

Public Disclosure Authorized

RESTRICTED

Annex IV to

**EA112**

Vol. 5

This report was prepared for use within the Bank. It may not be published nor may it be quoted as representing the Bank's views. The Bank accepts no responsibility for the accuracy or completeness of the contents of the report.

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

---

Public Disclosure Authorized

THE ELECTRIC POWER INDUSTRY

IN

YUGOSLAVIA

January 19, 1961

ANNEX IV

THE ELECTRIC POWER INDUSTRY IN YUGOSLAVIA

Table of Contents

	<u>Page</u>
<u>SUMMARY</u>	i-ii
I. <u>THE SETTING</u>	
Resources	1
The Recent Growth of the Industry	2-3
The System Today	3-5
II. <u>ORGANIZATION AND OPERATION OF THE INDUSTRY</u>	
Organization	6-8
The Calculations of Costs	8-9
The Return on Investment in Power	9-10
The Financing of Investment	10-11
The Criteria for Investment	11
III. <u>THE INVESTMENT PLANS FOR 1960-66</u>	12-13

MAP

TABLES (1 - 11)

APPENDIX I - STATEMENT OF CONDITIONS UNDER WHICH YUGOSLAV INVESTMENT  
BANK WILL RECEIVE AND EVALUATE APPLICATIONS FOR LOANS  
FOR ELECTRIC POWER PRODUCTION

## SUMMARY

i. Yugoslavia is richly endowed with water power resources of which only 7% are at present developed. A large expansion of hydro plant can be made with relatively low investment per unit of capacity. There are also large resources of coal of low quality distributed widely about the country.

ii. Much progress has been made since the war towards the construction of a national power system. Since 1950 the rate of growth of electricity production has been 14-15% per year, or about double the European average. Since 1953 the growth has been even more rapid. In the early post-war years, heavy emphasis was placed on hydro projects. The existing system is heavy on hydro (60% of capacity), short on storage and subject to large reductions in available power during the annual low water periods in the fall. This problem of power shortages during periods of low water and the need to construct new capacity quickly have led to a reappraisal of the role of thermal plants in the system. It is now expected that roughly 65% of capacity will be hydro by the mid-1960's instead of the previous goal of 80%.

iii. The industry is organized in a unique way. Each plant is a separate enterprise. There is a single transmission enterprise for each Republic and there are many distributing enterprises. Their operations are coordinated through associations of producers (Unions) on the Republican level and on the Federal level.

iv. Power is sold throughout the country according to a uniform schedule of rates while each producer is paid for his output according to a set of standards devised for his particular enterprise. The Republican Unions act as financial intermediaries - buying from producers and selling to distribution enterprises. Deficits and surpluses are balanced out at the Federal level. The method by which the costs of producing enterprises are computed is biased in favor of hydro power mainly because of especially low capital charges. However, since these costs do not provide the principal basis for investment decisions, the effects of such distortions are limited.

v. Investment is financed largely by loan funds from outside the industry, mainly those administered by the Investment Bank. However, enterprises contribute to these funds through the capital tax and that portion of their depreciation which is used to repay loans. There are plans to increase the power rate so that a greater amount of the funds used for investment can come from the enterprises.

vi. In addition to consideration of investment costs, the criteria under which loans are to be granted in the future by the Investment Bank recognize the need for the rapid construction of generating facilities, the need for firm power and the desirability for local (Republics, local governments and enterprises) participation in the investment.

vii. The plans for expansion seem realistic and the industry's staff appears competent to carry them out. The extension of the 220 KV grid and the construction of plants with considerably larger units than those heretofore make economic sense. Although the method of financing is unusual, it is workable and there are reasons to expect that what seems to be its most obvious deficiency, the not unusual one of charging too little for power, may be alleviated this year.

## The Electric Power Industry in Yugoslavia

### I. THE SETTING

#### Resources

1. The water power resources of Yugoslavia have been estimated to be sufficient to produce 66 billion kWh per year. At the present time less than 5 billion kWh or about 7% of this potential is developed. Yugoslav resources are of the same order of magnitude as those of Italy and France, somewhat less than Sweden and substantially exceeded only by those of Norway. However, among all Western European countries only Norway has more unexploited water power. Of this vast potential the Yugoslavs estimate that 30 billion kWh can be developed at an investment of 15 to 35 dinars per annual kWh produced. (Assuming 4,000 hours operation per year and 632 dinars to the dollar - the present clearing rate - 35 dinars per kWh per year is equivalent to \$220 per KW). Even with a generous allowance for the usual optimism of such estimates, there is no doubt that the country has many economically attractive hydro-electric sites.

2. The physical basis for this happy situation lies in the fortunate combination of high mountains and heavy rainfall. From the mountains that parallel the Adriatic Coast (Dinaric Alps) and those which extend northward through Slovenia into Austria (Julian Alps) the land drops quickly towards the Adriatic Sea, or the plains of the Sava and Danube rivers. As a result of the warm moist winds which sweep northward from the Mediterranean, these mountain areas receive heavy precipitation, especially in the winter months. The highest rainfall in Europe is in the mountains of Montenegro. In the southern part of the country this results in peak stream flows during the winter. In the north where the run off is retarded by the freezing weather, the rivers reach their peak in the spring. The combination of heavy flow and steep gradients produces conditions most favorable for hydro-electric development. On the other hand, the seasonal character of the precipitation results in large variations over the year in the flow of the rivers. Though the water regime of the northern Alpine rivers compliments that of the southern rivers to some extent, the availability of water in late summer and early fall is far below that of the early part of the year. At the present time generation during the driest part of the year (August to October) is about 40% of the maximum possible generation in the period of high water (March to April) and the variation between generation in an average and a dry year (1 out of every 10) is about 20%. In terms of power development, this makes it necessary to supplement run of the river power plants with a combination of large reservoirs and thermal plants.

3. Fortunately the coal resources of Yugoslavia are extensive even if of very low quality. Reserves are distributed widely about the country and are estimated to be 21.6 billion tons, 90% of which is lignite. At the current rate of consumption, this quantity would last for 1,000 years. At the present time about 20% of coal production is used for the generation of electric power and this proportion is steadily increasing.

The Recent Growth of the Industry

4. The production of electric power has always received heavy emphasis in the Yugoslav development plans. Between 1946-1959 about 20% of total investment in industry and mining was allocated to electric power. As a result about 4/5 of the country's power capacity has been constructed since the war and production has been increased to a level about 8 times pre-war. Since 1950 the rate of growth of power production has been 14-15% or roughly double the European average. However, in spite of this rapid expansion, consumption in 1959 had only reached 435 kWh per capita - a level below that of Spain and Hungary. The variations among areas within the country are very great. The per capita consumption in Slovenia is about 7 times that of Macedonia and Montenegro, and is similar to Belgium and France; the consumption in the other two republics is similar to that of Greece and Turkey.

5. In the post-war expansion particular emphasis has been given to the construction of hydro capacity, especially in the earlier years. Whereas 65% of total capacity and 61% of total generation was accounted for by thermal plants in 1939, the proportions had dropped to 40% and 42% by 1959. However, as shown in the following table, the preference for hydro appears less strong in the recent years.

Rates of Growth of Capacity

	<u>Hydro</u>	<u>Thermal</u>	<u>Total</u>
1945-50	6.5	3.5	5.0
1950-55	17.5	6.0	11.5
1955-60	17.0	12.0	15.0

6. This apparent shift in the evaluation of the relative merits of the two types of plants is also reflected in a change in expectations of the future composition of capacity. A few years ago it was expected that the system would have its capacity divided roughly 80% hydro and 20% thermal by the mid-1960's; today the plans are for a balance of 65% hydro and 35% thermal instead. The shift in the emphasis from hydro to thermal cannot in this case be explained simply in terms of the increasing cost of hydro as the best sites are developed. In fact, a number of the hydro projects constructed in the early period were very high cost - much higher than those now being constructed - and the Yugoslavs frankly state that under the investment criteria they are now using, these would never have been built. 1/

7. Basically the growing recognition of the attractiveness of thermal power has been the result of the development of more realistic methods of

---

1/ On the basis of data presented by the Federal Electricity Union, hydro-electric plants now being constructed are averaging 40% cheaper than those constructed during the early post-war years.

evaluating costs and benefits. In the early post-war period under the system of centralized administrative management, cost considerations were secondary, capital costs in particular were neglected, <sup>1/</sup> and the attraction of monumental projects was as strong in the field of electric power as elsewhere. The fact that domestic production could supply a greater part of the equipment for hydro-electric stations than for thermal plants was also in part a cause (and probably in part an effect) of the emphasis on hydro. The general re-organization of the economy with the increasing emphasis on costs, prices and profits, the hard problem of continual power shortages during periods of low water and the need to construct new power capacity quickly all have forced the Yugoslav authorities to adopt more realistic methods of project appraisal. <sup>2/</sup>

#### The System Today

8. By 1959 generating capacity in Yugoslavia had reached 1884 MW, of which 60% was hydro and 40% thermal. 88% of this total consisted of plants generating for public supply; the remainder was accounted for by industrial plants generating principally for their own use. Most of this capacity, 85% of the hydro and 55% of the thermal, was built since the war.

9. The hydro plants are mostly run of the river but storage capacity has been increased sharply in recent years. In 1956 it was 5% of total annual hydro generating capacity. By 1960 this had reached 11% and projects under construction are expected to bring it to 16% by 1965. Nevertheless, it will still not be sufficient to prevent a considerable decline in the availability of power during the annual low water period in the fall.

10. The thermal capacity of Yugoslavia is for the most part small, old and inefficient. Only three plants <sup>3/</sup> have units larger than 35 MW. However, these three, which were built since 1956, constitute 35% of the capacity for public supply and provide 40% of the generation. The thermal efficiency of the industry was 23% <sup>4/</sup> in 1958 and would have been 16% if the same three plants were excluded.

11. As shown in the attached map, the country is divided into three major power systems: the north-western system, comprising Slovenia and western Croatia; the central system, comprising Bosnia and Hercegovina, Montenegro and the rest of Croatia (Dalmatia and Slavonia) and the eastern system, comprising Serbia and Macedonia. In 1957 with the completion of the transmission line from the hydro plant at Jayce in the central system to Zagreb in the north-western system, the three became inter-connected at 110 KV. At the present time a national 220 KV grid is under construction. (see map) Part of this is completed and is carrying 220 KV, another part

---

<sup>1/</sup> This is still the case in the calculations of production costs in the electric power industry. See para. 23.

<sup>2/</sup> See para. 30 and Appendix I.

<sup>3/</sup> Kolubara, near Belgrade; Kakanj, in Bosnia, and Šostanj, in Slovenia.

<sup>4/</sup> Based on data on 83% of total generation for public supply.

is being used temporarily for 110 KV, and additional sections are to be built in the next few years. The Yugoslav system is also connected with Austria (110 KV), Greece (110 KV) and Hungary (40 KV) and negotiations are underway to connect with the Italian (220 KV) system. Yugoslavia exports a small amount of power to these countries.

Capacity, Generation and Peak Load by Systems <sup>1/</sup>  
1959

	Capacity		Peak Load MW	Generation		Consumption <sup>2/</sup> 10 <sup>6</sup> kWh
	Hydro %	Total MW		Hydro %	Total 10 <sup>6</sup> kWh	
North-western System	65	668	450	64	2,724	2,840
Central System	75	462	350	78	2,340	1,918
Eastern System	<u>60</u>	<u>523</u>	<u>400</u>	<u>53</u>	<u>2,001</u>	<u>2,052</u>
	66%	1,653	1,200	65%	7,065	6,810

<sup>1/</sup> Excludes capacity and generation of industrial plants which are predominantly thermal.

<sup>2/</sup> Excluding own consumption of power plants.

12. Industry is by far the largest consumer of electric power in Yugoslavia. In recent years it has accounted for 73% of total consumption. Since 1957 the proportion has dropped to 69% as a result of the rapid growth of household use, but it still stands at about the European average. Within the industrial sector the proportion consumed by electro-chemical and electro-metallurgical industries has been rising and in recent years has accounted for over 30% of the power consumed by industry.

Pattern of Electricity Consumption  
(% of total consumption)

	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>
Industry	73	73	70	69
of which:				
Power-intensive Industries <sup>1/</sup>	27	31	33	31
Households	17	17	19	20
Rest <sup>2/</sup>	10	10	11	11

<sup>1/</sup> Electro-chemical and electro-metallurgical.

<sup>2/</sup> Municipal lighting and services, commerce, etc.

13. The load factor for the public system is high. Over the past four years it has averaged about 64%. This is mainly due to the heavy industrial use and the important position of power-intensive industries. A contributing factor has been the highly differentiated system of rates which distinguishes between night and day, and between periods of high and low water.

## II. ORGANIZATION AND OPERATION OF THE INDUSTRY

### Organization

14. In the early post-war years the planning and operation of the electricity industry was under a single centralized authority, the Federal Ministry of Electricity. The move toward decentralization that took place throughout the economy after 1950 was reflected in the electricity industry by the establishment of enterprise self management ("workers management") for electricity enterprises, the organization of Republican Electricity Unions within which the enterprises were grouped, and the decentralization of the engineering functions of the Ministry of Electricity by the formation of a number of consulting engineering enterprises (projecting bureaux) in the major cities. <sup>1/</sup> Finally, the Republican Unions were organized into a Federal Electricity Union (Yugel) for the purpose of coordinating the activities of the industry on a nation-wide basis.

15. The Unions (associations of producers) were organized under what the Yugoslavs call "social management". This means in effect that the managing board of a union is made up of representatives of enterprises, state institutions and consumers, as well as its own employees. Similarly, the managing board of the Federal Electricity Union includes members from managing boards of Republican Unions, chambers of industry, conference of large cities (representing consumers), state and republican secretariats for industry and the Federal Planning Institute.

16. Under the present system there are separate enterprises for the production of power, its transmission and its distribution. In general, a production enterprise consists of a single plant. <sup>2/</sup> There is a single transmission enterprise for each Republic and there are many distribution enterprises.

17. In the field of electric power where the independent action of individual producers is at best severely limited, a system of autonomous enterprises would not appear to be a particularly appropriate form of organization. This is recognized by the government and changes may be expected. <sup>3/</sup> However, it should also be pointed out that the role of the

---

<sup>1/</sup> There is a consulting engineering enterprise dealing with hydro projects in the capital city of each Republic, except Montenegro, and with the exception of the one in Skopje (Macedonia), these also handle thermal power projects.

<sup>2/</sup> There are exceptions. Recently a single enterprise (Kosovo) has been set up to include both a coal mine and a power plant and there are plans to extend this integrated type of organization to other cases in the interests of greater efficiency.

<sup>3/</sup> "...in certain branches, such as...electric power...the system of management is not yet as efficient as it should be. Something will have to be done about this as quickly as possible in order to make these branches capable of carrying out their tasks properly." Marshal Tito, Report to the Fifth Congress of the Socialist Alliance of the Working People of Yugoslavia in Beograd, April 18, 1960.

enterprise is considerably modified by the power of the union to which it belongs and from which it receives technical services and operating instructions. The unions also play an important part in the planning and organization of new enterprises and the trend seems to be in the direction of increasing their strength vis-a-vis that of the enterprises.

18. The regional concerns of the Republican Unions are in turn modified by the position and influence of the Federal Union. The "normal costs" <sup>1/</sup> set for each enterprise are coordinated by the Federal Union and it handles the dispatching of power and the planning of investments on a country-wide basis. It also reviews the technical feasibility of all proposed power projects and together with the planning institute advises the Investment Bank on the allocation of investment resources. Thus, there is in fact a considerable centralization of control and standardization of operation in the industry.

19. With the development of a national grid and the increasing and evident need for a closer coordination of power activities on a country-wide basis, there is pressure for giving greater authority to the Federal Union. In a recent report on the 220 KV transmission system, a firm of American consulting engineers <sup>2/</sup> urged a strengthening of the technical staff of the Federal Union and its more active role in the control and direction of system operations, in the conduct of overall system studies and in the coordination of the work of the Republican Unions. Underlying this recommendation is the fact that the most natural division of the country in terms of electric systems, as already noted, simply does not coincide with the boundaries of the individual Republics.

20. The operating relationships between enterprises and unions are briefly as follows: the unions in effect buy power from their producing enterprises at cost, or from other unions at a price set by the Federal Union, pay the transmission enterprises for their services on the basis of costs and sell the power to large consumers or distribution enterprises. Actually the transactions with distribution enterprises, which are not members of the unions, are not in the form of sales, as the term is generally used. At present, power is sold to consumers at prices fixed for the country as a whole <sup>3/</sup> and the distribution enterprises withhold an amount to cover their cost returning the balance to the Union. <sup>4/</sup> Since

---

<sup>1/</sup> See para. 21.

<sup>2/</sup> Report on 220 KV Transmission System for Yugoslavia, prepared for Zajednica Jugoslovenske Elektroprivrede "Yugel", by Engineering Consultants, Inc., Denver, Colorado, Technical Consultant for U.S. Operations Mission to Yugoslavia, May, 1960.

<sup>3/</sup> The rate system differentiates among classes of consumers, between night and day consumption and, in some cases, between seasons of high and low water conditions. Particularly low rates are provided for power-intensive industries and for households. In general, the level of rates is set with reference to the average costs of production.

<sup>4/</sup> One of the proposed reforms for the system is to handle the transfer of power to the distribution companies on a strict sales basis and give the local authorities, under which these enterprises are organized, some control over setting the price to consumers.

the selling price is fixed throughout the country, since costs vary from plant to plant and since each plant must receive sufficient income to cover its costs, unions may have deficits or surpluses. Surpluses that occur are distributed to member enterprises; deficits are made up from a fund administered by the Federal Union formed from the income tax payments of all power enterprises (the unions themselves are not subject to income tax).

### The Calculations of Costs

21. The "costs" which the unions pay the enterprises for their production and services are calculated according to a standard set for each individual enterprise under the supervision of the Federal Union. Each cost schedule or set of "normative costs", as the Yugoslavs call them, is worked out in some detail. It includes all cash obligations of the enterprise, such as the tax on capital, interest on loans, <sup>1/</sup> prescribed contributions to certain funds, etc., as well as allowances for depreciation, <sup>2/</sup> fuel (based on the efficiency of the plant's boilers and the price of fuel), other materials, maintenance, and labor. The standards appear to be rather loose in respect to fuel, materials and labor so that an enterprise is able by careful operation to save on these operating expenses and make substantial "profits". <sup>3/</sup>

22. In respect to the amounts allowed for labor costs, there is as yet no general standard relating the wage bill to plant characteristics. Although the unions are apparently working towards this end, at the present time the practice appears to be to pay each plant a sufficient sum for labor to cover the guaranteed minimum wages for the labor force actually employed plus a margin for a "minimum profit". In general the size of the labor force in Yugoslav power plants is extremely large by comparison with, for example, U.S. practice. <sup>4/</sup> This is partly due to the fact that each plant is a separate enterprise with its own overhead, maintenance, etc., and also that many of them include in their labor force personnel required for constructing new additions and performing auxiliary services, such as the transport of coal from nearby mines, etc.

23. On the basis of the type of cost calculations outlined above, the average delivered cost of power in Yugoslavia was 11 dinars per kWh (1.7 cents at 632 dinars per dollar) in 1959, and the production cost of hydro power was about one-third that of thermal power (2.7 dinars compared with 9.7). The government recognizes that the price (cost) of power is too low and the Federal Union has been directed to recommend the increases necessary to place the price on an "economic level" defined in terms of the

---

<sup>1/</sup> There are special rates for electric power - capital tax of 1%, and interest of 2%; industry in general pays 6%.

<sup>2/</sup> Based on prescribed rates for the various items of equipment. Runs about 4% of original cost for thermal plants and about 2% for hydro plants.

<sup>3/</sup> There are also bonuses for performance and maintaining plant in a state of readiness and fines if a plant is not prepared to generate when called upon.

<sup>4/</sup> e.g. over 100-150 employees in hydro plants of 60-90 MW and 200-400 in thermal plants of 64 MW, or about 4 to 5 times the work force of U.S. plants of comparable size.

ability to finance a substantial part of new investment out of the rates. However, it appears to be less clearly recognized that the system of computing costs is biased in favor of hydro power. The fact that interest during construction is not included in capital costs plus the fact that the capital tax (1%) and the interest on loans (2%) are extremely low both work in favor of the more capital intensive method of production. In addition, the fact that there is no standard allowance for labor costs means that the tendency towards inflated labor forces has the greatest effect in raising total costs in the case of the more labor intensive type of plant (thermal).

24. The effect of this bias in method of computing costs, together with the real advantages of hydro, creates an incentive for the unions of producers to favor hydro plants in the construction of new capacity, because this leads to increased surpluses for the Union to distribute to its member enterprises. However, this bias for hydro is tempered by the need to obtain power quickly, the need for firm power during periods of water shortage and the fact that the unions have no direct control over the investment funds.

#### The Return on Investment in Power

25. The method used for providing income for the enterprises in the power industry makes any calculation of profitability meaningless as a basis for comparison among plants. Profits for a particular plant are simply a measure of "beating the norms" and the norms are not standard in respect to a very important input - labor. <sup>1/</sup> However, there may be some validity in attempting to make a rough estimate of return for the industry as a whole to obtain some measure of the relation between the price of power and the volume of capital invested in the industry. Such a calculation shows the return for the entire industry in 1958 to have been 4.9%.

#### Return on Investment in Electric Power Industry (Generation, Transmission and Distribution) 1958

in billions of dinars

Value of assets		386
Gross receipts		73
Operating expenses		
Depreciation	12	
Materials	37	
Wages	5	
Total		54
Income		19
Return before taxes		4.9%

Source: INDEKS #4, 1960

---

<sup>1/</sup> For example, the return on investment before taxes of the Zvornik hydro plant in 1958 was 2.5% while that of the Kolubara steam plant of similar output was 7.5%. But the cost of power from Zvornik was 2 dinars/kWh while that from Kolubara was 6.8 dinars/kWh. If Zvornik has received an equivalent income per kWh, its return would have been 16.5% (see Table 7).

26. Because of the unusual Yugoslav accounting practices, it is not clear to what extent this rate can be compared with those found in other member countries. However, it is low in relation to those calculated for other Yugoslav industries on the same basis <sup>1/</sup> and this is in large part a reflection of the special low capital tax (1%) and interest rate (2%) paid by electricity enterprises. If electricity rates were raised to enable the industry to pay the general rate of 6%, the return would be increased to 9-10%. However, the concern of officials in the Federal Union with the present level of electricity rates lies not so much in considerations of return as in providing a greater amount of the cash required for new investment out of the rates.

#### The Financing of Investment

27. Investment in the electric power industry is financed largely by funds from outside the industry - the general investment fund, and to a lesser extent republican and local investment funds. The first two are administered by the Investment Bank which in 1960 was given the responsibility for allocating funds among power projects through a process of "competitive bidding". <sup>2/</sup> Local funds are used mainly for local distribution or for providing a part of the "local funds" required to supplement loans from the Investment Bank in the case of larger projects.

28. Neither the Republican nor Federal Electricity Unions have investment funds of their own, and whereas enterprises do accumulate depreciation funds and earn profits, they have not been important sources for financing new investment. That part of depreciation not used to repay loans <sup>3/</sup> or for replacement and reconstruction is placed in the enterprise account with the National Bank and is not at the free disposal of the enterprise. Under certain conditions these funds can be used to help finance new investment and with the trend to decentralization of investment financing, it may be expected that greater use will be made of them for this purpose in the future. In the case of the net income of enterprises under the present system with its low prices and high taxes, very little remains after incentive wages have been paid.

29. Although enterprises do not supply investment funds directly, they do contribute to the resources of the Investment Bank that does finance the bulk of new investment through their payments of taxes and repayment of loans. In 1958, for example, for all production and transmission enterprises the repayment of loans (principal and interest) and the tax on capital assets amounted to 5.7 billion dinars, or about 17% of total receipts in that year. This was equivalent to about 11% of the average level of investment planned for the period 1960-66. (If all depreciation were included, the amount would have been 11.2 billion dinars, or 22% of the planned investment rate). These computations exclude taxes on income which though substantial go into a fund used to meet Union deficits and

---

<sup>1/</sup> In 1958 the return for other industries calculated on a similar basis was generally above 12% with important sectors earning over 20% and some much higher.

<sup>2/</sup> A method for determining priorities. See Appendix I.

<sup>3/</sup> Loans for electric power are at present amortized over 30 and 50 years; depreciation rates assume a life of 25 and 50 years for thermal and hydro respectively.

are not used for investment. Officials in the Federal Union and the Investment Bank would like to finance much more in this way and they expect it may be possible to increase rates sufficiently to finance about 50% of new investment "out of the rates" through payments by enterprises into the General Investment Fund. This would probably involve an increase in the general rate level on the order of 30%.

#### The Criteria for Investment

30. The recently adopted statement of criteria under which the Investment Bank is to grant loans for new investment projects in the field of power is shown in Appendix I. At the present time most of the funds the Investment Bank allots to power are absorbed by projects already underway. This new procedure will presently be applied to future expansions of existing plants and to new projects.

30a. Recognizing that the statement of criteria covers a wide range of considerations and that the weights to be given to the various factors cannot be known in advance, nevertheless it is possible to gain from this statement a general idea of what are considered to be the more relevant factors in appraising investments. The new emphasis on decentralization will be noted in the importance given to participation in the investment by the borrower with his own funds. The borrower in this case may be a republican government, a local government, or an enterprise. It will be also noted that whereas the method of computing costs would indicate that hydro power is by far the most attractive, the emphasis on investment per kWh, on producing during periods of low water, and on short completion time all favor thermal plants. The criteria set up by the Bank seem on the whole to make good economic sense, while the method of determining enterprise costs is obviously unrealistic. However, although the cost system used in the industry is distorted, nevertheless its economic effects would appear to be limited since it does not provide the basis for investment decisions.

III. THE INVESTMENT PLANS FOR 1960-66

31. The Yugoslavs expect the market for electric power to grow at a rate of 14.5% per year for the period 1960-66 (see Table 8). This is the same as the average rate 1950-59, but considerably less than the 18% rate at which consumption has grown since 1953. The most important component of this demand, industrial use, is expected to grow at a rate of 12%, somewhat less than the expected rate of expansion of industrial output (13%). Domestic and other uses are expected to grow correspondingly more rapidly, but not as rapidly as they have grown in the last few years because of the recent increases in rates for domestic consumers. Considering the rate of expansion of the economy these estimates seem reasonable and even if they should turn out to be over optimistic, the system could use some reserve capacity and there is also the possibility of export.

32. At the present time there is no effective reserve capacity in Yugoslavia. Although the installed capacity is greater than the peak load, the latter occurs in December at a time when the output of the system is considerably reduced by low water conditions. In fact, for this reason restrictions have had to be placed on industrial consumption in the past three years. In 1959 such curtailment amounted to about 3.5% of total consumption. Thus new plant will have to be constructed to cover at least the total expected increase in the market. This means nearly doubling capacity by 1966 and the Yugoslavs have already underway a sufficient number of projects to achieve this (see Tables 9, 10 and 11). The present (May 1960) estimated cost of this program is as follows:

	<u>Investment Program 1960-66</u> <sup>1/</sup>		
	<u>Total Cost</u> <u>10<sup>9</sup> dinars</u>	<u>Foreign Exchange</u> <u>Cost</u> <sup>2/</sup> <u>10<sup>9</sup> din.</u>	<u>Foreign Exchange</u> <u>Cost</u> <sup>3/</sup> <u>10<sup>6</sup> \$</u>
Hydro plants	196	49	77
Thermal plants	130	78	123
Transmission network	<u>16</u>	<u>3</u>	<u>5</u>
	342	130	205

<sup>1/</sup> Includes projects under construction and also new projects to be started during the period. The amount estimated for the latter is arbitrarily divided 55% thermal and 45% hydro.

<sup>2/</sup> Both direct purchase of foreign equipment and foreign supplies needed for manufacturing of Yugoslav equipment - 25% of total cost for hydro, 60% for thermal and 17% for transmission.

<sup>3/</sup> At 632 dinars per dollar.

---

33. As shown in Table 8, the planned expansion will not be sufficient to supply all the estimated requirements in a low water year, which is generally one year out of 10. When this occurs it is planned to curtail production in selected power-intensive industries.

34. The program of expansion represents a considerable change in the size of plants and generating units over those presently installed in Yugoslavia. Whereas the largest unit in existing thermal plants is now 40 MW, under the program 65, 75 and 125 MW units are to be installed. In the case of hydro, 4 projects with capacities in excess of 200 MW are being built, with units up to 110 MW; the largest plant now operating in the country has a capacity of 144 MW with 30 MW units.

35. In addition to the projects listed in Tables 9 and 10, new capacity will have to be started before 1966 to meet the increased needs of the following years. It has not yet been decided where these expansions will take place and the decision will presumably be made on the basis of the criteria established by the Investment Bank.

36. During the next few years important parts of the 220 KV network will be constructed to link new hydro projects with the main consuming centers and to continue the expansion of the national network (see map). Although important parts of this network have already been constructed, there are alternative ways of joining certain sections of the system that should be given careful consideration before the construction of some of the proposed lines is actually undertaken. <sup>1/</sup>

37. In summary: on the basis of a general survey of the industry, it appears that the Yugoslavs are attacking their power problems in a realistic manner. Their expansion plans are in line with their probable needs and their general scheme for the development of a mixed and balanced system integrated into a national network and their approach to the selection of projects within that scheme appears to make good economic sense. The staff of the electric power industry itself and the associated industries producing electrical equipment and constructing power plants seem competent to carry out the program as it is planned. Although their method of financing is unusual, it is workable and there are reasons to expect that what seems to be its most obvious deficiency, the not unusual one of charging too little for power, may be alleviated this year.

---

<sup>1/</sup> See report on 220 KV Transmission System for Yugoslavia by Engineering Consultants, Inc., Denver, Colorado, op.cit.

TABLE 1

Table 1

GROWTH OF CAPACITY AND PRODUCTION  
1939-1960

Year	Installed Capacity MW			Production millions of kWh		
	Total	Hydro	Thermal	Total	Hydro	Thermal
1939	505	174	331	1,173	566	607
1945	524	211	313	817	316	501
1946	523	207	316	1,160	478	682
1947	528	211	317	1,458	595	863
1948	629	281	348	2,065	1,045	1,020
1949	651	285	366	2,219	1,021	1,198
1950	662	290	372	2,409	1,234	1,175
1951	662	296	366	2,545	1,354	1,191
1952	742	342	400	2,694	1,427	1,267
1953	853	429	424	3,002	1,515	1,487
1954	973	499	474	3,451	1,805	1,646
1955	1,148	646	502	4,379	2,614	1,765
1956	1,409	722	687	5,048	2,870	2,178
1957	1,675	949	726	6,252	3,522	2,730
1958	1,798	1,060	738	7,356	4,300	3,056
1959	1,884	1,133	751	8,106	4,708	3,398
1960 <sup>1/</sup>	2,288	1,403	885	9,300	5,300	4,000

<sup>1/</sup> Estimated.

Source: Federal Electricity Union.

TABLE 2

Table 2  
INSTALLED CAPACITY BY SYSTEM AND TYPE OF PLANT  
1954-1959

System and Type of Plant	(in MW)					
	1954	1955	1956	1957	1958	1959
The North-Western System						
Hydro	292	307	330	362	387	435
Thermal	112	117	207	219	233	233
Total	404	424	537	581	620	668
The Central System						
Hydro	128	205	205	301	345	345
Thermal	52	53	117	117	117	117
Total	180	258	322	418	462	462
The Eastern System						
Hydro	45	94	117	227	290	315
Thermal	142	144	208	208	208	208
Total	187	238	325	435	498	523
<u>TOTAL CAPACITY FOR PUBLIC SUPPLY</u>						
Hydro	465	606	652	890	1022	1095
Thermal	306	314	535	544	558	558
<u>TOTAL</u>	<u>771</u>	<u>920</u>	<u>1187</u>	<u>1434</u>	<u>1580</u>	<u>1653</u>
Capacity of Industrial Enterprises for own Use						
Hydro	34	40	70	59	38	38
Thermal	168	191	152	182	180	193
Total	202	231	222	241	218	231
<u>TOTAL CAPACITY IN YUGOSLAVIA</u>						
Hydro	499	646	722	949	1060	1133
Thermal	474	502	687	726	738	751
<u>TOTAL</u>	<u>973</u>	<u>1148</u>	<u>1409</u>	<u>1675</u>	<u>1798</u>	<u>1884</u>

TABLE 3

Table 3

TOTAL POWER GENERATED BY SYSTEM AND TYPE OF PLANT  
1954-59

	(in millions of kWh)					
System and Type of Plant	1954	1955	1956	1957	1958	1959
<u>The North-Western System</u>						
Hydro	1091	1325	1339	1500	1814	1732
Thermal	316	438	657	895	916	992
Total	1407	1763	1996	2395	2730	2724
<u>The Central System</u>						
Hydro	462	830	877	1222	1480	1821
Thermal	198	123	204	299	403	519
Total	660	953	1081	1521	1883	2340
<u>The Eastern System</u>						
Hydro	94	292	495	626	878	1057
Thermal	580	548	594	766	908	944
Total	674	840	1089	1392	1786	2001
<u>TOTAL GENERATION FOR PUBLIC SUPPLY</u>						
Hydro	1647	2447	2711	3348	4172	4610
Thermal	1094	1109	1455	1960	2227	2455
<u>TOTAL</u>	<u>2741</u>	<u>3556</u>	<u>4166</u>	<u>5308</u>	<u>6399</u>	<u>7065</u>
<u>Generation of industrial enterprises for own use</u>						
Hydro	158	167	159	174	128	98
Thermal	552	656	723	770	829	943
Total	710	823	882	944	957	1041
<u>TOTAL POWER GENERATION IN YUGOSLAVIA</u>						
Hydro	1805	2614	2870	3522	4300	4708
Thermal	1646	1765	2178	2730	3056	3398
<u>TOTAL</u>	<u>3451</u>	<u>4379</u>	<u>5048</u>	<u>6252</u>	<u>7356</u>	<u>8106</u>

TABLE 4

Table 4

PRINCIPAL LOAD CENTERS WITH ANNUAL CONSUMPTION  
AND ESTIMATE OF PEAK LOAD  
 1957-1959

	1957		1958		1959	
	Consump- tion 10 <sup>6</sup> kWh	Peak MW	Consump- tion 10 <sup>6</sup> kWh	Peak MW	Consump- tion 10 <sup>6</sup> kWh	Peak MW
The North-Western System						
Ljubljana	123	24	145	29	176	34
Maribor	91	17	100	19	116	21
Zagreb	272	53	320	62	363	75
Rijeka	73	14	80	15	84	15
Kidricevo (industrial enterprises)	315	40	357	43	300	45
Ruse                   "	159	23	177	23	110	23
Store                   "	67	12	78	12	65	12
The Central System						
Split	124	24	139	26	154	29
Mostar	33	7	37	7	40	8
Sarajevo	68	14	75	15	80	17
Osijek	42	8	47	9	52	11
Split-Sibenik (industrial enterprises?)	391	58	400	62	360	67
Zenica                   "	147	32	167	38	180	40
Ilijas                   "	-	-	71	10	142	27
The Eastern System						
Beograd	366	85	443	92	490	112
Novi Sad	39	7	45	9	51	11
Nis	32	5	42	6	46	8
Skoplje	55	11	68	14	78	16
Bor (industrial enterprise)	134	17	150	19	155	20
Trepca                   "	57	10	58	10	62	10
Jegunovci               "	50	10	101	20	130	20

TABLE 5

Table 5

PATTERN OF ELECTRICITY USE  
1954-1959

	in millions of kWh					
	1954	1955	1956	1957	1958	1959
Gross production	3,445	4,384	5,062	6,249	7,356	8,106
- Own consumption of power plant	170	186	223	302	327	354
Net production	3,275	4,198	4,829	5,947	7,029	7,752
- Net exports	61	44	68	146	173	99
Net available	3,214	4,154	4,761	5,801	6,856	7,653
- Losses	468	547	621	771	984	1,071
<u>Net consumption</u>	<u>2,746</u>	<u>3,607</u>	<u>4,140</u>	<u>5,030</u>	<u>5,872</u>	<u>6,582</u>
Industry of which:	1,985	2,624	2,997	3,667	4,094	4,521
Power-intensive industries <sup>1/</sup>	376	650	817	1,143	1,344	1,381
Households	395	514	643	832	1,142	1,348
Rest <sup>2/</sup>	366	469	500	531	636	713

<sup>1/</sup> Electro-chemical and electro-metallurgical industries.

<sup>2/</sup> Municipal lighting and services; community facilities, commercial sector, etc.

Source: Yugoslav Electricity Union.

TABLE 6

Table 6  
COST OF POWER BY SYSTEM AND TYPE OF PLANT  
 1959

In dinars/kWh

	<u>North-Western System</u>	<u>Central System</u>	<u>Eastern System</u>	<u>Yugoslavia as a whole</u>
Average production costs for Hydro plants	2.27	2.32	3.99	2.68
Average production costs for Thermal plants	10.63	8.44	9.39	9.69
Average production costs for all plants	5.31	3.68	6.54	5.12
Average transmission and distribution costs	3.93	5.15	6.14	4.93
Average total costs	9.98	9.90	13.91	11.03

Source: Federal Electricity Union.

TABLE 7

Table 7

DISTRIBUTION OF TOTAL INCOME FOR TWO  
SELECTED ELECTRIC POWER ENTERPRISES  
1959

	<u>Zvornik (Hydro)</u>	<u>Kolubara (Thermal)</u>
Total receipts	769	2,336
Operating expenses	445	1,660
Fuel		970
Other materials	100	128
Insurance	32	48
Wages and social insurance, etc.	35	143
Depreciation	278	371
<u>Gross income</u>	324	676
Interest	121	215
Taxes	146	302
Tax on capital	56	8
Tax on income	89	290
Other taxes	1	4
<u>Net income</u>	57	159
Supplementary wages	21	111
Retained income	36	48
 <u>Data on plants</u>		
Value of plant	13,106	9,090
Capacity in MW	90	64
Year built	1955-57	1957
Production in millions of kWh	386	382
Sales in million kWh	384	342
Employees	143	584
Average total cost of prod.	2 dinars/kWh	6.8 dinars/kWh
Return on investment (before taxes and interest)	2.5%	7.5%

Source: Federal Electricity Union.

Table 8

PROJECTED DEMAND AND SUPPLY OF ELECTRIC POWER

(In millions of Kwh)

	1960	1961	1962	1963	1964	1965	1966
Estimated Demand <sup>1/</sup>	7,880	9,020	10,330	11,860	13,700	15,720	17,640
Net Production Ave. Year	8,137	9,916	11,543	13,039	14,521	16,572	18,163
Net Production Dry Year	7,115	8,839	10,223	11,534	12,847	14,527	15,530
Deficit in Dry Year	765	181	107	326	853	1,193	2,110
Planned Reductions in Selected Industries <sup>2/</sup>	320	340	350	380	430	490	500

<sup>1/</sup> Excluding own production of power plants and exports.

<sup>2/</sup> Represents the consumption of selected power-intensive industries which would be curtailed as necessary under dry year conditions.

Source: Federal Electricity Union.

Table 9

PROGRAM OF INVESTMENTS IN HYDRO PLANTS NOW UNDER CONSTRUCTION<sup>1/</sup>

(In millions of dinars)

Plant	Capacity in MW	1960	1961	1962	1963	1964	1965	1966	Total
Kokin Brod	121	2,200	700	500	184	-	-	-	3,584
Bajina Basta	240	1,000	5,000	5,088	4,820	4,820	2,526	1,662	24,916
Split I	216	6,000	4,869	2,048	-	-	-	-	12,917
Senj	216	1,000	4,678	5,000	4,724	3,000	1,086	-	19,488
Ozbalt	60	2,500	3,095	694	-	-	-	-	6,289
Trebisnjica	216	3,000	5,000	7,000	7,000	6,000	5,000	208	33,208
Globocica	42.6	2,000	2,500	2,000	1,000	761	-	-	8,261
Perucica II	144	1,700	3,000	2,050	1,195	-	-	-	7,945
Peruca	40	218	-	-	-	-	-	-	218
Mariborski Otok	16.8	224	-	-	-	-	-	-	224
<b>TOTAL</b>	<b>1,412.4</b>	<b>19,842</b>	<b>28,842</b>	<b>24,380</b>	<b>18,923</b>	<b>14,581</b>	<b>8,612</b>	<b>1,870</b>	<b>117,050</b>

<sup>1/</sup> The totals and the tranches may be changed depending on the volume of construction in particular years and on the prices in the market.

Source: Federal Electricity Union.

Table 10

PROGRAM OF INVESTMENTS IN THERMAL PLANTS NOW UNDER CONSTRUCTION<sup>1/</sup>

(In millions of dinars)

Plant	Capacity in MW	1960	1961	1962	1963	1964	Total
Kolubara II	65	2,500	1,000	632	421	-	4,553
Kolubara III	32	1,000	337	300	-	-	1,637
Kakanj II	64	2,200	929	352	-	-	3,481
Sostanj II	75	2,500	1,015	871	800	-	5,186
TO Zagreb	64	2,700	3,696	450	430	-	7,276
TO Beograd	64	500	3,000	4,628	1,697	-	9,825
Kosovo I	65	2,500	3,000	1,000	577	-	7,077
Kosovo II	125	300	3,441	6,805	3,800	853	15,199
Lukavac	64	1,000	4,500	3,000	922	-	9,422
Brestanica	<u>12.5</u>	<u>600</u>	<u>502</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1,102</u>
<b>TOTAL</b>	<b>630.5</b>	<b>15,800</b>	<b>21,420</b>	<b>18,038</b>	<b>8,647</b>	<b>853</b>	<b>64,758</b>

<sup>1/</sup> The totals and the tranches may be changed depending on the volume of construction in particular years and on the prices in the market.

Source: Federal Electricity Union.

Table 11

TOTAL INVESTMENTS IN ELECTRIC POWER 1960-1966

(In millions of dinars)

Plant	Capacity in MW	1960	1961	1962	1963	1964	1965	1966	Total
Hydro under construction	1,412.4	19,842	28,842	24,380	18,923	14,581	8,612	1,870	117,050
Thermal under construction	630.5	15,800	21,420	18,038	8,647	853	-	-	64,758
Transmission		8,224	6,800	918	-	-	-	-	15,942
Total	2,042.9	43,866	57,062	43,336	27,570	15,434	8,612	1,870	197,750
New Projects <sup>1/</sup>									<u>144,000</u>
Total									<u><u>341,750</u></u>

<sup>1/</sup> Estimate of investments to be made during 1960-1966 for construction of new generating capacity to be completed after 1966. Projects not yet designated but a preliminary estimate suggests 55% may be hydro and 45% thermal.

Source: Federal Electricity Union.

TABLE 11

STATEMENT OF CONDITIONS UNDER WHICH YUGOSLAV INVESTMENT BANK WILL  
RECEIVE AND EVALUATE APPLICATIONS FOR  
LOANS FOR ELECTRIC POWER PRODUCTION

In accordance with Article 21 of the Decree on Investment Loans/ "Official Gazette FPRY", No.31/56, 22/58 and 25/59, upon approval given by the Federal State Secretariat for Financial Affairs, the Yugoslav Investment Bank invites tenders for the

XLIII COMPETITIVE BIDDING

for granting investment loans out of the General Investment Fund for construction of electric power generating capacities including the necessary transmitting and transforming facilities

1. The Yugoslav Investment Bank shall grant under this competitive bidding out of the General Investment Fund loans for the construction of electric power generating capacities, including the necessary transmitting and transforming facilities for 110 KV and higher.
2. In this bidding may participate political subdivisions and unions of electricity enterprises, as well as other economic organizations.
3. Loans under this competitive bidding shall be granted under the condition that the loan requested and the funds of the borrower, and those of his guarantor, will secure the complete construction of the project for which the loan has been requested.
4. The borrower is under duty to participate in investment costs also with his own funds, and with his guarantor's funds with a percentage of the estimated value of investment to be subsequently determined.
5. The borrower is under duty to deposit a 5% guaranty amount according to regulations in force at the time of issuing the decision granting the loan.
6. Priority for obtaining loans under this competitive bidding shall be given to the borrowers:
  - a) with the lowest investment rate per kWh of annual production of electric power;
  - b) who are in a position to supply the largest possible part of their annual production during the periods between January 1 and February 28, and between July 15 and September 15;

- c) with the lowest ex-plant selling price per kWh;
- d) who, for the transport of the energy generated to the consuming center, request the lowest new investment funds per kWh generated, whereby the highest total energy losses during transport and including transformation up to the point of delivery to the 110 kV line may not exceed 8%;
- e) whose thermal plants use as fuel the highest percentage possible of waste coal of the lowest possible grade and with the lowest cost per 1,000 kcal delivered to the thermal plant store yard;
- f) who for the supply of fuel up to the thermal plant storage yard require the lowest amount of total new investment funds;
- g) who offer a shorter period for completion of the project;
- h) who offer a higher participation with their own funds.

The Bank can limit the maximum of total investment, and the investment out of the loan requested per unit of product, in excess of which the loan may not be granted.

7. Loans under this competitive bidding shall bear 2% interest annually, it being provided that the repayment date may not be longer than 40 years for hydro plants, and 25 years for thermal plants.

8. Any borrowers who wish to participate in this competitive bidding must submit, not later than July 30, 1960, their application to the Bank with the data stating the following:

- a) the type of the electric power project, and the situation, including the results and origin of investigations conducted, as well as data on the drafting of the design;
- b) the estimated installed capacity of the power plant and the explanation therefor;
- c) the amount of total annual production of energy in the plant at the generator;
- d) the amount of energy production which will be produced within the period of one year, especially in the period between January 1 and February 28 and between July 15 and September 15, those being critical periods for electricity supply;

- e) the amount of total construction costs for the whole project. Data should be given by projects and within the projects, by types of works (construction works, equipment, imported and domestic, and other);
- f) the sale price of electric energy ex-plant in terms of din./kWh;
- g) the reduced number of hours of use of the plant within a year (give a statement);
- h) the amounts required for new investments for transport of the electric energy generated to the consuming center up to the delivery of the energy to the 110 kV lines and higher. Describe in detail the character and the role of the plant within the power system, especially in respect to the consumption. To this should be added a description of the role of the existing power lines and transformer stations and an analysis of the possible need for the erection of new transmission lines;
- i) the type, calorific value and quality of coal, as well as the name of the mine from which coal will be supplied to the thermal plant. If waste coal is used, it is required to state it and to give the ratio. Give the estimate of fuel for 1,000 kcal, delivered to plant's storage;
- j) the amount of new investment required for securing the supply of the plant with the planned quantity of fuel, including investment for transport up to the plant's storage. In addition, data should be furnished on the stocks of coal at the disposal of the plant and for what number of years such stocks will be available. If new investments for coal supply facilities are required, the amount of funds needed should be stated.

For all the above stated data, an analysis of the method of obtaining such data should be furnished as well as a layout of the thermal plant.

9. The application for the investment loan should include all data set forth in Article 16 of the Decree on investment loans, such application being submitted in the prescribed Bank's forms.

10. The borrower shall submit with his application a fully drafted investment program as provided in Article 17, paragraph 1 and Article 15, paragraph 1 of the Decree on investment loans.

For hydroelectric plants, the production possibilities should be stated by months, that is data should be given for an average and medium-drought year. The production of thermal plants should be stated on a 6,300 working hours per annum basis with the allowed deviation depending on the supply of coal. The production should be stated in kWh on in-plant generator. In addition, for each new plant technical and economic data should be given relating to the construction of the transmission network as well as data relating to losses due to transmission of electric energy.

The specifications for the general plan of building works should be worked out by all items of building, handicraft and installation works, showing how individual amounts of work have been determined. The estimate of costs should be shown by all specification items on the basis of prevailing prices. Specifications and the estimate worked out on the basis of rough parameters shall not be accepted. As regards building works, instead of the general plan, the approved main design may be submitted.

The specification of equipment should include the statement of principal characteristics, as well as the statement of prices for each equipment item (separately for both imported and domestic equipment) and of assembly works.

11. Applications under this competitive bidding are required to draw up and to work out in detail a schedule of preparatory works with specifications and an estimate, as well as a time schedule of commitment of the funds required for the carrying out of the schedule of construction.

12. The borrower is required to submit, with his application to the Bank, a statement on the availability of funds for the deposit of the guaranty amount and of funds for participation in investment costs, if such funds are provided by the political subdivision.

13. The Bank may make the granting of the loan, dependent on the guaranty of the political subdivision or on the guaranty of the union of electricity enterprises, if the latter had not made a request for the loan.

14. The loan application with the necessary documentation shall be submitted in four copies to the nearest branch office of the Yugoslav Investment Bank.

15. For the filing of the definitive loan application, including all the documentation prescribed, two dates have been fixed: December 15, 1960 and April 15, 1961.

16. If up to the date of approval of the loan in favor of individual participants in the competitive bidding new regulations should be issued in the field of power economy, the provisions of such regulations, if they should affect the bidding, shall be binding on the participants in the bidding.

THE YUGOSLAV INVESTMENT BANK

Head Office

General Manager

A. Papic

Chairman

of the Board of Directors  
Hasan Brkic

