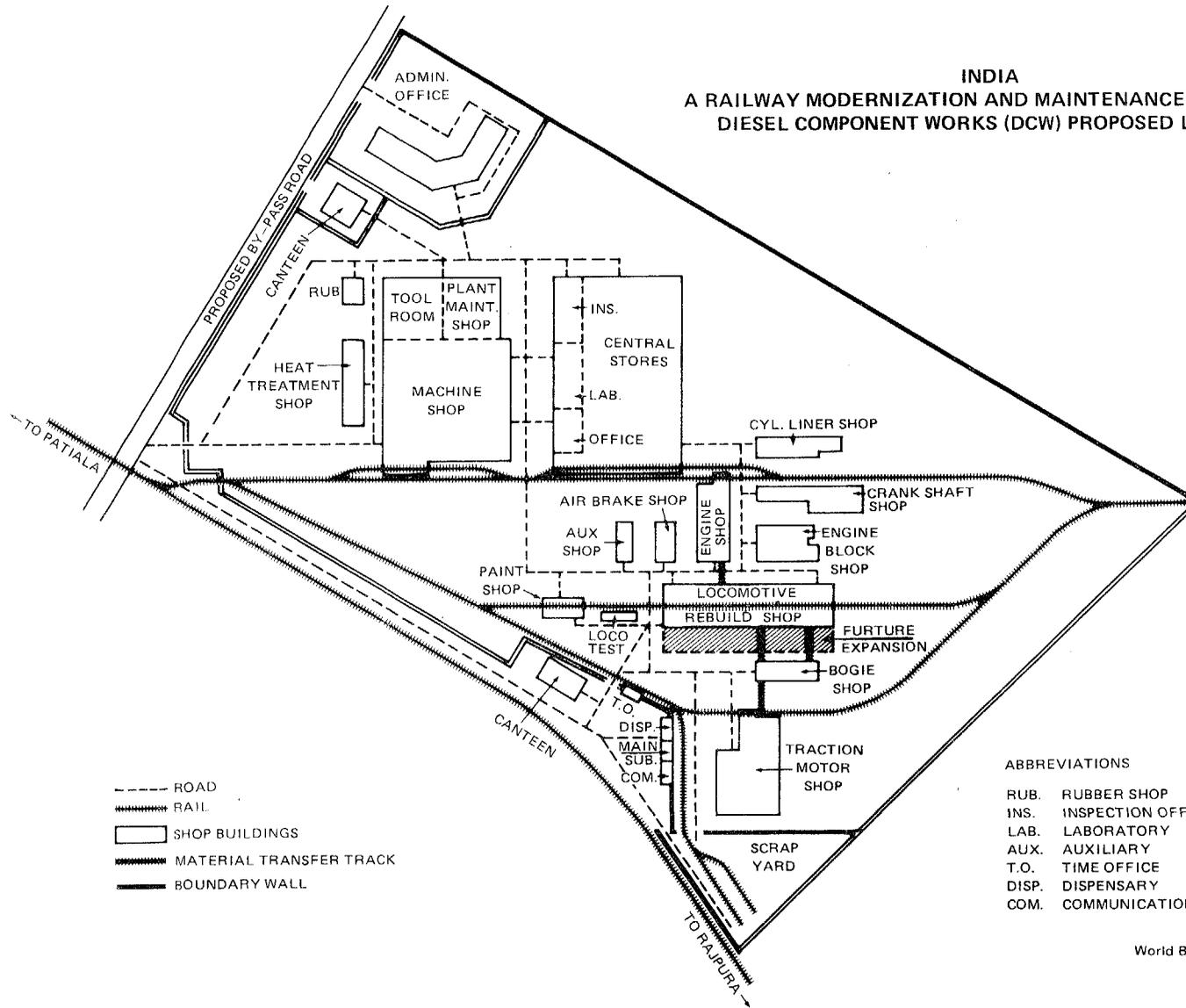
Notes

- (1) The financial capital costs have been adjusted by excluding price contingencies and custom duties, while foreign costs have been estimated at US\$ 1 = Rs 10. The overall effect is a reduction of 21.5% in the total plant cost.
- (2) Excise duty and sales tax on operating raw materials and supplies have been eliminated, as has the generation tax on electric power. The net effect is a reduction of 11.2% in production costs.
- (3) Prices of spare parts, assemblies and subassemblies have been eliminated as the C.I.F. value of imported goods. The value of parts and assemblies which constitute an input to the remanufacturing of locomotives have been excluded from the Spares and Assemblies column. They represent around 33% of DCW's total output valued at border prices.
- (4) For remanufactured locomotives, which are normally guaranteed as if they were new, recent prices in the USA from reputable industries (not owned by locomotive manufacturers or railroad companies) are around 80% of the manufacturers' new price for the same locomotive. Therefore, conservatively the benefit of DCW's locomotive remanufacturing has been set at 70% of the C.I.F. price of an equivalent new locomotive.

## INDIAN RAILWAYS ORGANIZATION CHART



INDIA  
A RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II  
DIESEL COMPONENT WORKS (DCW) PROPOSED LAYOUT

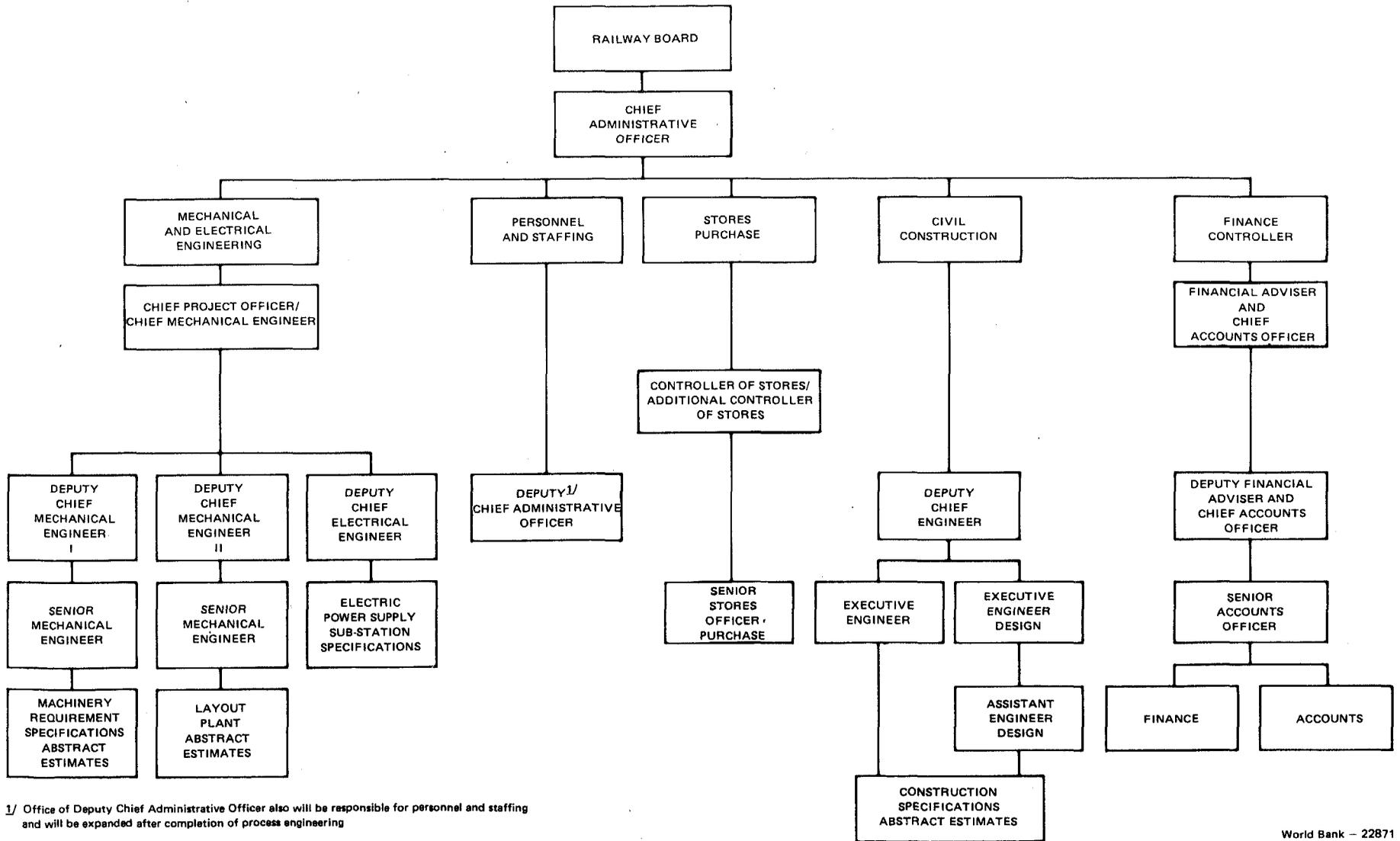


- ROAD
- ==== RAIL
- ▭ SHOP BUILDINGS
- ▬ MATERIAL TRANSFER TRACK
- BOUNDARY WALL

- ABBREVIATIONS
- RUB. RUBBER SHOP
  - INS. INSPECTION OFFICE
  - LAB. LABORATORY
  - AUX. AUXILIARY
  - T.O. TIME OFFICE
  - DISP. DISPENSARY
  - COM. COMMUNICATIONS

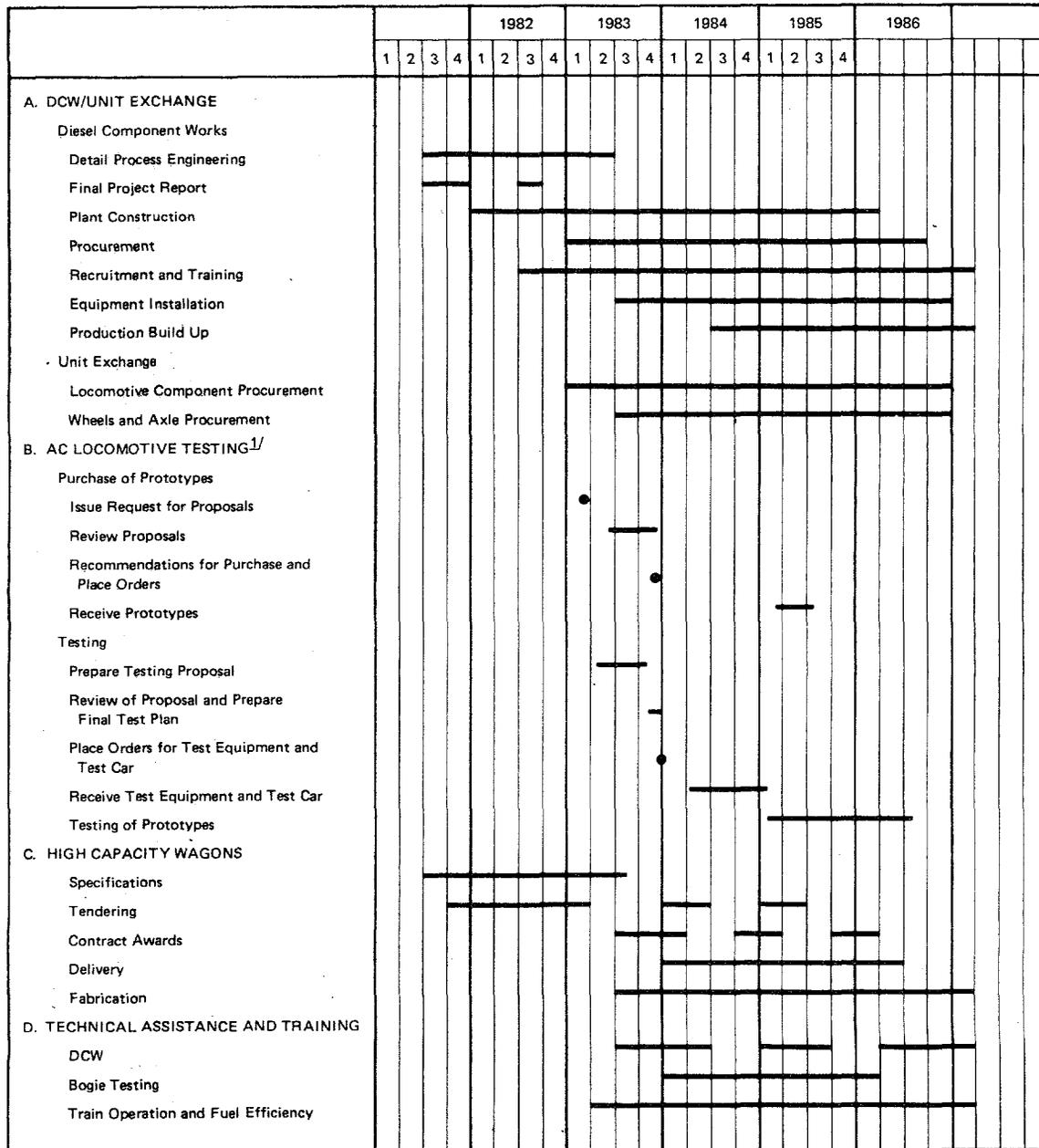
World Bank - 22870

**INDIA**  
**RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II**  
**DIESEL COMPONENT WORKS**  
**PROJECT IMPLEMENTATION ORGANIZATION**



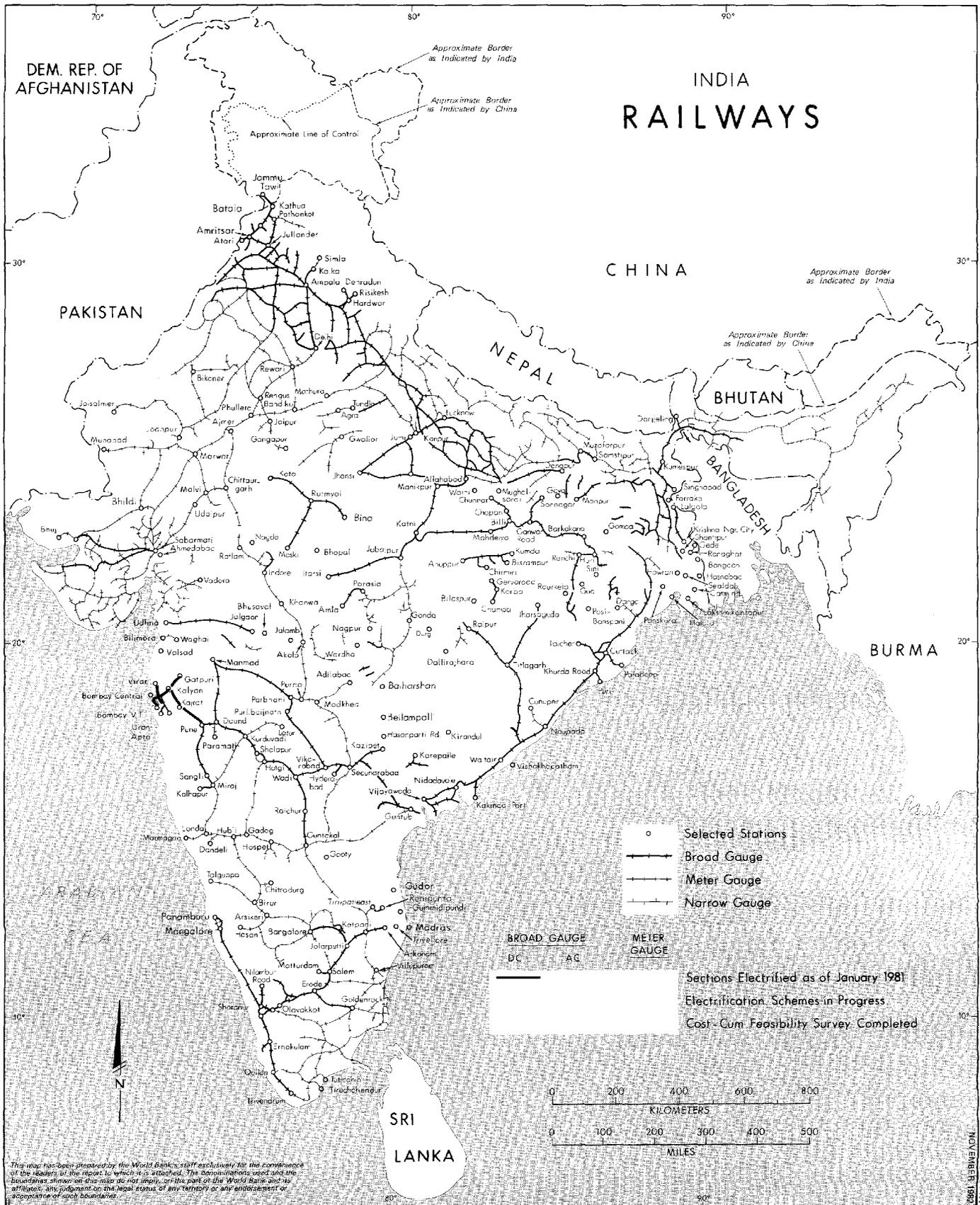
1/ Office of Deputy Chief Administrative Officer also will be responsible for personnel and staffing and will be expanded after completion of process engineering

**INDIA**  
**RAILWAY MODERNIZATION AND MAINTENANCE PROJECT II**  
**Implementation Schedule**



<sup>1/</sup> See Annex II of agreed minutes.

# INDIA RAILWAYS



DEM. REP. OF  
AFGHANISTAN

PAKISTAN

CHINA

NEPAL

BHUTAN

BANGLADESH

BURMA

SRI  
LANKA

- Selected Stations
- Broad Gauge
- Meter Gauge
- Narrow Gauge

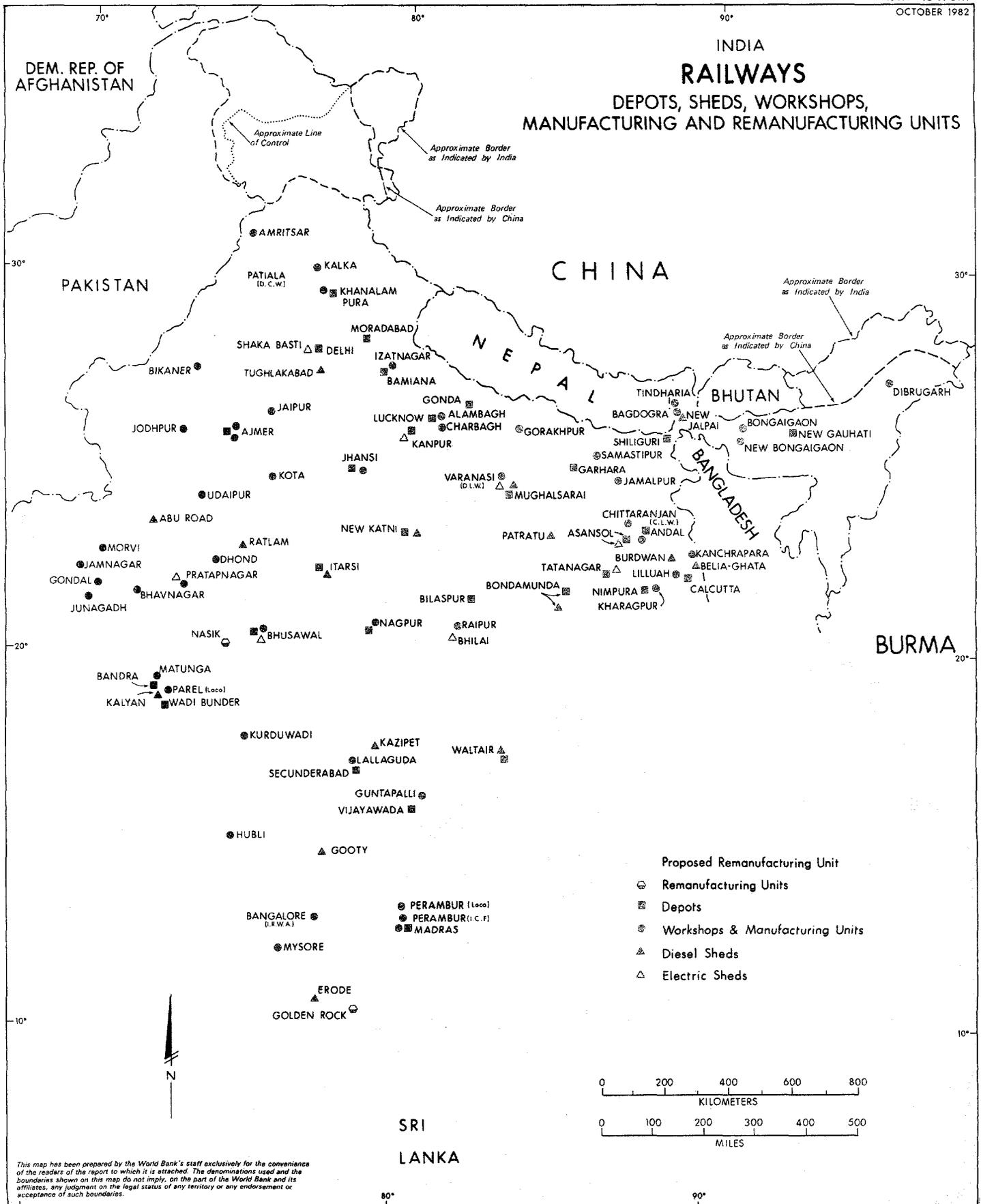
BROAD GAUGE      METER GAUGE  
DC      AC

Sections Electrified as of January 1981  
Electrification Schemes in Progress  
Cost-Cum Feasibility Survey Completed



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