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ECONOMIC INTELLIGENCE REPORT

THE HEAVY ELECTRICAL MACHINERY INDUSTRY IN THE SOVIET BLOC

CIA/RR 9

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CENTRAL INTELLIGENCE AGENCY

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S-E-C-R-E-T

CONTENTS

Appendixes

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CIA/RR 9
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S-E-C-R-E-T

SECURITY INFORMATION

THE HEAVY ELECTRICAL MACHINERY INDUSTRY IN THE SOVIET BLOC*

Summary

The heavy electrical machinery industry plays a vital part in the economy of the Soviet Bloc. The atomic energy program and most of the basic industries depend on this industry in two ways: first, directly, for motors, generators, and transformers for use in their own facilities; second, indirectly, because they are dependent on the general power system, one of the main users of heavy electrical machinery.

Despite the destruction of facilities throughout the Soviet Bloc during World War II, the capital equipment of the heavy electrical machinery industry has been refurbished and renewed to a considerable degree. This equipment is probably adequate, being equal, if not superior, to prewar facilities. East German plants are in the poorest condition because they were subject to the direct effects of war and to the removals of equipment by the Soviets. There are some deterrents to the complete use of facilities, such as the use of some plant areas for the production of military items. Expansion of the industry, however, has taken place at a rapid rate and is expected to continue for the next few years. Facilities probably are not in most cases the limiting factor in over-all expansion plans. Occasionally it is not clear whether the impact of the Bloc's military production program, the lack of raw materials, or the inadequacy of the physical capacity of the plant to contain all the necessary operations causes deficient production in a given plant.

Although it probably is true that the employment of the inputs in the heavy electrical machinery industry of the Soviet Bloc results in markedly better returns to the economy than would the employment of these inputs in other industries, the number and types of inputs in this industry cause a serious drain on some of the resources of both metals and manpower in the Bloc. The real shortage in the industry exists in the supply of basic raw materials rather than in the facilities in which such raw materials are used.

Notable shortages exist in these basic raw materials, primarily copper, transformer sheet steel, and transformer oil. Although the industry uses

* This report contains information available to CIA as of 1 February 1952.

only approximately 3 percent of the annual copper output of the Soviet Bloc, the supply allocated to the heavy electrical machinery industry is not adequate, especially in the Satellites. A substantial import of basic raw materials, including copper largely in the form of wire, is known to exist, no doubt alleviating some of the difficulty. The Bloc's highest quality of transformer sheet steel is produced in the USSR. However, none of the finest quality transformer sheet steel, which is manufactured solely by a very few US firms and their Western European licensees, is being imported into the Bloc. As compared with this type of sheet steel, more of the Bloc's product is required for each transformer, which, in turn, calls for the employment of more copper. Production of transformer oil in both the USSR and the Satellites is insufficient and of generally low quality, and its use is thereby limited to transforming equipment and circuit breakers of relatively low capacity. Transformer oil of high quality, presently imported by the Bloc, would become of critical importance to it in a general war.

The heavy electrical machinery industry of the Soviet Bloc cannot supply both as regards types and amounts the needs of all consuming sectors of the economy. In the case of steam turbines and hydroturbines the supply is adequate for all current civilian and military uses. The Bloc's annual production rate for heavy electrical machinery as of January 1952 is estimated as follows: 2,620,000 kilowatts of motors, 2,850,000 kilowatts of generators, 10,550,000 kilovolt-amperes of transformers, and 4,452,000 kilowatts of turbines. In spite of a heavy production schedule and of considerable imports, expansion of the low-priority sectors of the Bloc economy which depend on heavy electrical machinery is retarded. The annual shortage of such machinery, amounting to 638,000 kilowatts, probably will cause cutbacks in railroad electrification, and in municipal pumping installations.

The deficit of heavy electrical machinery in the Soviet Bloc would be compounded if imports were reduced. The level of current imports of heavy electrical machinery into the Bloc is estimated at a rate of 4,425,000 kilowatts a year, approximately one-quarter of the estimated production rate. This major deficit between domestic production and demand indicates an unusually large dependence on imports. Even with a range of error which cuts this import figure in half, the imports still would be enough to satisfy completely the requirements of the Bloc's atomic energy program for heavy electrical machinery. The strategic importance of the import program cannot be overlooked in view of its sizable contribution to the Bloc's potential for war.

Many of the Bloc's industries require heavy electrical machinery for defense or defense-supporting production. The submarine program, the steel

industry, the atomic energy program, and the railroad equipment industry are examples of strategic sectors of the Soviet Bloc economy which are likely to have difficulties in fulfilling planned output if either the supply of heavy electrical machinery or the output of other basic industries which in turn depend on this supply is curtailed. Another strategic sector to be affected would be the electric power industry, which consequently would probably be unable to relieve the chronic shortage of electric power. Since all the industries of the Soviet Bloc which consume heavy electrical machinery are of varying degrees of strategic importance, the Bloc is particularly vulnerable should Western countries greatly reduce their exports to the Bloc of heavy electrical machinery or should there be a curtailment of the Bloc's imports of the basic raw materials used to produce such machinery. A continued excess of demand for heavy electrical machinery over supply would in the long run adversely affect the Bloc's economy and its war potential.

I. Introduction.

1. Nature and Uses.

For the purposes of this report, heavy electrical machinery will be taken to mean the items listed below, in sizes over 500 kilowatts (kw) only, in the case of transformers, sizes over 500 kilovolt-amperes (kva).

a. Motors:	Alternating current (AC), single and polyphase, and direct current (DC), and synchronous condensers.
b. Generators:	AC, single and polyphase, and DC.
c. Steam turbines and hydro-turbines used to drive such generators.	
d. Motor-generator sets.	
e. Transformers.	

In order for any country to produce this range of products, the following general requirements must be supplied: (a) large machinery, including extremely large lathes, boring and turning mills, presses, and spacious layouts equipped with heavy lifting devices as well as special lifting devices; (b) a supply of high-quality metals and insulating

materials; (c) skilled workers; and (d) railroads and special railroad cars for shipping purposes. In some European countries such as the UK, however, special trucks are used for the distribution of the output.

2. Importance of the Industry. 1/*

The supply of ample electric power always has been one of the prime objectives of the Soviet Union. The GOELRO Plan,** which was announced in 1920 and was to last 15 years, laid heavy demands on the electrical machinery industry. Changes in technology over those 15 years were made with extreme rapidity, and goals of this plan were increased with advances in the technology.

Throughout the Soviet Bloc the heavy electrical machinery industry plays a vital part in the economy. The atomic energy program and most of the basic industries depend on this industry in two ways: first, directly, for motors, generators, and transformers for use in their own facilities; second, indirectly, because they are dependent on the general power system, one of the main users of heavy electrical machinery.

The relative priority presently assigned in the Soviet Bloc to the heavy electrical machinery industry is hard to determine. Some of the Bloc industries competing directly with it for manpower, materials, machinery, and other supplies are the shipbuilding industry, the electronics industry, and the railroad equipment industry, as well as the atomic energy program. In some instances this competition is so marked that it occurs within a given plant. Because these heavy electrical machinery plants have the skilled manpower and are equipped with the type of machinery needed, some of these plants also are engaged in the production of submarine parts, atomic energy program products, and other military items.

The consistent supply of power to industrial facilities is so important that the Soviets have gone to considerable lengths, not only in the USSR but also in the Satellite countries, to provide a great amount of emergency, stand-by, and similar non-central-station generating equipment to various industrial and agricultural enterprises. Many of these units are of a portable nature and of a relatively small size, although others are of sizes on the order of 3,000 kw.

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** A major plan for the electrification of the entire USSR (Gosudarstvennaya komissiya po elektrifikatsii Rossii -- State Commission for the Electrification of Russia).

Some of the many Soviet Bloc industries which depend greatly on heavy electrical machinery are as follows:

a. Power-generating industry (prime user).
b. Chemical, petroleum, and oil pipeline industries.
c. Steel industry (in which heavy electrical machinery is used for both the manufacture and the shaping of steel).
d. Mining industry.
e. Shipbuilding industry.
f. Railroad equipment industry (electric and diesel-electric locomotives).
g. Railroad transportation.
h. Atomic energy program.
i. Aviation.

3. History of the Industry. 2/

a. Prewar.

In the early 1920's the USSR was dependent largely on foreign countries for its supply of all types of electrical machinery, but it was during that decade, following the promulgation of the GOELRO Plan, that electrical machinery plants in the USSR began to convert to the production of equipment in the larger sizes. Although there was a continuing development in the electrical machinery industry during the 1920's, electrical machinery was imported from Central and Western Europe and from the US to make up the deficit caused by insufficient domestic production. The proportion of turbines and generators of foreign manufacture, however, decreased to a marked degree between 1930 and 1938, and this decrease apparently was followed in all types of Soviet electrical machinery. There is some evidence that this decline in imports was not fully compensated for by domestic production. Nevertheless, the expansion of the power-generating capacity of the USSR during the 1930's was impressive. Installed capacity increased from 2.3 million kw at the end of 1929 to 11.4 million kw in 1941. While the rate of new installations declined along with imports and never quite reached the high point of 1931, the growing requirements for electric power apparently were met by these new installations, of which an ever-increasing proportion was being supplied by Soviet generator plants. Evidence also indicates that boilers, turbines, and transformers were not produced in comparable adequate amounts.

b. World War II.

The German invasion dealt a heavy blow to the heavy electrical machinery industry in the USSR. At a time when the production of heavy generating equipment was particularly vital because of the loss of generating capacity in the enemy-occupied regions, the heavy electrical machinery industry, concentrated as it was in Leningrad, Moscow, and Khar'kov, was seriously damaged. It has been estimated that as much as 60 percent of the generating capacity and 40 percent of electric power equipment production was lost. Evacuations of plant machinery to the east did take place, resulting in the refurbishment of some of the then less well-known plants. The machinery that subsequently was used in the evacuated factories was obtained either through Lend-Lease arrangements or by forcible removals from conquered territories.

Mention has been made that supplemental electrical machinery was supplied to the USSR in the 1920's by Central and Western Europe. These areas include, of course, most of the nations which now are Satellites and whose industries were well developed long before that time. The German, Hungarian, and Czechoslovak industries, in particular, have been suppliers of electrical equipment in the past and were supplying the USSR as well as one another during the 1920's.

Although complete information concerning Soviet removals of heavy electrical equipment is not available for the immediate postwar period, estimated Soviet removals from East Germany amounted to 3.4 million kw, while another 500,000 kw were dismantled in former German territories. Removals from Finland and Hungary amounted to another 290,000 kw, and acquisitions in Finland, Poland, Rumania, and West Germany amounted to perhaps an additional 500,000 kw.

c. Postwar.

The postwar tendency in the USSR has been to manufacture the largest sizes of heavy electrical machinery. This trend, for example, is apparent in the development of hydro machinery for the major hydroelectric projects which form an integral part of the Soviet planning. Such projects as the rebuilding of the Dnepr Dam, the Stalyinsk Hydroelectric Power Station (Gidroelektrostantsiya -- GES), the Kuybyshev GES, and the Volga-Don project require enormous machines for the most efficient and practical generation of power. Each hydrogenerator built by the Electrosila Electrical Equipment Plant in Leningrad for the Dnepr Dam had a capacity of 78,000 kw; those for the Tsimlyanskaya hydroelectric project had a capacity of 40,000 kw. This same tendency toward the use of large sizes of generating equipment also is very noticeable in the steam generator field in the

USSR and the Satellites. Considerable attention has been given to planning the means by which materials can be supplied to the Satellite plants for the building of such large-size heavy electrical machinery. Especially in East Germany there has been considerable developmental activity for very large transformers and other high-voltage static equipment.

The Soviets also seem to favor the manufacture of hydroelectric turbines and generators in the smallest sizes. Although these small machines cannot be called heavy electrical machinery, a great number of them in service would reduce the demand for large central station equipment. The USSR and the Satellites are building many small hydroelectric units, as well as the large number of small engine- or steam-driven generators required to back up such units. These units reportedly are being installed wherever possible, particularly in the USSR. Although such units are impractical from the US point of view, there are many Soviet plants which cannot make very large units but which do have the technical knowledge, the labor, and the experience necessary for the manufacture of small ones. These can be erected by the technicians from the Machine Tractor Stations in rural areas. Although the power which they can generate is small and sporadic, these small units contribute to the individual farm area or factory the same amount of power as if the area were tied into a power net. In the more remote regions, especially in the USSR, the cost of providing a transmission and distribution network of electric power would be prohibitive and would require the use of enormous machines.

Generators driven by prime movers other than by hydroturbines have followed the same pattern of development in the postwar period, since, like the hydrogenerators, they are being built in the largest possible sizes. The largest generators known to be built in the USSR are of 100,000 kw, but, according to the speech in October 1951 of Beriya, Deputy Minister of the Council of Ministers, USSR, a generator of 150,000 kw is now under development. These generators, of the same general sizes as US generators, indicate that the Soviets have not slackened their efforts to build power networks wherever feasible, based on the largest sizes of central station equipment.

The Soviet Bloc also produces motors in large sizes. The Satellites have shipped a large quantity of such motors to the USSR, and the Soviets are trying to enforce Bloc production of standard series of these motors.

In conclusion, it may be said that the postwar development of power in the Soviet Bloc has resulted in an integrated plan for the construction of power networks based on large-size heavy electrical machinery and in a secondary plan for providing as much power as possible in

remote regions by using small machines.

There is little concentration in the location of the heavy electrical machinery industry in the Soviet Bloc. In the USSR there are two main plants in Leningrad; two in Riga; three in Economic Region III, two of which are in Khar'kov and the other in Dnepropetrovsk; three in Region V, two of which are in Yerevan and the other in Baku; and five in Region VII, three of which are in Moscow and one each in Tambov and Yaroslav. There also are plants at Permaiska; at Sverdlovsk; in the Kuznets industrial region; and at Kemerovo. In Austria there are five plants, four of which are in Vienna. In Czechoslovakia there are five. In East Germany there are nine plants which are well distributed over the area. In Hungary and Poland there are two plants each, and Rumania has one plant. In Albania and Bulgaria there are no such plants.

4. Organization. 3/

The most complete organizational setup of the heavy electrical machinery industry is in the USSR. Although the organizations of East Germany, Hungary, and Czechoslovakia are well defined, in the other Satellites the controlling governmental organization is subject to considerable variation. Generally, in a small geographical area a generator plant forms a complex with an iron and steel plant and a turbine plant. The iron and steel plant supplies the castings and forgings necessary for the turbine plants, which, in turn, furnish the drives for the generators made at the generator plant. The planning authorities try to minimize long-distance movements of parts needed by installations of the same or related industries, but it is possible, for example, that the Novo Kramatorsk steel plant in Khar'kov may be supplying the Leningrad Metal Plant (LMZ), a turbine plant, despite the distance between the two plants. An interesting point is that before 1947 some of the plants in the heavy electrical machinery industry produced their own spiral-type air coolers for generators. This production was in accordance with the then-familiar pattern of such plants being as independent as possible of other suppliers for special machinery. After 1947, however, the responsibility for producing these air coolers was, to an increasing degree, given to plants which had no other connection with the heavy electrical machinery industry.

a. USSR.

Heavy electrical machinery in the USSR is produced by plants under the Ministry of Electrical Industry. This Ministry is under the direction of D.V. Yefremov, appointed Minister in May 1951. Biographical sketches of Yefremov and a few of his deputies (see Appendix A) reveal that all of these men not only are reliable Party members but also are finished

technicians.

The Ministry of Foreign Trade, which has a variety of subsections, each dealing in the export and the import of a given range of products, is the contact between the USSR and the outside world on all questions regarding trade. Although a plant director under the Ministry of Electrical Industry cannot specify that equipment of a certain design should be ordered from abroad, he can suggest that this be done, and the export-import company (MASHINOIMPORT) handling heavy electrical machinery for the Ministry of Electrical Industry will attempt to procure it if there is no adequate substitute within the USSR or no lower-priced competitive equipment on the foreign market.

b. Czechoslovakia.

The latest reorganization of Czechoslovak industry on 7 September 1951 brought all productive resources under a system closely resembling that of the Soviet Union. The old Ministry of Industry was split into five new Ministries: Fuel and Power, Metallurgical Industry and Ore Mines, Chemical Industry, Heavy Machine Building, and General Machine Building. All such ministries are under the direction of the Chairman of the Party.

Of interest is the Kovo Company, Limited, which is a national import-export organization under the Ministry of Foreign Trade. Kovo is responsible for all import-export activity carried on in behalf of the industries that it serves, one of which is the heavy electrical machinery industry. It was necessary to divide Kovo into three independent corporations in 1951 because of its large volume of business. The three new corporations are called Investa, trading in heavy machinery; Kovo, trading in precision and electrotechnical goods; and Motokov, dealing in the products of light industry, including electric light bulbs. On 1 January 1951 the name of the parent company, Kovo, was changed to Kovo, Limited, Metal and Engineering Products and Raw Materials Trading Company, and the subsidiary company dealing in the production of precision and electrotechnical goods was changed officially to Kovo, Limited, Precision Engineering Products and Import and Export Company.

Through this organizational setup the Czechoslovak government like the Soviet government has complete control over the activities of the heavy electrical machinery industry and controls the import of materials and supplies related to it, the domestic production, and the prices and volume of exports.

c. East Germany.

In East Germany the heavy electrical machinery plants are either enterprises of the Association of People-owned Enterprises (Vereinigung Volkseigene Betriebe -- VVB) or members of a Soviet-owned stock corporation (Sowjetische Aktien Gesellschaft -- SAG). In December 1950 an East German government decree was issued reorganizing the economic ministries, effectively modifying the previous structure of the associations of people-owned electric engineering industries. The completion of this program was scheduled for 1 April 1951. The newly formed Ministry of Machine Building now has under it six Main Administrations (HV's), of which one, the HV Elektrotechnik, controls all VVB plants and laboratories in East Germany concerned either with electronics or with heavy electrical machinery.

The East German-owned portion of the East German electrotechnical industry, representing from 70 to 75 percent of the industry, is divided into the following groups: the Association of People-owned Enterprises of the Electrical Machine Industry (VVB-VEM), with 23 consolidated firms, having about 15,000 employees engaged in the development and manufacture of both light and heavy electrical machinery; and the Association of People-owned Enterprises for Installations, Cable, and Apparatus Material (VVB-IKA), with 51 consolidated firms, having about 20,000 employees engaged in the production and supply of components needed to support the industry. Seventeen key firms, having about 35,000 employees, report directly to the HV Elektrotechnik. Of these last-mentioned firms, 7, having about 20,000 employees, are in the heavy electrical manufacturing field.

In addition to the firms controlled by the Ministry of Machine Building, there are 13 large and important electrotechnical firms which are members of the Soviet-owned SAG-Kabel, controlled directly by the USSR through the Main Administration of Soviet Corporations in Germany, and which, for purposes of planning, payment, and materials allocations, are affiliated with the economic ministries of East Germany. In these firms, approximately 30,000 to 35,000 employees are engaged in the manufacture of equipment used in the heavy electrical machinery industry.

It was intended that the entire output of SAG firms in East Germany should be delivered to the USSR outside of the reparations account. This arrangement has not been feasible, however, and a significant portion of SAG production has been shipped for the reparations account, for which the SAG was reimbursed by materials and components deliveries from East Germany. In addition, the SAG firms have had to deliver certain items required by the East German electrotechnical industry, including both VVB and SAG enterprises.

The organization of the heavy electrical machinery industry of East Germany reflects an obvious effort to insure adequate supplies of raw materials for the industry from both indigenous and Western sources. The fact that some of the firms within the structure report directly to the Ministry of Machine Building indicates the importance which is assigned to the production of finished goods.

d. Hungary.

The administrative organ for the nationalized sector of heavy industry in Hungary is the Ministry of Heavy Industry, and it has assumed jurisdiction over several former Directorates. All of the facilities for the manufacture of heavy electrical machinery are well integrated into the Directorates of the Ministry of Heavy Industry and are closely allied with the production schemes envisaged by the USSR for the Bloc, as is the entire manufacturing economy of Hungary.

5. Technology. 4/

The Soviets seem to have arrived at a rather advanced technological position in the manufacture of heavy electrical machinery. They have been building 100,000-kw hydrogen-cooled generators ever since the end of World War II. In comparison to other European nations, which have not yet been able to manufacture such items, this advance is quite remarkable. The US has been producing generators of this and greater capacity for some time, with a 300,000-kw machine planned.

The quality of the Soviet machines appears to be good. For the most part, the Soviets follow well-established practices. They have been known for years as capable imitators. In more than one plant there are indications of direct conformance to German-design sheets which were captured during World War II. Many prisoners of war have reported making German-Russian translations of such blueprints and specification sheets.

Some of the industries supplying the Bloc's heavy electrical machinery industry are inferior to this industry. For example, the somewhat poorer grade of transformer sheet steel that is being made in the USSR reveals one of the most notable weaknesses of the supply industries. There does seem to be a restricted supply in the Bloc of the better quality of transformer sheet steel with losses lower than 1 watt per pound.

In the Satellites, technology now is coming to a higher level than it has been in the postwar years and much effort is being expended to achieve production of the latest type of electrical machinery. German, Czechoslovak, and Hungarian production was known during the prewar years to be of high

quality. Losses in technology caused by lack of contact with foreign firms and foreign development during World War II unquestionably will be made up. Since the USSR is contributing skilled engineering personnel and standardized Soviet designs to the Satellite producers of heavy electrical equipment, Satellite technology will probably be kept in step with the Soviet.

The active participation of Soviet scientists and scientific organizations, including the universities, in the development of the manufacturing arts applies to the heavy electrical machinery industry as well as to other industries of the USSR. (A list of such Soviet organizations known to be contributing to research and developmental work for this industry is contained in Appendix B.) The active participation of these organizations extends, as with other Soviet industries, to every field within the heavy electrical machinery industry, including its relations with constructors, erectors, suppliers, and users. In some instances, cooperative agreements are signed between workers groups and the scientific organizations in order to better design-planning, construction, installation, and plant practice. In addition, these scientific organizations act somewhat along the lines of US trade associations.

In some instances, the role of the Soviet universities is identical with that played by the other scientific organizations. The reason for the allocation of any particular developmental assignment to a specific scientific organization is not always clear, but probably depends on the availability of the qualified scientists. Over-all control of pure research projects seems to rest with the Academy of Sciences, USSR, the various Academies of Sciences of each Republic, the Moscow University, and presumably other universities acting in a subordinate capacity.

An example of how the research and development activities apply to actual production in the heavy electrical machinery industry of the USSR is the case of turbines for the Stalingrad and Kuybyshev GES. These turbines are to be produced by the Leningrad Metal Plant imeni Stalin, but assisted by scientists from both the Institute of Machine Technology of the Academy of Sciences, USSR, and the Power Engineering Institute of the Academy of Sciences, Ukrainian SSR, and by the laboratories of the Leningrad Polytechnic Institute imeni M.I. Kalinin and of the All-Union Scientific Research Institute of Hydraulic Machine Building. Two models of these turbines are to be produced by the Riga Turbine Machine Plant.

II. Supply. 5/

1. Production. 6/

Of all the plants known to be producing electrical machinery of all types throughout the Soviet Bloc, 41 plants (18 Soviet and 23 Satellite) are of special interest. (A description of these plants is contained in Appendix C.) Although 14 of these plants do not now produce heavy electrical machinery, some of them are potential producers and could be converted to such production. The remaining 27 plants probably account for almost 100 percent of all the heavy electrical machinery produced in the Soviet Bloc. Tables 1 and 2* estimate the annual rate of production of heavy electrical machinery as of January 1952 of the Bloc countries and of each individual plant.

The rate of growth of the heavy electrical machinery industry in the Soviet Bloc over the past few years has been slowing down as compared with the high rate during the immediate postwar period. The industry is now expanding production at the rate of approximately 12 percent a year and will probably continue at this rate. On this assumption the production for 1951 and 1952 can be estimated as being 94 and 106 percent, respectively, of the figures cited in Tables 1 and 2, below. The production estimates in these tables are conservative, because information may be incomplete. Production, for example, may be taking place in isolated plants which are unknown. In the case of turbines, estimated figures throughout this report regarding production, as well as regarding imports, are preliminary only, due largely to the lack of data in production input coefficients.

In view of these conservative production estimates, the variation which might be expected would have a limited range of between 95 and 115 percent of the figures estimated as follows in Tables 1 and 2.

2. Imports. 7/

During and immediately after World War II, Soviet imports of heavy electrical machinery were large, the value of Soviet imports of electrical machinery of all types during the period 1946 and 1947 being estimated at approximately $100 million. The Soviet Bloc, however, at that time was not dependent on imports for the largest part of its foreign supply but on Lend Lease.

* Table 1 follows on p. 14; Table 2, on p. 15.

Table 1

Estimated Annual Rate of Production of Heavy Electrical Machinery in the Soviet Bloc
As of January 1952

Country [a]	Motors [b] (Kw a Year)	Generators [b] (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
USSR	1,310,000	1,850,000	3,800,000	2,452,000
Austria	0	0	0	700,000
Czechoslovakia	300,000	500,000	2,300,000	0
East Germany	600,000	300,000	3,500,000	1,000,000
Hungary	300,000	150,000	650,000	300,000
Poland	110,000	0	100,000	0
Rumania	0	50,000	200,000	0
Total	2,620,000	2,850,000	10,550,000	4,452,000

a. In those Bloc countries not listed (Bulgaria, Albania, China, and North Korea) the production of heavy electrical machinery is either negligible or nonexistent.
b. Also may include rotary condensers and/or converters.

S-E-C-R-E-T

Table 2*

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
USSR					
BEMZ Electrical Equipment Plant	Baku	150,000	0	800,000	0
Dinamo Electric Transformer and Generator Plant	Dnepropetrovsk	0	0	0	0
KEMZ Electrical Equipment Plant	Kemerovo	0	0	0	0
KhEMZ Electrical Equipment Plant imeni Stalin	Khar'kov	450,000	550,000 c/ 175,000 d/	0	0
KhTGZ Turbogenerator Plant imeni Kirov	Khar'kov	0	0	0	650,000 c/ 60,000 d/
LMZ Metal Plant imeni Stalin	Leningrad	0	0	0	700,000 c/ 300,000 d/
Electrosila Electrical Equipment Plant imeni Kirov	Leningrad	600,000	600,000 c/ 225,000 d/	0	0
Transformer Plant imeni Kuybyshev	Moscow	0	0	2,000,000	0
Dinamo Electrical Machine Building Plant imeni Kirov	Moscow	50,000	0	0	0
Electric Motor Plant imeni Vladimir Ilyich	Moscow	0	0	0	0
Donets Electromechanical Plant imeni Karl Marx	Pervomaisk	0	0	0	0

* Footnotes for Table 2 follow on p. 21.

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
USSR (Continued)					
Turbomechanical Plant	Riga	0	0	0	0 b/ 42,000 d/
Urals Turbine Plant imeni Kirov	Sverdlovsk	0	0	0	400,000
Uralelektroapparat Urals Electrical Apparatus Plant	Sverdlovsk	50,000	300,000	500,000	0
Rev Trud (Revolutionary Labor) Machine Building Plant	Tambov	0	0	0	0
YaEMZ Electrical Machine Building Plant	Yaroslavl'	10,000	0	0	0
Electrical Machine Building Plant	Yerevan	0	0	500,000	0
Turbine and Generator Factory imeni Lepse	Yerevan	0	0	0	300,000
Subtotal		1,310,000	1,850,000	3,800,000	2,452,000

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
Austria					
Electrical Machinery Plant, Siemensstrasse	Vienna	0	0	0	0
Electrical Machinery Plant, Engerthestrasse	Vienna	0	0	0	0
AEG-Union Electrical Equipment Plant	Vienna	0	0	0	0
Electrical Equipment Plant	Vienna	0	0	0	0
J.M. Voith Industrial Equipment Plant	St. Polen	0	0	0	700,000
Subtotal		0	0	0	700,000
Czechoslovakia					
Foundry and Machine Shop	Kosice	0	0	0	0
CKD (Ceskomoravska Kolben Danek) Electric Motor and Equipment Plant	Bratislava	0	0	300,000	0

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
Czechoslovakia (Continued)					
Skoda Electric Products Plant	Pilsen/Doudlevce	300,000	500,000	2,000,000	0
AEG Electrical Equipment Factory	Decin	0	0	0	0
CKD Vysocany Electrical Equipment Plant	Prague	0	0	0	0
Subtotal		300,000	500,000	2,300,000	0
East Germany					
Bergmann-Borsig Turbine Plant	Berlin	0	0	0	600,000
TRO Transformer Factory	Berlin/Ober-schoeneweide	0	0	1,000,000	0
Turbinenfabrik VEB Turbine Plant	Dresden	0	0	0	400,000

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
East Germany (Continued)					
Fimag Electrical Equipment Works	Finsterwalde	0	0	0	0
Saxony Electric Motor Factory (Sachsenwerk)	Dresden/Niedersedlitz	400,000	250,000	1,500,000	0
Electric Motor Factory (Elektromotorenwerk VEM)	Wernigerode	0	0	0	0
Electric Motor Plant (ELMO)	Dessau	200,000	50,000	0	0
Transformer and X-ray Factory (TraRoe)	Dresden	0	0	1,000,000	0
Subtotal		600,000	300,000	3,500,000	1,000,000
Hungary					
Ganz Electrical Equipment Factory	Budapest	300,000	150,000	650,000	0

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
Hungary (Continued)					
Lang Machinery Factory	Budapest	0	0	0	300,000
Subtotal		300,000	150,000	650,000	300,000
Poland					
Rohn-Zielinski Electric Company	Zychlin	100,000	0	100,000	0
Electric Machine Factory M-10	Wroclaw	10,000	0	0	0
Subtotal		110,000	0	100,000	0

Table 2

Estimated Annual Rate of Production by Plant of Heavy Electrical Machinery
in the Soviet Bloc
As of January 1952 a/
(Continued)

Name of Plant	Location	Motors (Kw a Year)	Generators b/ (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
Rumania					
Caros Judet Electrical Machinery Plant	Recita	0	50,000	200,000	0
Total Satellites		1,310,000	1,000,000	6,750,000	2,000,000
Total USSR		1,310,000	1,850,000	3,800,000	2,452,000
Total Bloc		2,620,000	2,850,000	10,550,000	4,452,000

a. Although, as previously stated, 14 of these plants do not produce heavy electrical machinery, some of them are potential producers and could be converted to such production.
b. Also may include rotary condensers and/or converters.
c. Steam-driven.
d. Hydro-driven.

Present imports to the Soviet Bloc are continuing at a high level. In spite of the increasing Western controls on shipments to the Bloc, considerable heavy electrical machinery moves from West to East, largely as a result of the Western attitude that such machinery is not of strategic value and therefore need not be restricted to such a degree as more direct war materials.

It is estimated, as shown in Table 3,* that the Soviet Bloc will be able to continue importing approximately $88.5 million of heavy electrical machinery annually, representing 4,425,000 kw. These estimates are made by country of origin. Thus, some countries which have been known to supply the Soviet Bloc with heavy electrical machinery which they have previously obtained from other countries will not appear as suppliers. On the other hand, the countries listed in Table 3 have their transshipments reported as direct shipments. These estimates attempt to give the probable total exports to the Bloc, but will, in virtue of the methodology available (see Appendix F 3) [redacted] have a wide margin of error, and their reliability is low. In all cases, the estimates represent the reasonable amount of shipments to the Bloc from country of origin to be expected during 1951. 50X1

A discussion of imports by country of origin follows.

a. UK.

The UK has shipped a great deal more equipment to the Bloc than that country has admitted. According to available evidence in 1950 and 1951 the UK shipped at least $12 million worth annually of heavy electrical machinery to the USSR, with another $3 million worth being shipped annually to the Satellites. Therefore, it is reasonable to assume that $15 million can be considered to be the current annual level of UK exports to the Soviet Bloc of heavy electrical machinery. A very large traffic in smaller machinery items is known to exist.

b. Netherlands.

Traffic between the Netherlands and the Soviet Bloc is thought to be negligible in view of the fact that manufacturing facilities in that country are small.

* Table 3 follows on p. 23.

Table 3

Estimated Annual Soviet Bloc Imports of Heavy Electrical Machinery a/

Country	Exports to Soviet Bloc (Million $ US)	Exports to Soviet Bloc (Kw) b/	Production (Kw)	Percent of Production Going to Soviet Bloc
UK	15.0	750,000	13,178,970	5.7
Netherlands	Negligible	Negligible	494,760	Negligible
Italy	13.0	650,000	4,120,340	15.8
West Germany	8.0	400,000	6,882,750	5.8
France	3.0	150,000	6,695,220	2.2
Denmark	Negligible	Negligible	156,940	0
Belgium-Luxembourg	6.0	300,000	2,564,240	11.7
US	2.0	100,000	Unknown	Unknown
Sweden	15.0	750,000	2,882,110	26.0
Switzerland	12.0	600,000	4,083,100	14.7
Austria	6.0	300,000	684,950	43.8
Finland	3.5	175,000	Unknown	Unknown
Others	5.0	250,000	Unknown	Unknown
Total	88.5 c/	4,425,000 c/		

a. One of the most helpful sources regarding imports are the figures which the Coordinating Committee of certain Western European nations (COCOM, Paris) has submitted. The way in which these figures are used is discussed in Appendix F 3.
b. Conversion to kilowatts has been made by assuming that 1 kilowatt of machine capacity costs $20, which is reasonable for a general range of machine types and sizes in the European market.
c. Although it is impossible to give an exact import estimate for each main type of heavy electrical machinery, the totals may be divided roughly as follows: 37½ percent transformers, 25 percent motors, 25 percent generators, and 12½ percent turbines.

c. Italy.

For the past several years, Italy has had practically no restraints placed on its trade with the Soviet Bloc, and Italian statistics (COCOM), $7.5 million, are believed to be conservatively stated. The estimated current rate of Italian shipments to the Bloc, unless drastically curtailed by pressure from the US, will be $13 million a year.

d. West Germany.

Estimated shipments to the Bloc from West Germany are $8 million. This estimate is of low reliability.

e. France.

According to French official 1950 statistics, France shipped about $3 million worth of all types of electrical equipment to the Soviet Bloc. There are indications that current exports to all parts of the Soviet Bloc have increased, and heavy electrical machinery items may be expected to reach a total volume of $3 million in 1952.

f. Denmark.

Danish exports of heavy electrical machinery to the Bloc have not been, nor are they likely to become, of any significance.

g. Belgium-Luxembourg.

Belgium and Luxembourg contain some manufacturers of high-quality heavy electrical machinery. Furthermore, these countries have no compunctions about the export to the Soviet Bloc of the portion of their manufacture which the domestic market cannot absorb. Belgium and Luxembourg export heavy electrical machinery to the Soviet Bloc at an estimated annual rate of $6 million.

h. US.

COCOM statistics show that the US has exported to the Bloc an annual average of $1,538,000 worth of heavy electrical machinery in recent years. The estimated annual rate will probably amount to $2 million.

i. Sweden.

Swedish exports of heavy electrical machinery to the USSR are large and of high value, there being no apparent reason for Sweden not to carry on an unrestricted trade with the Bloc in such machinery. Soviet shipments can be made between Sweden and the USSR with considerable facility. Certain shipments include the most complex types of equipment and machinery of the largest sizes. Sweden's current export rate to the USSR is estimated at approximately $15 million annually.

j. Switzerland.

Although shipment from Switzerland is difficult, this country can be considered to be another important supplier of the Soviet Bloc import needs. Although many of the Swiss companies deny that such shipments do exist, or will depreciate their value, exports of heavy electrical machinery do exist. The export rate is assumed to be as high as $12 million a year.

k. Austria.

Recent reports have given details of the shipments from the Administration of Soviet Properties in (Eastern) Austria (Upravleniye Sovetskogo Imushchestva (Vostochnoy) Avstrii -- USIA) and from non-USIA firms to the Soviet Bloc, and total of such shipments run to quite sizable amounts. In the first half of 1951, for example, USIA firms have exported to the remainder of the Soviet Bloc about 13,000 metric tons of motors, transformers, and other similar items. Austria's exports to the Bloc probably will amount to a total of $6 million annually of heavy electrical machinery.

l. Finland.

Finland has one major producer of heavy electrical machinery, the Stromberg Company, which has plants at Pitajamaki and Vaasa. The production of these plants for the past few years has been used for reparations. Although demands for such reparations recently have slackened, it is assumed that most of the production of these plants will still go to the USSR. This production may be valued as high as $3.5 million annually.

m. Other Countries.

From all other areas of the world there may be exported to the Soviet Bloc another $5 million worth of heavy electrical machinery.

III. Requirements.

The estimated annual requirements of the Soviet Bloc for heavy electrical machinery by consuming industry as of January 1952 are shown below in Table 4.* As indicated in this table, annual Bloc requirements exceed production by 5,063,000 kw,** and, since Bloc imports of heavy electrical machinery amount to 4,425,000 kw a year, an estimated 638,000 kw of requirements were not filled during 1951. This estimate is supported by reported deficits during 1951 in certain Bloc plans for installing heavy electrical machinery, principally in the electric power supply system and in the railroad transportation industry. There was also reportedly a more critical shortage of generators than of other types of heavy electrical machinery. The negligible deficit of turbines as shown in Table 4 confirms that turbine production is more satisfactory than the production of motors, generators, and transformers.

The kw requirements for heavy motors and generators in the case of some Soviet Bloc industries, as shown in Table 4, have been calculated on the basis of their known or estimated expansion plans. In the case of the other industries (see footnote c, Table 4), their requirements for motors and generators have been estimated by using US data -- the sales statistics of two US companies -- assuming that the relationship among Soviet industries regarding such requirements is somewhat similar to such relationship among US industries. The kw and kva requirements for all industries for transformers and turbines have been estimated by using the relationship in any country among these four classifications of heavy electrical machinery.

IV. Use Pattern. 8/

1. Strategic.

All of the industries of the Soviet Bloc consuming heavy electrical machinery are of strategic significance to the Bloc. Some of these industries make products or furnish services of direct military use; other consuming industries have an output which goes to defense and defense-supporting purposes. None of the products of the heavy electrical machinery industry, however, are finished military items per se, although some of these products, such as submarine drive motors, have direct military application.

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* Table 4 follows on p. 27.

** This figure has been given in kw by converting kva totals for transformers to kw, assuming a unity power factor for these transformers.

Table 4

Annual Pattern of Requirements of Heavy Electrical Machinery
in the Soviet Bloc
January 1952

Consuming Industry	Motors (Kw a Year)	Generators (Kw a Year)	Transformers (Kva a Year)	Turbines (Kw a Year)
Electric Power a/	335,000	2,500,000	10,000,000	2,500,000
Atomic Energy Program	450,000	300,000	1,200,000	300,000
Naval Shipbuilding Program	175,000	175,000	none	780,000
Railroad Transportation	360,000	100,000	b/	b/
Steel	600,000	250,000	b/	b/
Chemicals, Petroleum c/	530,000	0	b/	b/
Mining c/	230,000	0	b/	b/
Aviation c/	270,000	0	b/	b/
Others c/	530,000	175,000	2,200,000	875,000
Total Requirements	3,480,000	3,500,000	14,100,000	4,455,000
Production	2,620,000	2,850,000	10,550,000	4,452,000
Deficit	860,000	650,000	3,550,000	3,000

a. Includes 160,000 kw of synchronous condensers. It is estimated that these condensers, on the basis of US practice, are used primarily in the electric power industry, having practically disappeared from use in other industries.
b. Requirements are included in the category of other industries.
c. Estimates based on US data.

The high importance of the heavy electrical machinery industry to the Soviet Bloc's war potential is clearly shown by the three consuming sectors of the Bloc's economy which use the heavy electrical machinery assigned to them solely to increase the Bloc's war potential. These sectors are the atomic energy program, the naval shipbuilding program, and the aviation industry. The atomic energy program requires large motors to drive water pumps in connection with the manufacture of fissionable materials. The second consuming sector, the naval shipbuilding program, uses heavy electrical machinery in submarines and in other naval vessels. The largest sizes of motors are most likely used by the third consuming sector, the Bloc's aviation industry, which requires them in wind tunnels to test aircraft. The industry's large heavy electrical machinery requirements for 1951 have been estimated on the basis of comparable US data and of the Bloc's current interest in the development of jet aircraft and engines.

The other consuming sectors of the Bloc's economy (see Table 4) contribute the larger part of their output indirectly as well as directly to the Bloc's war potential and therefore have less strategic importance than the three consuming sectors discussed in the above paragraph. The electric power industry, for example, supplies the electric power necessary for defense and defense-supporting industries as well as for the military establishment. Another example is the railroad transportation industry which serves to increase the war potential by electrifying those sections of track upon which strategic industries in general and the military forces are most dependent. A continued excess of demand for heavy electrical machinery over supply will in the long run adversely affect the Bloc's economy and its war potential.

2. Exports. 9/

The countries of the Soviet Bloc have not exported in the past few years much heavy electrical machinery to any country outside the Bloc. It is not possible to arrive at a more definite assessment. As regards intra-Bloc trade, East Germany, Czechoslovakia, and Hungary are exporters of heavy electrical machinery to the USSR and to the other Bloc countries. Rumania, Albania, and Poland have received heavy electrical equipment, mostly generating station equipment, from the USSR and also from the other Satellites; substantial shipments of heavy electrical machinery also have been made to China by other members of the Bloc. The Satellites apparently try to satisfy their import requirements, first, by importing from outside countries, in return for nonstrategic finished goods and agricultural products; second, by importing from other Satellite countries; and third, by importing from the USSR.

As regards the raw materials for the manufacture of the finished products, the USSR apparently wishes to avoid the obligation to ship these materials to the Satellites. In some instances, notably in East Germany, the USSR supplies Satellite manufacturers with raw materials for the machinery items that are to be delivered to the USSR. However, there is an acute need in the East German industry for copper and electrical sheet steel as well as for skilled technicians.

V. Input Requirements. 10/

In order to ascertain the materials and labor requirements needed to support the rate of production of heavy electrical machinery in the Soviet Bloc (estimated in II 1, above), it will be necessary, first, to divide the figures cited as the estimated annual rate of production into figures representing specific classifications of equipment types and sizes; second, to apply input requirements per unit of output (see methodology in Appendix F 4) to these groupings to determine the total requirements of manpower and metals.

The approximate breakdown of machinery into specific sizes is believed to be adequate for the purposes of calculating materials requirements. The difference existing between the production totals developed in II 1 on the one hand and the simulation of these totals on the other arises because the production pattern uses a series of discrete product sizes. These figures representing product sizes are not necessarily evenly divisible into the figure representing the total estimated production in each group.

The breakdown of general production estimates is made with the aid of figures developed by a US manufacturer whose production pattern is considered to be representative of the entire US industry. For machinery items of the size under consideration in this report, the US production pattern, which is assumed to be typical of the Soviet Bloc production pattern, is used with almost no modification.

The total production figures for motors in the USSR and in the Satellites will be divided on the following basis: induction motors, 30 percent of the total; synchronous motors, 32 percent of the total; and direct current motors, 38 percent of the total. The total production figures for generators will be divided on the following basis: USSR, 75 percent steam-driven and 25 percent hydro-driven; and for the Satellites, 85 percent steam-driven and 15 percent hydro-driven.

The above categories, when broken down according to US practice, give the pattern presented under the heading "Estimate of Production and Size Range" in Table 5.* In addition to conforming to the US pattern, the total number

* Table 5 follows on p. 30.

Table 5*

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor for the Production of Heavy Electrical Machinery (Based on US Experience) a/ Production Rate as of January 1952

Estimate of Production and Size Range			Total Steel	Steel Plate	Steel Punchings	Steel Castings	Steel Forgings	Copper	Aluminum	US Base for Computing Direct Labor (Man-hours) a/
Motors			Pounds							
Induction										
Units	Rating	Total Kw								
3	18,000	54,000	709,020	259,740	247,860	106,920	94,500	75,600	Negligible	23,970
6	10,000	60,000	787,800	288,600	275,400	118,800	105,000	84,000	Negligible	93,300
150	3,000	450,000	5,908,500	2,164,500	2,065,500	891,000	787,500	630,000	Negligible	699,750
222	1,000	222,000	2,914,860	1,067,820	1,018,980	439,560	388,500	310,800	Negligible	345,210
381	Total	786,000	10,320,180	3,780,660	3,607,740	1,556,280	1,375,500	1,100,400		1,162,230
Synchronous										
Units	Rating	Total Kw								
1	15,000	15,000	338,100	105,300	156,450	26,100	50,250	30,000	Negligible	37,200
3	10,000	30,000	676,200	210,600	312,900	52,200	100,500	60,000	Negligible	74,400
75	5,000	375,000	8,452,500	2,632,500	3,911,250	652,500	1,256,250	750,000	Negligible	930,000
100	2,500	250,000	5,635,000	1,755,000	2,607,500	435,000	837,500	500,000	Negligible	620,000
225	750	168,750	3,803,625	1,184,625	1,760,175	293,625	565,200	337,500	Negligible	418,500
404	Total	838,750	18,905,425	5,888,025	8,748,275	1,459,425	2,809,700	1,677,500		2,080,100

* The footnote for Table 5 follows on p. 36.

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor for the Production of Heavy Electrical Machinery (Based on US Experience) a/ Production Rate as of January 1952 (Continued)

Estimate of Production and Size Range			Total Steel	Steel Plate	Steel Punchings	Steel Castings	Steel Forgings	Copper	Aluminum	US Base for Computing Direct Labor (Man-hours) a/
Motors (Continued)			Pounds							
Direct Current										
Units	Rating	Total Kw								
3	20,000	60,000	1,374,600	723,600	549,600	7,800	93,600	207,600	2,400	165,000
5	10,000	50,000	1,145,500	603,000	458,000	6,500	78,000	173,000	2,000	137,000
60	7,500	450,000	10,309,500	5,427,000	4,122,000	58,500	702,000	1,557,000	18,000	1,237,500
120	3,000	360,000	8,247,600	4,341,600	3,297,600	46,800	561,600	1,245,600	14,400	990,000
100	750	75,000	1,398,800	803,300	485,200	12,800	97,500	329,300	3,800	222,000
288	Total	995,000	22,476,700	11,898,500	8,912,400	132,400	1,532,700	3,512,500	40,600	2,751,500
Total Motors Requirements			51,702,305	21,567,185	21,268,415	3,148,105	5,717,900	6,290,400	40,600	5,993,830

S-E-C-R-E-T

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor
for the Production of Heavy Electrical Machinery
(Based on US Experience) a/
Production Rate as of January 1952
(Continued)

Estimate of Production and Size Range			Total Steel	Steel Plate	Steel Punchings	Steel Castings	Steel Forgings	Copper	Aluminum	US Base for Computing Direct Labor (Man-hours) a/
Generators			Pounds							
Steam-turbine Driven										
Hydrogen-cooled										
Units	Rating	Total Kw								
2	100,000	200,000	864,000	240,000	474,000	10,000	140,000	60,000	4,000	167,200
2	60,000	120,000	518,400	144,000	284,400	6,000	84,000	36,000	2,400	100,320
4	40,000	160,000	691,200	192,000	379,200	8,000	112,000	48,000	3,200	133,760
10	22,500	225,000	972,000	270,000	533,250	11,250	157,500	67,500	4,500	188,100
18	Total	705,000	3,045,600	846,000	1,670,850	35,250	493,500	211,500	14,100	589,380

S-E-C-R-E-T

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor for the Production of Heavy Electrical Machinery (Based on US Experience) a/ Production Rate as of January 1952 (Continued)

Estimate of Production and Size Range				Total Steel	Steel Plate	Steel Punchings	Steel Castings	Steel Forgings	Copper	Aluminum	US Base for Computing Direct Labor (Man-hours) a/
Generators (Continued)				Pounds							
Steam-turbine Driven (Continued)											
Air-cooled											
Units	Rating		Total Kw								
60	10,000		600,000	3,942,000	714,000	2,400,000	48,000	780,000	390,000	12,000	1,209,600
125	5,000		625,000	4,106,250	743,750	2,500,000	50,000	812,500	406,250	12,500	1,260,000
310	1,000		310,000	2,036,700	368,900	1,240,000	24,800	403,000	201,500	6,200	624,960
495		Total	1,535,000	10,084,950	1,826,650	6,140,000	122,800	1,995,500	997,750	30,700	3,094,560

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor
for the Production of Heavy Electrical Machinery
(Based on US Experience) a/
Production Rate as of January 1952
(Continued)

Estimate of Production and Size Range			Total Steel	Steel Plate	Steel Punchings	Steel Castings	Steel Forgings	Copper	Aluminum	US Base for Computing Direct Labor (Man-hours) b/
Generators (Continued)			Pounds							
Water-wheel Driven										
Units	Rating	Total Kw								
1	70,000	70,000	1,702,400	875,000	604,800	90,300	132,300	135,800	1,400	140,000
3	22,500	67,500	1,641,600	843,750	583,200	87,075	127,575	130,950	1,350	135,000
8	10,000	80,000	1,945,600	1,000,000	691,200	103,200	151,200	155,200	1,600	160,000
50	5,000	250,000	6,080,000	3,125,000	2,160,000	322,500	472,500	584,000	5,000	500,000
145	1,000	145,000	3,526,400	1,812,500	1,252,800	187,050	274,050	281,300	2,900	290,000
207	Total	612,500	14,896,000	7,656,250	5,292,000	790,125	1,157,625	1,188,250	12,250	1,225,000
Total Generators Requirements			28,026,550	10,328,900	13,102,850	948,175	3,646,625	2,397,500	57,050	4,908,940

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor
for the Production of Heavy Electrical Machinery
(Based on US Experience) a/
Production Rate as of January 1952
(Continued)

Estimate of Production and Size Range			Total Steel	Steel Plate	Steel Punchings	Copper	Insulation	Oil	Miscellaneous	US Base for Computing Direct Labor (Man-hours) a/
Transformers			Pounds							
Units	Rating	Total Kva								
2	110,000	220,000	330,840	107,400	223,440	75,240	27,300	113,400	16,780	46,000
6	100,000	600,000	1,161,840	408,000	753,840	172,920	70,800	376,800	43,860	122,400
9	62,500	562,500	1,201,680	282,600	919,080	170,775	71,100	406,800	46,800	124,200
12	50,000	600,000	1,161,840	408,000	753,840	172,920	70,800	376,800	43,860	140,028
30	20,000	600,000	2,169,600	636,000	1,533,600	316,800	128,700	750,000	128,700	189,000
200	10,000	2,000,000	8,232,000	3,120,000	5,112,000	1,056,000	429,000	2,500,000	429,000	920,000
400	7,500	3,000,000	11,113,600	5,200,000	5,913,600	1,346,400	312,000	5,920,000	912,000	1,795,600
1,000	1,500	1,500,000	11,690,000	2,810,000	8,880,000	3,630,000	750,000	0	144,000	3,200,000
2,935	500	1,467,500	11,352,580	2,935,000	8,417,580	3,099,360	971,485	0	296,435	8,805,000
4,594	Total	10,550,000	48,413,980	15,907,000	32,506,980	10,040,415	2,831,185	10,443,800	2,061,435	15,342,228
(Average Rating 2,296)										

Table 5

Estimated Annual Soviet Bloc Input Requirements of Materials and Labor
for the Production of Heavy Electrical Machinery
(Based on US Experience) a/
Production Rate as of January 1952
(Continued)

Summary Requirements	Total Steel	Copper	Aluminum	Oil	US Base for Computing Direct Labor (Man-hours) a/
	Pounds				
Motors	51,702,305	6,290,400	40,600	0	5,993,830
Generators	28,026,550	2,397,500	57,050	0	4,908,940
Transformers	48,413,980	10,040,415	0	10,443,800	15,342,228
Total	128,142,835	18,728,315	97,650	10,443,800	26,244,998

a. From the figures given for direct labor, which are typical of US experience, it is possible to obtain an indication of the total input requirements of factory labor for the estimated Soviet Bloc production of heavy electrical machinery. On the assumption that productivity in the Soviet Bloc industry is one-fifth of US productivity, the figure 26,244,998 presented in the table must be multiplied by 5 to obtain a figure for direct labor input requirements of the Soviet industry. On the further assumption that the ratio of direct to indirect factory labor in the production of heavy electrical machinery in the Soviet Bloc is 1:1, this figure must in turn be multiplied by 2 to obtain the total number of man-hours spent at the factory level in producing the equipment listed in the above table. The resulting total (262,449,980 man-hours) is merely an indicative figure, since the assumptions made in deriving it are based on only rough estimates of Soviet Bloc practice and efficiency.

of motors estimated for calculation purposes seems compatible with the 1950 Plan for the USSR.

Table 5 summarizes the annual materials and labor requirements for production of motors, generators, and transformers in the Soviet Bloc at the production rate estimated for January 1952. 50X1

[redacted] these input requirements have been extrapolated to cover the range of products which has been set up and also have been adjusted to cover the differences between US manufacturing practices and those of the Soviet Bloc. For example, the weight of transformer sheet steel has been increased by one-third and the copper content of transformers by 10 percent to account for the inability of the Soviet Bloc to obtain transformer sheet metal of a standard comparable to that used in the US. The above process makes it possible to apply the material in Table 6, Appendix D, as direct multipliers to the list of products. 50X1

One check that can be applied to the over-all estimate of production of heavy electrical machinery in the Soviet Bloc is the amount of copper used, which in 1951 was 3.17 percent of the estimated supply of 590 million pounds a year which the Bloc produces. This percentage is comparable to that in the US, which in 1947 was 3.13 percent. To demonstrate the validity of the established input factors when applied to a single plant, the following comparison is made of the reported deliveries of materials to the KhEMZ plant in Khar'kov and of the estimated input requirements. From prisoner-of-war reports it is estimated that this plant would receive for its production of heavy electrical machinery a total of 23,208,120 pounds of sheet steel and 5,157,360 pounds of copper. The input estimates for the plant are 23.8 million pounds of sheet steel and 4,672,500 pounds of copper. The difference is very small -- in the case of steel, 2.6 percent, and in the case of copper, 9.4 percent. This test case indicates that the input factors as developed in Appendix D can be applied with some measure of accuracy to individual plants. The methodology by which the above figures were arrived at is given in Appendix F 4.

It has not been possible to develop input factors for mica, a highly strategic item and believed to be in relatively short supply in the Soviet Bloc. 11/ Note is taken in Appendix C in the discussion of the Ganz factory in Budapest that failures in equipment have occurred because the quality and the application of the insulation was poor. Since, on large machinery, the coils are wound with mica tapes or with mica sheets, the supply of such material was probably insufficient.

The manpower requirements of the Bloc's heavy electrical machinery industry, as estimated by input coefficient analysis, are shown to be approximately 120,000 workers. This requirement figure shows considerable variation from an estimate made of the actual working force in this industry, which is arrived at by adding all of the reported workers in the plants. This figure approaches 200,000 workers, which possibly suggests that the conversion (see Table 5, note a) of US to foreign manpower requirements is not high enough. In view of the fact that estimates of the working force based on direct observations within a given plant are known to be inaccurate, the calculated figure may be the more realistic.

VI. Capabilities, Limitations, and Vulnerabilities.

1. Capabilities.

a. Expansion.

A few of the means by which productivity in heavy electrical machinery in the Soviet Bloc can be increased are improvement in capital equipment, technology, organization and control, plant morale, and standardization of products. All of these devices have been employed both in the USSR and in the Satellites in order to expand output. Technological improvements are widely reported, and the Soviets claim that these improvements make the greatest expansion of output possible. Standards which control the technical production specifications for electrotechnical plants have been established for the entire USSR -- a typical device for improving organization and control of production. Compliance with the established specifications is compulsory for all plants. Along with this, there has been a widespread attempt to standardize designs of products. Examples are departmental technical specifications for manufacture; installation regulations, which are norms regulating the design of high-current electrotechnical units; and operating regulations, which cover requirements in the exploitation of electrical units.

The Soviets insist that their standards be adhered to in the Satellite plants making equipment for the Soviet account. There are numerous examples of this in East Germany and in Hungary, as well as numerous reports of Soviet inspection parties and Soviet plant directors in Satellite plants.

Soviet efforts to improve plant morale are the most spectacular of the many methods employed to increase productivity. The Stakhanovite movement, the establishment of the "Order of Heroes of Labor," and the ceaseless repetition of the Leninist dictum of "joy through labor" are well known. Although little is known of the effect on productivity of such measures on

heavy electrical machinery plants, the results are probably not insignificant.

As estimated in II 1, the output of heavy electrical equipment in the Soviet Bloc is rising by about 12 percent a year. While the available data do not permit a calculation of the proportion of this increase attributable to increased productivity of labor as against the balance attributable to increased use of other resources, it is estimated that the former accounts for approximately 2 to 3 percent of the annual expansion of output.

b. Convertibility. 12/

The presence of a great number of general-purpose machine tools in the Bloc's heavy electrical machinery industry makes it possible for the plants to convert to the manufacture of other end products. However, in view of the advances made in equipping the plants of other Bloc industries since the end of World War II, there seems to be little reason to anticipate such a large-scale conversion of heavy electrical machinery plants as that which took place during World War II in the USSR. The great need for heavy electrical machinery also will have some effect in retarding any Soviet Bloc plans for conversion. There are reports, however, of plans to convert some of the plants in the industry. The Ganz plant in Hungary, for instance, reputedly is set up in such a manner that it could be in full production on a series of military products in a matter of 2 months. The same situation reportedly obtains in the Skoda plant in Czechoslovakia. The best presumption that can be made at present is that there will be some conversion to the manufacture of heavy weapons such as gun barrels but that the great demand which exists for heavy electrical machinery will require that these plants, for the most part, continue with the manufacture of regular items.

2. Limitations. 13/

The serious limiting factor on Soviet manufacture of heavy electrical machinery is the supply of input materials, particularly copper and transformer sheet steel. There seems to be no question that these materials are in short supply throughout the Bloc. There are recurrent reports of a copper shortage. Although the heavy electrical machinery industry consumes only 3 percent of the total copper supply in the Bloc, the shortage of copper is the most critical and sensitive feature of the industry. A lively trade with foreign countries exists, and heavy imports of copper bars and wire are indications of how necessary this metal is to the Bloc.

Even such potentially high-quality producers as the East German plants are restricted in the supply of copper. Direct reparations orders

and special orders can be filled by these plants only when they receive Soviet deliveries of copper, the East German industry being forced otherwise to depend on the very meager indigenous supply.

So-called "oriented" transformer sheet steel, the finest quality, having very low losses and being used for the fabrication of transformer cores, is manufactured by very few US firms and their Western European licensees, and no such metal is available to the Bloc. The USSR can manufacture, however, a very good trade of transformer sheet steel. The domestically produced supply of acceptable grades of transformer sheet steel, however, is not adequate for the production programs envisaged by the Bloc planners, and a sufficient amount of imports of such grades is not possible.

Certain secondary, but nevertheless important, inputs also seem to be in short supply. Noteworthy among these are transformer oil and hydrogen gas for the cooling of turbogenerators. In 1949 a German electrical engineer, [redacted] had occasion to test the Soviet-made transformer oil that had been sent to Mingechaur, USSR, for use in the 1,750-kva transformer in the substation. The oil had a dielectric strength which did not satisfy the substation specifications and could not by repeated cleaning be brought to specification level. Another quantity of oil, secured from Baku and marked for use at the transformer voltage, also proved unsatisfactory. 50X1

Finally, upon urgent request to Moscow the substation was allowed a sufficient quantity of German-made transformer oil which met specifications. Transformer oil might turn out to be one of the most significant and critical shortages in the future.

The postwar developments in hydrogen-cooled generators also have created a supply problem for the Soviets, who have not yet been able to develop a convenient method for obtaining hydrogen at the station in which the generators are located. An electrolyzing apparatus and pumps of a size suitable for the high-pressure storage of this hydrogen have to be installed. Delivering hydrogen in bottles to various power stations in remote areas cannot be considered to be an adequate channel of supply. It may, however, become a vital supply channel if electrolyzing apparatus is not supplied to each power station having a hydrogen-cooled generator.

3. Vulnerabilities.

In view of the Bloc's dependence on imports of heavy electrical machinery, under cold war conditions a curtailment of these imports, as well as of the basic raw materials required to produce such machinery, is considered to be the best method of striking at the expansion plans of some of the Bloc's critical industries. In the event of a full-scale war with the Bloc, one of the most effective measures would be interruption of the railroad system, for it is on this means of transportation that the industry depends almost entirely, both to move in the large quantities of raw materials and to move out the heavy products which it manufactures.

APPENDIX A

OFFICIALS OF THE SOVIET MINISTRY OF ELECTRICAL INDUSTRY

YEFREMOV, Dmitriy Vasil'yevich.

Career:

1947-48. Deputy Minister of Electrical Equipment Industry, 6 May.

1948. Received award for successful fulfillment of quota at investiture held by N.M. Shvernik at the 30th anniversary Ukrainian SSR in May. Participated in All-Union Conference of Directors of Construction and Installation Organizations, Moscow, 1-3 December.

1948-50. Deputy Minister of Electrical Industry.

1951- . Minister of Electrical Industry, appointed 6 May.

Remarks:

D.V. Yefremov replaced I.G. Kabanov as Minister of Electrical Industry by decree of the Presidium of the Supreme Soviet USSR in May 1951. He has been identified with the Ministry since 1947 as Deputy Minister and then as First Deputy Minister. He was replaced as First Deputy Minister in March 1950, but in the absence of any official statement it was considered likely that he retained his position as Deputy Minister.

An able administrator, who began his career as a factory engineer with a group of engineers of the Electrosila Electrical Equipment plant in Leningrad, he was awarded in 1947 a Stalin Third Prize of 50,000 rubles for the invention of a 100,000-kw, 3,000-rpm hydrogen-cooled turbogenerator. This turbogenerator has been installed at the Stalingorsk Power Station in the Moscow area.

PEKSHEV, Aleksandr Alekseyevich.

Career:

1947- . Deputy Minister of Electrical Equipment Industry, 26 May.

CHERNICHKIN, Dmitriy Semenovich.

Career:

1947- . Deputy Minister of Electrical Equipment Industry and member of Collegium of the Ministry, 27 March. He was criticized in 1949 for failing to give proper attention to the workers of the Vladimir Ilyich Plant in Moscow.

POZYNAKOV, Viktor Alekseyevich.

Career:

1946-50. Deputy Minister of Electrical Equipment Industry, 10 August.

1950- . Deputy Minister of Electrical Industry. Participated in the Third Plenary Session, All-Union Central Council of Trade Unions, 4 February.

FADIN, Ivan Akindinovich.

Career:

1942. Deputy People's Commissar of Electrical Industry and member of Collegium of the People's Commissariat for Electrical Industry.

1946- . Appointed Deputy Minister of Electrical Equipment Industry, 10 August.

MESHCHERYAKOV, K.N.

Career:

1942. Deputy People's Commissar of Electrical Industry and member of Collegium of the People's Commissariat for Electrical Industry.

1944. Awarded Order of Lenin.

1946- . Deputy Minister of Electrical Equipment Industry, appointed in March.

Remarks:

Meshcheryakov was [redacted] having a fair knowledge of the field but as being rather slow in grasping new ideas. In 1944, he still was identified as Deputy People's Commissar for Electrical Industry. He probably continued in this position until 1946, when the Commissariat of Electrical Industry became the Ministry of the Electrical Industry. 50X1

TOVSTOPALOV, Anton Iosipovich.

Career:

1940. Member of Collegium of the People's Commissariat for Electrical Industry, 6 May. Deputy Commissar, 18 June.

1944. Awarded Order of Lenin.

1946- . Deputy Minister of Electrical Equipment Industry, 10 August.

1947. Member of editorial board of "Elektrichestwo" (an official periodical of the electrical machinery industry).

YERMAKOV, Vladimir Sergeyevich.

Career:

1949. Deputy Minister for General Affairs, Ministry of Electrical Industry, June.

Remarks:

There is a Vladimir Sergeyevich Yermakov, deputy from 1947 to 1951 to the Azerbaydzhan SSR and a member of the Baku City Party Committee, elected in January 1949. He may be the same person as the USSR Deputy Minister for Power Stations, identified in 1949. In October 1951, a V.S. Yermakov participated in a meeting of Moscow city and oblast power workers.

APPENDIX B

SCIENTIFIC ORGANIZATIONS IN THE USSR CONTRIBUTING TO THE SOVIET HEAVY ELECTRICAL MACHINERY INDUSTRY

The following is a list of the scientific organizations in the USSR contributing to the research and developmental work of the Soviet heavy electrical machinery industry. The relationship of all of these organizations to one another is not known, and some of them possibly have been reported under more than one name.

1. The Academy of Sciences, USSR.
2. The Academies of Sciences, Union Republics.
3. The Moscow State University.
4. Leningrad Polytechnic Institute imeni M.I. Kalinin.
5. The All-Union Scientific Research Institute of Hydraulic Machine Building.
6. The All-Union Society and Technical Society of Power Engineers.
7. Leningrad Electrical Research Institute imeni Molotov.
8. Central Scientific Research Laboratory of Electrical Engineering, Ministry of Electric Power Stations.
9. Scientific Research Institute, Ministry of Electrical Industry.

APPENDIX C

DESCRIPTION OF CERTAIN ELECTRICAL MACHINERY PLANTS

A description follows of the 41 plants named in Table 2. Although 14 of these plants are described as not producing heavy electrical machinery at present, some of them are potential producers and could be converted to manufacture such machinery.

A. USSR.

1. BEMZ Electrical Equipment Plant, Baku.

Although construction probably did not start until 1945, the plant already is a factor in the heavy electrical machinery industry. Its production is concentrated on electric motors and transformers. Much of the equipment used in this plant was removed from the Saxony Electric Motor Factory in East Germany and can be presumed to be of good quality. There are no reliable estimates of the present labor force, but there were reportedly 1,000 workers at the plant in 1947. In view of the numerous references by the Soviet press to the plant and to its production record, the labor force probably must be doubled by now. The 1950 Plan called for "an output of 800 motors of a size greater than 100 kw," but there is no available information as to the number of transformers which might be built.

Probable annual output of the plant is estimated as follows: motors, 150,000 kw in sizes above 500 kw each; and transformers, 800,000 kva in sizes above 500 kva.

2. Dinamo Electric Transformer and Generator Plant, Dnepropetrovsk. 50X1

Although definitive information is lacking, [redacted] this plant may be producing significant amounts of special-purpose generators and power transformers. It does not produce electrical machinery over 500 kw. 50X1

Comprising an area of 400 x 400 meters the plant seems to be well-organized and operated with no apparent difficulty in the supply of raw materials. Three shifts a day appear to be usual, and the work force is estimated at 900 workers, a conservative estimate given the size of the area. The generators produced by the plant reportedly run at 5,000 rpm and are about 2 feet in diameter. This suggests use in high-frequency

induction heating applications, and it might reasonably be supposed that the production of high-frequency induction heating devices is the plant's main function.

3. KEMZ Electrical Equipment Plant, Kemerovo.

The production of this plant has been devoted exclusively to motors less than 500 kw in size. The plant is one of the primary suppliers of smaller motors for the mining industry. Such motors are made in sizes of from 3 to 250 horsepower, and many of them are waterproofed.

Expansion of the plant is in progress, including the construction of new buildings, the older section having been refurbished with captured equipment, particularly with new machinery from Leipzig. This expansion already may have resulted in production of motors in sizes over 500 kw.

4. KhEMZ Electrical Equipment Plant imeni Stalin, Khar'kov.

This is one of the three largest plants in the USSR devoted to the production of electrical machinery. With a working force of nearly 20,000 persons, the plant can produce the largest sizes of the most complex electrical machinery, and, together with the KhTGZ plant in Khar'kov, which normally manufactures the turbines for the KhEMZ generators, forms an integrated complex for the production of such items.

Badly damaged during World War II, the plant was quickly rehabilitated and can be considered to be back in full production. The electric power installation was completely destroyed, and, while it is not known definitely that this has been replaced, efforts to do so are at least under way. This installation is not of fundamental importance, since the city power plant can handle the load imposed by this plant. A large production hall also is being constructed which, when completed (possibly by now) will add perhaps 15 percent more productive capacity. Reparations equipment for the plant was removed from the AEG plant in Berlin and can be considered of good quality.

The plant makes a wide range of motors, apparently of all types and sizes. The specialty in the postwar period was the MA series of motors. This series, the largest units of which were in sizes of about 105 kw, has been discontinued. A much broader pattern of standardized motors probably is now being produced. The plant also manufactures generators, including hydrogen-cooled types, switching apparatus, and other static equipment. It is of special interest that the plant is undoubtedly making motors for submarines (the Electrosila Electrical Equipment Plant being the prime supplier of such equipment) and reportedly contact mines.

Recent press reports have indicated that this plant has been deficient in fulfilling the plan for heavy electrical equipment. Since there have been such reports previously, this deficiency may be a chronic condition, indicating that the plant is less efficient than the Electrosila Electrical Equipment plant with which it compares in size and facilities.

Estimated annual production is as follows: turbogenerators, 550,000 kw; hydrogenerators, 175,000 kw; and motors, 450,000 kw.

5. KhTGZ Turbogenerator Plant imeni Kirov, Khar'kov.

This plant complements the KhEMZ Electrical Equipment Plant since it produces the turbines for the generators manufactured in the latter. The KhTGZ plant has large and productive shops, fully capable of manufacturing turbines of the largest sizes and to the limit of Soviet capabilities.

There are probably over 10,000 workers in the plant, and it consists of an area of 100 by 300 meters. Many PW's reported the periodic visits to the plant of officials high in the Ministry, which may suggest the plant's importance. The machinery is described as being of the newest type and is thought to be well kept.

Frequent mention is made of the production of ship and submarine turbines, and some of the production figures given by observers at the plant confirm the opinion that it can outproduce the KhEMZ plant.

The KhTGZ plant must be considered in its relation with the KhEMZ plant. [redacted] the drives for ship-electric machinery go almost invariably to the KhEMZ plant, and the reports of production of turbo-electric drives in that plant support the observations on drives for ship-electric machinery. Submarine drives probably are a major portion of the production of both plants. 50X1

Estimated annual production for the KhTGZ plant is as follows: steam turbines, 650,000 kw; and hydroturbines, 60,000 kw.

6. LMZ Metal Works imeni Stalin, Leningrad.

The LMZ plant supplies turbines for the Electrosila Electrical Equipment Plant in Leningrad just as the Kirov plant supplies turbines for the KhEMZ plant. The plant is about the same size as the Kirov plant, or possibly a bit larger, and the line of products manufactured is practically identical. Both plants manufacture hydroturbines, steam turbines for generator drives, and steam turbines for marine drives and for other purposes.

The capacity of the LMZ plant to build turbines is larger than is the capacity of the Electrosila plant to absorb them, most of the excess capacity in the LMZ plant being devoted to the production of marine turbines.

Annual production estimates for the LMZ plant are as follows: steam turbines, 700,000 kw; and hydroturbines, 300,000 kw.

7. Electrosila Electrical Equipment Plant imeni Kirov, Leningrad.

Constructed in 1897, the Electrosila plant, formerly the Siemens-Halske works, has been since then one of the major Soviet producers of heavy and other electrical machinery. It still is the largest and most productive of the Soviet plants, and its contribution to the Soviet economic potential is correspondingly great.

There are approximately 20,000 employees in the plant, a three-shift 8-hour day being the usual practice. The efficiency of the Electrosila plant is attested to by numerous reports of overfulfillments of plans, economical operation, and by the fact that it is rarely rebuked by the Soviet press. The plant has its own power installation, and after the evacuation to Tomsk and Barancha during World War II received a great deal of first-rate machinery from Germany, including "the largest turning lathe in the world," which had been made by the Krupp factory. A quantity of new machine tools also was received from the US.

The plant can produce a complete line of electrical machinery and equipment, including both AC and DC motors, hydrogenerators, and turbogenerators. These generators are hydrogen-cooled and up to 150,000 kw in size, which is comparable to the size of the best US types. The DC machinery is known to range in size up to 30,000 horsepower, which suggests, since no other plant is known to produce DC machinery with such capacity, that this plant is the leading supplier of motorgenerator sets for use in steel mills and in electrolytic refining processes. It also is true that the plant can handle an ambitious program for the production of submarine motors. This plant probably makes all the rectifiers for subways and for railroad electrification in the USSR.

Four generators out of a total of nine installed at the Dnepr dam before World War II were manufactured in this plant, the balance of the generators and all nine turbines being supplied by the US. When the dam was reconstructed after the war the Soviets decided to reequip it with six Soviet-built generators and turbines. The failure of one of the new US step-bearings and the replacement of the others by ones made in Electrosila were seized upon by the Soviet press as an example of the superiority of

Soviet technology over US technology.

Estimated annual production is as follows: turbogenerators, 600,000 kw; hydrogenerators, 225,000 kw; and motorgenerators, 600,000 kw.

8. Transformer Plant imeni Kuybyshev, Moscow.

The plant is the primary supplier of transformers in the USSR. It has been known to exist since the early days of the Soviet Union. Apparently, the plant always has made transformers exclusively and has managed to keep abreast of the times in the development of transformers of larger sizes and in the building of rotating machinery. A US engineer set up a design section for this plant in the early 1930's, and the section remained intact until World War II at least.

A labor force of around 5,000 has been reported, but there is no definite information on the number of shifts worked. Information is generally limited to general plant description and production reports of a qualitative type. It can be established, however, that the plant makes over 3,000 types of transformers, and production ranges from specialty transformers to the very largest power transformers. Apparently, US design practice is being followed since such products as unit substations, as well as mobile distribution sets, are known to have been produced. The largest transformer about which there is information is of 100,000 kva size, although it is thought that this is by no means the largest size possible for this plant. The Soviet press has stated that if suitable core materials were provided, a transformer of 400,000 kva could be manufactured.

Estimated production of transformers over 500 kva in size is at the volume of 2,000,000 kva a year.

9. Dinamo Electrical Machine Building Plant, Moscow.

In the USSR Economic Information Bulletin, the Moscow Dinamo plant was referred to as being "the largest producer of electrical equipment in the USSR," which is believed to mean that the plant produces a wide range of such equipment, including most of the motors used in the Soviet transportation systems. Starting and control equipment and such electrical drive machinery as is used for controlling canal locks are produced. The products receiving the most emphasis are traction motors for mine and other electric locomotives, but there is also some production of DC machinery.

The labor force at the plant numbers approximately 15,000. Before World War II, 14,000 employees were at this plant, parts of which were evacuated to Magnitogorsk, Chelyabinsk, and Penza. The plant was completely reconstructed after the war, reparations equipment coming from the German Messerschmitt works. The present labor force is at least as large as it was before World War II. The prewar power installation was removed to Chelyabinsk, and it is not known whether the plant has such an installation at present.

Since the Dinamo plant concentrates on the production of motors used in the transportation system, it produces correspondingly fewer of the very large-size motors. It is known that one type of electric locomotive employs six-drive motors totaling 3,300 horsepower. Thus, these motors, which are produced at Dinamo, would be about 400 kw in size. This gives rise to the speculation that they may be producing motors for the newer types of electric locomotives which may have drive motors somewhat above 500 kw in size. At least, it can be assumed that this plant manufactures very large-size motors in some limited quantities. The manufacture of DC machinery is well substantiated.

Estimated production of motors about 500 kw in size is 50,000 kw a year.

10. Electric Motor Plant imeni Vladimir Ilyich, Moscow.

Founded in 1847, the plant formerly produced spare parts for agricultural machinery, drives for Moscow factories and works, flywheels, and other metal parts. Since the revolution the factory has been considerably expanded and a large number of buildings erected. During World War II, the plant switched over to the production of artillery shell cases and was evacuated in 1941. Returned to its original site in 1942, it continued production of war materials. In 1947 the factory was transferred from the ministry controlling agricultural machinery to the Ministry of Electrical Industry, new equipment was added, and more workers were hired. Production of a series of motors began in late 1947, and by July 1950 40 different types of electric motors were being manufactured.

The plant now employs about 5,500 workers, who generally work in three 8-hour shifts, but sometimes in two 8-hour shifts. The leading personnel are Director M.S. Zarazhnov, Chief Engineer Skorikov, Chief Technologist Surkov, Chief Metallurgist Eliovich, and Chief Mechanic Kainov.

The plant has been set up for the serial production of the smaller motors. A conveyor belt which was installed in one shop facilitates the painting and drying of motors, and there is a conveyor belt in the motor assembling shop No. 31 which also speeds production. In the first half of 1950 about 4,000 motors were produced, but only 3,000 in 1948. Other products which may be in volume production are automatic circuit breakers, rheostats, and, possibly, rural station generators.

There is no production of motors over 500 kw in size.

11. Donets Electromechanical Plant imeni Karl Marx, Pervomaisk.

Fairly large and occupying 500 square meters, the plant employs about 2,500 workers. The machines and installations which were received as reparations equipment came from a prewar AEG plant in Berlin.

The plant manufactures motors, oil switches, and transformers, as well as parts. [redacted] 50X1
[redacted] 50X1
The plant then was producing the Pobeda motor of the "MAD" series, which had a 40-kw rating. Three thousand of these units were planned for 1950. The factory also was producing the "MAL" 126/18 motor, with a rating of 150 kw, of which from 800 to 900 units were planned for 1950. [redacted] there is production of comparable motors and that the plant may be manufacturing motors in larger sizes and may be growing in importance as a supplier of large motors. There also is reportedly some production of portable transformers at the plant. 50X1

The plant does not produce electrical machinery in sizes over 500 kw.

12. Turbomechanical Plant, Riga.

In Riga there are two plants of importance to the electrical machinery industry. One is the Turbomechanical Plant, which manufactures turbines and comparable machinery. The other is the so-called "REZ" plant, which manufactures such electrical machinery as small (including fractional horsepower) motors and generators. It appears that the usual relationship between two such plants does not exist, because the turbine-manufacturing plant has the ability to produce drives which are much larger than the electric generators produced in the electrical machinery plant. The output of the turbine plant is shipped to unknown destinations.

[redacted] the turbine plant manufactures turbines up to at least 1,200 kw in size, primarily for rural electric stations. Other reports have mentioned the production of turbines blades for the LMZ Metal Works in Leningrad, reportedly the parent factory. It also is of interest that propeller-type turbines have been produced in the Turbomechanical Plant. 50X1

This plant is a large facility which concerns itself with the manufacture of three types of product: water turbines, parts for steam turbines, and bulldozers, or, at least, some type of excavating machinery. There is some confusion as to whether this plant manufactures complete steam turbines, but it is probable that it manufactures turbines comparable to the Westinghouse type "E" turbines. [redacted] 50X1 the plant produces blades for steam turbines at the rate of 5,500 blades a month. The plant also has been reported as either producing the complete rotor assembly, or as establishing facilities to do so.

The hydroturbines are made in various sizes and configurations, including Kaplan turbines. Six to eight turbines of up to 1,200 kw in size were being completed each month in 1950. There probably are 900 workers in the plant, which occupies 200 square meters. Production of hydroturbines above 500 kw in size is estimated at 42,000 kw a year. The estimated production of steam turbines is negligible.

13. Urals Turbine Plant imeni Kirov, Sverdlovsk.

The plant, one of the most important turbine producers in the Soviet Union, was expanded during World War II by machinery evacuated from the KhTGZ Turbogenerator Plant in Khar'kov and in 1942 employed 6,000 workers. It is assumed that the present labor force is about the same as the prewar figure, although there have been reports that the number of employees has doubled. In 1941 it was proposed that this plant produce turbines of from 1,500 to 12,000 kw in size, as well as the parts for these turbines. This plan has since been implemented. In the postwar period the plant has been known to produce even larger turbines, in particular some of 25,000-kw size and, possibly, of 100,000 kw.

This plant, [redacted] is expanding. Soviet press reports have mentioned that the plant received a new rolling mill in 1950, and [redacted] the receipt of some East German reparations equipment and which state that the plant is producing diesel motors suitable for submarine drives. This plant undoubtedly could produce diesel motors and turbines at the same time, although priority problems would arise. 50X1 50X1

Estimated production of turbines is 400,000 kw a year.

14. Uralelektroapparat, Urals Electrical Apparatus Plant, Sverdlovsk.

The plant produces small hydrogenerators for rural power plants, large generators, motors, condensers, oil circuit breakers, large- and medium-sized transformers, and other static electrical equipment. Having a labor force of approximately 7,500, the plant reportedly is building a laboratory for the testing of high-voltage equipment. This laboratory conforms to a production program involving both transformers and condensers. According to Izvestiya, production space was scheduled to be expanded five times during the Fourth Five Year Plan (1946-50).

Apparently, the products produced in the Urals Turbine Plant and in this plant are complementary. Estimated production is as follows: motors, 50,000 kw a year; generators, 300,000 kw a year; and transformers, 500,000 kva a year.

15. Rev Trud (Revolutionary Labor) Machine Building Plant, Tambov.

The plant received new German and US machinery during World War II for the manufacture of turbines, small generators, welding transformers, and other electrical machinery. The plant does not produce heavy electrical machinery.

A high percentage of the plant's output seems to be portable electric power plants. [redacted] the capacity of these portable plants as 75 kw each. [redacted] the destination of these units as being the transportation industry, although it is quite possible that such units are being sent to other industries. The plant is capable of producing 15 or 20 of these portable sets a day, and efforts are being made to expand. 50X1 50X1 50X1

16. YaEMZ Electrical Machine Building Plant, Yaroslavl'.

The plant manufactures motors of all sizes above one-half kw, equipment for hydro plants, special motors for the textile industry, starters, dynamos, generators, alloys and castings, and aircraft engine parts. It also has manufactured ammunition.

With 3,500 workers and a monthly output given in 1948 as 3,500 motors, the pattern of production is now approximately as follows: 3,000 motors a month in small sizes of 5 kw average capacity; 200 to 500 motors a month in sizes averaging 125 kw.

Since these motors represent only the average size of motors produced, it is possible that the factory is engaged in limited production of motors and equipment above 500 kw in size. In 1947 the factory was modernized and supplied with new machinery manufactured in the US. Machines of German design also were added to the factory, but it is not known whether these were East or West German.

Production of motors, above 500 kw in size, is estimated at 10,000 kw a year.

17. Electrical Machine Building Plant, Yerevan.

The Electric Machine Building Plant at Yerevan was built possibly as late as 1946, but by 1949 was considered by the Soviet press as being one of the largest industrial enterprises in the Armenian SSR, producing electrical machinery, including generators. The production of diesel motors was scheduled for the end of 1949. [redacted] generators are built in the smaller sizes of 15, 20, and 25 kw, and, as a result of improved production-line techniques, it is planned to manufacture 15,000 generators a year. 50X1

The plant may be equipped to build 10,000 kva transformers at a rate of 2,000 a year and presently manufactures such necessary insulating materials as bakelite. In a Soviet publication mention has been made of the production of mobile substations for agricultural use. This output may partially account for the plant's reportedly poor production record, since these substations are difficult to manufacture. It is not possible to estimate production, although transformers are being produced at the rate of 500,000 kva a year. The motors and generators seem to be of small sizes, but the transformers may be quite large.

18. Turbine and Generator Factory imeni Lepse, Yerevan.

In 1940, the Turbine and Generator Factory at Yerevan was reportedly planning to manufacture small hydroturbines and generators for kolkhoz use. The capacity of the assembled unit was to be 30 to 40 kw and the total weight less than 1 ton.

The plant is back in operation, and [redacted] expansion is going on at a rapid rate. In 1949 the plant expected to modernize and double its capacity for the production of hydroturbines, to start production of larger hydroturbines, and to add 3,000 square meters of plant space. 50X1

Both this plant and the Electric Machine Building Plant follow the common pattern of coupling of a plant manufacturing turbines with a plant manufacturing generators and other electrical equipment.

Estimated turbine production of the plant is 300,000 kw a year.

B. Soviet Zone of Austria.

Of the five plants manufacturing electrical machinery in the Soviet Zone of Austria the J.M. Voith plant in St. Polen is the only one manufacturing heavy electrical machinery. The other four plants produce a variety of electric motors and transformers in sizes less than 500 kw or 500 kva. Their contribution to the Soviet Union, however, is worthy of attention, and a brief description of all five plants is as follows:

1. and 2. Electrical Machinery Plant; Siemenstrasse, Vienna (formerly Siemens-Schuckert).

Electrical Machinery Plant; Engerthestrasse, Vienna (formerly Siemens-Schuckert).

The two plants were considered by the Soviets as enemy assets, and considerable capital equipment was removed from them before the USSR stopped this practice and began to demand payments in products. Such payments have consisted of motors and generators from both plants and transformers from the Siemensstrasse plant. Deliveries to the Soviet Union probably amount to 50 percent of the total production of these two plants, and their range of motor sizes runs up to 500 kw.

3. AEG - Union Electrical Equipment Plant, Vienna.

Similar in production pattern to the former Siemens-Schuckert plants, the AEG Union Plant in Vienna was almost completely dismantled by the Soviets and then shipped to the USSR It now is back in production, however, with a line of motors which includes all sizes to 200 kw and generators to about the same size.

4. Electrical Equipment Plant, Vienna (formerly Brown-Boveri).

This plant also producing for Soviet account manufactures equipment that is slightly smaller than the other three plants described above. Motor sizes range only up to 100 kw, but there is a wide variety of types.

5. J.M. Voith Industrial Equipment Plant, St. Polen.

This plant is one of the most important turbine manufacturers in the entire Soviet Bloc. It has a great deal of new equipment and reportedly can machine Kaplan turbines of either 15-meter diameter or 6-meter height. In 1950 there were about 3,000 workers in this plant, which can produce turbines of capacities up to 90,000 kw and reputedly is building a subsidiary plant to manufacture its own electric motors. These motors will be used in textile machinery and in electric pumps, both of which the plant manufactures.

In addition to turbines, textile machinery, and pumps, the plant also produces steam governors and hydro governors, boiler regulators, match-tipping machinery, cycloidal-propellers for Soviet river craft, and other industrial machinery.

Production of turbines is estimated at 700,000 kw a year.

C. Czechoslovakia.

1. Foundry and Machinery Shop, Kosice.

An important producer of hydroturbines and other electrical and nonelectrical machinery, the plant is administered by the Ministry of Heavy Machine Building. Nonelectrical production includes industrial machines and special parts of unknown amounts for other firms. The plant has a reported working force of 1,000, which seems to be a low figure since the plant is manufacturing a wide range of products, much of the production being apparently rather large units, such as turbines, 6 meters in diameter. Among the principal products manufactured, hydroelectric turbines and machines for making copper wire are of interest.

Steel and pig iron are received from a steel plant located in Vitkovice, Czechoslovakia, and steel and iron scrap are stockpiled in the foundry. It has been specifically reported, however, that no finished parts are stockpiled. High-grade bituminous coal is received directly from mines located in the Ostrava-Karvinna area of Czechoslovakia.

There is no production of electrical machinery over 500 kw.

2. CKD (Ceskomoravska Kolben Danek) Electric Motor and Equipment Plant, Bratislava.

The range of products in the plant includes motors, generators, electric ovens, transformers, and reportedly either 2 automatic switchboards or 10 PBX boards a month. The motors and generators produced, which are possibly fractional or integral horsepower motors and generators for communication devices, are quite small. Four or five "Russian-type" generators are produced weekly, the significance of this designation being unknown. Transformers are reportedly of large size, mention being made in other reports of transformers with a 100,000 volt primary and up to a capacity of 5,000 kva. Assuming that these reports deal with the same transformer type, this transformer would be useful in a primary substation.

The only fact bearing on the possible level of production is the size of the working force, which seems to be approximately 2,000. If it is assumed that no more than one-fourth of this force works on the production of large transformers, such production is estimated at 300,000 kva a year.

There is no production of electrical machinery over 500 kw.

3. Skoda Electric Products Plant, Pilsen/Doudlevce.

The plant is one of the primary suppliers of heavy electrical machinery in the Soviet Bloc. Materials used by the plant come from many sources. Aluminum and copper in significant amounts come from the USSR. Some steel is received from Sweden, the remainder apparently coming from mills at Brno and Povrly in Czechoslovakia. Insulation is produced by the Kablo National Corporation of Czechoslovakia, and transformer oil reportedly comes from Pardubice, Czechoslovakia, which has not been previously reported as an oil producer.

The two sections of the plant probably have 4,000 workers, 1,500 of whom are estimated to be in the "Gigant" section, which is responsible for the production of heavy electrical machinery. Construction of important additions to the plant in 1948, notably a six-story building, will increase production considerably. [redacted] the production of small motors will be transferred to a plant in Moravski, so that the Skoda plant will be concerned exclusively with heavy electrical machinery. The other products now being made are transformers of 100-kva size and higher; generators of various sizes, primarily large ones, possibly ranging to 100,000 kw; and motors ranging up to 200 kw or probably higher. 50X1

Production is estimated as follows: motors, 300,000 kw a year; generators, 500,000 kw a year; and transformers, 2 million kva a year.

4. CKD Vysocany Electrical Equipment Plant, Prague (formerly "Marshal Tito" plant and more recently the "Stalingrad" plant).

This plant was one of the largest prewar plants in Czechoslovakia for the production of electrical machinery of all types, including turbines, generators for power plants, motors, rectifiers, transformers, and switch gear. Prisoner-of-war reports from 1945 to 1948 indicate that in the immediate postwar years there were approximately 6,000 workers in the plant and that it was turning out complete hydroelectric installations in sizes up to 25,000 kw. Turbines were made on order at the rate of 10 a month.

The most recent information indicates that the plant has been converted to the production of war materials almost exclusively. Among the products now made are compressors for wind tunnels, castings for tanks (85 percent of all castings made in the plant foundry are for such use), and electrical equipment for searchlights. The change in production pattern made in this plant is one of the best examples of the competition between the military and civilian sectors of the economy for production facilities.

The plant is fully capable of making heavy electrical machinery, but doubt now exists that such machinery is being made.

5. AEG - Electrical Equipment Factory, Decin.

Another plant that is scheduled for movement to Moravski is this former AEG plant which does not produce heavy electrical machinery. The pattern of production within this plant is unusual because it makes both electronic and electrical machinery items. The purpose of the move to Moravski is reportedly to find a more reliable source of gas. Although thyratrons no longer are in production, the output of motors and transformers has been increased.

With 200 administrative and 900 production workers, the production of small motors and transformers no doubt is at an adequate level. Acoustic homing devices for torpedoes also are produced at this plant.

D. East Germany.

1. Bergmann-Borsig Turbine Plant, Berlin.

Although the facilities of the plant were damaged during World War II, it now manufactures turbines of the largest sizes. In early 1950, production got under way, probably on four 10,000-kw machines. It is believed that turbine designs are strictly standardized. The working force has reportedly expanded to about 6,000, as compared with 3,000 in early 1950. New construction under way also is frequently reported. At present, this plant probably is one of the most important significant producers of turbines in the Soviet Bloc. Parts for boiler installations also are produced.

Production at the start of postwar operations was limited by two factors. First, although plans called for large hydroturbines, the plant did not have a lathe capable of turning to a diameter of over 3 meters. The second factor was the continuing shortage of metals.

Production of turbines is estimated at 600,000 kw a year.

2. TRO Transformer Factory, Berlin/Oberschoeneweide.

This plant, covering 300,000 square meters, suffered only minor damages during World War II. From the end of the war until October 1947, however, the plant was not in production. The Soviets completely stripped the works, and production was resumed with equipment acquired piecemeal from smaller enterprises or manufactured in the plant. When Soviet orders began to come in, priorities were established for machinery procurement, and by late 1949 the plant had 400 machine tools of all kinds. Meanwhile, the working force had expanded to 3,600. The high-priority production of transformers was in part concerned with deliveries to Wismut AG, and further support was given in the form of some high-quality transformer sheet metal from two Soviet foundries. In mid-1949 the plant started production of motors on urgent orders, and 3,000 motors of 37 kw were turned out in 1949. Twelve thousand such motors were ordered from the plant in 1950, and presumably are intended for Wismut AG.

Among other products are coupling condensers. In 1950 an order for 200 coupling condensers was given the plant, one-half of them being for 100 kilovolts and the other half for 200 kilovolts. Presumably, these condensers are to be used in the USSR for high-frequency telephony over high-voltage lines. Air-blast circuit breakers and other switch gear also are on the production schedule. Although the plant can manufacture

transformers of the largest sizes, as well as a variety of other products, materials shortages block the production plans.

Considering these materials shortages and the recently reported departure of some skilled workers, production of transformers is estimated at 1 million kva a year.

3. Turbinenfabrik VEB Turbine Plant, Dresden (formerly Bruckner and Kanis, by which it is sometimes known).

The plant produces turbines and parts for turbines and also does installation work. In 1947 the factory stationed eight of its skilled fitters at Rostock to equip Soviet destroyers with turbines.

The plant has been called on to deliver a considerable amount of reparations equipment, including a number of mobile generating stations. The generators for these stations probably are manufactured by the Oschatz firm in Meerane, East Germany. In 1949 the plant was to produce 207 of the turbines for the mobile generating stations and probably did so. Production of 300 more generators immediately upon completion of the original order was planned. These are very small units, normal operation being at about 7.5 horsepower.

The turbines produced by the plant are small, the largest reported being 1,100 kw. Kaplan wheels, possibly larger than 1,100 kw, also may be manufactured. Under a development contract the plant produced a gas turbine of 21,000 horsepower, which did not satisfy the Soviets who terminated the contract and ordered that all experimental parts and models be transferred to Leningrad.

Production of turbines is estimated at 400,000 kw a year.

4. Fimag Electrical Equipment Works, Finsterwalde (also called the Electrotechnical Company).

The plant makes portable generators for Soviet account, as well as other small motors and small generators. Production during 1950 of 1,000 of these portable generators, between 40 and 100 kw in size, was planned, but the lack of copper may have prevented fulfillment of this plan.

Limited facilities and the small labor force of 900 workers restrict the size of the electrical machinery which can be manufactured, none of which is over 500 kw.

5. Saxony Electric Motor Factory (Sachsenwerk), Dresden/Niedersedlitz.

The plant makes power-generating and distribution equipment, including control devices, switchboards for power plants, large electric switches for high-voltage operation, transformers, motors, and generators of all sizes. Although some of the plant's machinery was delivered to Baku in the immediate postwar period, with even the heavier plant machines as replacement this plant is one of the leading suppliers of power plant and station equipment in East Germany and is constantly expanding. Production emphasis is on heavy electrical machinery, the motors for instance being possibly 5 meters high. Transformers of from 20,000 to 100,000 kva also are built, as well as motor-generator sets operating at 2,400 cycles per second and believed to be for high-frequency induction heating.

There are 4,500 workers in this plant. At one time crews were sent out for construction and installation work all over Saxony. This may no longer be true.

Estimated production is as follows: Transformers, 1.5 million kva a year; DC motors, 100,000 kw a year; AC motors, 300,000 kw a year; DC generators, 60,000 kw a year; and AC generators, 190,000 kw a year.

6. Electric Motor Factory, Electromotorenwerk VEM, Wernigerode.

The plant produces a range of motors up to 200 kw in size. There are approximately 2,400 employees, including an administrative staff of 600. Production of a class of motors, "LK" 19 to 14, was begun in September 1950 and increased the range of motors from 40 hp to 200 hp in size. Two or three of these 200-hp motors can be made a day, which implies the ability to make larger machines and may indicate that the plant is preparing to produce another series of motors larger than 200 horsepower as soon as it has the necessary machinery.

Like other East German plants, the plant is beset by the lack of copper wire and dynamo sheets, annual requirements of dynamo sheet being about 8,000 tons. The copper-producing plant at Hettstedt has been the supplier of copper wire, and the USSR and West Germany have supplied dynamo sheet. Ball bearings also reportedly are in short supply.

7. Electric Motor Plant ELMO, Dessau (part of a complex which is variously referred to as the Bamag Turbine Plant, or the Berlin Anhalt Machine Factory).

Since the end of World War II the plant has been engaged solely in the production of electric equipment and motors, up to 80 kw in size.

Although the labor force was expanded in mid-1949 from 900 to 1,400 workers, subsequent difficulties forced the plant to curtail some of its planned output and to reduce its labor force. Still a key producer of East Germany, the plant is reputedly going to start turning out electrical generators and other high-voltage apparatus. In mid-1950 the design of high-voltage motors of from 800 to 1,500 kw was proceeding, and facilities, including a boring and turning mill of 6 meters in diameter, were being set up for the production of this series.

Taking into account the developmental work and expansion plans, motor production is estimated at 200,000 kw a year and generator production at 50,000 kw a year.

8. Transformer and X-ray Factory (TraRoe), Dresden (referred to as Koch and Sterzel, its former name).

This plant, which produces heavy electrical machinery, is equipped to manufacture X-ray and other high-voltage equipment as well as a complete line of transformers. Transformer production is similar to production at the TRO Transformer Factory in Berlin/Oberschoeneweide and ranges from specialty transformers of from 10 to 220 volts to experimental transformers operating at voltages up to 3 million kilovolts.

In 1951 the Soviets authorized nuclear research for medical purposes in East Germany. As a result, the plant was charged with the construction of a high-tension transformer installation for such research. This installation was finished in the first half of 1951, the experience gained in building a similar installation for delivery to Leningrad, USSR, making the rapid completion possible. The installation which was shipped to Leningrad, USSR was first tested at Niederwartha, East Germany.

Steel sheets, steel tubing, and porcelain have been in critically short supply, but with the expected availability of all types of supplies, production at this plant may be of considerable significance. With about 1,700 workers, the plant no doubt can equal the production at the TRO plant in Berlin. Estimated production of transformers is 1 million kva a year.

E. Hungary.

1. Ganz Electrical Equipment Factory, Budapest.

The plant is Hungary's largest producer of electrical goods and power-generating equipment and, having a labor force of 10,000, makes a complete range of electrical equipment, including the largest heavy

electrical machines. Transformer sizes run to at least 45,000 kva and turbogenerators in sizes from 1 to 25,000 kw. Production of heavy motors and other power equipment is scheduled. It is believed that the Elprom factory in Sofia manufactures some classes of Ganz-type motors under a licensing agreement.

The plant was 70 percent damaged during World War II, but since has been reconstructed and enlarged. Machine tools of US, Swedish, Swiss, and prewar German design are used with an estimated number of from 1,000 to 1,200. During reconstruction the sections of the plant which were in production sent 75 percent of the output to the USSR as reparations. Such reparations deliveries seem to have diminished.

Critical shortages of ball bearings, iron, copper, and insulating materials prevail, but despite such limitations, the plant will be able to contribute significantly to the Soviet Bloc economy. Reports indicate that quality is being sacrificed in order to fulfill the plan quotas. Insulation for motors is applied so poorly and is of such bad quality that large turbogenerators produced frequently fail after short periods of service.

There is some concentration on the production of motor-generator sets, particularly Ward-Leonard sets for steel mill and mine use. The plant is contributing heavily to the equipment for a 120-kilovolt national electric transmission system. A number of 100-kilovolt transformer stations will be reconstructed for this system.

Estimated production is as follows: motors, 300,000 kw a year, generators, 150,000 kw a year, and transformers, 650,000 kva a year. The collapse of the new building which was built in the postwar period for the production of heavy machinery has retarded production considerably.

2. Lang Machinery Factory, Budapest.

The plant specializes in the production of four classes of products: boilers, steam turbines, stationary diesels, and chemical plant equipment. Having a labor force of from 4,000 to 5,000 persons, the plant produces all of the power-generating turbines manufactured in Hungary.

With the capacity for making a more diverse line of products than it does now, the plant probably could supply the Ganz plant with prime movers and could still be able to produce an exportable surplus of this product.

Production of turbines is estimated at 300,000 kw a year.

F. Poland.

1. Rohn-Zielinski Electric Company, Zychlin (formerly a Brown-Boveri subsidiary).

The plant is a primary producer of electrical machinery of all types, including generators, transformers, large electrical machines, turbogenerators, tramway engines, and oil transformers. The three-phase motors produced in 1948 were in sizes up to 3,500 kw. DC machines of 6,000 volts were produced also, while mention has been made of transformers in sizes of 24,000 kva and 220 kilovolts.

Production of motors is estimated at 100,000 kw a year and transformers at 100,000 kva a year.

2. Electric Machine Factory M-10, Wroclaw.

Part of the plant, which produces heavy electrical machinery, was in production in 1948, construction having begun in 1947 with imported equipment. Eventual production will include heavy electrical motors, electric traction engines, turbines, and large transformers. Production of motors is estimated at 10,000 kw a year.

G. Rumania.

Caros Judet Electrical Machinery Plant, Recita (part of the Metaltras metals combine).

Although probably the largest electrical machinery producer in Rumania, the plant is not yet of great significance. However, it is expected to become important in the near future.

In 1949, about 100 electric motors, copies of old Siemens-Halske types, reportedly were being produced each month, 95 percent going to the USSR. These motors probably were not over 100 kw. [redacted] 50X1 the plant as rewinding a 6,000-kw generator, and the casting of parts for a large turbine. In early 1950 the plant was reportedly receiving not only Soviet equipment, but also Soviet technical advice. For a time, the plant director was Soviet, as were several consultants. Consistent with the above information is a report in mid-1950 of the production of transformers over 700 kw in size and of generators over 4,000 kw in size.

Estimated annual production is as follows: motors, in nominal amounts; generators, 50,000 kw; and transformers, 200,000 kva.

APPENDIX D

COLLECTED INPUT COEFFICIENTS

Table 6 shows as follows the input coefficients, collected up to now, for use in computing the input requirements of the heavy electrical industry in the Soviet Bloc. On these input coefficients are based the estimated annual Soviet Bloc input requirements of materials and labor, as shown on Table 5, p. 30.

Table 6*

Heavy Electrical Machinery

Input Requirements per Unit [a]

1. Motors

Type	Total Steel [a]	Steel Plate [a]	Steel Punchings [a]	Steel Castings [a]	Steel Forgings [a]	Copper [a]	Aluminum [a]	Total Weight of Inputs	US Base for Computing Direct Labor [b]
	Pounds								Man-hours
Induction	US Inputs per Kw [c]								
373 kw	13.39	5.42	4.42	2.36	1.19	1.56	Negligible	14.95	1.555
1,865 kw	12.87	4.20	4.76	1.60	2.31	1.23	Negligible	14.10	0.858
	Inputs per Unit, Soviet Bloc Sizes [d]								
18,000 kw	236,340	86,580	82,620	35,640	31,500	25,200	Negligible	261,540	27,990
10,000 kw	131,300	48,100	45,900	19,800	17,500	14,000	Negligible	145,300	15,550
3,000 kw	39,390	14,430	13,770	5,940	5,250	4,200	Negligible	43,590	4,665
1,000 kw	13,130	4,810	4,590	1,980	1,750	1,400	Negligible	14,530	1,555

* Footnotes for Table 6 follow on p. 74.

Table 6

Heavy Electrical Machinery
Input Requirements per Unit
(Continued)

1. Motors (Continued)

Type	Total Steel [a]	Steel Plate [a]	Steel Punchings [a]	Steel Castings [a]	Steel Forgings [a]	Copper [a]	Aluminum [a]	Total Weight of Inputs	US Base for Computing Direct Labor [b]
	Pounds								Man-hours
Synchronous				US Inputs per Kw [c]					
149 kw	23.58	10.70	10.87	0.67	1.34	4.83	Negligible	28.42	2.48
2,238 kw	22.54	7.02	10.43	1.74	3.35	1.99	Negligible	24.58	0.590
				Inputs per Unit, Soviet Bloc Sizes [d]					
15,000 kw	338,100	105,300	156,450	26,100	50,250	30,000	Negligible	368,100	37,200
10,000 kw	225,400	70,200	104,300	17,400	33,500	20,000	Negligible	245,400	24,800
5,000 kw	112,700	35,100	52,150	8,700	16,750	10,000	Negligible	122,700	12,400
2,500 kw	56,350	17,550	26,075	4,350	8,375	5,000	Negligible	61,350	6,200
750 kw	16,905	5,265	7,823	1,305	2,512	1,500	Negligible	18,405	1,860
Direct Current				US Inputs per Kw [c]					
550 kw	16.45	10.00	5.09	0.14	1.22	4.27	0.05	20.76	2.91
620 kw	16.61	10.08	5.16	0.24	1.13	5.44	Negligible	22.06	3.23
2,238 kw	22.91	12.06	9.16	0.13	1.56	3.46	0.04	26.43	2.75

Table 6

Heavy Electrical Machinery
Input Requirements per Unit
(Continued)

1. Motors (Continued)

Type	Total Steel a/	Steel Plate a/	Steel Punchings a/	Steel Castings a/	Steel Forgings a/	Copper a/	Aluminum a/	Total Weight of Inputs	US Base for Computing Direct Labor b/
	Pounds								Man-hours
Direct Current (Continued)	Inputs per Unit, Soviet Bloc Sizes d/								
20,000 kw	458,200	241,200	183,200	2,600	31,200	69,200	800	528,600	55,000
10,000 kw	229,100	120,600	91,600	1,300	15,600	34,600	400	264,300	27,500
7,500 kw	171,825	90,450	68,700	975	11,700	25,950	300	198,225	20,625
3,000 kw	68,730	36,180	27,480	390	4,680	10,380	120	79,290	8,250
750 kw	13,995	8,033	4,852	128	975	3,293	38	17,310	2,220

2. Generators

Turbogenerators	US Inputs per Kw c/								
Air-cooled									
6,250 kw	6.57	1.19	4.00	0.08	1.30	0.65	0.02	7.20	2.016

Table 6

Heavy Electrical Machinery
Input Requirements per Unit
(Continued)

2. Generators (Continued)

Type	Total Steel [a]	Steel Plate [a]	Steel Punchings [a]	Steel Castings [a]	Steel Forgings [a]	Copper [a]	Aluminum [a]	Total Weight of Inputs	US Base for Computing Direct Labor [b]
	Pounds								Man-hours
Turbogenerators (Continued)									
Air-cooled (Continued)	Inputs per Unit, Soviet Bloc Sizes [d]								
10,000 kw	65,700	11,900	40,000	800	13,000	6,500	200	72,000	20,160
5,000 kw	32,850	5,950	20,000	400	6,500	3,250	100	36,000	10,080
1,000 kw	6,570	1,190	4,000	80	1,300	650	20	7,200	2,016
Hydrogen-cooled	US Inputs per Kw [c]								
70,588 kw	4.32	1.20	2.37	0.05	0.70	0.30	0.02	4.56	0.836
	Inputs per Unit, Soviet Bloc Sizes [d]								
100,000 kw	432,000	120,000	237,000	5,000	70,000	30,000	2,000	456,000	83,600
60,000 kw	259,200	72,000	142,200	3,000	42,000	18,000	1,200	273,600	50,160
40,000 kw	172,800	48,000	94,800	2,000	28,000	12,000	800	182,400	33,440
22,500 kw	97,200	27,000	53,325	1,125	15,750	6,750	450	102,600	18,810

S-E-C-R-E-T

Table 6

Heavy Electrical Machinery
Input Requirements per Unit
(Continued)

2. Generators (Continued)

Type	Total Steel a/	Steel Plate a/	Steel Punchings a/	Steel Castings a/	Steel Forgings a/	Copper a/	Aluminum a/	Total Weight of Inputs	US Base for Computing Direct Labor b/
	Pounds								Man-hours
Water-wheel Generators	US Inputs per Kw c/								
108,000 kva	22.84	9.87	9.33	1.85	1.79	1.79	0.01	24.65	2.00
30,000 kva	16.62	11.87	3.54	0.13	1.08	1.27	0.03	17.92	2.00
20,000 kva	33.50	15.75	13.06	1.88	2.81	2.75	0.03	36.25	2.00
	Inputs per Unit, Soviet Bloc Sizes d/								
70,000 kw	1,702,400	875,000	604,800	90,300	132,300	135,800	1,400	1,838,900	140,000
22,500 kw	547,200	281,250	194,400	29,025	42,525	43,650	450	591,075	45,000
10,000 kw	243,200	125,000	86,400	12,900	18,900	19,400	200	262,700	20,000
5,000 kw	121,600	62,500	43,200	6,450	9,450	9,700	100	131,350	10,000
1,000 kw	24,320	12,500	8,640	1,290	1,890	1,940	20	26,270	2,000

Table 6

Heavy Electrical Machinery
Input Requirements per Unit
(Continued)

3. Transformers [e]

Type	Total Steel	Steel Plate [a]	Steel Punchings [a]	Copper [a]	Insulation [a]	Oil [a]	Miscellaneous [a]	Total Weight of Inputs	US Base for Computing Direct Labor [b]
	Pounds								Man-hours
110,000 kva	165,420	53,700	111,720	37,620	13,650	56,700	8,390	281,780	23,000
100,000 kva	193,640	68,000	125,640	28,820	11,800	62,800	7,310	304,370	20,400
62,500 kva	133,520	31,400	102,120	18,975	7,900	45,200	5,200	210,795	13,800
50,000 kva	96,820	34,000	62,820	14,410	5,900	31,400	3,655	152,185	11,669
20,000 kva	72,320	21,200	51,120	10,560	4,290	25,000	4,290	116,460	6,303
10,000 kva	41,160	15,600	25,560	5,280	2,145	12,500	2,145	63,230	4,600
7,500 kva	27,784	13,000	14,784	3,366	780	14,800	2,280	49,010	4,489
1,500 kva	11,690	2,810	8,880	3,630	750	Negligible	144	16,214	3,200
500 kva	3,868	1,000	2,868	1,056	331	Negligible	101	5,356	3,000

a. Materials input coefficients include only those materials delivered to the assembly departments; materials used in the fabrication of other products are not included.

b. Labor input coefficients include the labor of only the category of employees in direct production and closely related employees, as defined in the 1947 US Census of Manufacturers. This category includes only employees engaged in assembly departments. For further computations required to obtain estimates of total man-hours at the factory level in the Soviet Bloc, see footnote to Table 5, in text p. 36.

c. US inputs per Kw are computed from late 1951 data for the sizes given, obtained from a US manufacturer. Material input coefficients have been adjusted in accordance with known differences in Soviet Bloc practices and materials. Labor input coefficients have not been so adjusted in the table.

d. Figures given under Inputs per Unit, Soviet Bloc Sizes, are computed from the base figures given under US Inputs per Kw. In cases where US data are presented for more than one size of unit, the base figure used in computing is that considered to be the most representative -- sometimes a figure for one of the US sizes listed, sometimes an average of the data for all US sizes listed.

e. All figures for transformers are base figures.

Next 19 Page(s) In Document Denied

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