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ECONOMIC INTELLIGENCE REPORT

TRENDS IN THE ELECTROTECHNICAL INDUSTRY OF THE SINO-SOVIET BLOC

CIA/RR 71

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CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

~~SECRET~~

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S-E-C-R-E-T

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(ORR Project 36.518)

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FOREWORD

This report summarizes and brings up to date the intelligence on small segments of the electrotechnical industry of the Sino-Soviet Bloc and develops over-all statistics on the industry and its three main sectors: the electronic and telecommunications equipment industry, the electrical machinery industry, and the wire and cable industry. The production of telecommunications equipment is considered to be a part of the electronics industry, and the production of steam and hydraulic turbines used to drive electric generators is considered to be a part of the electrical machinery industry.

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TRENDS IN THE ELECTROTECHNICAL INDUSTRY OF THE SINO-SOVIET BLOC*

Summary

Total production of the electrotechnical industry** of the Sino-Soviet Bloc in 1952 was US $3,100 million,*** increasing to US $3,800 million in 1953 and to US $4,400 million in 1954. Production is expected to reach US $10,100 million in 1960. The magnitude of these figures indicates the economic importance of this industry to the Bloc.

A large portion of the production of the electrotechnical industry has been devoted to military requirements. In 1954, 32 percent of the production of the electronic and telecommunications equipment sector of the industry was for military radar, 22 percent for military radio, and 10 percent for other military items, totaling 64 percent for military purposes. The armed forces also consumed many products of the electrical machinery**** and wire and cable sectors of the electrotechnical industry.

The electrotechnical industry of the USSR was comparatively small before World War II, but since the war the USSR has been successful in improving technology and expanding the industry, largely through the use of equipment removed from East Germany, Hungary, and Czechoslovakia; the forced technical assistance of East German specialists; and the exploitation of advanced Western designs and technology. The electronic and telecommunications equipment sector of the industry has shown the greatest production gains, progressing from a poorly equipped industry with limited capacity to a major producer second only to the US in total production. Except for isolated cases, there are no shortages of materials or personnel in the electrotechnical industry of the USSR.

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* The estimates and conclusions contained in this report represent the best judgment of ORR as of 15 February 1956.

** The electrotechnical industry includes three sectors: the electronic and telecommunications equipment industry, the electrical machinery industry, and the wire and cable industry.

*** Unless otherwise noted, all references to US dollars are in terms of 1951 US prices.

**** The electrical machinery sector includes the production of steam and hydraulic turbines used to drive electric generators.

After the USSR, East Germany is the next largest producer of electrotechnical equipment in the Sino-Soviet Bloc, followed by Hungary and Czechoslovakia. The contributions of the other members of the Bloc are relatively unimportant. Plants in the European Satellites have been nationalized, and production is planned and controlled by Soviet-type administrative units of the national government. Stringent security regulations are in effect in most sectors of the industry.

There is considerable intra-Bloc trade. East Germany, Hungary, and Czechoslovakia ship to the USSR and to other members of the Sino-Soviet Bloc. Some materials or components are shipped from the USSR to the other members of the Bloc, but whenever possible the other Bloc members are required to obtain materials indigenously, from each other, or from the West. Although the Bloc imports some critical materials and various end products from the West, its former dependence on the West is rapidly decreasing. It apparently is the intention of the USSR to make the electrotechnical industry of the Bloc independent of Western sources of supply and self-sufficient in every respect.

It also is apparently the intention of the USSR to expand the electrotechnical industry as rapidly as is necessary to meet future military requirements. It is expected that the electronic and telecommunications equipment sector of the industry will continue to expand more rapidly than the electrical machinery sector.

I. Introduction.

A. Definition and Scope of the Problem.

This report is primarily a study of production and capabilities for production of electrotechnical equipment in the Sino-Soviet Bloc. The following categories of electrotechnical equipment are discussed: electrical machinery, including steam and hydraulic turbines used to drive electric generators, electric generators, electric motors, transformers, switchgear and switchboard apparatus, engine electrical equipment, and electric welding equipment; electric wire and cable; other electrical equipment, devices, and supplies, including batteries,

electric alarm and signal systems, railroad signal equipment, wiring devices and supplies, electric measuring instruments, industrial electric controls, electric furnaces and heating equipment, rectifying apparatus (excluding electronic), and electric lamps; electronic equipment and devices, including household radio and television receivers, commercial radio communications equipment, radio and television broadcasting equipment, military radio equipment, radar, special military devices, electron tubes, electronic components, and industrial electronic equipment; and wire communications equipment, including telephone instruments, telephone switchboards, carrier equipment, and teletypewriters.

The products of the electrotechnical industry fall into two general categories: electrical equipment and electronic equipment. Some products may be assigned to either category, depending on their use.

The electrotechnical industry is an important sector of the economy of all industrial countries and is essential to military strength. The USSR became aware of the importance of electronics during World War II and has made extraordinary efforts to increase production, particularly of military electronic end items. An ample supply of electric power also has been a prime objective, and the USSR has steadily increased its production of electrical machinery.

B. History.

1. USSR.

Before World War II the electrotechnical industry of the USSR had only a small electronics sector, which consisted largely of the electron tube and electric lamp industry, established in 1923. The electronics industry was given impetus during 1935-38, when technical assistance, manufacturing equipment, and production materials for making electron tubes were furnished by the Radio Corporation of America (RCA). 1/* During World War II, much electronic equipment, including radar, test equipment, and production machinery, was shipped to the USSR from the US and the UK. The interest of the USSR in electronics was stimulated during World War II by the many military applications of such equipment. Since that time, expansion of production has been rapid, mainly because of the efforts of the German specialists who were brought to the USSR; the removal of production machinery from the European Satellites to the USSR, resulting in an expansion of

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facilities in the USSR; the use of imported Western equipment as prototypes to be copied; and the use of Western technical literature to avoid the time and expense required for research and development. With the help of German specialists the USSR has made an intensive effort to train personnel in electronics.

Before World War II, production of electrical machinery in the USSR was of minor significance, and requirements were fulfilled primarily from imports. Although the productive capacity of the industry grew rapidly until 1938, 2/ much of this capacity was destroyed during the war. In the immediate postwar period, electrical machinery was acquired from East Germany, Finland, Hungary, Poland, Rumania, and West Germany. Since World War II the USSR has made every effort to produce electrical machinery or to obtain it from the European Satellites.

The wire and cable industry of the USSR was started before World War I and expanded during the war. Between World War I and World War II the industry was expanded slightly by the use of German machinery. Since World War II, expansion has been rapid, and the industry now is modern, well developed, and well equipped.

2. East Germany.

Before World War II the electronics industry was well developed in that area of Germany which now is East Germany and produced much equipment for export. The industry suffered much destruction during the war and disruption, as a result of the removal of men, equipment, and materials to the USSR, after the war. In some cases, facilities were separated from associated plants, suppliers, or customers in the West. In addition, the USSR adopted US rather than German standards for electron tubes, thus reducing the market for German tubes and end equipment. Conditions are improving, however, and the East German electronics industry now exports to the USSR and to other Satellites.

Turbines were among the important products of the German electrical machinery industry before World War II, but the manufacturers of large turbines were located in western Germany. Some producers of small turbines were located in eastern Germany, and the USSR has exploited the research and development abilities of these plants in an attempt to establish an East German turbine industry capable of producing large machines up to 30,000 kilowatts (kw). 3/ Other electrical

machinery plants in East Germany produce a complete range of products, including motors, generators, transformers, and switchgear. Since World War II, production has suffered from shortages of manpower and materials from the removal of production machinery to the USSR. 4/

As in all sectors of the electrotechnical industry, Germany attained a pre-eminent position in the production of wire and cable earlier than did any other European country. Prewar facilities produced a wide range of products in each plant and also processed the materials used in making wire and cable from unfinished forms. Such plants could make various types of electric wire and cable, handle copper in bar form, make wire rods from bar stock, and draw and tin the various sizes of wire. The wire and cable industry of Germany was badly damaged during World War II, and much of the heaviest and best equipment was later removed to the USSR. The East German industry was further hampered by a fire in one of the major plants in 1948, but by that time reconstruction and refurbishment of the facilities was well under way and directed toward the establishment of a wire and cable industry second only to that of the USSR in total production and diversification of product. By 1955 this goal had been attained. 5/

3. Hungary.

The electrotechnical industry of Hungary is located almost entirely in the metropolitan area of Budapest. Although much of the industry's equipment was removed to the USSR after World War II, the industry was quickly re-equipped and soon resumed production. 6/

The electron tube and electric lamp sector of the electrotechnical industry of Hungary is efficient and relatively large. Before World War II, UILCO "Tungsram" (United Incandescent Lamp Company) was the third largest European company in its field, led only by Philips Gloeilampenfabrieken NV of the Netherlands and Osram GmbH of Germany. The Hungarian electronics industry has produced radio equipment, test equipment, and, more recently, radar equipment. 7/

The electrical machinery industry of Hungary produces a complete line of electrical machinery, including motors, generators, transformers, and turbogenerators.

Historically, both the electronics and the electrical machinery sectors of the electrotechnical industry of Hungary have depended upon foreign trade, particularly with Western countries, for imports of important raw materials as well as for a market for 50 to 90 percent of their production. Since 1949 a major readjustment of the trade pattern has occurred. Most of the production in Hungary now goes to other Sino-Soviet Bloc areas, and exports to the West have decreased proportionately.

The wire and cable industry of Hungary has been an important sector of the electrotechnical industry of Hungary. Before World War II it was controlled by German parent companies which established and operated the only significant facilities. 8/

4. Czechoslovakia.

Czechoslovakia never has produced large quantities of electronic equipment. Since World War II, some improvements have been made in the electron tube industry, and production of a few US tube types was started in 1949 or 1950.

Czechoslovakia has been a leading producer of electrical machinery, producing both small and large machines in excess of domestic requirements. Since 1939, World War II and subsequent dislocations have interfered with progress in the Czechoslovak turbine industry. 9/

The wire and cable industry of Czechoslovakia was modernized, and new facilities were added in the late 1920's or early 1930's. After the war, some new machinery was obtained from West Germany. 10/

5. Other Members of the Sino-Soviet Bloc.

The other members of the Sino-Soviet Bloc have not been significant producers of electrotechnical equipment. Under Soviet direction, some efforts are being made toward self-sufficiency in the production of electrical equipment, particularly in Communist China and Poland.

C. Technology.

The electrotechnical industry is made up of two main sectors, which differ widely in production methods and in input requirements. The electronic and telecommunications equipment sector is known in Europe as the "weak current" sector of the industry. This sector requires much labor, test equipment, specialized materials, and, in some cases, specialized production machinery, but little plant floorspace. In contrast the electrical machinery and the wire and cable sectors are known in Europe as the "heavy current" sector of the electrotechnical industry. These sectors require skilled and semiskilled labor and specialized production machinery, much of which is large and difficult to build. The machinery often requires much floorspace and plants with high ceilings. Cranes and other material-handling equipment also are required.

1. USSR.

Sightings of advanced types of radar equipment, statements of returned German specialists, and information on the production of components indicate that the USSR is highly capable in the production of electronic and telecommunications equipment.

The adoption by the USSR of US standards for electron tubes and the acquisition of large amounts of US prewar and Lend-Lease production equipment has compelled the electron tube industry of the USSR to follow US production practices. During the postwar period the USSR also has produced tube machinery similar to US designs. In at least one plant, however, native Soviet equipment is used generally for the production of large transmitting tubes. At present there is evidence of excellent tooling, comparable with current US standards, and the quality of the electron tubes produced in the USSR is quite acceptable. Tube shrinkage (reject percentage) is reasonable, although higher than the US average. 11/

The quality of Soviet electrical machinery, including steam and hydraulic turbines, appears to be good. For the most part, the USSR follows well-established practices, often similar to those followed by the US, the UK, or West Germany. Soviet plants use many complex special-purpose tools, such as copying or profile milling machines. Native Soviet equipment is heavier, has larger safety factors, and requires less maintenance than Western equipment. It is often made with less labor but with more input materials. 12/

The wire and cable industry of the USSR is based on plant equipment received from East Germany. Some machines of native Soviet design and construction, however, are used to produce coaxial cables and show a high degree of practical ingenuity in design. 13/

2. East Germany.

The East German electronic and telecommunications equipment industry is still suffering from the following three factors: separation from West Germany, Soviet dismantling, and the removal of German specialists to the USSR. The industry is relatively less efficient and less competent technically than other industries employing East German engineering skill. Furthermore, East German methods and plant equipment in the electronic and telecommunications equipment industry are notoriously wasteful of manpower. German electron tubes, which are made to standards different from those of the US, the USSR, and most other countries, require much hand labor. Because the East German electron tube and electric lamp industry is restricted by a lack of necessary materials and items of new plant equipment, its productivity has been low even by European standards. 14/

The major products of the electrical machinery industry of East Germany are produced by methods similar to those used for equivalent products in the US, the UK, or West Germany. Shortages of certain materials have prevented a continuous operation of some production processes, resulting in reduced production and a waste of manpower. The industry is not maintaining the precision standards necessary for quality mass production. The large turbine and generator industry is new and is not now equipped with the heavy machinery necessary for proper production. Standards have been relaxed for motors, transformers, switchgear, turbines, generators, and electrical instruments in order to maintain high rates of production with a minimum of rejects. East Germany is aware of more advanced production methods but has not been able to make the necessary capital expenditures to modernize its plants. 15/

Technology in the wire and cable plants of East Germany is better than in any other Sino-Soviet Bloc country. As a primary supplier of wire, cable, and cablemaking machinery to other European countries, the industry is well established. Although the industry was stripped of much of its machinery by the USSR and is still limited by shortages, enough has remained of the old plant facilities

and equipment to enable East Germany to piece together a superior wire and cable industry which seems to be attaining the pre-eminent position that it had before World War II. 16/

East Germany has lost many of its key research, design, and management personnel either to the USSR or to the West. The engineering force of the East German electrotechnical industry is not being expanded rapidly enough to keep pace with industrial requirements.

3. Czechoslovakia.

The Czechoslovak electronics industry is in a weak position, although some progress was made during the postwar period. Plant equipment in the electron tube and electric lamp industry is inefficient but is slowly being replaced. 17/

Czechoslovakia has the necessary large machine tools, heat-treating ovens, testing apparatus, and material-handling equipment to sustain former production levels of electrical machinery and turbines. 18/

Czechoslovak technology in the production of wire and cable is acceptable. Production machinery, which is of German and Hungarian origin, is old but serviceable. Most of the production difficulties are attributable to Sino-Soviet Bloc shortages of inputs, such as copper, aluminum, and diamond wire-drawing dies. 19/

4. Hungary.

The production efficiency of the Hungarian electronics industry is high, but limited to some extent by shortages of critical materials, such as molybdenum, tungsten, mica, and nickel. Although plant efficiency is hampered by occasional shortages of materials and labor, there is no evidence of a reduction in technological competence. The electron tube and electric lamp industry of Hungary has replaced its prewar plant equipment, using equipment of domestic design based on the best features of US and German machinery. This industry is the second largest in the Sino-Soviet Bloc and probably is the most advanced in industrial technology and production efficiency.

The electrical machinery industry of Hungary, although smaller than those of the USSR, East Germany, and Czechoslovakia, is an important producer of a complete line of electrical machinery in-

cluding steam turbines. Seventy percent of the Ganz Electrical Equipment Factory, Hungary's largest producer, was damaged during World War II, but it has since been reconstructed and enlarged. Shortages of ball bearings, iron, copper, and insulating materials prevail, but, in spite of these limitations, the industry contributes significantly to the economy of the Sino-Soviet Bloc.

The wire and cable industry of Hungary is notable for the production of wire and cable using aluminum conductors, which are important because of the scarcity of copper in the Sino-Soviet Bloc.

5. Other Members of the Sino-Soviet Bloc.

a. Electron Tube and Electric Lamp Industry.

Among the other members of the Sino-Soviet Bloc there is no significant electron tube industry, and the potential capabilities are not important at this time. In Poland, where the electronics industry was destroyed almost entirely during World War II, a limited production of electron tubes was reached by the end of 1950, and further expansion has been started.

There is some production of electric lamps in Rumania, but there are no indications of production of electron tubes.

In Communist China a small electron tube and electric lamp industry has existed for some time, producing low-grade miniature and general-service lamps. One electron tube plant is known to exist, but its capabilities are extremely limited in scope of product and in size of production.

b. Electrical Machinery Industry.

Efforts are being made to increase production of electrical machinery in Poland. One plant produces a nearly complete line of generators, motors, and transformers. Another plant for large electrical machinery was brought into production in 1948. Technical assistance in the development of the electrotechnical industry of Poland has been obtained from other Sino-Soviet Bloc countries, particularly from East Germany.

c. Wire and Cable Industry.

Rumania has 2 plants known to be manufacturing wire and cable, and Poland has 6. Little is known about these plants, but they are believed to have a high collective potential as Sino-Soviet Bloc producers of wire and cable.

II. Administrative Structure.

A. USSR.

1. Electronic and Telecommunications Equipment Industry. 20/

Before 1946 the electronic and telecommunications equipment industry of the USSR was primarily the responsibility of the People's Commissariat of the Electrical Industry. During the reorganization of the Soviet government in 1946, the Ministry of Communications Equipment was formed to supervise most of the facilities and to prepare plans for this industry. In January 1954 the Ministry of the Radiotechnical Industry was formed to assume most of the functions of the former Ministry of Communications Equipment. These functions had been assigned to the Ministry of Electric Power Stations and Electrical Industry for a short time after Stalin's death.

Although most of the Soviet facilities in the field of electronic and telecommunications equipment are subordinate to the Ministry of the Radiotechnical Industry, a number of important military electronic equipment plants are subordinate to the Ministry of Shipbuilding, the Ministry of the Defense Industry, and the Ministry of the Aviation Industry. In addition, an increasing number of civilian radios, television receivers, and phonographs have been scheduled for production at plants subordinate to republic and local industries. It is believed, however, that most of the basic component parts for the production of electronic and wire communications equipment in the USSR are engineered and produced in the facilities of the Ministry of the Radiotechnical Industry.

Detailed plant studies and Soviet press reports have indicated clearly defined functional boundaries between various administrative units. It is believed that all electron tubes and nearly all electronic capacitors and resistors are produced by enterprises subordinate to main administrations headed by deputy ministers of the Ministry of the Radiotechnical Industry.

The major nationwide Soviet organizations concerned with engineering, research, and development in the field of electronic and telecommunications equipment are the Scientific Council on Radio Physics and Radio Engineering of the Academy of Sciences of the USSR and the All-Union Scientific and Technical Society of Radio Engineering and Electric Communications imeni A.S. Popov (VNORiE). In particular, VNORiE is reported to be a central coordinating organization for research and development in this field and to be charged with the duties of stimulating development and production, allocating priority, and instituting specific projects.

2. Electrical Machinery Industry. 21/

In the USSR most of the electrical machinery is produced in plants subordinate to the Ministry of the Electrotechnical Industry. Six main administrations are directly responsible for the production of the various items of electrical machinery, such as large motors and generators, precision instruments, wire, and cable. Some electrical equipment, particularly small motors, also is produced under the supervision of the Ministry of Shipbuilding; the Ministry of the Aviation Industry; and the Ministry of Automobile, Tractor, and Agricultural Machine Building.

The major Soviet turbine plants are subordinate to the Ministry of Heavy Machine Building, through the Main Administration of Boilermaking and Turbine Construction. Some turbine plants also are under the supervision of the Ministry of Transport Machine Building, the Ministry of Shipbuilding, and the Ministry of the Electrotechnical Industry.

B. East Germany.

1. Electronic and Telecommunications Equipment Industry. 22/

Almost all of the electronic and telecommunications equipment industry of East Germany is composed of state-owned facilities. None of the significant plants are privately or locally owned. By 1954, all of the former Soviet corporate enterprises in this field were returned to East German control.

Industrial administrative reorganizations which took place between 1946 and mid-1954 resulted in the establishment of the Ministry for Machine Construction. This Ministry consists of

4 production areas, to which are subordinated 17 main administrations (HV). One of these, the Main Administration for Radio and Communications Technology (HV-RFT), is responsible for the engineering, manufacturing, and sales of all electronic and telecommunications equipment. Under the Ministry for Machine Construction, the HV-RFT is subordinate to the production area for general machine construction.

2. Electrical Machinery Industry. 23/

In East Germany the manufacture of electrical machinery and turbines is supervised by the Ministry for Machine Construction. The Main Administration for Electric Machine Construction and the Main Administration for Cable and Apparatus are responsible for most of the production of electric power machinery, cables, and related equipment. Some items in this category, such as small motors, are produced to a limited extent under the supervision of the Main Administration for Radio and Telecommunications.

C. Other European Satellites. 24/

In the other European Satellites the larger manufacturing plants of the electrotechnical industry have been nationalized and are operated in accordance with plans established or approved by administrative units of the national government. The administrative structures are generally similar to those of the USSR and East Germany.

D. Communist China.

The national state-owned plants of the electrotechnical industry of Communist China appear to be under the Electrical Equipment Industry Control Bureau which is subordinate to the First Ministry of the Machine Industry, although some relatively simple military communications items may possibly be produced under the Second Ministry of the Machine Industry. 25/

Local state-owned, joint public and private, and other electrotechnical plants appear to be under the control of the newly formed Third Ministry of the Machine Industry. 26/

III. Production.*

The electrotechnical industry of the Sino-Soviet Bloc grew rapidly in the immediate postwar years. Although the rate of growth has not been as rapid in recent years, it is still rising. The electronic and telecommunications equipment sector has had a more rapid rate of growth than the electrotechnical industry in all the postwar years. An estimate of production of the electrotechnical industry of the Sino-Soviet Bloc during 1938 and 1946-54 and projections through 1960 are shown in Table 1.** Total production of the electrotechnical industry of the Sino-Soviet Bloc was US $3,100 million in 1952, increasing to US $3,800 million in 1953 and to US $4,400 million in 1954. Production is expected to reach US $10,100 million in 1960.

The growth of the electrotechnical industry is expected to continue because of an anticipated increase in electric power consumption and because of the large requirements for air defense, guided missiles, television, and the automation of industry. Because the magnitudes of these requirements are difficult to estimate, no estimates of production have been attempted beyond 1960.

IV. Trade.

A. East-West Trade.

Before World War II the Sino-Soviet Bloc depended on imports for much of its electrotechnical equipment. The Bloc undoubtedly would import more electrotechnical equipment at the present time if Western trade restrictions were not in force.

Products from the West desired by the Sino-Soviet Bloc include heavy electric power generating equipment, power transmission equipment, large motors, up-to-date radio and wire communications equipment, and wire and cable. Even more important to the Bloc are fabricated production materials which are needed to support the growing electrotechnical industry. Although the Bloc has the basic raw materials, it lacks such fabricated materials as electrolytically refined copper, thin capacitor paper, magnetic materials, and various metallic materials for producing electron tubes. 27/

* See Appendix B.
** Table 1 follows on p. 15.

Table 1

Estimated Production of the Electrotechnical Industry of the Sino-Soviet Bloc a/
1938, 1946-56, and 1960

Million 1951 US $

Item	1938	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1960
USSR													
Electrical machinery and equipment	N.A.	360	520	700	900	1,000	1,300	1,500	1,800	2,100	2,400	2,600	3,900
Electronic and telecommunications equipment and supplies	80	N.A.	200	230	240	320	460	600	750	900	1,280	1,800	3,800
Total			720	930	1,100	1,300	1,800	2,100	2,600	3,000	3,700	4,400	7,700
Communist China and European Satellites													
Electrical machinery and equipment	N.A.	200	240	300	380	520	660	820	990	1,100	1,200	1,300	1,700
Electronic and telecommunications equipment and supplies	130	N.A.	N.A.	52	66	83	120	180	230	320	390	470	700
Total				350	450	600	780	1,000	1,200	1,400	1,600	1,800	2,400
Sino-Soviet Bloc													
Electrical machinery and equipment	N.A.	560	760	1,000	1,300	1,500	2,000	2,300	2,800	3,200	3,600	3,900	5,600
Electronic and telecommunications equipment and supplies	210	N.A.	N.A.	280	330	400	580	780	980	1,200	1,670	2,300	4,500
Total				1,300	1,600	1,900	2,600	3,100	3,800	4,400	5,300	6,200	10,100

a. For documentation, see Appendixes B and C. Totals are rounded.

It has not been possible to determine accurately the value of shipments to the Sino-Soviet Bloc, because official statistics are too vague or general to permit the identification of the various electrotechnical categories. Destinations shown may be transshipment points. In addition, there are no reliable estimates of the amount of illicit trade.

The quantity of electrotechnical equipment imported by the Sino-Soviet Bloc from the West in 1952 probably represented not more than 4 percent of the total supply of the Bloc in that year, or equipment worth about US $120 million. 28/

In 1953, Western exports to the European Satellites exceeded exports from the Satellites to the West by a ratio of 5 to 1. This estimate is based on official statistics which do not take illicit trade into consideration and which usually do not identify the important production materials. The largest exporters to the European Satellites are West Germany, the UK, and Austria. The bulk of these shipments have been received by Poland and Rumania, but it is suspected that some shipments are transshipped.

Hungary, Czechoslovakia, and East Germany are the principal countries of the Sino-Soviet Bloc exporting to the West. Exports to the West are widely distributed, with Finland, France, the Netherlands, Brazil, Sweden, and Turkey receiving relatively large amounts.

B. Trade within the Sino-Soviet Bloc.

Trade within the Sino-Soviet Bloc is controlled by the USSR. On a value basis, the USSR probably receives twice as much electrotechnical equipment from the European Satellites as it ships to them. Exports from the European Satellites to the USSR are believed to consist of twice as much electrical machinery as electronic and telecommunications equipment. Production materials and components needed for completing export orders destined for the USSR comprise most of the exports from the USSR to the European Satellites. The USSR draws most heavily on the production of East Germany, Czechoslovakia, and Hungary.

The European Satellites other than East Germany, Czechoslovakia, and Hungary are primarily importers of electrotechnical equipment. Communist China imports large quantities of electrotechnical equipment and exports little or no electrotechnical equipment.

V. Use Pattern.

A. Electronic and Telecommunications Equipment Industry.

1. General.

Products of the electronic and telecommunications equipment industry of the Sino-Soviet Bloc include primarily items of the following categories: consumer goods, such as radio and television receivers; commercial and industrial products, such as communications stations, test equipment, and industrial apparatus and controls; telephone and telegraph equipment for domestic services and military field use; military radio communications equipment, such as ground, airborne, and marine transmitters, receivers, and navigational aids; military radar; and special military devices, such as missile-guidance and control and infrared devices.

The major effort in the electronic and telecommunications equipment industry has been devoted to the production of military equipment. In 1954, 32 percent of the production of this industry in the Sino-Soviet Bloc was for military radar, 22 percent for military radio, and 10 percent for other military items, totaling 64 percent for military purposes. (See Table 3.*) Continued expansion, with the emphasis on meeting present and future military requirements, is expected. Production of consumer goods has increased, especially since 1953, but the civilian share of electronic and telecommunications equipment will continue to be far less than that of the armed forces.

2. USSR.

An analysis of the indicated product mix and of the estimated production of specific categories of electron tubes provides the means of determining the use pattern for the Soviet electron tube industry. 29/ In addition, individual plant studies indicating employment and type of production activity provide an independent means of establishing a probable industry use pattern. 30/ As most items of finished electronic and telecommunications equipment are related to specific end uses, the estimates of individual commodity production, although incomplete, provide an approximate confirmation of the other two methods.**

* P. 20, below.
** See Appendix B.

A summary of results obtained from these three independent methods and an estimate of the most probable use pattern of the electronic and telecommunications equipment industry of the USSR in 1954 is shown in Table 2.

Table 2

Estimated Use Pattern
of the Electronic and Telecommunications Equipment Industry
of the USSR a/
1954

Percent

End Use	Probable Industry Use Pattern
Consumer goods	17
Domestic radio and industrial electronics	9
Wire communications equipment	
Nonmilitary	5
Military	5
Military radar	40
Military radio	18
Special military devices	6
Total	100

a. Data include electronic supplies for maintenance and replacement.

3. Sino-Soviet Bloc.

In the electronic and telecommunications equipment industries of the other members of the Sino-Soviet Bloc, the product mix and use pattern have differed from those of the USSR in the following respects: production of more complex and highly classified types of radar has been largely confined to the USSR, with some production of radar in Hungary and Czechoslovakia and limited activity recently

in East Germany; the emphasis of the larger producers in Hungary, East Germany, Czechoslovakia, and of the recently expanded industries of Communist China and Poland, has been directed increasingly toward the production of commercial and industrial electronic devices, military radio, and consumer goods; and the limited production of the Balkan Satellites has been directed almost exclusively toward the production of civilian radios. 31/

The value of the total production of electronic and telecommunications equipment in the European Satellites and Communist China is estimated to have been US $320 million in 1954. Of this total, the production of consumer goods was about US $100 million; domestic radio and industrial electronic products, about US $70 million; military radio, about US $90 million; and wire communications equipment and radar, about US $60 million. Exports to the USSR have been high, especially in the categories of military radio and wire communications equipment, radar, and television receivers. In meeting over-all requirements, the electronic and telecommunications equipment industry of the Sino-Soviet Bloc must be considered to be relatively well integrated.

An estimate of the use pattern of the electronic and telecommunications equipment industry of the Sino-Soviet Bloc in 1954 is shown in Table 3.*

B. Electrical Machinery Industry.

1. General.

Many products of the electrical machinery industry of the Sino-Soviet Bloc are of direct military use or are used for military-support purposes. Electrical machines constitute the basic components of electrical systems in aircraft, tanks, motor vehicles, guided missiles, and electric power supplies. Very small precision motors are used as servomotors and remote indicators, and larger motors are used in power or drive systems, all of which are common military items. Military and civilian telecommunications systems, aircraft, ships, motor vehicles, and the electric power industry require large quantities of wire and cable. Prime-mover types of steam and gas turbines are used as propulsion units in ships, as drives in submarines, and as generator or pump drives in guided missiles. The most important single military application of batteries

* Table 3 follows on p. 20.

Table 3

Estimated Use Pattern
of the Electronic and Telecommunications Equipment Industry
of the Sino-Soviet Bloc a/
1954

Percent

End Use	Probable Industry Use Pattern
Consumer goods	19
Domestic radio and industrial electronics	12
Wire communications equipment	
Nonmilitary	5
Military	5
Military radar	32
Military radio	22
Special military devices	5
Total	100

a. Data include electronic supplies for maintenance and replacement.

is the power unit of a submarine. Power generation and distribution networks use substantial quantities of capital goods, such as large turbines and generators, power distribution transformers, and switchgear.

2. USSR.

Those products of the electrical machinery industry of the USSR which are concerned with the generation and distribution of bulk power -- large turbines, generators, transformers, heavy switchgear, and power cable -- may be regarded as being used directly by the electric power industry. The ultimate use of these products also may be regarded as prorated among the users of electric power and in some measure related to energy consumption. Other items, such as

motors and lamps, are used directly by the energy consumer. The breakdown of the estimated electrical energy requirements of the USSR in 1951 as shown in Table 4 indicates the use pattern of electrical machinery. 32/

Table 4

Estimated Electrical Energy Requirements of the USSR
1951

Percent of Total Energy Production

Consuming Sector	Percent
Industry	
Basic raw materials and construction materials	4.8
Ferrous and nonferrous metals and alloys	23.1
Chemicals	11.4
Machinery and equipment	11.0
Light industry	4.8
Military end items	10.3
Transportation	2.9
Household, commercial, and municipal	14.6
Agriculture	1.5
Military installations	0.4
Electric power stations, line loss, and other	15.2
Total	100.0

Although detailed information is not available on the use of all items produced by the electrical machinery industry, Table 5* shows an estimate of the use pattern of the major items of heavy electrical machinery and transformers in the USSR in 1953. 33/

3. East Germany.

An estimate of the use pattern of electrical machinery in East Germany in 1953 is shown in Table 6.* Turbines have been excluded from this table. 34/

* Tables 5 and 6 follow on p. 22.

Table 5

Estimated Use Pattern
of Heavy Electrical Machinery and Transformers
in the USSR
1953

Percent

Consuming Industry	Motors	Generators	Turbines
Electric power, including atomic energy	23	80	73
Naval shipbuilding	5	5	22
Railroad transportation	10	3	a/
Steel	18	7	a/
Chemicals and petroleum	16	a/	a/
Mining	6	a/	a/
Aviation	7	a/	a/
Other	15	5	5
Total	100	100	100

a. Included under other categories.

Table 6

Estimated Use Pattern
of Electrical Machinery in East Germany
1953

Consuming Sector	Percent
Households	8
Industry, agriculture, and services	
Investment for productive purposes	13
Direct consumption	25
Exports, including reparations	54
Total	100

An estimate of the use pattern of turbines in East Germany during 1948-54 is shown in Table 7. 35/

Table 7

Estimated Use Pattern of Turbines in East Germany
1948-54

End Use	Percent
Power-generation equipment	77
Ship propulsion	12
Pump, fan, and miscellaneous drive	11
Total	100

4. Other Members of the Sino-Soviet Bloc.

If exports to the USSR are excluded, the use pattern of electrical machinery in the other European Satellites is generally similar to that in East Germany. Shipments to the USSR may be considerable in the case of Czechoslovakia and Hungary.

Little is known of the use pattern of electrical machinery in Communist China, but the use of this machinery is small in comparison with that in the Sino-Soviet Bloc as a whole.

VI. Inputs.*

In addition to floorspace, specialized production machinery, and, for some products, special handling equipment, the electrotechnical industry requires inputs of skilled labor and of special conducting, insulating, and magnetic materials. The material inputs which are used in significant quantities and which are considered to be in critical supply in the Sino-Soviet Bloc include copper, steel, aluminum, lead, nickel, electrical sheet steel, large forgings, and refractory metal products such as those requiring tungsten and molybdenum.

* See Appendix A.

Estimates of the inputs of manpower and selected materials for the electrotechnical industry of the Sino-Soviet Bloc in 1954 are shown in Table 8.*

VII. Capabilities and Vulnerabilities.

As a result of the emphasis placed on the production of electronic and telecommunications equipment in the Sino-Soviet Bloc, there has been a rapid expansion of production since World War II, and this expansion probably will continue. It is believed that the Bloc is capable of supplying all the electronic and telecommunications equipment necessary for current needs. The Bloc will have sufficient capacity in the future to support a general war, to provide for essential services, and also to provide a small amount of civilian radio-broadcasting and receiving equipment. The Bloc will not be capable of meeting all conceivable military needs simultaneously, but its electrotechnical industry is adequately organized and equipped to provide electronic and telecommunications equipment for most of the necessary advanced and complex applications such as fire-control, airborne intercept radar, navigation systems, and missile guidance. The only bottlenecks are the supplies of a few specialized materials and quality control.

The production of electrical machinery and turbines in the Sino-Soviet Bloc has been increasing steadily since World War II. The USSR seems to have no critical requirements for imported input materials, although shortages of materials do exist in the European Satellites. In the USSR there are no shortages of manpower or materials, but there are difficulties in maintaining quality control and providing engineers with production experience.

East Germany has had a shortage of turbines for prime movers. Large diesel engines and steam engines have been used where such substitutions are applicable. Because these substitutions are limited to engines of about 10,000 horsepower, substitutions have been possible only in the small- to medium-power sizes.

The electrotechnical industry of the USSR is concentrated mainly in the western industrial areas, particularly in the Leningrad and Moscow areas. This concentration of industry is an important vulnerability.

* Table 8 follows on p. 25.

Table 8

Estimated Inputs of Manpower and Selected Materials for the Electrotechnical Industry of the Sino-Soviet Bloc a/
1954

Input	Unit	Electrical Machinery and Equipment			Electronic and Telecommunications Equipment			Total Electrotechnical Machinery and Equipment		
		USSR	Communist China and European Satellites	Total	USSR	Communist China and European Satellites	Total	USSR	Communist China and European Satellites	Total
Manpower	Man-years	460,000	290,000	750,000	300,000	170,000	470,000	760,000	460,000	1,200,000
Steel	Metric tons	710,000	370,000	1,100,000	54,000	19,000	73,000	770,000	390,000	1,200,000
Copper	Metric tons	140,000	76,000	220,000	9,000	3,200	12,000	150,000	79,000	230,000
Aluminum	Metric tons	21,000	11,000	32,000	2,200	800	3,000	23,000	12,000	35,000
Iron castings	Metric tons	130,000	67,000	200,000	1,300	450	1,700	130,000	68,000	200,000

a. For documentation and methodology, see Appendix C. Totals are rounded.

VIII. Conclusions.

The USSR has recognized the importance of the electrotechnical industry to the economy and well-being of the country as a whole and has been impressed with the military importance of the industry, particularly of the electronic and telecommunications equipment sector. Since World War II the electronic and telecommunications equipment industry of the USSR has grown from a poorly equipped industry having an extremely limited capacity to an important world producer with modern plant equipment. A variety of complex types of equipment has recently appeared. Much of this equipment is of native design, indicating a technological capability greatly superior to that of the industry before 1950.

The USSR is second only to the US in the production of electronic and telecommunications equipment. A larger proportion of production is used for military requirements in the USSR than in the US. There is a trend in the USSR toward continued expansion of production, with greater emphasis on military end items than on consumer goods. Because of the large area covered by the Sino-Soviet Bloc, the requirements for electronic and telecommunications equipment in air defense are very large, involving large quantities of search and fire-control radar, communications equipment, and, eventually, electrical and electronic equipment for guided missiles.

The intention of the USSR apparently is to expand its electrotechnical industry as rapidly as necessary to meet future military requirements and to make the industry self-sufficient in every respect. The industry is almost self-sufficient now and depends on imports for only a few critical materials. Substitutions for these imports could be made if necessary.

The electronic and telecommunications equipment sector of the electrotechnical industry of the USSR probably will expand more rapidly than the electrical machinery sector, because of the policy of emphasizing military electronics and because of the requirements of the electrical machinery industry for heavy production machinery and special-handling equipment. Considerable time is required for the development and manufacture of this production equipment.

APPENDIX A

INPUTS AND INPUT COEFFICIENTS

A. Input Coefficients.

The principal input coefficients for manpower and for selected materials for the production of the electrotechnical industry of the Sino-Soviet Bloc in 1954 are shown in Table 9. In this table the industry is divided into its two main sectors, electronic and telecommunications equipment and electrical machinery.

Table 9

Input Coefficients of Manpower and Selected Materials for the Production of the Electrotechnical Industry of the Sino-Soviet Bloc a/
1954

		Inputs per Million 1951 US $	
Category of Input	Unit	Electronic and Telecommunications Equipment	Electrical Machinery
Manpower	Man-years	330 b/	220
Steel	Metric tons	60	340
Copper	Metric tons	10	69
Aluminum	Metric tons	2.5	10
Iron castings	Metric tons	1.4	61

a. For documentation and methodology, see Appendix D.
b. The figure is for the USSR only. The figure is 530 for Communist China and the European Satellites.

B. Input Coefficients for Selected Items of Electrotechnical Equipment.

Most of the following input data is for US equipment or is based on US equipment inputs because in most cases US inputs are the same as those for the Sino-Soviet Bloc. In a few cases the data were obtained by an analysis of Soviet equipment.

The input coefficients for the production of all receiving and allied electron tubes, including metal and glass receiving tubes, miniature tubes, subminiature tubes, and tubes of the general size and with characteristics similar to those of receiving tubes in the USSR in 1954, are shown in Table 10.

Table 10

Input Coefficients
for the Production of Receiving and Allied Electron Tubes
in the USSR a/
1954

Category of Input	Unit	Inputs per Thousand Tubes Quantity
Manpower	Man-hours	150 to 2,500
Mica (raw material before punching)	Pounds	15.0
Tungsten wire	Pounds	0.17
Grid wire (includes nickel, molybdenum, and iron alloys)	Pounds	1.2
Glass		
For glass-type tubes	Pounds	90.0
For miniature-type tubes	Pounds	40.0
For metal-type tubes	Pounds	18.0
Energy		
Coal	Pounds	90
Electricity	Kilowatt-hours	60

a. 36/

The input coefficients for the production of subminiature tubes in the USSR in 1954 are shown in Table 11. Although included in Table 10, this category is given in detail in Table 11 as an aid in determining proximity fuse data.

Table 11

Input Coefficients for the Production of Subminiature Tubes in the USSR a/
1954

	Inputs per Thousand Tubes	
Category of Input	Unit	Quantity
Mica (raw material, highest quality)	Pounds	4
Glass tubing	Pounds	15
Dumet sealing wire	Pounds	7

a. 37/

The input coefficients for the production of large transmitting tubes and special tubes in the USSR in 1954 are shown in Table 12.

Table 12

Input Coefficients for the Production of Large Transmitting Tubes and Special Tubes in the USSR a/
1954

	Inputs per Thousand Tubes	
Category of Input	Unit	Quantity
Manpower b/	Man-hours	4,000 to 25,000
Tungsten rod and heavy wire	Pounds	15 to 35
Molybdenum rod and sheet	Pounds	15 to 35
Energy		
Coal	Pounds	1,500
Electricity	Kilowatt-hours	1,000

a. 38/
b. Manpower inputs include all employees.

The input coefficients for the production of small, medium, and large radar magnetrons in the USSR in 1954 are shown in Table 13.

Table 13

Input Coefficients for the Production of Radar Magnetrons in the USSR a/
1954

	Inputs per Thousand Tubes	
	Quantity (Pounds)	
Category of Input	Medium and Small Magnetrons	Large Magnetrons
Copper rods, bars, tubes, and heavy sheet (oxygen-free, high-conductivity -- OFHC)	5,000	72,300
Molybdenum	6	4,600
Kovar sealing metal	100	6,150

a. 39/

The input coefficients for the production of transmitting, special, and microwave tubes in the USSR in 1954, based on US practice, are shown in Table 14.

Table 14

Input Coefficients for the Production of Transmitting, Special, and Microwave Tubes in the USSR a/
1954

	Inputs per Thousand 1950 US $
Category of Input	Quantity (Pounds)
Copper (OFHC)	46.0
Tungsten	0.93
Molybdenum	1.08
Kovar sealing metal	4.30
Nickel	3.75

a. 40/

Inputs for the production of electric lamps vary widely depending on the types of production machinery used and the sizes of lamps manufactured. The input coefficients for the production of general-service lamps in the USSR in 1954 are shown in Table 15.

Table 15

Input Coefficients for the Production of Electric Lamps in the USSR a/
1954

	Inputs per Thousand Lamps	
Category of Input	Unit	Quantity
Manpower b/	Man-hours	25
Tungsten wire (800 to 1,050 meters)	Pounds	0.21
Glass bulbs	Pounds	88
Glass tubing	Pounds	6.5

a. 41/
b. Manpower inputs are based on US practice.

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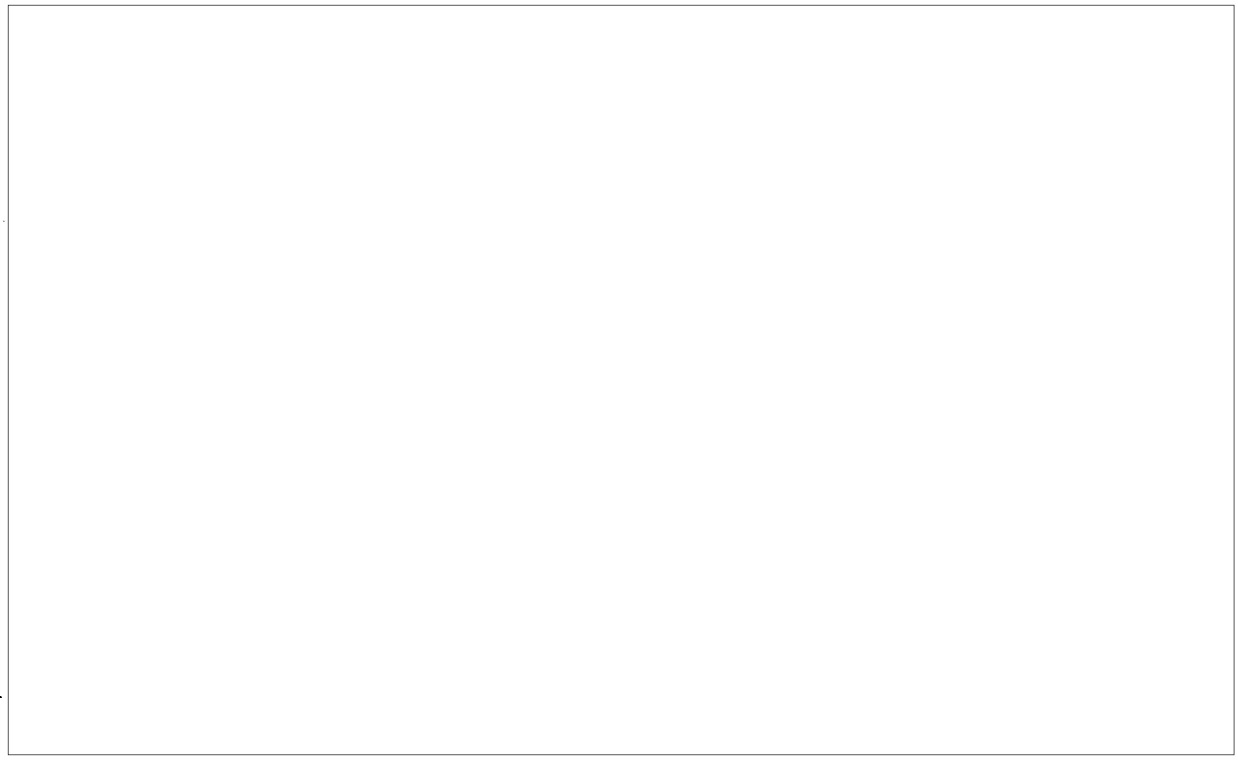

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The input coefficients for the production of Soviet field telephone switchboards in the USSR in 1954, based on analysis of Soviet equipment, are shown in Table 21.

Table 21

Input Coefficients for the Production
of Field Telephone Switchboards
in the USSR a/*
1954

		Inputs per Unit	
		Quantity	
Category of Input	Unit	Type K-10	Type PK-10
Manpower	Man-hours	35	45
Steel	Pounds	12.4	3.4
Copper	Pounds	0.3	6.5
Aluminum	Pounds	N.A.	0.5
Iron	Pounds	N.A.	0.9

* Footnote for Table 21 follows on p. 35.

Table 21

Input Coefficients for the Production of Field Telephone Switchboards in the USSR a/ 1954 (Continued)

Category of Input	Unit	Inputs per Unit: Quantity, Type K-10	Inputs per Unit: Quantity, Type PK-10
Plastics	Pounds	0.6	1.1
Hard rubber	Pounds	0.3	0.6
Wood	Pounds	N.A.	10.5
Brass		N.A.	N.A.
Energy			
Coal	Pounds	21	27
Electricity	Kilowatt-hours	7	9

a. 47/

The input coefficients for the production of TAI-43 field telephone sets in the USSR in 1954, based on an analysis of a Soviet set, are shown in Table 22.

Table 22

Input Coefficients for the Production of TAI-43 Field Telephone Sets in the USSR a/* 1954

Category of Input	Unit	Inputs per Set: Quantity
Manpower	Man-hours	10
Steel	Pounds	1.9
Copper	Pounds	0.3
Plastics	Pounds	4.2
Brass	Pounds	1.4

* Footnote for Table 22 follows on p. 36.

Table 22

Input Coefficients for the Production
of TAI-43 Field Telephone Sets
in the USSR a/
1954
(Continued)

		Inputs per Set
Category of Input	Unit	Quantity
Lead	Pounds	0.5
Energy		
Coal	Pounds	6
Electricity	Kilowatt-hours	2
Battery (1.5-volt dry cell)	Units	1

a. 48/

The input coefficients for the production of ST-35 teletype sets in the USSR in 1954, based on an analysis of a Soviet set, are shown in Table 23.

Table 23

Input Coefficients for the Production
of ST-35 Teletype Sets
in the USSR a/
1954

		Inputs per Set
Category of Input	Unit	Quantity
Manpower	Man-hours	170.
Steel	Pounds	58.8
Wood	Pounds	30.3

a. 49/

The input coefficients for the production of radio communications equipment in the USSR in 1954 are shown in Table 24.

Table 24

Input Coefficients for the Production of Radio Communications Equipment in the USSR a/
1954

		Inputs per Set		
		Quantity		
Category of Input	Unit	Type A-7-B	Type RB	Type RBM-1 b/
Manpower	Man-hours	110	110	110
Steel	Pounds	10.6	9.0	20.3
Copper	Pounds	2.6	1.8	4.3
Aluminum	Pounds	N.A.	6.0	8.1
Iron	Pounds	N.A.	0.8	0.3
Plastics	Pounds	1.5	2.0	3.5
Foam rubber	Pounds	N.A.	N.A.	0.3
Wood	Pounds	10.6	N.A.	25.0
Brass	Pounds	0.2	0.9	0.5
Canvas	Pounds	N.A.	0.9	3.9
Ceramics	Pounds	0.2	N.A.	0.9
Glass	Pounds	N.A.	N.A.	0.3
Other				
Electron tubes (receiving)	Units	9	8	8
Batteries				
BAS-60 or BAS-80 (primary)	Units	2	2	4
NKN-22 (storage)	Units	2	1	2
Energy				
Coal	Pounds	66	66	66
Electricity	Kilowatt-hours	22	22	22

a. 50/
b. Inputs for the production of the type RBM-1 include packing, spare parts, the sending key, and aerial equipment.

The input coefficients for the production of wire and cable in the US in 1952 are shown in Table 25.

Table 25

Input Coefficients for the Production of Wire and Cable in the US a/
1952

Pounds per Pound of Copper Conductor

Category of Input	Quantity
Carbon steel	0.23
Alloy steel	0.04
Copper	1.00
Aluminum (conductor only)	0.16
Rubber (including synthetic)	0.07
Lead	0.18
Polyethylene	0.03

a. 51/

The input coefficients for the production of radar-grade coaxial cable and field wire in the USSR in 1954 are shown in Table 26.

Table 26

Input Coefficients for the Production of Radar-Grade Coaxial Cable and Field Wire in the USSR a/
1954

Inputs per Thousand Feet

Category of Input	Unit	Quantity	
		Field Wire	Radar-Grade Coaxial Cable
Manpower	Man-hours	N.A.	12
Copper	Pounds	28	20
Polyethylene	Pounds	N.A.	23
Polyvinyl chloride	Pounds	N.A.	30

a. 52/

The input coefficients for the production of various items of aircraft electrical equipment in the US in 1954 are shown in Table 27.*

* Table 27 follows on p. 39.

Table 27

Input Coefficients for the Production of Aircraft Electrical Equipment in the US a/
1954

Category of Input	Unit	Inputs per Unit: Actuator Type D2-14	Starter Type 6BPSR-3	Generator Type G29-8B	Inverter Type F46-2
Manpower	Man-hours	90	40	80	95
Steel plate	Pounds	35	11	18	17
Steel punchings	Pounds	18	17	52	51
Forgings	Pounds	36	30	55	N.A.
Copper	Pounds	10	1	23	17
Aluminum castings	Pounds	6	2	11	5
Mica	Pounds	1	10	Negligible	1
Insulation material	Pounds	2	2	2	2
Roller bearings	Units	6	4	2	2
Energy					
Coal	Pounds	55	24	50	55
Electricity	Kilowatt-hours	35	16	30	40

a. 53/

The input coefficients for the production of the PES-50 portable electric power generating station in the US in 1954 are shown in Table 28.

Table 28

Input Coefficients for the Production of the US PES-50 Portable Electric Power Generating Station a/ 1954

		Inputs per Unit
Category of Input	Unit	Quantity
Manpower (drive and generator)	Man-hours	3,840
Drive and accessories		
Cast iron	Pounds	6,440
Steel	Pounds	640
Babbitt	Pounds	7
Bronze, brass, copper, and plastics	Pounds	73
Generator and exciter		
Steel plate	Pounds	750
Steel punchings	Pounds	762
Steel castings	Pounds	47
Steel forgings	Pounds	94
Copper	Pounds	338
Aluminum, miscellaneous material	Pounds	3
Energy		
Coal	Pounds	230
Electricity	Kilowatt-hours	155

a. 54/

The input coefficients for the production of primary batteries in the USSR in 1954, based on an analysis of Soviet batteries, are shown in Table 29.*

* Table 29 follows on p. 41.

Table 29

Input Coefficients for the Production of Primary Batteries in the USSR a/ 1954

		Inputs per Metric Tons
Category of Input	Unit	Quantity
Manpower	Man-hours	1,100
Manganese dioxide	Pounds	600
Ammonium chloride	Pounds	264
Zinc chloride	Pounds	176
Zinc	Pounds	594
Starch	Pounds	198
Graphite	Pounds	176
Miscellaneous chemicals	Pounds	132

a. 55/

The input coefficients for the production of 80-ampere-hour storage batteries in the USSR in 1954, based on an analysis of Soviet batteries, are shown in Table 30.

Table 30

Input Coefficients for the Production of 80-Ampere-Hour Storage Batteries in the USSR a/ 1954

		Inputs per Unit
Category of Input	Unit	Quantity
Manpower	Man-hours	0.5
Hard rubber	Pounds	10
Sulfuric acid	Pounds	3.5
Lead	Pounds	18

a. 56/

The input coefficients for the production of heavy electrical machinery in the US and in the USSR during 1951-52, based on both the US and the Soviet practice, are shown in Table 31.*

* Table 31 follows on p. 42.

Table 31

Input Coefficients for the Production of Heavy Electrical Machinery in the US and the USSR a/*
1951-52

Type of Machinery	Pounds								Manpower c/ (Man-hours)
	Total Steel b/	Steel Plate b/	Steel Punchings b/	Steel Castings b/	Steel Forgings b/	Copper b/	Aluminum b/	Total Weight	
Motors									
Induction	US Inputs per Kw d/								
373 kw	13.4	5.42	4.42	2.36	1.19	1.56	Negligible	15.0	1.56
1,865 kw	12.9	4.20	4.76	1.60	2.31	1.23	Negligible	14.1	0.86
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
18,000 kw	236,000	86,600	82,600	35,600	31,500	25,200	Negligible	262,000	28,000
10,000 kw	131,000	48,100	45,900	19,800	17,500	14,000	Negligible	145,000	15,600
3,000 kw	39,400	14,400	13,800	5,940	5,250	4,200	Negligible	43,600	4,660
1,000 kw	13,100	4,810	4,590	1,980	1,750	1,400	Negligible	14,500	1,560
Synchronous	US Inputs per Kw d/								
149 kw	23.6	10.7	10.9	0.67	1.34	4.83	Negligible	28.4	2.48
2,238 kw	22.5	7.02	10.4	1.74	3.35	1.99	Negligible	24.5	0.59
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
15,000 kw	338,000	105,000	156,000	26,100	50,200	30,000	Negligible	368,000	37,200
10,000 kw	225,000	70,200	104,000	17,400	33,500	20,000	Negligible	245,000	24,800
5,000 kw	113,000	35,100	52,200	8,700	16,800	10,000	Negligible	123,000	12,400
2,500 kw	56,400	17,600	26,100	4,350	8,380	5,000	Negligible	61,400	6,200
750 kw	16,900	5,260	7,820	1,300	2,512	1,500	Negligible	18,400	1,860

* Footnotes for Table 31 follow on p. 45.

Table 31

Input Coefficients for the Production of Heavy Electrical Machinery in the US and the USSR a/
1951-52
(Continued)

Type of Machinery	Pounds								Manpower c/ (Man-hours)
	Total Steel b/	Steel Plate b/	Steel Punchings b/	Steel Castings b/	Steel Forgings b/	Copper b/	Aluminum b/	Total Weight	
Motors (Continued)									
Direct current	US Inputs per Kw d/								
550 kw	16.4	10.0	5.09	0.14	1.22	4.27	0.05	20.8	2.91
620 kw	16.6	10.1	5.16	0.24	1.13	5.44	Negligible	22.0	3.23
2,238 kw	22.9	12.1	9.16	0.13	1.56	3.46	0.04	26.4	2.75
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
20,000 kw	458,000	241,000	183,000	2,600	31,200	69,200	800	528,000	55,000
10,000 kw	229,000	121,000	91,600	1,300	15,600	34,600	400	264,000	27,500
7,500 kw	172,000	90,400	68,700	975	11,700	26,000	300	198,000	20,600
3,000 kw	68,700	36,200	27,500	390	4,680	10,400	120	79,200	8,250
750 kw	14,000	8,030	4,850	128	975	3,290	38	17,300	2,220
Generators									
Turbogenerators	US Inputs per Kw d/								
Air-cooled									
6,250 kw	6.57	1.19	4.00	0.08	1.30	0.65	0.02	7.24	2.02
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
10,000 kw	65,700	11,900	40,000	800	13,000	6,500	200	72,400	20,200
5,000 kw	32,800	5,950	20,000	400	6,500	3,250	100	36,200	10,100
1,000 kw	6,570	1,190	4,000	80	1,300	650	20	7,240	2,020

Table 31

Input Coefficients for the Production of Heavy Electrical Machinery in the US and the USSR a/
1951-52
(Continued)

Type of Machinery	Pounds								Manpower c/ (Man-hours)
	Total Steel b/	Steel Plate b/	Steel Punchings b/	Steel Castings b/	Steel Forgings b/	Copper b/	Aluminum b/	Total Weight	
Generators (Continued)									
Turbogenerators (Continued)									
Hydrogen-cooled	US Inputs per Kw d/								
70,588 kw	4.32	1.20	2.37	0.05	0.70	0.30	0.02	4.64	0.84
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
100,000 kw	432,000	120,000	237,000	5,000	70,000	30,000	2,000	464,000	83,600
60,000 kw	259,000	72,000	142,000	3,000	42,000	18,000	1,200	278,000	50,200
40,000 kw	173,000	48,000	94,800	2,000	28,000	12,000	800	186,000	33,400
22,500 kw	97,200	27,000	53,300	1,120	15,800	6,750	450	104,000	18,800
Water-wheel	Input US Inputs per Kw d/								
108,000 kva	22.8	9.87	9.33	1.85	1.79	1.79	0.01	24.6	2.00
30,000 kva	16.6	11.9	3.54	0.13	1.08	1.27	0.03	17.9	2.00
20,000 kva	33.5	15.8	13.1	1.88	2.81	2.75	0.03	36.3	2.00
	Inputs per Unit of Sino-Soviet Bloc Sizes e/								
70,000 kw	1,700,000	875,000	605,000	90,300	132,000	136,000	1,400	1,840,000	140,000
22,500 kw	547,000	281,000	194,000	29,000	42,500	43,600	450	591,000	45,000
10,000 kw	243,000	125,000	86,400	12,900	18,900	19,400	200	263,000	20,000
5,000 kw	122,000	62,500	43,200	6,450	9,450	9,700	100	131,400	10,000
1,000 kw	24,300	12,500	8,640	1,290	1,890	1,940	20	26,300	2,000

Table 31

Input Coefficients for the Production of Heavy Electrical Machinery in the US and the USSR a/
1951-52
(Continued)

Type of Machinery	Pounds								Manpower c/ (Man-hours)
	Total Steel b/	Steel Plate b/	Steel Punchings b/	Copper b/	Insulation b/	Oil b/	Miscellaneous b/	Total Weight	
Transformers f/									
110,000 kva	165,000	53,700	112,000	37,600	13,600	56,700	8,390	282,000	23,000
100,000 kva	194,000	68,000	126,000	28,800	11,800	62,800	7,310	304,000	20,400
62,500 kva	134,000	31,400	102,000	19,000	7,900	45,200	5,200	211,000	13,800
50,000 kva	96,800	34,000	62,800	14,400	5,900	31,400	3,660	152,000	11,700
20,000 kva	72,300	21,200	51,100	10,600	4,290	25,000	4,290	116,000	6,300
10,000 kva	41,200	15,600	25,600	5,280	2,140	12,500	2,140	63,200	4,600
7,500 kva	27,800	13,000	14,800	3,370	780	14,800	2,280	49,000	4,490
1,500 kva	11,700	2,810	8,880	3,630	750	Negligible	144	16,200	3,200
500 kva	3,870	1,000	2,870	1,060	331	Negligible	101	5,360	3,000

a. 57/
b. Input coefficients for materials include only those materials delivered to the assembly departments. Materials used in the production of other products are not included.
c. Input coefficients for manpower include the labor of only the category of employees in direct production and closely related employees, as defined in the US Department of Commerce, Census of Manufactures: 1947, 1950. This category includes only employees engaged in assembly departments.
d. US inputs per kw are computed from late 1951 data for the sizes given, [redacted] Input coefficients for materials have been adjusted in accordance with known differences in practices and materials in the Sino-Soviet Bloc. Input coefficients for manpower have not been so adjusted.
e. Figures given under "Inputs per Unit of Sino-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 figure 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.
f. All figures for transformers are for standard sizes.

50X1

The input coefficients for the production of steam turbines in the USSR in 1952, based on US practice, are shown in Table 32. The 10,000-kw size is typical of Soviet turbines.

Table 32

Input Coefficients for the Production of Steam Turbines in the USSR a/
1952

		Inputs per Kilowatt			
		Size of Turbine (Kw)			
Category of Input	Unit	5,000	10,000	50,000	100,000
Manpower	Man-hours	8.52	8.35	3.24	3.34
Carbon steel					
Bars and shapes	Pounds	0.639	0.606	0.186	0.096
Sheet and strip	Pounds	0.506	0.258	0.136	0.067
Plate	Pounds	8.045	5.27	1.03	0.527
Forgings	Pounds	0.921	0.449	0.918	0.274
Castings	Pounds	0.897	1.06	0.301	0.153
Other carbon	Pounds	0.276	0.498	0.761	0.534
Alloy steel					
Stainless	Pounds	0.581	1.05	0.587	0.584
Other alloy	Pounds	0.670	3.02	4.18	2.46
Nonferrous metal					
All types	Pounds	0.230	0.296	0.081	0.075
Total weight	Pounds	12.8	12.5	8.18	4.77
Cost	Dollars	30.0	29.7	21.3	17.3

a. 58/. Data are based on US 1952 practice.

The input coefficients for the production of hydraulic turbines in the USSR in 1952, based on US practice, are shown in Table 33.*

* Table 33 follows on p. 47.

Table 33

Input Coefficients for the Production of Hydraulic Turbines in the USSR a/
1952

Pounds per Kilowatt

Category of Input	Size of Turbine (Kw) 3,750	7,500	37,500	75,000
Carbon steel				
Bars and shapes	1.34	1.94	2.0	0.8
Sheet and strip	0.67	0.2	0.134	0.1
Plate	6.7	9.38	11.5	8.04
Forgings	1.39	2.55	1.88	1.55
Castings	15.8	15.6	1.69	7.76
Other carbons	0.8	0.134	0.24	0.20
Alloy steel				
Stainless	0.08	0.035	0.8	0.34
Other alloy	0.134	0.027	0.03	0.016
Nonferrous metal				
All types	0.67	0.462	0.34	0.268
Total	27.6	30.3	18.6	19.1

a. 59/. Data are based on US 1952 practice. The weights shown do not include the turbine base.

The input coefficients and input requirements for the production of turbines in the Sino-Soviet Bloc in 1951 are shown in Table 34.*

* Table 34 follows on p. 48.

Table 34

Input Coefficients and Input Requirements for the Production of Turbines in the Sino-Soviet Bloc a/
1951

Category of Input	Steam Turbines		Hydraulic Turbines b/	
	Input Coefficient (Pounds per Kw)	Input Requirement (Thousand Pounds per Year)	Input Coefficient (Pounds per Kw)	Input Requirement (Thousand Pounds per Year)
Carbon steel				
Bars and shapes	0.485	1,830	2.33	1,930
Sheet and strip	0.206	777	0.24	199
Plate	4.22	15,900	11.3	9,330
Forgings	0.361	1,360	3.06	2,530
Castings	0.845	3,190	18.7	15,500
Other carbon	0.399	1,510	0.16	133
Alloy steel				
Stainless	0.845	3,190	0.50	414
Other alloy	2.41	9,110	0.03	24.9
Nonferrous metal				
All types	0.236	891	0.55	456
Total	10.0	37,800	36.9	30,500

a. 60/
b. The weight of hydraulic turbines includes the turbine base.

APPENDIX B

PRODUCTION TABLES

Estimates of the growth trends for specific categories of electrotechnical equipment in the USSR during the postwar years and the predicted trends for 1955, 1956, and 1960 are shown in Table 35.*

Estimates of the growth trends for specific categories of electrotechnical equipment in the European Satellites and Communist China during the postwar years and the predicted trends for 1955, 1956, and 1960 are shown in Table 36.** The anticipated rate of growth is much less than for the USSR.

* Table 35 follows on p. 50.
** Table 36 follows on p. 51.

Table 35

Estimated Production of Selected Items of Electrotechnical Equipment in the USSR
1938, 1946-56, and 1960

Item	Unit	1938	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1960
Electrical machinery and equipment														
Electrical machinery														
Turbines a/	Thousand kw	N.A.	920	1,500	1,800	2,600	2,800	3,300	3,600	5,000	5,700	6,500	7,800	16,000
Motors b/	Thousand kw	2,800	1,600	2,300	3,600	4,800	5,800	7,500	8,000	9,900	11,000	13,000	14,500	20,500
Generators c/	Thousand kw	600	400	1,300	1,300	1,300	1,300	2,800	3,600	5,100	5,600	6,300	7,100	9,900
Transformers d/	Thousand kva	3,900	2,200	3,200	5,000	6,700	8,100	10,500	11,000	14,000	16,000	18,000	20,000	29,000
Switchgear e/	Million US $ f/	100	55	80	130	170	200	270	290	350	410	460	510	730
Electrical wire and cable g/	Thousand MT h/	N.A.	25	29	34	40	49	62	73	87	98	110	130	190
Other electrical equipment														
Primary batteries i/	Thousand MT h/	N.A.	N.A.	10	11	12	13	14	15	16	17	18	19	25
Storage batteries j/	Thousand MT h/	N.A.	N.A.	17	20	25	29	33	36	39	42	44	48	66
Electronic and telecommunications equipment														
Radio receivers k/	Thousand units		272	314	518	856	1,040	1,210	1,280	1,630	2,870	3,500	4,300	7,700
Television receivers l/	Thousand units		0.1	1	3	5	10	20	42	95	284	550	930	2,500
Electron tubes m/	Million US $ f/	N.A.	13	18	22	24	34	50	65	78	92	110	120	190
Electronic components														
Resistors n/	Million US $ f/	N.A.	N.A.	N.A.	N.A.	3.2	7.1	8.6	N.A.	19	N.A.	N.A.	N.A.	N.A.
Capacitors o/	Million US $ f/	N.A.	N.A.	N.A.	N.A.	7.4	19.5	24.5	N.A.	57	N.A.	N.A.	N.A.	N.A.
Electronic test equipment p/	Million US $ f/	N.A.	N.A.	11	11	13	15	17	19	21	23	26	29	46
Wire communications equipment q/	Million US $ f/	N.A.	32	32	32	32	32	41	52	62	72	88	96	150
Electric lamps r/	Million US $ f/	N.A.	4.2	4.6	6.0	10	11	13	14	15	15	16	17	27

a. 61/
b. 62/
c. 63/
d. 64/
e. 65/
f. In 1951 values.
g. 66/
h. Metric tons of copper content equivalents.
i. 67/
j. 68/
k. 69/
l. 70/
m. 71/
n. 72/
o. 73/
p. 74/
q. 75/
r. 76/

Table 36

Estimated Production of Selected Items of Electrotechnical Equipment
in the European Satellites and Communist China
1938, 1946-56, and 1960

Item	Unit	1938	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1960
Electrical machinery and equipment														
Electrical machinery														
Turbines a/	Thousand kw	460	360	590	740	840	990	1,300	1,500	1,700	2,000	2,300	2,500	3,800
Motors b/	Thousand kw	N.A.	1,100	1,100	1,600	2,100	3,200	4,400	5,500	6,600	7,600	8,400	9,400	13,000
Generators c/	Thousand kw	N.A.	290	390	530	670	820	1,100	1,400	1,900	2,400	2,700	3,000	4,200
Transformers d/	Thousand kva	N.A.	1,400	1,600	2,500	3,400	4,900	6,000	7,600	9,700	10,500	11,500	12,500	17,000
Switchgear e/	Million US $ f/	45	21	20	30	46	66	83	110	130	140	150	160	200
Electrical wire and cable g/	Thousand MT h/	N.A.	28	40	41	43	45	55	63	73	78	81	82	90
Other electrical equipment														
Primary batteries i/	Thousand MT h/	N.A.	3.0	3.5	4.0	4.3	4.9	5.4	6.0	6.5	6.9	7.2	7.8	9.6
Storage batteries j/	Thousand MT h/	N.A.	N.A.	N.A.	12	14	16	18	19	21	22	23	25	31
Electronic and telecommunications equipment														
Radio receivers k/	Thousand units	N.A.	210	310	500	620	740	980	1,100	1,400	1,700	1,900	2,100	2,600
Television receivers l/	Thousand units	N.A.	N.A.	Negligible	Negligible	Negligible	Negligible	31	34	40	86	96	110	160
Electron tubes m/	Million US $ f/	N.A.	N.A.	N.A.	4.4	5.5	7.4	11	16.5	23	33	40	48	59
Electronic components														
Resistors n/	Million US $ f/	N.A.	N.A.	N.A.	N.A.	5.8	7.2	8.0	8.7	9.7	10	12	14	15
Capacitors o/	Million US $ f/	N.A.	N.A.	N.A.	N.A.	5.8	6.6	7.8	8.4	9.1	9.2	9.7	11	11
Electronic test equipment p/	Million US $ f/	N.A.	N.A.	N.A.	N.A.	4.2	5.8	7.1	8.2	9.1	9.9	11	12	14
Wire communications equipment q/	Million US $ f/	N.A.	N.A.	N.A.	14	13	14	15	17	18	19	21	23	27
Electric lamps r/	Million US $ f/	N.A.	N.A.	N.A.	9.3	11	14	15	16	18	20	22	23	27

a. 77/
b. 78/
c. 79/
d. 80/
e. 81/
f. In 1951 values.
g. 82/
h. Metric tons of copper content equivalents.
i. 83/
j. 84/
k. 85/
l. 86/
m. 87/
n. 88/
o. 89/
p. 90/
q. 91/
r. 92/

APPENDIX C

METHODOLOGY

1. Production of Individual Commodities.*

The estimated production of the individual commodities shown in Appendix B was obtained primarily from the earlier commodity studies to which the estimates are referenced. Gaps in the time-period coverage of the earlier studies were filled by interpolation, by reference to official plan announcements, and by plant studies. The projections through 1960 were made by extrapolating past trends and by taking account of the reported availabilities of materials and of reported plant construction. 50X1

2. Estimates of Aggregate Production.

a. Electrical Machinery and Equipment.

(1) USSR.

The total value of the production of electrical machinery and equipment in the USSR was estimated by analogy with similar production in the US during 1947. After subtraction for double counting** and adjustments for known differences between US and Soviet product mix, the total value of the production of the industry in the USSR in 1951 US dollars was related to US production in the same industry. 94/

* See Appendix B.

** The term double counting is used when the production of two industries, one of which consumes part of the production of the second in its own production process, is added. For example, in 1951 in the USSR, about 6 percent of the production of electrical wire and cable (magnet wire) was used in the production of motors, of generators, and of transformers. When the production of motors, of generators, and of transformers is added to the production of wire and cable, to avoid counting the production of magnet wire twice, it is necessary to deduct the value of magnet-wire shipments from the value of the production of motors, of generators, and of transformers.

This procedure was used because the products grouped in this industry are complementary in consumption and because the several commodities have been examined individually.

(2) Other Members of the Sino-Soviet Bloc.

Although the proportions in which electrical machinery and equipment are produced in Communist China and in the individual European Satellites differ substantially from those in the US and in the USSR, it is believed that a fair approximation to US proportions can be obtained by treating China and the European Satellites together. Accordingly, the total production of electrical machinery and equipment in China and in the European Satellites was estimated by relating the total value of the production of those commodities for which individual estimates were available to US production by the same method used for the Soviet estimate.

b. Electronic and Telecommunications Equipment and Supplies.

(1) USSR.

50X1

50X1

For the USSR, where the electronic and telecommunications equipment industry is defined to include wire communications equipment, this ratio is close to 9 to 1. With production of tubes in 1954 estimated at 1 billion rubles, 96/ the total production of the electronic and telecommunications equipment industry is estimated at 9 billion rubles. The ratio of 9 rubles to US $1 results when the relationship of tube production to industry production is determined in rubles. It is somewhat higher when US dollar values are used. The ruble-dollar exchange rates are based on prices of comparable commodities in the USSR and in the US. For the industry as a whole, an exchange ratio of 10 rubles to US $1 was used; for the electron tube sector of the industry, a ratio of 12 rubles to US $1 was used. This latter ratio changed slightly in the years after 1950 because of product-mix and price changes. Other techniques for estimating industry production, based on labor productivity data for the 300,000 industry employees and on an aggregate of the product value of selected categories of equipment, although approximate, provide an acceptable check of the 9-billion-ruble figure.

Current estimates of the production of electron tubes in the USSR in 1938 and during 1946-56 and a projection for 1960 are shown in Table 35.* Recent reports by Soviet officials indicate a fourfold increase in the production of the electronic and telecommunications equipment industry between 1950 and 1955 and a planned threefold increase between 1955 and 1960. 97/ Total production of the electronic and telecommunications equipment industry of the USSR in 1938 and during 1946-56 and a projection for 1960, based on these official statements and on estimated tube production, are shown in Table 1.** For 1938, estimates are based on an estimate of production of 5 million electron tubes in the USSR.

(2) Hungary.

The estimates of the production of electrotechnical equipment in Hungary shown in Table 36*** are somewhat lower for the years after 1953 than in previous reports because of recently reported industry difficulties resulting mainly from shortages of materials. Estimates of the production of electron tubes during 1954-56, therefore, are only slightly greater than estimates of production in 1953. 98/ Over 60 percent of the tubes produced in Hungary are exported, and the total value of production of the electronic and telecommunications equipment industry is 3 to 4 times the value of the production of tubes. The production of the electronic and telecommunications equipment industry during 1952-54 has been estimated by totaling reported production of specific categories of equipment. 99/

(3) East Germany.

Recent reports have provided relatively accurate estimates of the production of electronic and telecommunications equipment in East Germany during 1953-54. 100/ For other postwar years, the total production of the industry is assumed to have been proportional to the production of electron tubes. In 1938, it is believed that about 25 percent of the entire German electrotechnical industry was located in East Germany. 101/ Of this, about 30 percent appears to have been in the electronic and telecommunications equipment sector.

* P. 50, above.
** P. 15, above.
*** P. 51, above.

(4) Czechoslovakia.

Estimates of the production of electronic and telecommunications equipment in Czechoslovakia are included in Table 1,* at a value of 9 times the estimated production of electron tubes. 102/

(5) Other Members of the Sino-Soviet Bloc.

Until 1954 the production of electron tubes by the other members of the Sino-Soviet Bloc was negligible. Sizable expansions initiated and/or planned in Poland and Communist China will provide significant production capacity, increasing rapidly after 1955. 103/ China, Poland, and, to a lesser extent, the Balkan Satellites have produced civilian and military radios, electric lamps, and wire communications equipment, depending largely upon imports from other Bloc areas for electron tubes and component parts. In view of indicated shipments of tubes and occasional reports on plants, it is believed that the total production of electronic equipment in China, Poland, and the Balkan Satellites represents 25 to 30 percent of the total production of the members of the Sino-Soviet Bloc other than the USSR.

3. Electrotechnical Products.

Total production of electrotechnical products in the Sino-Soviet Bloc was obtained by adding the production of electrical machinery and equipment to the production of electronic and telecommunications equipment and supplies. There is a small amount of double counting involved in adding the two categories of production. For example, about 9 percent of the production of electrical wire and cable in the USSR in 1954 was consumed in the production of electronic and telecommunications equipment. Because it is estimated that this duplication does not exceed 2 percent of the total, no further adjustment has been made.

4. Input Coefficients.

The input coefficients** for steel, aluminum, and iron castings of the electrotechnical industry of the Sino-Soviet Bloc were derived from 1947 US data after appropriate adjustment for known differences in product mixes and production methods between the US and the Sino-Soviet Bloc. 104/

* P. 15, above.

** Appendix A, Table 9, p. 27, above.

The copper input coefficients and the manpower coefficients for electrical machinery were derived by interpolation from a materials balance study of the Soviet economy for 1951-55. 105/ The manpower coefficients for electronic and telecommunications equipment were obtained from the data presented in Tables 1 and 8.*

5. Inputs.

The estimated inputs of materials and of manpower for electrical machinery and equipment in 1954 were obtained by multiplying the appropriate production figures shown in Table 1* by the input coefficients listed in Table 9.** [redacted] 50X1

[redacted] 50X1

* Tables 1 and 8, pp. 15 and 25, respectively, above.
** P. 27, above.

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