

P.C. 32. IV

5.500



28 NOV 1957

GOVERNMENT OF INDIA
PLANNING COMMISSION

SECOND FIVE YEAR PLAN
IRRIGATION AND POWER

G
333-9130954

J7

BY THE GENERAL MANAGER, GOVT. OF INDIA PRESS,
PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI, 1957

Explanatory Note

The expression 'lakh' and 'crore' signify 100,000 and 10,000,000 respectively



INTRODUCTION

With the object of assisting study and implementation, the Second Five Year Plan is being made available in the following sections:

- I. Approach to the Second Five Year Plan.
- II. Administration and Organisation
- III. Agriculture
- IV. Irrigation and Power
- V. Industry and Transport
- VI. Education and Social Services

The numbering of pages in the different sections is in accordance with the text of the Plan.



CONTENTS

Part IV

IRRIGATION AND POWER

	Page
Chapter XVII.—IRRIGATION AND POWER	321
I. <i>Irrigation</i>	321
Water Resources	321
Existing Development	322
Future Development	324
Programme for the Second Plan	325
Tube Wells	329
II. <i>Power</i>	331
Power Resources	331
Existing Development	332
Future Development	335
Programmes for the Second Plan	335
Small Town and Rural Electrification	340
Utilisation of Power	342
III. <i>Flood Control</i>	343
IV. <i>Investigations, Surveys and Research</i>	345
Investigations	345
Surveys	346
Research	347
V. <i>Planning and Organisation</i>	349
<i>Annexures</i>	358
I. Principal Irrigation Works	358
II. Cultivated and Irrigated Area 1954-55	360
III. Principal Irrigation Projects in the Second Five Year Plan	362
IV. Outlay and benefits—Irrigation Projects	364
V. Principal Power Generation Schemes in the Second Five Year Plan—	
(i). Public Sector	366
(ii). Private Sector	369
VI. Outlay and benefits—Power Projects.	370



PART IV
IRRIGATION AND POWER



CHAPTER XVII

IRRIGATION & POWER

I IRRIGATION

WATER RESOURCES

THE integrated development of the water and land resources of the country is of fundamental importance to its economy and programmes for achieving this have a high priority. As the First Five Year Plan has pointed out, the utilisation of the water resources has to be planned on a national basis.

2. The total river water resources in India were computed a few years ago at 1356 million acre feet. Investigations for an accurate assessment of water resources have begun and will continue during the second five year plan. The river flow that can be used for irrigation depends on topography, flow characteristics, climate, and soil conditions of the region, and differs from river to river. Of the available supplies, it is estimated that approximately 450 million acre feet could be put to beneficial use.

3. Only about 76 million acre feet had, however, been utilised upto 1951. This represented only 5.6 per cent. of the river flow in the country. Additional supplies will, however, be utilised by the projects taken up in the first plan, as a result of which the percentage of water used will rise to 10 in 1956. The position in regard to utilisation of water resources in the important river basins will approximately be as set out, below :—

River System	Estimated average flow	Utilisation upto 1951	Additional Utilisation by projects entered in the I Plan (on full development)	Additional Utilisation by projects entered in the II Plan (on full development)
(Figures in million acre feet)				
1. Indus	168	8.0	11.00	1.2
2. Ganga	400	20.0	21.5	14.5
3. Brahmaputra	300	nil	nil	nil
4. Godavari	84	12.0	1.0	1.5
5. Mahanadi	84	0.6	10.5	0.2
6. Krishna	50	9.0	15.6	2.6
7. Narmada	32	0.2	nil	10.1
8. Tapti	17	0.2	0.7	3.5
9. Cauvery	12	8.0	1.3	0.6

Large quantities of waters will still be available. A programme for planned development of these resources has, therefore, to be continued

4. Substantial supplies are available from underground waters also. No inventory of these resources has been prepared so far, but as a result of the exploratory tubewells which have been taken up, reliable information in regard to sub-soil water resources for some of the regions in the country will become available. These waters would be utilised for irrigating areas which cannot be economically irrigated by canals or in areas which are susceptible to water-logging where irrigation by tubewells is preferable to irrigation by canals.

EXISTING DEVELOPMENT

5. Irrigation has been practised in India from ancient times. Efficient and extensive irrigation works were constructed during the nineteenth century on the Ganga and Jamuna in Uttar Pradesh, on the Ravi and Sutlej in the Punjab, on the Godavari, Krishna and Cauvery in Madras and on the Sone in Bihar. During the past few decades, further irrigation works were constructed on the Sutlej in Punjab, on the Betwa and Sarda in Uttar Pradesh, on the Mahanadi in Madhya Pradesh and Orissa, on the Godavari in Bombay and Hyderabad, on the Krishna in Andhra and on the Cauvery in Mysore and Madras. Several large irrigation schemes were taken up under the first five year plan also, a number of them being multi-purpose in character. In many cases, they involved construction of dams and reservoirs to store monsoon flows. Work is still in progress on some of the projects and most of it will be completed during the second plan. Statement I in the Annexure gives particulars of important irrigation works in the country.

6. The land utilisation statistics for the country as reported for 1954-55, are given below :—

	Million Acres (Approximate)
Gross area	811
Classified area	722
Forests	133
Not available for cultivation	122
Uncultivated land excluding fallows	95
Current fallows	28
Fallows other than current fallows	29
Net area sown	315
Culturable area	467
Cultivated area	343

Statement II in the Annexure shows important agricultural and irrigation statistics by States.

7. The area irrigated from all sources in 1950-51 was 51.5 million acres, out of which 17.9 million acres was irrigated by Government canals, 2.8 million acres by private canals, 8.8 million acres by tanks, 14.7 million acres by wells and 7.3 million acres by other sources. This constituted about 17.5 per cent of the total cultivated area of the country. Additional irrigation amounting to about 6.3 million acres will be available by 1956 from major and medium irrigation works taken up during the first plan. On full development, these works will irrigate about 22 million acres. The benefits for different States are given below:—

State	Irrigation available by 1956	Irrigation on full development
Thousand acres		
Andhra	89	1960
Assam	152	234
Bihar	689	2576
Bombay	309	1505
Madhya Pradesh	10	244
Madras	240	396
Orissa	90	1875
Punjab	1520	3280
Uttar Pradesh	1674	1920
West Bengal	639	2144
Hyderabad	72	1517
Madhya Bharat	120	706
Mysore	39	384
Pepsu	204	1011
Rajasthan	182	1758
Saurashtra	116	270
Travancore-Cochin	38	138
Jammu & Kashmir	35	170
Ajmer	1	10
Himachal Pradesh	24	100
Kutch	24	48
Vindhya Pradesh	..	37
TOTAL	6267	22283

8. An addition of 10 million acres is expected to be made to the irrigated area from minor irrigation works taken up during the first plan. Some areas which were previously irrigated by minor works like wells and tanks will now be served by large irrigation works giving more secure irrigation. The net addition to irrigated area from the projects in the first plan may, therefore, be taken as 15 million acres. The percentage of irrigated area to cultivated area will increase from 16 per cent in 1951 to 20 per cent at the end of the first plan.

FUTURE DEVELOPMENT

9. *Irrigation*.—Adequate data are not available for determining the eventual target for irrigation or the total irrigation development possible under different kinds of sources in the country. It has, however, been roughly estimated that about 75 million acres may eventually be irrigated by multi-purpose, large and medium irrigation works. An equal area could be irrigated under other categories of irrigation sources thus making a total of about 150 million acres under irrigation from all sources. An all-India survey of the irrigation possibilities was made by the Irrigation Commission more than 50 years ago. There has been a great change in conditions since then. Firstly, there have been improvements in techniques of dam construction and in irrigation engineering generally. Schemes which were considered impossible in those days have now become practical propositions. Secondly, in recent years, there has been a great advance in the techniques of dry-farming, contour bunding, soil conservation etc. The estimates of possibilities of irrigation have to be revised from both these angles. We recommend that the Central and State Governments jointly should undertake a careful survey of future possibilities of large and medium irrigation projects and for minor irrigation schemes like tanks and wells. In each region, the question should also be studied at what point irrigation may cease to be economical and the adoption of dry-farming methods should be advocated. The investigations which we have proposed will provide a correct appreciation of the possibilities of development in the three directions indicated above, namely, how much irrigation can be developed under large and medium irrigation works; what are the possibilities of developing irrigation under minor irrigation works, wells, etc; and thirdly, the scope for adopting dry-farming techniques, contour-bunding, arrangements for the preservation of soil moisture etc. Such investigations are necessary for drawing up future plans for the development of irrigation.

10. It is also essential that water requirements for crops under dry-farming conditions are kept in view in preparing projects for water utilisation by canal system. There is a danger that the total utilisation of catchment waters in lower areas by canal systems or storage reservoirs may deprive areas which cannot benefit from canal irrigation of the use of water through dry-farming techniques. Reservoirs should, therefore, not be so designed as to store the entire run-off from catchments without taking into consideration future water requirements of disadvantageously located areas in the upper reaches. Similarly, the requirements of areas lower down should be kept in mind in fixing sizes of storage reservoirs in the upper reaches of a river.

11. *Navigation.*—Apart from irrigation, power generation, water supply and disposal of sewage, an important use of river waters is for purposes of navigation. Being a cheap means of transport, navigation can play an increasingly useful part in meeting the growing requirements of communications. The development of inland water transport has been hitherto confined to certain parts of Assam, West Bengal, Bihar and U.P., and much progress has not been made in this direction during the first plan. In view of the growing requirements of development, the communication aspects of river waters have to be given greater attention and the possibilities of economic development of waterways for navigation have to be investigated more fully during the second five year plan. The problem has also to be given greater attention in connection with the planning of river valley projects.

12. *Soil Conservation.*—The problems of soil conservation and steps to meet them were dealt with in the first plan. The necessity for careful attention to this problem is all the greater in areas affected by river valley projects, where large storage reservoirs are constructed and the normal regimes of rivers and tributaries in the basin are considerably changed. Without suitable soil conservation measures in catchment areas, the detritus brought by flowing waters is deposited in reservoirs and the streams below and impairs their capacities. The flow conditions in the rivers below the reservoirs are also significantly altered by the construction of dams. This, in turn, affects the flow conditions in the tributaries with the result that the soil erosion problem in the valley below becomes more serious. Soil conservation measures should, therefore, receive particular attention in areas affected by river valley projects and find an important place in soil conservation programmes. Check dams required for the safety of the works connected with river valley projects should also receive attention simultaneously and should form an integral part of every large river-valley project.

PROGRAMME FOR THE SECOND PLAN

13. *Physical Benefits.*—The first five year plan was drawn up in the background of a long-term plan to double the area under irrigation from Government works over a period of 15 to 20 years. The total area irrigated in the country from all sources in 1951 was about 51 million acres. During the first plan, additional irrigation of 16·3 million acres would have been achieved: 6·3 million acres from large and medium projects and 10 million acres from minor works. During the second plan, it is proposed to bring under irrigation an additional area of 21 million acres: 12 million acres from large and

medium projects and 9 million acres from minor irrigation works. Out of the 12 million acres to be irrigated by large and medium projects, 9 million acres will be irrigated by projects which are at present under execution and 3 million acres by new projects to be taken up during the second plan. The latter have an ultimate potential in irrigation benefits of about 15 million acres. During the second plan, in the first three years, irrigation from these projects is expected to increase at the rate of 2 million acres per annum and in the last two years at the rate of 3 million acres per annum.

14. *Financial Outlay.*—During the first plan and in the immediately preceding years, there has been considerable activity in all parts of the country on irrigation projects. The total cost of irrigation and power projects initially included in the first five year plan was about Rs. 970 crores, of which irrigation accounted for about Rs. 620 crores. Additions were subsequently made such as the programme of medium irrigation schemes for permanent improvements in scarcity areas which involved an outlay of about Rs. 40 crores. The scope of some of the schemes was enlarged and, in certain cases, estimates had to be revised. Thus, the total cost of irrigation projects included in the first plan is about Rs. 720 crores of which about Rs. 80 crores had been spent before the commencement of the plan. The expenditure during the first plan is estimated to be Rs. 340 crores, the balance being carried over to the second and third plans. It is essential that projects in hand should be completed quickly so that expenditure already incurred may be put to productive use and benefits realised as soon as possible. During the second plan, these projects will require an outlay of about Rs. 209 crores.

15. The total cost of new irrigation projects included in the second plan is about Rs. 380 crores of which about Rs. 172 crores are expected to be spent during the second plan, the balance being required in the third and subsequent plans. The total provision during the second plan for major and medium irrigation works is Rs. 381 crores. An additional provision of Rs. 35 crores has been made for commencing projects for the utilisation of India's share of waters that will be released on the Indus system and certain other projects, decisions on which are yet to be taken.

16. The programme includes 195 new irrigation projects. Ten of these cost between Rs. 10 and 30 crores, seven between Rs. 5 and 10 crores and the rest less than Rs. 5 crores. Thus, in the second plan, there is a marked preference for medium irrigation projects. The

total number, costs, and benefits of the different sizes of new projects included in the second plan are set out below:—

Estimated cost	Number of Projects	Total estimated cost. (Rs. crores)	Approximate irrigation benefits on completion (million acres)
Between Rs. 10 and Rs. 30 crores	10	191	8.4
Between Rs. 5 and Rs. 10 crores	7	54	1.5
Between Rs. 1 and Rs. 5 crores	35	85	3.4
Less than Rs. 1 crore	143	46	1.5
TOTAL	195	376	14.8

The particulars of important irrigation projects in the second plan are shown in Statement III in the Annexure.

17. The inclusion of a project in the plan does not mean that it has been fully investigated from every point of view. In fact, for a number of projects detailed technical investigations and economic assessment will have to be completed before construction can begin. In the initial stages, work on such projects will have to be confined to surveys and investigations for completing the project reports or, in particular cases, to works of a preliminary nature like access roads etc. The technical, economic and financial aspects of some of these projects may require considerable modification as a result of detailed investigations and even their scope may need to be reviewed. As was emphasised in the first five year plan, it would be desirable that at defined stages in the course of its execution the economic and financial aspects of every project as a whole and of its different parts and phases, should be carefully reviewed.

18. In carrying out the irrigation programmes, it is desirable that States should give close attention to the question of phasing. Apart from considerations of finance, the phasing of projects will be determined by several other factors, such as the technical personnel available, the need for realising benefits from some of the projects at an earlier stage, the claims of projects under execution and the requirements or needs of different areas within a State. Thus, a number of major projects included in the plan will have to be taken up in the later stages rather than in the earlier stages of the plan. Along with certain schemes, where investigations are yet incomplete, the Vamsadhara project in Andhra; the Kansai in Bihar; the Ukai, the Narmada, the Mahi, the Khadakwasla, the Girna and the Banas in Bombay; the Tawa in Madhya Pradesh; and the Kangsabati project in West Bengal are in this category. On some of these, the scope and benefits are yet to be defined. The total cost of these

projects exceeds Rs. 200 crores against which a provision of about Rs. 50 crores has been made in the second plan.

19. In the preparation of the plans of different States, in addition to the requirements of additional irrigation and the level of development already attained, the capacity for implementing the proposed programmes has been taken into consideration. The size of programme of the different States in the second plan is shown in Statement IV in the Annexure.

20. *Major and Minor Irrigation Projects.*—In the Irrigation programme, there is need for a careful balance between major and minor irrigation schemes, which are complementary in character and scope. Each area has to be served by the kind of schemes, for which it offers suitable facilities. The first five year plan provided for 7 irrigation projects costing more than Rs. 30 crores, 6 irrigation projects costing between Rs. 10 crores and Rs. 30 crores, 4 costing between Rs. 5 crores and Rs. 10 crores, 50 costing between Rs. 1 crore and Rs. 5 crores each and about 200 costing less than Rs. 1 crore. Although as much as Rs. 340 crores will have been spent during the first plan, by 1956 the additional irrigation will amount to about 6.3 million acres, compared to a potential of about 22 million acres. Projects carried over from the first plan will call for an outlay of Rs. 209 crores during the second plan, out of a total provision in the plan of Rs. 416 crores. Both for ensuring a sequence of irrigation benefits and for financial and economic considerations, it was essential that in the second plan, in selecting new projects, preference should be given to medium-sized projects. At the same time, minor irrigation works will continue to occupy a prominent place in the programme of irrigation.

21. Both major and minor irrigation works have relative advantages of their own. The major schemes utilise surplus river waters which would otherwise run to waste, they benefit large areas, give surer protection in years of scarcity, and can often be designed for multiple uses. Minor schemes require comparatively small outlay, yield quick results and can be executed speedily with local resources. But they give limited protection and need careful maintenance. The Grow More Food Enquiry Committee observed in 1952 that many minor irrigation works constantly fell into derelict condition. In view of the large sums being spent on these works, there is need for special measures to ensure their satisfactory maintenance. It is necessary that the responsibility for keeping minor works in good condition should be borne by the beneficiaries. For works which benefit a considerable section of the village population, efficient maintenance should be the joint responsibility of the local community. We recommended that State Governments should take

power to levy a special maintenance cess, from the proceeds of which village panchayats separately and jointly can undertake the necessary repairs and renovations.

22. *Economy in use of irrigation supplies.*—The need to use the available supplies of water with greater economy and efficiency than was customary was stressed in the first five year plan. Optimum use of available irrigation supplies presents two sets of problems, agricultural and engineering. Agricultural aspects such as water requirements of crops in relation to system of irrigation, frequency of watering, methods of cultivation, application of fertilizers etc. are being studied in the Indian Agricultural Research Institute at Delhi and other research stations in States. The work will be continued in the second plan.

23. Larger areas can be irrigated from existing supplies by reducing absorption losses on canals, branches, distributaries and more especially, on water courses. It was recommended in the first five year plan that consideration might be given to the possibility of lining of irrigation channels, and lining carried out where justified on economical grounds. Except in a few States, inadequate progress has been made in this direction. This aspect may be given further consideration in the second plan. Economy in use of water can also be obtained by the proper alignment of water courses. The agency of the national extension service could give useful help in alignments as well as in the construction and maintenance of water courses.

TUBEWELLS

24. There were about 2,500 tubewells in India prior to 1951, about 2,300 of which were in the Uttar Pradesh. These tubewells irrigated about a million acres. The first plan provided for the construction of 2,650 tubewells under the Indo-U.S. Technical Cooperation Programme, 700 tubewells under the grow-more-food programme and 2,480 tubewells in the development plans of States. The number of tubewells to be constructed in different States and the progress made upto the end of 1955 are given below:—

State	Indo-U.S. Technical Cooperation Scheme		G. M. F. Programme		State plans	
	No. allotted	No. com- pleted	No. allotted	No. com- pleted	No. allotted	No. com- pleted
Bihar . . .	385	378	..	..	424	424
U. P. . . .	1275	1094	420	93	1400	1165
Punjab . .	530	445	150	..	256	256
PEPSU . .	460	369	130	..	..	..
Bombay . .	..	..	..	..	400	198
TOTAL . .	2650	2286	700	93	2480	2043

The additional irrigated area by these tubewells will be about 2 million acres on completion and full development.

25. As a result of technological advances in tubewell engineering, the possibilities of utilisation of underground waters have appreciably increased. A programme for drilling 350 deep exploratory tubewells for assessing the possibilities of exploiting ground water resources for irrigation was begun during the first plan. Explorations have been conducted at 22 sites so far and will be continued in the second plan.

26. The programme for the second plan provides for the construction of 3581 tubewells. The total outlay on these tubewells will be about Rs. 20 crores, which has been included in the provision under the minor irrigation programme which forms part of the Agriculture sector, and the irrigation expected therefrom is 916,000 acres. The distribution of these tubewells by States is shown below:

Name of State	Number of tubewells	Estimated cost (Rs. lakhs)	Area to be irrigated ('000 acres)	Approximate number of exploratory tubewell borings
Andhra . . . . .	..	..	..	25
Assam	50	30	15	15
Bihar	150	10	15	16
Bombay	330	150	66	15
Madhya Pradesh and Bhopal	98	70	39	30
Madras	300	75	6	50
Orissa	25	20	7	20
Punjab	466	280	77	46
Uttar Pradesh	1500	1050	485	47
West Bengal	150	100	32	37
PEPSU	292	150	133	5
Rajasthan	50	35	16	5
Saurashtra	70	25	14	10
Travancore-Cochin . . . . .	..	..	..	5
Delhi	50	21.5	8	..
Kutch . . . . .	..	..	..	10
Pondicherry	50	12.5	3	..
Other areas . . . . .	..	..	..	14
TOTAL	3581	2029	916	350

27. Outside Punjab, Pepsu, Uttar Pradesh, Bihar and the northern part of Gujarat in Bombay, over large areas underground conditions need to be studied. This is the object of the exploratory tubewell scheme. The tubewell programmes which have been drawn up in several states may require modification according to the results of investigations.

28. The cost of irrigation by tubewells is generally higher than that of irrigation by gravity canals. Studies in the economics of irrigation by tubewells have been initiated by States at the suggestion of the Planning Commission. These need to be followed up systematically and their results published, since in regions which cannot be commanded by gravity canals, tubewell irrigation will become increasingly important.

II

POWER

POWER RESOURCES

29. Although a complete field survey has not so far been undertaken, some progress has been made during the first plan in making a preliminary assessment of the hydro-electric potential in the country. General studies have been made on the power potential of the east and west flowing rivers of south India and the rivers of central India. Similar work has been begun on the Himalayan and other river systems in northern India. It has been estimated that the total hydro-electric potential, which it might be possible to develop from various likely sites, is about 35 million kW. This includes about 4 million kW from the west flowing rivers and about 7 million kW from the east flowing rivers of the southern region, about 4 million kW from the Narmada, Tapi, Mahanadi, Brahmini and Baitarni basins in the central region and about 20 million kW from the Ganga, Brahmaputra, Indus and other Himalayan rivers in the northern & north-eastern regions. The potential of the southern and central regions, has been estimated from the available data and topographical maps. On the other hand, the potential of the Himalayan rivers can be indicated only in a rough way, as studies in respect of the region are still in progress. A further stage of study, which it is hoped to begin during the second plan, is to re-examine the potential on the basis of more detailed considerations such as the economics of development, period of construction, load demand and other local limiting factors.

30. Side by side with the development of water power, coal fired thermal stations will continue to be important sources of electrical energy in this country. With about 40,000 million tons of known

coal reserves of steam and non-coking varieties and possibilities of further reserves of lignite, no difficulty in meeting the coal requirements for power generation is anticipated in the foreseeable future. Only about 10 per cent. of the coal raised is being used for power generation at present, and, as coal production steadily increases, the proportion required for power generation is not likely to exceed his percentage. Power generation from diesel oil is at present limited to small isolated installations. During the next few years it is unlikely that diesel power generation will be used for power development on any large scale.

31. While the coal and hydro resources of the country are sufficient to meet the overall power requirements during the next few decades, there are, nevertheless, certain industrially developing zones which are remote from coalfields and where the hydro potential may either not be available or may have been already developed. In such areas, because of its substantially lower cost of fuel, atomic power may profitably supplement thermal power for generating electricity. Capital costs are still somewhat higher for atomic than for thermal power stations, but this difference may be offset in varying degrees by other economies. The country has adequate resources of uranium and thorium for developing this new source of energy. Atomic power might be expected to begin supplementing power from other sources during the next few years.

EXISTING DEVELOPMENT

32. At the beginning of the first five year plan, the total installed capacity of power generating plant was 2·3 million kW of which 1·7 million kW was in electricity supply undertakings in the public and private sectors and 0·6 million kW in industrial establishments generating their own power. The target for the first five year plan was 1·3 million kW, of which 1·1 million kW was to be provided in the public sector and 200,000 kW by private electricity supply companies. Of this target, the public sector has achieved about 800,000 kW and the private sector 200,000 kW. In addition, work on power plants with an aggregate capacity of about 200,000 kW has been almost completed in the public sector and these will be commissioned before the end of 1956. No targets had been set for power plants in industrial establishments. A number of them have closed down their less economic generating plants and changed over to bulk supply from public utility grid systems. However, during the first plan there was a net increase of about 100,000 kW in the power plant capacity of industrial establishments bringing the total capacity to 700,000 kW in March, 1956. The position in respect

of installed capacity and electrical energy generated at the beginning and at the end of the first five year plan is stated below:—

	1950-51	1955-56	Percentage increase during the first plan
(1) Installed capacity kW in millions			
Public utility undertakings :			
(a) State-owned	0.6	1.4	133
(b) Company-owned	1.1	1.3	18
Self generating industrial establishments	0.6	0.7	17
TOTAL	2.3	3.4	48
(2) Energy generated (kWh in millions)			
Public utility undertakings :			
(a) State-owned	2104	4500	114
(b) Company-owned	3003	4300	43
Self generating industrial establishments	1468	2200	50
TOTAL	6575	11,000	67

33. The principal power schemes completed and brought into service during the first plan are:

1. Nangal (Punjab)	48,000 kW
2. Bokaro (Bihar)	150,000 kW
3. Chola (Kalyan, Bombay)	54,000 kW
4. Khaperkheda (Madhya Pradesh)	30,000 kW
5. Moyar (Madras)	36,000 kW
6. Madras City Plant Extensions (Madras)	30,000 kW
7. Machkund (Andhra & Orissa)	34,000 kW
8. Pathri (Uttar Pradesh)	13,600 kW
9. Sarda (Do.)	27,600 kW
10. Sengulam (Travancore-Cochin)	48,000 kW
11. Jog (Mysore)	72,000 kW

In addition, considerable progress has been made on a number of major projects which will be completed during the second five year plan. The Bhakra, Hirakud, Koyna, Chambal, and Rihand come within this group and from all of these about 1.7 million kW of power generating capacity is expected to be added during the second plan. A detailed list of these continuing schemes is given in statement V, in the Annexure.

34. Satisfactory progress has also been made in the construction of transmission lines for expanding the grid systems in the country. About 19,000 miles of sub-transmission and transmission lines of 11 kV and above, have been added during the first plan, representing an increase of 100 per cent over that of 1951.

35. There has also been a marked increase in the number of towns and villages which are served with electric power as will be seen from the following table:—

Population	1950-51*		1955-56	
	Total number according to 1941 census	Number electrified as at March 1951	Total number according to 1951 census	Number electrified as at March 1956
Over 1,00,000 . . .	49	49	73	73
50,000 to 1,00,000 . . .	88	88	111	111
20,000 to 50,000 . . .	277	240	401	366
10,000 to 20,000 . . .	607	260	856	350
5,000 to 10,000 . . .	2367	258	3101	1200
Less than 5,000 . . .	559062	2792	556565	5300
	562450	3687	561107	7400

*NOTE :—The electricity statistics available for 1950-51 are based on the number of villages as per 1941 census only, in view of the time lag in the publication of 1951 census data.

The total number of communities with a population of less than 10,000 which have received electricity has been more than doubled during the first plan period. The actual number of electrified villages with a population of less than 5000 has increased from 2792 to 5300.

36. As a result of the generation and distribution programmes referred to above, the *per capita* consumption in the country has increased from 14 units in 1950-51 to 25 in 1955-56.

37. The total plan provision for expenditure on power projects included in the first five year plan amounted to Rs. 260 crores including the proportionate cost of multipurpose projects. In major river valley projects like Bhakra-Nangal, D.V.C., Hirakud, Chambal, Koyna, Rihand, etc., where extensive civil works were involved, considerable delay was experienced during the initial stages in completing the investigations, in revising the scope of the projects and in setting up the necessary organisation for their execution. In addition, as the country had to depend largely on imported machinery and equipment for generation and transmission of power, delays occurred due to protracted deliveries from foreign manufacturers. Difficulties in the procurement of key materials like steel and cement were also experienced to some extent. Despite these difficulties, the progress on the power programme during the first plan period has been fairly satisfactory.

FUTURE DEVELOPMENT

38. Planning for power projects is a continuous process and has to be based on long-term objectives. At the time of formulation of the first plan, the 15-year target for additional power capacity was set at 7 million kW. In view of the progress which has been made and the growing demand for power from industry, small towns and rural areas, this target has to be revised upwards. So far as can be ascertained at the present time, for the second and third plans, it will be necessary to set forth, as an objective of planning, a rate of increase of about 20 per cent annually in the installed capacity of public utility undertakings. On this basis, the tentative target for 1965 would be to raise the total installed capacity in the country to about 15 million kW. In the nature of things a target such as this cannot be regarded as being rigid; adjustment will certainly be needed from time to time so as to take account of changes in the scope of industrial programmes, location of industrial units and the growth and pattern of consumption.

PROGRAMMES FOR THE SECOND PLAN

39. *Power plant capacity and generation.*—The power development programme under the second plan is intended to fulfil three aims:

- (a) to meet the normal load growth in the existing power systems,
- (b) to provide the requisite capacity for reasonable expansion of the areas of supply, and
- (c) to meet the needs of industries which are to be established under the second five year plan.

40. It is estimated that about 1.4 million kW. of additional power demand will arise on account of the normal development of medium and small industries and of commercial and domestic consumption. In addition to this, a further demand of 1.3 million kW is expected on account of new programmes of industrial development included in the second plan. Making allowance for the requisite standby capacity and for seasonal variations in water flow conditions in hydro-electric installations, it is estimated that an addition of 3.5 million kW will be required during the next five years. As more systematic load surveys are undertaken and details of industrial programmes are determined, these estimates may have to be reviewed. Out of the total requirement of 3.5 million kW of installed power plant capacity, 2.9 million kW will come from State-owned undertakings, 300,000 kW from companies in the electricity supply industry and the remaining 300,000 kW from the lignite project and from

steel, cement, paper and other factories which will have their own generating plant. The result of these programmes will be to increase the total installed capacity of power plant in the country from 3.4 million kW in March, 1956 to 6.9 million kW by March, 1961. The amount of energy generated is expected to increase from about 11,000 million units in 1955-56, to 22,000 million units in 1960-61. Corresponding to the programme of development indicated above the per capita consumption of electricity is expected to increase from 25 units at the end of the first plan to about 50 units at the end of the second plan. The details of the proposed increase in generating capacity and energy generated are given below:—

	1955-56	1960-61	Percentage increase during the second plan
<hr/>			
(1) <i>Installed capacity (kW in millions)</i>			
Public utility undertakings :			
(a) State-owned	1.4	4.3	207
(b) Company-owned	1.3	1.6	23
Self-generating industrial establishments	0.7	1.0	43
TOTAL	3.4	6.9	103
<hr/>			
2) <i>Energy generated (kWh in millions)</i>			
Public utility undertakings :			
(a) State-owned	4500	13500	200
(b) Company-owned	4300	5300	23
Self-generating industrial establishments .	2200	3200	45
TOTAL	11,000	22,000	100
<hr/>			

41. The addition of 2.9 million kW in power plant capacity, proposed for the public sector, will include 2.1 million kW of hydro-electric plant and 800,000 kW of thermal plant, the latter also including a small amount of diesel capacity. Forty four hydro and steam power generating schemes (both new and extension to existing stations) are proposed to be undertaken during the second plan, a list of which is given in Statement V in the Annexure. Of these, 25 are hydro-electric stations and 19 are thermal stations. Most of the new power schemes will yield benefits within the five-year period. A number of schemes which require further investigation will, however, be started in the second half of the plan, and financial provision for them has been made on this basis. In considering the details of the programmes of States, care has been taken to ensure that benefits from most of the projects will be available during the second plan period and will keep pace with the demand for power in the areas to be served. The programme of the private

sector provides for important plant additions in Calcutta, Ahmedabad and in the Tata power system as also additions in small sizes in a number of systems in Uttar Pradesh, Madhya Pradesh and Saurashtra all of which total to about 300,000 kW in the second plan period. A list of important plant additions by the companies in the electricity supply industry is also given in Statement V, in the Annexure.

42. *Financial outlay.*—A number of projects commenced in the first plan are at present in different stages of construction. A total outlay of Rs. 160 crores is required for these schemes during the second plan. An additional outlay of Rs. 245 crores is proposed for new schemes to be completed during the second plan and Rs. 22 crores for schemes, the benefits from which will be derived in the third plan. The outlay and benefits from the continuing and new schemes are shown below:—

	Outlay in the second plan Rs. crores	Benefits during the second plan (kW in	Benefits during the third plan million)
Schemes carried over from the first to the second plan	160	1·7	..
New schemes which will yield benefits during second plan	245	1·2	..
New schemes which will yield benefits during the third plan	22	..	0·9
TOTAL	427	2·9	0·9

Schemes included in the third group above will be taken up in the later stages of the plan period and will require an outlay of about Rs. 145 crores for completion during the third plan. Among the important projects in this category are Sileru (Andhra), Rana Pratapsagar (Rajasthan), Ukai (Bombay) and either the Pamba or the Pringalkuthu (Travancore-Cochin). The size of the power programmes of the different States in the second plan is shown in Statement VI in the Annexure.

43. An approximate breakdown of the capital outlay of Rs. 427 crores in the public sector into generation, transmission and distribution schemes is given below:—

	Rs. crores
Generation.	235
Transmission	92
Distribution in urban areas	25
Small town & rural electrification	75
	427

44. In terms of capital outlay, the new power generation schemes included in the second plan can be classified as follows:—

Schemes costing over 10 crores of rupees	10
Schemes costing between 5-10 crores of rupees	4
Schemes costing between 1-5 crores of rupees	18
Schemes costing less than 1 crore of rupees	12
	<hr/> 44 <hr/>

45. During the second plan private electricity supply companies are expected to invest about Rs. 42 crores, of which about Rs. 29 crores will be required for the installation of generating capacity and the balance for extensions to existing transmission and distribution systems.

46. *Hydro-electric and Thermal schemes.*—The selection of a hydro-electric or a thermal project has to be made on the basis of the long term or the short term need for power in any particular region. Thus, a number of medium sized thermal power station projects have been included in the plan for meeting the immediate power requirements of certain areas. The hydro, steam and diesel plant capacities as at March, 1951 and March, 1956 and the anticipated capacity in March, 1961 are set out below:—

Installed capacity of power plant—(kW in millions)

	In March 1951	Additions during the first plan	In March 1956	Additions during the second plan	In March 1961
Hydro	0.36	0.40	0.96	2.10	3.06
Steam	1.00	0.53	1.53	7.10	2.63
Diesel	0.15	0.06	0.21	0.02	0.23
TOTAL	1.71	1.01	2.72	3.22	5.94*

*NOTE 1.—These figures do not include the one million kW of plant installed in self-generating industries which are mostly thermal.

47. The programme of development proposed for the second plan visualizes hydro-electric capacity of more than twice the thermal plant. It is expected that this emphasis on hydro installations will continue for some time. At the same time thermal power development will also maintain more or less the present rate of growth. They are specially needed to firm up the large quantum of seasonal power in hydro-electric stations and to serve regions which are short of water power potential.

48. The existing diesel power plant capacity in public utilities is about 8% of the total and it would be replaced gradually by bulk supply from grid systems. A certain amount of new capacity, made up of small units, will be added for nursery schemes and for providing supply to isolated locations.

49. A study of the economics of atomic power generation in the country is being made by the Atomic Energy Department. From such studies as have been made it appears that nuclear energy may be competitive in areas far removed from sources of coal or with no hydro-electric resources. It is of utmost importance that India should remain abreast of developments in the field of nuclear power, and the Atomic Energy Department has drawn up a detailed programme of work.

50. *Grid systems and transmission lines.*—Power development during the past decade has proceeded in the direction of grid systems which carry power over long distances to serve extensive areas. Generation of power is confined, to a few large and efficient power stations which may be hydro or thermal or a combination of both, depending upon the resources available in a region. As a result of advances in transmission techniques, large blocks of power can now be economically transferred over distances of 300 to 400 miles. This makes it possible to harness hydro-electric potentials in different regions and to utilise power in widely separated centres of industry. Similarly, thermal power on a large scale can be produced economically in colliery areas, often using inferior grades of coal, and the power which is produced can be fed into grid lines and carried over hundreds of miles. This will also make it possible to provide power supply economically to rural areas lying alongside the routes of transmission lines connecting important urban and industrial load centres. Furthermore, regional grids can be inter-connected with one another so as to provide for inter-change of power and for achieving improved efficiency and economy, reduction in standby capacity and greater security of supply. A few examples of such inter-connections in India are (i) the Pykara, Mettur, Papanasam and Madras city systems in the Madras State, (ii) the two tie lines between the Madras and Travancore-Cochin State systems, (iii) linking of the Jog (Mysore) and Tungabhadra (Andhra) systems, (iv) inter-connection of Nangal and Delhi power stations with a future possibility of connecting them with the western Uttar Pradesh power system, and (v) inter-connection of D.V.C.'s thermal and hydro stations in Bihar with the Calcutta city system. A larger number of such inter-connections have to be established in future and it is recommended that grid systems in the various States should be planned to fit in with the general aim of inter-connecting as many power systems as possible and eventually of establishing an all-India grid.

51. The second plan provides for a total length of 35,000 miles of transmission and sub-transmission lines of voltages varying from 220 kV. to 11 kV. This addition represents a doubling of the transmission mileage constructed during the first plan.

SMALL TOWN AND RURAL ELECTRIFICATION

52. Out of 585 medium and large towns with a population of 20,000 and above, 550 have been electrified by the end of the first plan. In the next range of population, namely, 10,000 to 20,000, only 350 have been electrified out of a total of 856. All the remaining towns and small towns with a population of 10,000 and over will be electrified during the second plan. The development of small towns is essential also for the development of the adjoining rural areas.

53. In towns and villages with a population of less than 10,000 electrification raises difficult economic problems, especially in the villages. Most villages are comparatively distant from developed power sources. It is estimated that the average cost of providing distribution lines and sub-station equipments would be Rs. 60,000 to Rs. 70,000 per village and if all the villages in the country were to be electrified, the capital outlay involved in the distribution lines alone would exceed Rs. 3000 crores. The programme of rural electrification has thus to be on a phased basis. In the second plan, out of a total outlay of Rs. 427 crores on power programmes, about Rs. 75 crores will be spent on the electrification of small towns and villages.

54. In comparison with large urban areas, rural areas lack what is described as load density. The capital cost as well as the operation and maintenance charges are, therefore, much higher. The 'most practical approach to the problem is, in the first instance, to undertake extension of power supply to villages which lie in proximity to town areas where power supply exists. Similarly, wherever possible, supply lines should be constructed from grid transmission lines to villages lying near their routes. Further, in the financial working of the schemes, the urban and rural schemes should be integrated so that the surplus from the revenues realised from urban and industrial consumers can be utilised for reducing rates to rural consumers. There is justification for adjusting tariffs for urban and industrial consumers with a view to carrying out this policy. For rural electrification schemes it may not always be possible to apply the usual yardstick of financial return. In special cases, where electricity would provide large benefits to the community the State Governments, subject to their finances permitting, may even sponsor schemes which are not expected to be self-supporting within the usual period of 10 years.

55. In 1954-55 a scheme for the expansion of power facilities for providing employment opportunities was introduced. The object of this scheme was to improve the power position with a view to expanding employment opportunities in (i) rapidly growing small

and medium sized towns, (ii) suburbs of large towns already electrified, and (iii) community project areas in which, on account of the available skills and local resources or new development programmes, employment in small industries could be expanded by utilising power. For this purpose a loan amount of Rs. 20 crores was set apart by the Government of India for the various State Governments on easy terms of repayment over a long period. This programme, which includes a number of diesel generating stations and extensions to existing distribution systems, is now in progress and will be completed within 18 months from now. It is proposed that this form of assistance should continue during the second plan period.

56. For the successful implementation of rural schemes, a large amount of cooperative effort on the part of the people has to be organised by national extension and other field staff. In an area in which the demand for irrigation pumping or electrical working of small industries can be developed, the community project workers in cooperation with villagers, should make a careful survey of present and prospective needs and prepare schemes for utilizing electricity to the greatest possible advantage of the village economy. In many cases the people will be able to contribute a portion of the cost and provide labour for construction. Similarly, consumers' cooperative societies can be formed for the purchase of motors, pumps, etc. on easy terms and for servicing them. Under the second plan there is provision for extending power to over 10,000 villages, but through an intensive cooperative approach, more can be achieved with the existing financial provision.

57. In spite of the fair rate of expansion of grid systems, it would take a long time before power lines could reach the country-side in any large measure. Where there is scope for the utilisation of electricity in agriculture and in small industries local schemes could be undertaken in the form of diesel installations or in hilly areas through small hydro-electric stations. In this connection, reference may be made to research initiated recently by the Council of Scientific and Industrial Research for the development of wind power. It is hoped that some small working units would soon be evolved which could be installed in coastal areas with fairly high wind velocities for a part of the year. All these small-scale power schemes could be developed by co-operative efforts of the people with a certain amount of financial and the technical assistance from the State Governments. These schemes should be conceived as a part of the overall development of such localities so that the consuming industries are also developed side by side. Depending upon the use for electricity in the area, the

power stations and distribution lines could be designed and run on austerity standards for restricted hours and without full provision for standby capacity so that the utmost economy in working is achieved. Pilot schemes on these lines may be undertaken where conditions are favourable.

58. The following table gives the breakdown in terms of population range, and the number of towns and villages to be electrified by 1961.

Population Range]	Total number according to 1951 census	Number electrified as at March 1956	Number to be electrified as at March 1961
Over 1,00,000	73	73	73
50,000-1,00,000	111	111	111
20,000-50,000	401	366	401
10,000-20,000	856	350	856
5,000-10,000	3101	1200	2659
Less than 5,000	556565	5300	13900
	561107	7400	18000

It will be seen that about 10,600 additional towns and villages, of which 8600 will have less than 5000 population, are programmed to be electrified in the next five year period which will mean an increase of 140 per cent. over the present level.

UTILIZATION OF POWER

59. With growing emphasis on industrialisation and large-scale development of basic industries, the pattern of utilization of power by different consumer groups will show a gradual change. A shift towards increased consumption of power in industries can already be observed and is likely to become more marked by the end of the second plan, as may be seen from the statement below:—

	1950		1955		1960	
	Consumption kWh in millions	Percentage of total	Consumption kWh in millions	Percentage of total	Estimated consumption kWh in millions	Percentage of total
Domestic	525	12.7	800	11.5	1480	9.0
Commercial	309	7.4	500	7.1	984	6.0
Public lighting	60	1.5	110	1.6	250	1.5
Industrial	2609	62.7	4600	65.7	12000	72.0
Traction	319	7.4	440	6.3	655	4.0
Irrigation	162	3.9	260	3.7	655	4.0
Water works	182	4.4	290	4.1	576	3.5
TOTAL	4156*	100.0	7000*	100.0	16600*	100.0

*NOTE.— These figures represent the units sold by public utilities and exclude energy generated by self generating industrial establishments which is wholly consumed in industry.

There will be marked increase in industrial consumption which will rise from 4600 million units in 1955 to 12,000 million units in 1960. Pumping water for irrigation purposes provides the main demand for power in rural areas, and with the increased tempo of rural electrification, there will be substantial increase in the energy utilised for this purpose. Next to irrigation, power in rural areas is consumed by small industries. It is estimated that the energy utilised in rural areas may amount to about 7.5 per cent of the total.

III

FLOOD CONTROL

60. Floods occur frequently in some parts of the country and cause enormous damage. Large areas are inundated in Uttar Pradesh, Bihar, West Bengal and Assam and several towns suffer erosion year after year. Although the problem is not extensive or frequent in Jammu and Kashmir, Punjab, Pepsu, Orissa and Andhra, some areas in these States periodically suffer from floods. Inundation is also caused by the coastal rivers and by the sea in some areas in the South.

61. Many of the rivers traverse more than one State, and the problem of flood control is necessarily an inter-state problem. A Central Flood Control Board was therefore constituted in 1954 to draw up a coordinated flood control programme and to consider projects proposed by the States. Four River Commissions have been created for (i) the Ganga, (ii) the Brahmaputra, (iii) the rivers in North West and (iv) the rivers in Central India to assist the Central Flood Control Board in technical matters, including preparation of integrated plans for river basins. The Central Water and Power Commission has been strengthened by the addition of a Flood wing for assisting in the preparation of flood control schemes and drawing up of integrated plans, and for scrutinizing proposals received from the States.

62. When the first plan was drawn up, flood control schemes were envisaged as a part of multipurpose river projects and no separate provision was made for flood control programme. The floods of 1954 were, however, exceptionally heavy and highlighted the need to deal with the flood control in a coordinated and planned manner independently as a problem distinct from the development of irrigation and power. A tentative programme of works to be carried out during the first five year plan was prepared and a provision of Rs. 16.5 crores was made for assistance by way of loans to states for flood control schemes. A total amount of about Rs. 8 crores is likely to have been spent during the first Plan

63. Obviously, floods can neither be stopped completely, nor is it advisable to do so. Floods bring fine silt and add to fertility of the areas which they submerge. In some years, however, when they are abnormal, they cause great devastation and misery. To reduce frequency and extent of damage, the intensity of floods has to be controlled. This requires systematic programmes. The measures generally adopted are:—

- (i) embankments;
- (ii) storage reservoirs, preferably on the tributaries;
- (iii) detention basins, where the excess of flood waters may be stored for a short time;
- (iv) diversion of water from one river into another;
- (v) increasing the slope in the river by cutting across loops;
- (vi) dredging and channelling river reaches where water-way has been reduced by silting;
- (vii) local protection works such as revetments and spurs to safeguard particular areas against erosion; and
- (viii) afforestation and contour bunding.

64. A choice of appropriate methods depends on various factors and cannot be made without complete data. The preparation of a balanced scheme for a river basin is a complex engineering, economic and social problem. All factors have to be carefully considered in arriving at a suitable programme of works for each river basin, and the main difficulty in drawing up comprehensive plans is usually the lack of basic topographical, meteorological, geological and hydraulic data.

65. For want of essential data, it has not yet been possible to draw up comprehensive plans for flood control schemes. It is of primary importance that surveys should be completed and necessary data collected to formulate appropriate flood control proposals expeditiously. Until this is done, only protective works of an immediate nature which will eventually form part of comprehensive plans can be carried out.

66. The outline of the programme of flood control works has recently been drawn up by the Ministry of Irrigation and Power. It is divided into three phases:—

- (i) *Immediate*.—This will cover investigation, and preparation of plans and estimates. Revetments, spurs and embankments may be constructed in selected localities.

- (ii) *Short-term*.—During this phase, embankments and channel improvements will be undertaken. This type of protection will apply to a major portion of the areas subject to floods.
- (iii) *Long-term*.—This phase will cover construction of storage reservoirs on rivers and tributaries which will in general be taken up along with irrigation and power projects for multi-purpose development of the basin.

67. A provision of Rs. 60 crores has been made in the second plan for immediate and short term measures including Rs. 5 crores for surveys and collection of data. Soil conservation and afforestation are important measures for flood control and should be given special consideration in all flood control proposals.

68. While both the direct and indirect benefits of flood control works are considerable, it should be mentioned that such works may in certain conditions have adverse effects by depriving inundated areas of silt which has considerable fertilising value. The principal benefits of flood control works are in the greater economic security and continuous development which they ensure. As stated earlier, it is impracticable to provide complete protection against floods. Even if this were technically possible, the cost would be prohibitive. Flood control works selected for a region have, therefore, to be such as will conform to the local conditions and afford appreciable protection at reasonable cost.

IV

INVESTIGATIONS, SURVEYS AND RESEARCH

INVESTIGATIONS

69. For many irrigation projects proposed for the second five year plan the supporting data were either incomplete or inadequate. Continuous investigations are, therefore, required in a number of directions. First may be placed the need for more complete and better coordinated records of hydrologic data, that is the establishment at all strategic points of continuous records of precipitation, run off, underground water, and so on. Second, not unrelated to the collection of data recommended above, is a complete and fairly detailed inventory of all the water resources of each region—rivers, lakes and ponds and underground waters. Third, there should be continuous investigations of possible project areas and of promising specific projects. Irrigation projects take a long period to investigate. To ensure continuity in the development of water resources, project areas and projects should be defined and basic

engineering surveys carried out in advance. In the fourth place, determination of future desirable projects should be followed by detailed surveys followed by basic designs which can be revised and utilised when necessary. There are project areas in which the need for dams in the future is unquestionable. This need having been determined, at least the basic surveys including topographic maps, borings, etc. required for working out the nature and location of the dams should be made. Complete designs could be made in a relatively short time subsequently if the basic data from detailed surveys are in hand.

70. The need for such surveys was stressed in the first plan, but sufficient progress has not been achieved. In most States, the governmental organisations have been largely devoted to construction of projects and in certain States, the importance of investigations has not been adequately recognised. For projects included in the second plan which have not been fully investigated, it is essential that investigations should be completed and detailed reports prepared before actual construction is taken in hand. In some States, investigations are also required for working out alternative schemes which may, if found necessary, be substituted for the schemes included in the plan. We therefore attach the greatest importance to this work. Where necessary, separate staff under the respective public works or electricity departments should be put on this task specifically by the States. An amount of Rs. 5.9 crores has been provided in the plans of States for investigations and surveys: Rs. 4.4 crores under "Irrigation" and Rs. 1.5 crores under "Power". To avoid delays in the commencement of projects in the second plan and similar delays in the selection and commencement of additional projects in future a carefully worked out programme of investigations has great importance.

SURVEYS

71. *Power load surveys.*—During the last few years, the rate of utilisation of power has been more rapid than before. It is likely to rise during the second plan. In areas served by projects such as the Bhakra-Nangal, Hirakud, DVC and in the grid systems of Andhra, Bombay, Madras, Uttar Pradesh and Mysore the load prospects have far exceeded previous anticipations. The gradual lifting of restrictions on power supply in various parts of the country has been, to some extent, responsible for the increased demands. But even more than this, are the effects of economic development during the first five year plan. The present estimates of loads for the next ten years will probably have to be revised upwards. A systematic power load survey, is, therefore, urgently needed. The Ministry of Irrigation and Power have taken up the survey on a

national basis, and field data are being collected through four regional centres and will be compiled by the Central Water & Power Commission. The information available in the States will also be drawn upon and field work will be organised in collaboration with State Governments. The first survey is expected to be completed within the next three years.

72. Soil surveys.—The crop pattern in a region largely depends on soil and climate. Extension of irrigation alters the crop pattern in the area as diverse and more profitable crops can be grown with irrigation facilities. The change, however, depends largely on the soil conditions of the locality. Comprehensive soil surveys in all States will, therefore, be of considerable advantage in determining in advance the crops that can best be grown in the different regions. As quantities of water required for irrigation depend on the crops to be grown, the classification of soils is equally important for determining the proper sizes of canals and reservoirs. The proposals for such schemes are sometimes insufficiently related to these basic requirements.

73. Water requirements.—The water requirements of areas to be irrigated require careful assessment for determining the size and scope of an irrigation project. Data pertaining to proportion of areas irrigated to commanded areas and the water requirements are usually available in regions which are already under irrigation by wells or other sources. This is, however, only one of the factors in forecasting the water required for irrigation. Future changes in the crop pattern, improvement in economic conditions, difference in costs of application of water from the project and from alternative sources are other factors which influence the area that would ultimately be irrigated by the project. Areas already commanded by irrigation projects, and situated under similar conditions also yield valuable information. The compilation and correlation of existing information which would assist in estimating irrigation and water requirements in different basins, is a necessary step in the preparation of a comprehensive plan for irrigation in each State and should be taken in hand for areas not commanded by irrigation projects.

RESEARCH

74. Irrigation.—Problems connected with irrigation works hydraulics and soils are studied at the central research station at Poona and at 12 other research centres under State Governments. With increase in the programme of water resources development, the activities of these stations are likely to expand further. A new

research station is also proposed to be established by the Government of Assam. During the second plan it is proposed that these research stations should give attention to fundamental problems along with problems of applied engineering. The Central Board of Irrigation and Power has drawn up a scheme of research on basic problems such as cavitation in hydraulic structures, engineering properties of soils, use of puzzolonic materials with cement, air entrainment in concrete, subsoil flow in tubewell areas etc. The programmes will be carried out at various research stations and coordinated with the help of the board. Irrigation and agricultural research stations will have to collaborate in the study of certain problems such as the system of irrigation in relation to the soil type, interaction between soil fertility and efficient utilisation of irrigation water, critical periods of growth and quality of produce and relative merits of various systems of irrigation.

75. Power.—In view of the extensive power development envisaged in the second and subsequent plans effective research on problems relating to power generation, transmission and distribution has become urgent. The scope of the electrical equipment manufacturing industry in the country is also expected to increase rapidly and there is considerable need for research in this direction. The lines on which research should proceed are now being examined by a technical committee appointed by the Government of India. The following are a few illustrations of problems on which research could be undertaken usefully in the near future.

- (i) uses of indigenous materials in the electrical industry, particularly for insulating purposes.
- (ii) development and testing of special designs for transmission towers, including wood pole supports.
- (iii) development of equipment and designs for rural electrification.
- (iv) development of D.C. transmission technique.
- (v) cavitation in hydraulic structures.
- (vi) lightning protection and attenuation of surges on transmission lines.
- (vii) corona under impulse conditions.
- (viii) coordination of transmission lines and sub-station equipment.
- (ix) loading and temperature conditions for power and distribution transformers and
- (x) high voltage switchgear testing and development of new switchgear designs.

Provision has been made in the second five year plan for the establishment of a power engineering research laboratory during the second plan period. The project also includes a suitable switch-gear testing station for very high voltages.

76. *Other programmes.*—Besides investigations, surveys and research the programmes of the Ministry of Irrigation and Power will include (i) the setting up of an Engineering Museum at Delhi for displaying models of various projects for general information, (ii) establishment of centres for training operators and mechanics for heavy earth-moving equipments and (iii) training in the new technique of "hot line work" for maintenance of electric transmission and distribution lines and other equipments on which there is no experience so far. A provision of Rs. 9 crores has been made for investigations, surveys and research on irrigation and power in the second plan in addition to Rs. 5.9 crores distributed in the various State plans.

V

PLANNING AND ORGANISATION

77. *Integrated development.*—For achievement of optimum benefits, development schemes of different states have to be closely coordinated. Water stored in reservoirs in one state may be used with advantage for irrigation in adjoining states. Similarly, power available in one state may be distributed in other states. In certain cases, it may be useful to divert waters from one basin to another for the benefit of the region as a whole. Co-operation between States is, therefore, essential for investigations, allocation of waters and sharing of costs. Differences however, often arise between States in regard to the sharing of costs and benefits of such schemes. In order to resolve such difficulties, the Government of India have introduced two bills in Parliament, namely, River Boards Bill, 1955 and the Inter-State Water Disputes Bill, 1955. The first bill would enable the Government of India to constitute boards for different inter-state rivers or river valleys in consultation with the States concerned. These boards will be entrusted with the work of the preparation of schemes, allocation of costs and benefits and coordination of the activities of the State organisations etc. The second bill provides for the constitution of tribunals with the necessary authority for the adjudication of disputes between two or more States in respect of river valley projects and their benefits.

78. *Obtaining of maximum benefits from projects.*—The phasing of irrigation and power projects and their execution should be carefully arranged to yield maximum returns from investment at each stage. Invariably it is possible through better organisation and planning to obtain larger benefits from expenditure incurred.

79. This aspect has not always received sufficient attention in carrying out projects in the first five year plan. There have been instances where reservoirs were completed before the associated canal systems, land had not been prepared for irrigation when canal systems were completed, sub-station equipments and transmission lines were not erected when consumers were ready to take power and generating stations commenced operation, tube wells were drilled without arrangements in advance for power supply and so on. These defects in planning and execution lock up capital and obviously involve waste of resources. Every effort should be made to ensure that these do not occur in the second plan.

80. To obtain maximum results, benefits should accrue at each stage and there should be no time lag between the availability of benefits and their utilization. All inter-related activities should, therefore, be carefully coordinated. Before starting work on a project detailed investigations should be made and the scope of the works to be included in the programme clearly determined. Project reports, estimates and financial forecasts should be complete and changes in them should be necessary only for special reasons. Increases in estimates in a number of major projects in recent years have evoked adverse comment. Arrangements for financing should be settled in advance and the requirements of staff should be carefully worked out for different stages of each project and steps taken for their placement at the appropriate time.

81. The phasing of projects calls for attention from another important point of view. It is of the utmost importance that irrigation from reservoirs should be fully utilised as soon as water is stored in them. This means, firstly, that the canal system should be completed, including field channels, at the same time as the reservoir and secondly that the agriculturists should have their lands ready for wet cultivation when the water becomes available. The same considerations apply to power projects. The first is largely a matter of planning the works and the order in which they should be carried out. As regards the second, steps should be taken to prepare the people for using water and electricity and they should be guided and assisted in their scientific use so that the maximum increase in production can be realised. Demonstration farms should be started at selected localities and the lands which will benefit made fit for irrigation by the time water becomes available. In this the national extension movement has an important role to play and should be utilised from the start for ensuring that all the preparatory steps are taken by the agriculturists in the area to utilise irrigation when it is available and in power projects, to build up the demand for power and also the arrangements for its use as soon as it is supplied.

82. *Public Co-operation.*—For the successful completion of projects, a large measure of public cooperation is of fundamental importance. The average citizen is able to see vividly and to contribute actively to work that lies near him, or touches his life and well-being intimately. Irrigation and flood control programmes thus provide a good opportunity for seeking the cooperation of the people and in this vital field of national development there is vast scope for voluntary effort. The State Governments' attention was invited to this important point in the first plan, and it was recommended that works on which unskilled labour is almost entirely employed, like the canal systems, should, as a rule, be done by the villagers themselves and not through contractors and that in each village or group of villages the villagers should be organised into cooperatives taking up the work in their own area. Apart from saving in cost the system has the following advantages:—

- (i) The villages will benefit by the large sums spent on the canal system which will come into the cooperative movement and will be available for agricultural improvements.
- (ii) Cooperation among villagers over large areas in executing works of such magnitude will lead to cooperation in other spheres and assist in raising their level of life.
- (iii) The organisation set up during the execution of the canal system will be useful in its maintenance, in the distribution of water and in measures for effecting economy in use of water.

The progress on this has however been extremely limited. Only a beginning was made by the formation of labour cooperatives on the Gangapur, Ghataprabha, Mahi and, Kakrapar projects in Bombay. Some response from the public also came forth in connection with the raising of the village sites in eastern Uttar Pradesh and on the protection works at Dibrugarh in Assam. Except on the Kosi Project where very satisfactory progress is reported to have been made with the assistance of the Bharat Sevak Samaj, the results have on the whole been poor. Nevertheless, these instances of peoples' participation reveal the great possibilities of this method.

83. The scope for this is even greater in the second plan as there are large numbers of medium projects spread all over the country and it is expected that such participation will be organised from the very commencement of the works. A sum of Rs. 1 crore has been provided for enlisting the desired public cooperation on the various projects in the second plan.

84. *Betterment Levy.*—The most important and difficult issue connected with the second five year plan is the raising of capital resources. Every effort has, therefore, to be made to add to them and an equitable way is to levy betterment contribution on areas benefited by irrigation projects. About 6·3 million acres of land will have received canal irrigation from major and medium projects in the first plan and 12 million acres are expected to be irrigated in the second plan. Betterment levy on all these areas will evidently make a useful contribution to capital resources.

85. The principle of betterment levy has been confirmed more than once by the National Development Council and is now the accepted policy of the country. Legislation has already been passed in Assam, Andhra, Bombay, Madras, Punjab, Hyderabad, Mysore, Pepsu, Rajasthan, Himachal Pradesh, and Orissa, and Bills have been prepared in Madhya Pradesh, Madhya Bharat, Travancore-Cochin, Bihar, West Bengal and Saurashtra. Although a number of projects have started irrigation in different States, for example, the Bhakra Nangal, the Kakrapar, the Mayurakshi etc. realisations have not commenced in any State. Legislation should, therefore, be passed immediately in States where this has not been done, and necessary steps taken to commence realisations as soon as possible.

86. Lands irrigated by tubewells also derive secure irrigation. More than 2 million acres are expected to be irrigated by tube wells in the second plan. It is equitable that beneficiaries from tube wells and such other minor irrigation works which provide secure irrigation are also included in the scope of legislation and required to pay betterment contribution.

87. Betterment levy should be related to increase in value of land, and being a capital levy should either be paid in lump sum or instalments spreading over a period not exceeding 15 years. The state should also have power to recover it in the shape of land. This provision will be useful for acquiring land for community purposes, consolidation of holdings, and settlement of displaced persons and landless labourers.

88. *Rates for Water and Power.*—The Project costs are now considerably more than in the past. Similarly, the cost of maintenance is higher than before. Production increases considerably as a result of irrigation and a portion of the increased produce must be returned to meet the cost of maintenance. Existing water rates were, in many cases, determined years ago. There has since been considerable increase in the value of crops produced. Increases in water rates are therefore, clearly justified and it is

necessary that the possibility is explored by State Governments urgently. The water rates were revised in Travancore-Cochin, Madhya Bharat, Rajasthan, Andhra, Punjab, Uttar Pradesh, and Bihar and the question is under consideration in Orissa, Assam, Madras and Mysore. Similar review of power rates on a rational basis may also be made in respect of power projects so that the electric supply undertakings work on a self sufficient basis. The subject needs further attention and early steps should be taken in all States, particularly where no action has been taken so far.

89. *Selection of Projects.*—In October, 1953, a Technical Advisory Committee was constituted by the Planning Commission to examine the projects proposed by the State Governments and to advise the Planning Commission on the technical and financial soundness of the various proposals. The number of projects which have been tentatively included in the second plan and those for which project reports have been received are given below:—

	Irrigation		Power	
	No. of Schemes	Estimated cost in Rs. crores	No. of schemes	Estimated cost in Rs. crores
1. Total number of projects tentatively included in the second plan . . .	195	376	181	423
2. Schemes for which project reports have been received (Excluding Investigation Schemes)	70	277	117	386

The Committee has drawn pointed attention to the unsatisfactory position regarding the investigation and finalisation of the projects. In the case of a number of schemes, for which project reports were received and examined by the Committee, it was found that the investigations were not complete and the reports lacked details essential for technical and financial scrutiny. However, a number of such projects have been provisionally included in the plan for regional and other considerations, in anticipation of further investigation and detailed revision of the scope and estimate of the projects. The project reports for the schemes provisionally included will be examined by a committee comprising of the representatives of the Planning Commission, Ministries of Irrigation and Power and Finance and specialists in the field who may be associated with the work of the committee from time to time.

90. *Key materials.*—Based on preliminary estimates, the essential key materials required for the irrigation, power and flood control programmes in the second plan are listed below:

Five year requirements of		Irrigation & flood control	Power	Total over 5 year period
Steel (tons in Million)	. . . .	0.15	0.6	0.75
Cement	Do. . . .	4.8	7	6.5
Coal	Do. . . .	0.5	24.5	25.0

91. For being able to obtain these materials according to schedule, it is essential for every project authority and State government to carefully assess and communicate their requirements to the coordinating authority sufficiently in advance. The Central Water and Power Commission with their constant touch with the progress, will periodically assess the needs of the various projects and make suitable recommendations in this regard.

92. In view of the acute shortage of these key materials the urgency and importance of measures to economise their use need hardly be stressed. All avoidable use should be scrupulously cut down by proper design and construction methods. For example, the use of (i) reinforced concrete in place of steel structurals, (ii) masonry in preference to reinforced concrete, (iii) lime mortar in the place of cement and such other methods should receive greater attention. Indigenous materials like timber etc. should be put to greater use wherever possible for reducing the demand for steel and cement which will have to be imported from other countries in increasing measure in the second plan.

93. *Heavy electrical equipment.*—For the plant and machinery required for power projects, the country is largely dependent on imports. Only a few items of light electrical equipment such as transformers, small motors, conductors, wires, lamps etc. are being manufactured in the country. Even here the full needs are not being met. The annual imports of electrical equipment during the last 2 years is of the order of Rs. 30 crores, of which heavy electrical equipment alone was of the order of Rs. 20 crores per year. During the second and the third plans the requirements of electrical equipment would increase substantially. It has, therefore, become a matter of urgency to create manufacturing capacity in the country. Accordingly, it has been decided to establish a factory for manufacturing heavy electrical equipment such as hydraulic turbines, alternators, motors transformers, switchgear

etc. Preliminary work on this project is now in progress. It is expected that the factory will go into production in 1961 and meet a part of the country's requirements thereafter.

94. Foreign Exchange.—The programme for Irrigation and Power envisaged in the second plan would need about Rs. 150 crores of foreign exchange for power projects and Rs. 20 crores for irrigation projects during the next 5 years. In view of the compelling need to reduce the demand on the foreign exchange, every effort should be made by the project authorities to eliminate avoidable indents on imported machinery.

95. Personnel and Employment.—Technical personnel is a primary need for the implementation of the construction programme in the second plan which is about 50% higher than in the first plan. The need for adequately trained personnel at all levels was keenly felt even in the first plan. To assess the availability and requirements of the personnel in future years, and to recommend proper arrangements for training the required number, a River Valley Projects Technical Personnel Committee was constituted by the Ministry of Irrigation & Power in 1954. This Committee observed that the position in respect of technical personnel will become acute in the early periods of the second plan. As the scope of examination of this Committee was limited to the requirements of river valley projects only, the Planning Commission, on further consideration, appointed a more comprehensive 'Engineering Personnel Committee' to assess the position in respect of the engineering personnel required in all fields of developmental activity including Industries, Railways, Highways etc. This Committee has assessed, that for Irrigation and Power Projects the additional requirements of engineers and supervisors will be as follows:—

Officers	Civil	Mechanical & Electrical
Engineering Graduates . . .	2100	1600
Supervisors (Diploma holders) . .	9000	4000

Adequate steps have to be taken by Government for training of engineering personnel for the plan. Programmes for specialised training for fresh engineers, refresher courses for serving engineers and training of operators and mechanics at project sites have been started on a limited scale. To supplement this programme it would be useful for the irrigation and power departments to introduce systematic internal training programmes of a specialised nature for the various types of technicians.

96. The average number of persons likely to be employed continuously over the next 5 years, on the construction works of Irrigation & Power projects is roughly estimated to be as follows:—

	Irrigation and flood control	Power	Total
Administrative	8,000	7,000	15,000
Technical (Supervisory)	15,000	10,000	25,000
Skilled	30,000	30,000	60,000
Unskilled	180,000	100,000	280,000
TOTAL	233,000	147,000	380,000

The works programmed during the second plan when completed, will provide permanent employment for 50,000 (35,000 for power and 15,000 for irrigation) additional men at all levels. These figures exclude the indirect employment that will be created as a result of the power and irrigation works.

97. The use of construction machinery on river valley projects should be viewed against the background of the huge man power available in the country and the urgent need for providing gainful employment for them. Indiscriminate and extensive use of machinery imposes additional strain on the country's foreign exchange position. It is hoped that State Governments and project authorities will, devote greatest attention to this matter and, consistent with economy and speed in realisation of benefits, limit mechanised construction technique to the minimum.

98. *Organization.*—Execution of irrigation and electricity projects is primarily the responsibility of State Governments. In several States, particularly those in which development projects have been under execution during the last few decades, a degree of technical and administrative efficiency has been built up. In others, the existing organisations will need strengthening before they can undertake large programmes successfully. The C.W. & P.C. has been rendering technical assistance to States where required. For the successful implementation of the irrigation and power programme the State organisations and the Central Water and Power Commission should continue to work in close cooperation.

99. The question as to what should be the most suitable type of organisation through which the river valley projects should be administered and executed is of considerable importance. The usual agency of the Irrigation & Power departments of the States, has not been found to be sufficiently flexible in many cases. As the

aim is to achieve economy with speed, the administering organisations should have adequate powers to take quick decisions. Expenditure on major projects is now largely met by financial assistance from the Centre. The Central Government is, therefore, directly interested in the efficient and economical execution of these projects. It was, therefore, recognised that a high power board consisting of representatives of the Centre and the concerned State Governments would be the proper kind of set-up for laying down policy and exercising general supervision over the execution of the project. During the last few years, a number of Control Boards have been formed for large river valley projects viz., Bhakra-Nangal, Hirakud, Rihand, Chambal, Koyna, Kosi, Nagarjunasagar and Tungabhadra. The only case where a statutory agency has been constituted for an inter-state development project is the Damodar Valley Corporation. The experience gained so far seems to indicate that the control board is the most suitable type of organisation for the execution of large river valley projects.

100. Most of the State Governments are managing their electricity undertakings through their public works departments. In conformity with the Electricity Supply Act, the States of Madhya Pradesh, West Bengal, Bombay, Delhi and Saurashtra have already constituted the State Electricity Boards. It is expected that some of the other States would also be forming Boards in the near future. These organisations with the semi-autonomous power vested in them would be suitable for the construction and operation of power schemes, except for major projects, where the construction work may be entrusted to a special agency as the one referred to in the above paragraph.

101. In view of the large programmes of irrigation and power development required all over the country and the urgency of special attention for backward regions, the Central and State Governments should work in close cooperation in the execution and development of important irrigation and power projects. It is, therefore, essential that engineers should be recruited and trained on a common basis and that they should have uniform standards of efficiency and the feeling of belonging to common and important cadres. For all this, an efficient and well organised service of engineers is urgently needed. This service would also yield a pool of engineers from which men with particular lines of experience can be made available to new schemes whenever required. The State Re-organisation Commission have also recommended the need for the constitution of an all-India service of engineers. The Planning Commission recommend that the States should cooperate with the Central Government in establishing such an organisation as early as possible.

ANNEXURE

Statement I

List of Principal Irrigation Works

(Referred to in para 5)

Name of Scheme	Year of completion	Total capital outlay (Rs. lakhs)	Area irrigated ('000 acres)
1	2	3	4
Andhra			
Romperu Drainage	1956	153	10
Tungabhadra	1956	2544	167
Godavari Delta System	1890	210	1299
Krishna Delta	1898	227	1002
Rallapad	1956	90	8
Bihar			
Sone Canals	1875	268	655
Tribeni Canal Extension	1957	113	62
Bombay			
Nira Left Bank Canal	1906	148	90
Paravara Canals	1926	151	90
Gangapur Reservoir	1957	334	45
Nira Right Bank Canals	1938	412	89
Gataprabha Left Bank Canal	1957	545	138
Kakrapara Canals (Lower Tapi)	1957	1101	562
Madhya Pradesh			
Tandula Canals	1925	120	158
Mahanadi Canals	1927	159	199
Madras			
Periyar System	1897	108	202
Cauvery Mettur	1934	646	232
Lower Bhavani	1955	961	207
Malampuzha	1957	528	46
Araniar Reservoir	1957	104	3
Walayar Reservoir	1957	113	7
Orissa			
Orissa Canals	1895	380	40
Punjab			
Western Jumna Canals	1820	204	1018
Upper Bari Doab Canal	1879	..	783
Sirhind Canal	1884	267	2312
Eastern Canal	1928	114	190
Nangal Barrage	1954	406	..
Uttar Pradesh			
Ganga Canal	1856	486	1620
Agra Canal	1875	129	343
Lower Ganga canal	1880	467	1251
Sarda canal	1930	1157	1297
Extension of Sarda canal	1955	110	176
Sarda Canal Reservoir (Stage I).	1957	480	172
Mata Tila (Stage I)	1956	488	265

Name of Scheme	Year of completion	Total capital outlay Rs. lakhs	Area irrigated ('000 acres)
1	2	3	4
<i>West Bengal</i>			
Damodar Canals . . . . .	..	128	184
Mayurakshi	1958	1611	600
<i>Hyderabad</i>			
Nizam Sagar	1940	472	275
Godavari (Stage I)	1957	441	67
<i>Mysore</i>			
Krishnarajasagar Canals	1932	260	92
Tunga Anicut	1957	231	22
Nugu	1957	244	20
Tungabhadra	1956	1022	93
<i>Rajasthan</i>			
Jawai Project	1956	300	45
Parbati Project	1956	80	15
Meja Project	1956	59	43
<i>Travancore-Cochin</i>			
Kuttanad	1956	101	21
Peechi	1956	205	46
Perinchandi	1955	67	6
Neyyar ₁	1956	143	31
<i>Jammu & Kashmir</i>			
Sind Valley	1956	124	18
<i>Saurashtra</i>			
Rangola	1952	62	
Brahmani	1956	100	
Moj	1954	81	
Aji	1955	80	
Machha	1956	125	



STATEMENT II

Statements of Cultivated and (net) irrigated area—1954-55. (Provisional)
(Referred to in para 6)

(Area in thousand acres)

State	Gross area	Classified area	Culturable area	Culti- vated area	Net sown area	Areas irrigated by					Percent- tage of targe of col. column					Percent- targe of col. column				
						Govt. canals.	Tanks	Private canals	Wells	Other sources	Total	6 to 4	12 to 6	12 to 5	12 to 4	6 to 4	12 to 6	12 to 5	12 to 4	
I	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					
Andhra	40,711	40,572	24,570	18,495	16,204	2,805	1,498	63	421	181	4,968	66.0	30.6	26.9	20.2					
Assam	54,408	35,714	7,685	5,670	5,031	182	(a)	767	..	733	1,682	65.5	33.4	29.7	21.9					
Bihar	45,011	44,790	29,685	24,106	19,805	748	803	302	454*	1,889	4,196	66.7	21.1	17.4	14.1					
Bombay	71,213	71,139	52,691	44,370	43,186	476	188	69	1,590*	93	2,416	81.9	5.6	5.4	4.6					
Madhya Pra- desh	83,375	82,924	45,129	32,349	31,017	876	724	(a)	239	97	1,936	68.7	6.2	6.0	4.3					
Madras	38,632	38,452	25,951	19,051	16,636	1,939	2,040	5	1,187	137	5,308	64.1	31.9	27.8	20.6					
Orissa	38,487	38,401	22,984	16,206	13,825	471	686	76	70	632	1,935	60.1	13.9	11.9	8.4					
Punjab	23,922	23,919	15,849	13,917	13,307	3,245	7	141	1,861*	24	5,278	83.9	39.6	37.9	33.3					
Uttar Pradesh	72,597	74,774	52,937	42,057	41,652	4,426	1,035	37	5,999*	738	12,235	78.8	29.4	29.1	23.2					
West Bengal	19,693	19,846	14,675	13,105	11,860	420	870	950	40	570	2,850	80.8	23.2	20.9	18.7					
Hyderabad	52,572	51,045	40,839	33,900	29,463	254	1,068	8	638	59	2,027	72.1	6.8	6.0	4.9					
Madhya Bharat	29,785	28,294	19,707	12,257	12,031	159	25	..	368	10	562	61.1	4.7	4.6	2.9					
Mysore	21,316	19,584	14,913	9,130	7,929	309	561	6	123	140	1,139	53.2	14.4	12.5	7.6					
P.E.P.S.U.	6,431	6,371	5,869	5,136	4,675	1,619	..	..	743*	23	2,385	79.9	51.0	14.5	40.6					

Rajasthan	83,327	83,160	58,697	128,612	15,805	818	140	7	1,581	68	2,914	43.9	11.3	10.2	4.9
Surashtra]	13,655	12.9	9,187	8,417	8,187	47	..	..	390	3	440	89.1	5.4	5.2	4.7
Travancore-Cochin	5,852	5,658	3,257	2,865	2,821	346	113	68	26	368	921	86.6	32.6	32.1	28.3
Jammu and Kashmir	59,379	5,507	2,813	1,943	1,681	200	..	421	..	49	670	59.9	39.8	34.5	23.8
Ajmer	1,547	1,549	967	577	366	..	18	..	112	1	131	38.8	35.8	23.7	13.6
Bhopal	4,402	4,406	2,714	1,828	1,802	4	3	(a)	16	4	27	66.4	1.5	1.4	1.0
Coorg	1,015	1,012	431	205	204	5	3	(a)	..	1	9	47.3	4.4	4.4	2.1
Delhi	366	566	287	230	230	44	6	..	47	..	97	80.1	42.2	42.2	33.8
Himachal Pradesh	6,982	2,313	1,756	719	679	..	..	..	(a)	95	95	38.7	14.1	13.2	5.4
Kutch	10,864	10,864	2,716	1,634	1,209	14	2	..	83	..	99	44.5	8.1	6.1	3.7
Manipur	5,522	346	311	218	218	N.A.	..	145	..	..	145	69.8	..	..	..
Tripura	2,580	2,634	994	503	479	..	..	..	..	..	..	48.2	..	..	..
Vindhya Pradesh	15,104	14,848	9,278	5,569	4,602	4	27	..	169	2	202	49.	4.4	3.6	2.2
Andaman and Nicobar Islands	2,058	82	29	13	12	..	..	..	..	..	..	41.4	..	..	..
N.E.F.A.	N.A.	N.A.	N.A.	N.A.	N.A.	..	..	..	..	..	..	..	..	..	..
Pondicherry	73	N.A.	57	57	54	19	..	..	..	..	19	90.4	3.5	3.3	3.3
TOTAL	8,10,879	7,21,739	4,66,868	34,31,79	31,49,70	19,430	9,817	3,065	16,457	5,917	54,686	67.5	17.3	15.9	11.7

N.B.—The figures given Statewise are provisional and those for Manipur still need verification. Culturable Area=Classified area —(Forests+Not available for cultivation)

(a) Figures less than 500 acres.

• Figures include area under State Tube Wells.

Cultivated area=Net Sown Area+Current Fallows.

STATEMENT III

Principal Irrigation Projects in the Second Five Year Plan:

(Referred to in Para 16)

Name of Scheme & State	Total cost (Rs. lakhs) (approximate)	Expenditure in Second Plan for Irrigation (Rs. lakhs)	Benefits ('000 acres)	
			On completion.	during Second Plan
I	2	3	4	5
<i>Continuing Schemes</i>				
1. Bhakra Nangal (Punjab, Pepsu, & Rajasthan)	16,000†	2,823	3,604	2,347
2. Damodar Valley (West Bengal and Bihar)	8,600†	993	1,141	750
3. Hirakud (Stage I) including Mahanadi Delta (Orissa)	8,570†	2,194	1,785	1,288
4. Chambal (Stage I) (Rajasthan & Madhya Bharat)	4,803†	2,105	1,100	480
5. Tungabhadra (Hyderabad, Andhra and Mysore)	6,000†	550	700	370
6. Mayurakshi (West Bengal)	1,611†	212	600	600
7. Bhadra (Mysore)	1,775†	1,102	224	179
8. Kosi (Bihar)	4,595	1,700	1,600	..
9. Nagarjunasagar (Stage I) (Andhra & Hyderabad)	7,508	3,400	1,910	..
10. Tungabhadra High Level Canal (Andhra & Mysore)	1,896	620	380	24
11. Kakrapar Canal (Lower Tapi) (Bombay)	1,101	386	562	309

† Includes outlay on power portion.

* Figures are yet to be finally accepted.

Name of Scheme & State	Total Cost (Rs. lakhs) (approximate)	Expenditure in Second Plan for Irrigation (Rs. lakhs)	Benefits ('000 acres)	
			On completion	during Second Plan
1	2	3	4	5
<i>New Schemes</i>				
*1. Ukai (Bombay)	6,000†	650	614	..
*2. Tawa (Madhya Pradesh)	1,839†	711	590	..
3. Purna (Hyderabad)	773†	500	157	60
*4. Varnasadhara (Andhra)	1,256	100	306	..
5. Narmada (Bombay)	2,500	400	1,157	..
*6. Banas (Bombay)	737	300	120	..
7. Mula (Bombay)	839	350	204	..
8. Girna (Bombay)	808	550	184	20
9. Khadakwasla (Bombay)	1,182	400	204	..
10. New Kattalai (Madras)	149	148	21	12
11. Salandi (Orissa)	445	425	353	172
12. Gurgaon Canal (Punjab)	230	154	106	50
*13. Kangsabati (W. Bengal)	2,514	500	950	..
14. Chandrakeshar (Madhya Bharat)	75	75	15	15
15. Kabini (Mysore)	250	250	30	6
*16. Banas (Rajasthan)	480	280	250	10
17. Bhadar (Saurashtra)	400	106	90	..
18. Boothathankettu (Travancore-Cochin)	348	348	63	32
19. Lidder Canal (Jammu & Kashmir)	75	58	15	5
*20. Barna or Kolar (Bhopal)	400/500†	230	250	..
21. Laxminathirtha (Coorg)	25	25	3	3
22. Kasayari (Vindhya Pradesh)	160	25	40	..
23. Vidur (Pondicherry & Madras)	61	61	4	4

† Includes outlay on power portion.

* Figures are yet to be finally accepted.

Mysore	.	.	.	3,081	2,850	478	3,328	1,653.8	138	90	188	414	212
PEPSU	.	.	.	2,364	2,333	4	2,337	593.0	634	..	634	..	173
Rajasthan	.	.	.	5,331	4,342	1,375	5,717	2,450.0	880	255	1,135	1,237	1,195
Saurashtra	.	.	.	1,382	813	684	1,497	918.6	100	41	141	294	114
Travancore-Cochin	.	.	.	767	599	564	1,163	617.4	100	75	175	..	31
J. & K.	.	.	.	509	158	301	459	282.7	97	60	157	100	56
Ajmer	.	.	.	50	42	83	125	95.3	9	12	21	21	6
Bhopal	.	.	.	10	..	565	565	280.3	..	12	12	270	250
Coorg	.	.	.	..	..	25	25	23.8	..	3	3	..	..
Delhi	.	.	.	..	..	15	15	16.6	..	21	21	..	..
Himachal Pradesh	.	.	.	80	..	..	..	..	76	..	76	..	..
Kutch	.	.	.	145	137	47	184	92.3	24	17	41	..	9
Manipur	.	.	.	..	..	10	10	9.5	..	..	..	..	..
Tripura	.	.	.	..	..	..	..	..	..	..	..	..	..
Vindhya Pradesh.	.	.	.	81	81	355	436	233.5	25	68	93	136	84
Andaman & Nicobar Islands	.	.	.	..	..	..	..	..	..	..	..	..	..
North-East Frontier Agency	.	.	.	..	..	..	..	..	..	..	..	..	..
Pondicherry	.	.	.	..	..	33	33	23.5	..	2	2	..	..
TOTAL	.	.	.	71,762	59,559	37,644	97,203	38,097.7	9,048	2,946	11,994	27,331	18,854

Principal Power Generation Schemes in Second Plan

(Referred to in paragraphs 33 and 41)

(i) Public Sector.

Scheme & Name of the State	Total cost	Expendi- ture in Second Plan for Power	Benefits '000 kW	
			On com- pletion	In Second Plan
	Rs. lakhs.	Rs. lakhs.		
<i>Continuing Schemes</i>				
1. Tungabhadra (Andhra Hyderabad & Mysore) .	*6,000	793	34	34
2. Bhakra Nangal (Pun- jab, PEPSU & Rajas- than) .	*16,000	2,769	594	546
3. Hirakud (Stage I) Ori- ssa) .	* 8,370	803	123	123
4. D. V. G. (Bengal and Bihar). .	*8,600	1,062	254	100
5. Chambal (Stage I), (Ma- dhya Bharat & Rajas- than) .	*4,803	1,330	69	69
6. Machkund (Andhra and Orissa) .	2,732	611	85	51
7. Umrta (Assam) .	158	53	7.5	7.5
8. Koyna (Bombay) .	3,322	2,900	240	240
9. Periyar (Madras). .	1,048	798	105	105
10. Madras Thermal Sta- tion extension (Madras)	1,043	271	60	30
11. Rihand (U. P.) .	4,526	2,600	250	150
12. Ramagundam (Hyder- abad) .	406	32	38	38
13. Thermal Power Station (Rajasthan) .	310	216	24	24
14. Meriamangalam (T. C. State). .	290	260	45	45
15. Poringalkuthu (T. C. State). .	346	20	32	32
<i>New Schemes</i>				
1. Ukai (Bombay)† .	*6,000	..	160	..
2. Tawa (Madhya Pradesh) .	*1,839	..	30	..

*The total cost shown includes outlay on irrigation portion.

†Figures are yet to be finally accepted.

Scheme & Name of State	Total cost	Expenditure in Second Plan for Power	Benefits '000 kW	
			On completion	In Second Plan
	Rs. lakhs	Rs. lakhs		
1. Purna (Hyderabad)	*773	218	10	10
4. Chambal Stage II (M. Bharat & Rajasthan)	*1,356	500	92	23
5. Silera (Andhra)	2,453	50	73	..
6. Machkund Extn. (Andhra and Orissa)	280	250	17	17
7. Tungabhadra Nellore scheme (Andhra and Mysore)	770	725	66	66
8. Umtru Stage II (Assam)	100	100	5	5
9. Cherapunjee Steam Station (Assam)	70	60	5	5
10. Barauni Steam Station (Bihar)	484	484	20	20
11. South Gujarat Elec. Grid Stage II (Bombay)	450	400	45	45
12. Korba Thermal Station (M. Pradesh)	1,234	[1,179]	90	90
13. Southern Grid Extension (M. Pradesh)	777	777	60	60
14. Katni Power Station (M. Pradesh)	270	270	20]	20
15. Kundah (Madras)	3,544	[2,300	180	145
16. Pykara dam (Madras)	30	30	3	3
17. Papanasam dam (Madras)	41	41	4	4
18. Hirakud Stage II (Orissa)	1,432	[1,250	109	109
19. Yamuna Hydel Scheme (U. P.)	2,083	990	201	51
20. A Scheme in western U. P.	[1,100	50	75	..
21. Harduaganj Steam station extensions (U. P.)	[300	300	30	30
22. Matatila hydel scheme (U. P.)	453	377	15	15
23. Kanpur Power Station extension (U. P.)	186	186	15	15
24. Jaldhaka hydel scheme (West Bengal)	350	150	17	..

*The total cost shown includes outlay on Irrigation portion.

Scheme & Name of the State	Total cost	Expenditure in Second Plan for Power	Benefits '000 kW	
			On completion	In Second Plan
	Rs. lakhs	Rs. lakhs		
25. Konar hydel station or alternative (D. V. C.) (Bengal & Bihar) . . .	449	..	40	..
26. Durgapur thermal station (D. V. C.) (Bengal & Bihar) . . .	1,480	1,480	150	150
27. Bokaro extension (D.V.C.) (Bengal & Bihar) . . .	456	456	50	50
28. Tungabhadra extension (Hyderabad) . . .	50	50	9	9
29. Ganderbal Power House (Jammu & Kashmir) . . .	46	46	6	6
30. Mohora Power House (Jammu & Kashmir) . . .	89	89	6	6
31. Bhadra (Mysore) . . .	242	82	33	33
32. Sharavathy (Mysore) . . .	2,297	1,300	142	..
33. Jodhpur (Rajasthan) . . .	30	30	3	3
34. Rajkot (Saurashtra) . . .	20	20	2	2
35. Porbunder (Saurashtra) . . .	150	150	15	15
36. Jamnagar (Saurashtra) . . .	95	95	10	10
37. Morvi-Wankaner (Saurashtra) . . .	64	64	4	4
38. Bhavnagar (Saurashtra) . . .	50	50	8	8
39. Surendranagar (Saurashtra) . . .	72	72	4	4
40. Veraval (Saurashtra) . . .	100	100	10	10
41. Panniar (T. C. State) . . .	295	295	30	30
42. Sholayar (T. C. State) . . .	425	391	54	54
43. Pamba or Poringalkuthu (T. C. State) . . .	1,000	400	75	..
44. Burhar & Satna extensions (Vindhya Pradesh) . . .	260	240	20	20

*Financial provision in second plan under consideration.

(ii) Private Sector.

Name of undertaking	Generat- ing plant to be added	Cost of generat- ing plant
	kw.	Rs. lakhs.
1. Calcutta Electric Supply Corpn. (Bombay)	50,000	470
2. Ahmedabad Electricity Company Ltd. (Bombay)	45,000	278
3. <i>Tata Power System (Bombay)</i>		
(a) Trombay Thermal Station	1,00,000	1,400
(b) Bhira hydro-electric extensions	60,000	550
4. Sholapur (Bombay)	3,000	30
5. Jubbulpore Elect. Supply Co. (M. P.)	4,000	35
Agra Elect. Supply Co. (U. P.)	4,000	25
6. Benares Electric Light & Power Co., Ltd. (U. P.)	4,000	25
8. United Provinces Electric Supply Co., Ltd. (U. P.)	4,000	25
9. Bhavnagar Electricity Co., Ltd. (Saurashtra)	8,000	50
10. Minor Schemes	5,000	23
TOTAL	2,87,000	2,911

STATEMENT VI
(Referred to in Paragraph 42)
Abstract of Outlay and benefits—'POWER' Projects

Name of State	Total estimated cost in Rs. Lakhs			Expenditure provision in second plan for continuing & new schemes Rs. Lakhs	Benefits in Second Plan—installed capacity '000 kw.			Spillover into Third Plan		
	Schemes continuing from First to Second Plan	New schemes in Second Plan	Total col. 2+3		By continuing schemes	By new schemes in second plan	Total col. 6+7	Expenditure (Rs. Lakhs)	Benefits (000 kw.)	
1	2	3	4	5	6	7	8	9	10	
Andhra	.	3161.0	4091.5	7252.5	2099.5	64.5	70.7	135.2	2478	75.0
Assam	.	200.0	336.0	536.0	380.0	7.5	8.15	15.65	..	..
Bihar	.	2406.5	2529.0	4935.5	2700.9	52.25	120.0	172.25	..	..
Bombay	.	3976.0	5389.0	9365.0	4100.0	248.0	46.0	294.0	3839	160.0
Madhya Pradesh	.	..	3018.3	3018.3	2393.2	23.0	170.0	193.0	518	30.0
Madras	.	4673.0	5867.0	10540.0	5759.8	135.0	152.0	287.0	1244	35.0
Orissa	.	3468.0	1808.0	5276.0	2552.6	138.3	119.4	257.7	..	..
Punjab	.	4698.0	582.0	5280.0	2743.6	546.0	..	546.0	..	..
Uttar Pradesh	.	6799.0	5160.4	11959.4	5462.5	190.6	111.0	301.6	3007	325.0
West Bengal	.	1833.0	1633.7	3466.7	1269.0	54.0	100.84	154.84	230	17.0
Hyderabad	.	717.9	1082.8	1800.7	1258.8	56.0	19.0	75.0	136	9.0
Madhya Bharat	.	1005.0	800.4	1805.4	1155.3	39.5	18.5	58.0	208	37.5
Mysore	.	704.6	2951.9	3656.5	2137.5	7.2	40.4	47.6	1001	143.0

Pepsu	1398.0	207.0	1605.0	889.0	..	..	..	218	37.5
Rajasthan	2193.0	654.0	2847.0	1900.0	58.3	20.7	79.0	109	10
Saurashtra	212.0	759.2	971.2	475.0	3.0	56.55	59.55	600	75
Travancore-Cochin	638.0	2620.0	3258.0	2185.0	77.0	84.0	161.0	30	..
Jammu & Kashmir	182.0	329.2	511.2	329.1	0.3	15.75	16.05	..	..
Ajmer	7.5	105.0	112.5	99.5	..	0.17	0.17	..	..
Bhopal	71.0	161.0	232.0	198.1	..	6.0	6.0	..	..
Coorg	..	43.0	43.0	39.0	..	0.36	0.36	..	..
Delhi	..	425.0	425.0	403.8	..	..	..	..	..
Himachal Pradesh	71.0	209.3	280.3	213.8	1.0	2.1	3.1	34	..
Kutch	94.0	117.5	211.5	174.1	6.3	..	6.3	13	..
Manipur	..	100.0	100.0	95.0	..	..	..	..	..
Tripura	..	45.0	45.0	42.8	..	2.3	2.3	..	..
Vindhya Pradesh	102.0	330.0	432.0	328.9	3.84	20.0	23.84	20	..
Andaman & Nicobar Islands	..	2.5	2.5	2.5	..	..	..	..	..
N. E. F. A.	..	19.0	19.0	19.0	..	0.79	0.79	..	..
Pondicherry	13.0	48.3	61.3	60.0	..	..	..	1	..
D. V. C.—Centre's share and for additional schemes	1833.0	887.0	2720.0	1220.0	..	..	..	856	..
TOTAL	40456.5	42312.0	82768.5	42667.3	1711.59	1184.71	2896.3	14542	933.0

