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PROVISIONAL INTELLIGENCE REPORT

THE ELECTRIC POWER INDUSTRY IN MANCHURIA

CIA/RR PR-39
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CIA/RR PR-39

(ORR Project 44.1.1)

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THE ELECTRIC POWER INDUSTRY IN MANCHURIA*

Summary

In Manchuria the Chinese Communists have their best existing base for the development of heavy industry, and electric power is vital to this development. Although the Russians removed much industrial equipment following World War II, the plants which remained constituted the largest group of integrated facilities anywhere in China. The importance of Manchuria in the economy of Communist China has been increasing, and in 1952 this area accounted for over 55 percent of the total industrial production in the country.

Electric power plants, like most other industrial installations, suffered from Russian removals of equipment in the years immediately following World War II. Nevertheless, the Chinese Communists had an estimated installed capacity by 1952 of 1,036,000 kilowatts (kw), of which 63 percent was in steam plants and 37 percent in hydroelectric plants. From this installed capacity an estimated 3.9 billion kilowatt-hours (kwh) were produced. Despite damage during the fighting, 1946-48, the transmission network is presumed to be restored, for the most part, to its 1944 level. This transmission network is the best that exists anywhere in Communist China and permits the steam plants to augment the hydroelectric plants and one another when necessary. It also permits the hydroelectric plants to supply a maximum portion of the load.

Industrial use accounts for about two-thirds of the total consumption of electric power. In the immediate future, just as in 1952, the supply of electric power to all but the most essential consumers probably will be curtailed.

Although Manchuria has adequate coal and an adequate number of hydroelectric sites for any probable expansion of the industry, the problem of procuring new equipment will act as the major limitation on the expansibility of the industry. There will be a continuing

* This report deals with the area known historically as Manchuria, plus the addition of Jehol Province. It contains information available as of 1 April 1953 except for the revised 1953 Plan figures announced in May 1953.

restoration of installations, and it is assumed that the USSR will supply new equipment in quantities sufficient to achieve an installed capacity of 2.35 million kw by 1957. It is further estimated that the production from this installed capacity will amount to 10.5 billion kwh in 1957.

Coal is the most significant input to the industry. In 1952 an estimated 2.3 million metric tons, about one-seventh of the total Manchurian production, was consumed by the electric power industry. There appears to be adequate coal for any probable expansion. Sufficient quantities of replacement parts and new equipment, however, are not available in Communist China, and, owing to the dismissal of Japanese and White Russian personnel, there is an increasingly critical shortage of technical supervisors.

It is concluded that the electric power industry in Manchuria will expand at a rate which will keep pace with the expansion of heavy industry and that the latter will not be hampered in its development by a lack of electric power.

I. Introduction.

In the development of the economy of an area the availability of electric power* is of primary importance because it limits the amount of industrial equipment which can be operated. The provision of an adequate supply of electric power is and has been a prerequisite to the establishment and the expansion of any industrial enterprise.

The total industrial output of Manchuria accounted for the following percentages of the total industrial output of Communist China: in 1949, 35 percent; in 1950, 43 percent; in 1951, 52.6 percent; and in 1952, 55.9 percent. 1/** The significance of Manchurian industry

* The term electric power as discussed herein is limited to the production and delivery of electric power and to the facilities which are involved in this production and delivery.

** Footnote references in arabic numerals are to sources listed in Appendix D.

in general and of the electric power industry in particular is vividly reflected in 1953 plans, as announced in February 1953. Communist China as a whole is scheduled to expand production of electric power by 27 percent, and Manchuria, which already accounts for 57 percent of the total production, is scheduled to expand its production by 44 percent, thus concentrating 93 percent of the expansion in Manchuria. The 1953 plans for Communist China were cutback in May 1953 to call for an expansion of only 18.3 percent, but it is believed that a major portion of the planned expansion will be in Manchuria.

Another indication of the relative importance of the electric power industry among the other industries in Manchuria is shown in the proportion of the total investment that it represented in 1945. The Japanese had a total investment in Manchuria of 11 billion yen, of which 640 million yen represented the capitalization of the Manchuria Electric Company, 2/ thus indicating that this utility company represented about 5.82 percent of the total investment. Inasmuch as the Manchuria Electric Company owned about 80 percent of the total installed capacity*, the facilities for the production of electric power represented about 7.3 percent of the total investment, a rather significant proportion.

A preponderance of the mineral resources is to be found in a single area in southern Manchuria. This area consists of the land southwest of a line from Fou-hsin to An-tung: that is, the Kwangtung Peninsula and the area northeast of this line as bounded by Fou-hsin -- Mukden (Shen-yang) -- Ch'ang-ch'un -- Kirin (Chi-lin) -- south to the Yalu River (Ya'lu Chiang) -- An-tung. This area extends from Port Arthur (Lu-shun) about 450 miles northeast to Kirin and from An-tung about 200 miles northwest to Fou-hsin. Included herein is three-fourths of all of China's known iron ore and important supplies of coal. Aluminum, copper, lead, zinc, oil shales, and other minerals are also mined in the area. The availability of these minerals has led to the presence of much heavy industry in the area and the attendant development of other industries.

* Installed capacity is defined as the total of the manufacturer's intended productive capacities of the equipment concerned. Installed capacity also is known as rated capacity and nameplate capacity.

The Fu-shun and Fou-hsin mines are several times as large as any other coal mines in Manchuria. The mines at Pei-feng and at Pen-ch'i are also important producers. The steel works at An-shan, Pen-ch'i, and in the vicinity of these cities accounted for almost all of the iron produced in Manchuria and a large portion of the semifinished and finished steel products. The major cement plants are at An-shan and vicinity, Dairen (Ta-lien), Fu-shun, and Pen-ch'i and together account for almost all of the cement produced in Manchuria. By far the largest concentration of textile plants is in the Mukden vicinity. The major shale oil plant in Manchuria is at Fu-shun. An important chemical plant producing ammonia, ammonium sulfate, ammonium nitrate, nitric acid, and sulfuric acid is at Dairen, as is a soda ash plant. There are important vegetable-oil-processing plants at Mukden and Dairen, and the largest sugar refinery in Manchuria is located at Ch'ang-ch'un. Port Arthur provides an important naval base, and Dairen is quite important as a commercial port. Thus it can be seen that the area contains a genuine concentration of diversified products.

The electric power industry was developed in order to service these industries. The major hydroelectric plant at Sup'ung (Suiho) Reservoir on the Yalu River is centrally located on the southern border of this region and is connected by the highest voltage transmission lines in China (220 kilovolts -- kv) to An-shan and to An-tung and Dairen. From the other large hydroelectric plant, Ta-feng-man, just southeast of Kirin in the northern portion of the area, 110-kv transmission lines run to Ch'ang-ch'un and Fu-shun and from the latter place to Mukden and An-shan. It will be seen by reference to the accompanying map* that the steam plants were located at or near the concentrations of load caused chiefly by the mining, metallurgical, and other heavy industries and that these steam plants were augmented by the large hydroelectric plants through a rather adequate transmission network.

This report is limited to a discussion of plants of 1,000 kilowatts (kw) and larger because almost all of the smaller plants are used as a source of illumination, not of industrial electric power, and thus do not contribute directly to the industrial economy of the area.

* See the map, Manchuria: Major Electric Power Facilities, inside back cover.

A. History. 3/

The development of the electric power industry, like the development of other Manchurian industries, has been largely a matter of foreign enterprise. The South Manchuria Railway Company, organized by the Japanese in 1906, had begun by 1907 to expand some of the enterprises along its line, including an enlarged electric power plant in Dairen. Other electric power plants were erected, including those at Fu-shun, Mukden (Shen-yang), Ch'ang-ch'un, and An-tung during the next 4 years. Other new companies and plants were also established at Harbin (1905), Lu-pin (1906), Kirin (Chi-lin) (1907), Mukden (1909), and Ch'ang-ch'un (1911).

In 1926 the South Manchuria Electric Company was formed, taking over most of the South Manchuria Railway Company's electrical properties. It appears, however, that the South Manchuria Railway Company retained control of several major electric power plants as late as 1943. The South Manchuria Electric Company continued to expand, especially through the construction of a medium-high-voltage transmission network.

With the seizure of Manchuria in 1931 by the Japanese Kwantung Army and the establishment of Manchukuo (Manchuria) as a separate state, development of this area by Japan was expedited. In 1934 the Manchuria Electric Company was formed at Ch'ang-ch'un with the intention of unifying the entire electric industry of the country. It took over the properties of the South Manchuria Electric Company and by 1936 had, with these facilities and other local plants, an installed capacity of 188,088 kw out of the Manchurian total of approximately 400,000 kw.

Before 1939, almost all generation has been in coal-fired steam plants. In 1937 a survey was conducted indicating 60 hydroelectric sites with a potential total maximum capacity of 6 million kw and an total average available capacity of 3.2 million kw.* The state-owned Hydroelectric Power Construction Bureau was separately organized to

* The maximum capacity of a hydroelectric site refers to the total amount of equipment which might be installed in order to utilize the flow of water during a given period, usually several months, of large flow. The average available capacity refers to the potential utilization of equipment over a period of an entire year as limited by the varying flow of water.

construct and operate plants at these sites. This bureau started several projects, completing only the smallest one, before it was consolidated in April 1944 under the reorganized Manchuria Electric Company.

By July 1945 the Manchuria Electric Company had an installed capacity of 1,202,698 kw out of a total installed capacity of 1,732,338 kw in Manchuria, had 2,250 kilometers (km) of transmission lines at 110 kv and up, and had generated in the previous year over 4 billion kilowatt-hours (kwh). It should be noted that even at this time some of the large electric plants which were part of other industrial installations, especially the large steel mills, were not under the control of the Manchuria Electric Company.

Between the years 1941 and 1945, while engaged in a major war, Japan managed to increase the total installed capacity in Manchuria from about 900,000 kw to 1,786,000 kw, thus nearly doubling it. Table 1* gives some conception of the success of the Japanese in the use of these facilities. It indicates that in a period of less than a decade, the last 3 years of which were those of Japanese participation in World War II, total production quadrupled. It is interesting to note that as the cheaper hydroelectric power became available, production of electric power at the steam plants of the Showa Steel Works at An-shan and at the large coal mines at Fu-shun was curtailed.

In August 1945, almost all Manchurian facilities were turned over by the Japanese to the Soviet occupying force. Although the shortage of repair parts for foreign equipment had caused some loss in operable capacity** late in the war, the facilities were in good condition.

In 1946 it was estimated that there was a total installed capacity of 1,786,253 kw, including 300,000 kw for the hydroelectric plant at Sup'ung (Suiho) Reservoir on the Yalu River. 4/ The operable capacity available from this total installed capacity was estimated at 1,456,260 kw under normal conditions. 5/ It was also

* Table 1 follows on p. 7.

** Operable capacity is defined as the output of which the equipment is capable as limited by the capacity of all the auxiliaries involved and the age and state of maintenance of all the equipment.

Table 1

Annual Production of Electric Power in Manchuria 6/
1935-44

Thousand Kilowatt-Hours

	Manchuria Electric Company		Industrial Installations				
Year	Steam	Hydro a/	Fu-shun Electric Plant	Pen-ch'i Coal and Iron Company	An-shan Steel Works	Other	Total
1935	463,865		408,720	41,429	76,093	88,753	1,078,860
1936	571,874		568,462	53,285	83,794	73,074	1,350,489
1937	663,663		687,936	59,359	71,552	141,430	1,623,940
1938	831,653		976,434	70,989	76,546	177,764	2,133,386
1939	990,311		1,168,616	80,778	112,776	182,000	2,534,481
1940	1,363,412		1,188,168	94,927	126,163	156,000	2,928,670
1941	1,706,056	171,378	1,165,046	131,552	219,144	126,623	3,519,799
1942	1,730,896	978,843	964,600	166,651	142,791	102,531	4,086,312
1943	1,927,700	1,843,639	b/	210,001	123,601	201,453	4,306,394
1944	1,596,075	2,454,119	b/	200,000	130,000	209,344	4,589,538

a. It is presumed that hydroelectric plants were not available as a major source of energy until 1941.
b. It is presumed that as the cheaper hydroelectric power became available in the area, the installed capacity of this plant was not operated but was held in reserve.

estimated that, of this installed capacity, the Soviet forces during their occupation of the area from August 1945 to May 1946 removed 56 percent, or 1,008,300 kw, and also removed 385,000 kw of equipment, which was in the process of being installed. 7/ The remaining skeletal facilities, stripped of most of their comparatively modern equipment, were taken over by the Chinese Nationalist government in 1946.

The Chinese Nationalist control of this area from 1946 to 1948 was always tenuous, with their forces quickly being closed into the larger cities by the Chinese Communist forces which roamed the countryside at will. The result was continuing damage to the transmission network. Various groups, however, were commended for turning over the plants in good operating condition and complete with records to the occupying Chinese Communists. This is an indication that little major damage was done during this period, despite numerous Chinese Nationalist reports to the contrary.

B. Organization and Administration.

Over-all responsibility for management of electric power plants in Communist China is vested in the Ministry of Fuel Industry. This Ministry is subordinated to higher Central Government organs, and the entire governmental apparatus is controlled by the Chinese Communist Party.

The Ministry of Fuel Industry is 1 of the 13 economic ministries established in October 1949. Minister Ch'en Yu, a Communist, is assisted by three vice-ministers. The Ministry's Electricity Control Bureau is the Chinese counterpart of a Soviet main administration and is responsible for the actual management of electric power plants. The Ministry also has a Hydroelectric Engineering Office, which may be concerned with hydroelectric power development. 8/

Between the Central Government organs and the electric power enterprises are three principal units of territorial administration: the largest regions, such as the Northeast Administrative Region of Communist China, which for the purpose of this report is considered as roughly equivalent to Manchuria; the provinces; and the municipalities. Each of these has an administrative structure

somewhat similar to that of the Central Government, with electrical industry bureaus responsible for supervision of electric power plants under their respective jurisdiction. Many of the larger municipalities, including the seats of the six regional administrations, are exempt from provincial control. 9/

C. Natural Resources.

Manchuria has both coal for steam plants and good sites for hydroelectric plants. Coal is considered to be China's most valuable natural resource. A recent estimate of Communist China's total coal reserves is 273.114 billion metric tons, of which 11.281 billion metric tons, or only 4 percent, are to be found in Manchuria. Contrasted with this, however, is the 1952 total production of 35 million metric tons, of which 15 million metric tons, or about 43 percent, were concentrated in Manchuria. It should be mentioned that Hopeh Province, just southwest of Manchuria, produced an estimated 7 million metric tons, or another 20 percent, thus localizing 63 percent of the coal production in this same general area. 10/ Most of this coal is of a type roughly comparable with US bituminous or soft coal.

The preceding figures show that an adequate supply of coal is in the ground and that the mining facilities are adequate to bring it out. As evidence of the adequacy of this supply, note that no expansion of the production of coal in 1953 over 1952 is planned. There even have been several references critical of the coal industry because of excess stocks accumulated in 1952 at some installations. The present government has worked hard on the rehabilitation of the railroads and has them in quite satisfactory condition to deliver coal to the electric power plants. Therefore, it is concluded that there is an adequate amount of coal available in Manchuria for any expansion of the production of electric power.

China is well endowed with potential hydroelectric power. Some estimates indicate a total potential installed capacity of about 150 million kw for the country. These same estimates assign a potential installed capacity of about 6.5 million kw to Manchuria. 11/ A survey of economically feasible sites in Manchuria tabulated 30 sites with a total potential installed capacity of about 4.5 million kw. 12/ As of 1945, the Japanese had scheduled projects with a total installed capacity of 3.666 million kw and an average available capacity of 2.522 million kw. Of these, they had in operation 3 plants with an installed capacity of 0.916 million kw and an average

available capacity of 0.876 million kw. In addition, they had under construction 2 projects with a proposed installed capacity of 0.420 million kw and an average available capacity of 0.250 million kw. 13/

It is evident from these figures that the Chinese can expand their present total installed capacity of about 1 million kw in Manchuria by at least 2 million kw average available capacity of hydroelectric power when they find the capital for these major projects. Although the equipment costs for steam and hydroelectric plants are roughly the same, the total cost of a hydroelectric project may be several times that of a steam plant of the same capacity because of the cost of the hydraulic structure (dams, canals, and locks). It is also true that the construction of a hydroelectric project involves a long period, up to 5 or 10 years, whereas a steam plant may be completed in 2 to 3 years. These facts may lead the Chinese to postpone any new hydroelectric projects for at least several years.

II. Production and Transmission Facilities.

A. Production Facilities.

Appendix A shows that at the end of 1952 the total installed capacity of plants over 1,000 kw was about 1,036,000 kw. Of this total, the facilities included as public utility plants account for 86 percent, or 894,000 kw, leaving 14 percent, or 142,000 kw, still presumed to be managed as a part of individual industrial enterprises.

Only 3 hydroelectric projects of significant size exist: the plant at Ching-po Hu (Lake) with an installed capacity of 36,000 kw; the plant at Ta-feng-man near Kirin (Chi-lin) with 143,000 kw; and the plant at Sup'ung (Suiho) Reservoir on the Yalu River. The latter plant had an installed capacity of 600,000 kw at one time but only sufficient transmission lines and transformers to transmit about 200,000 kw to Manchuria, the remainder being intended for North Korea and as general reserve. Therefore the installed capacity available at Sup'ung for use in Manchuria is considered to be 200,000 kw, and the total hydroelectric installed capacity of Manchuria is calculated to be 379,000 kw, or 37 percent of the total installed capacity.

There is no record of large internal-combustion engines being used to furnish electric power in this area. The electric power produced comes almost exclusively from steam plants, the majority of which are coal fired. These steam plants total 657,000 kw, or 63 percent of the available installed capacity. Of these steam plants, public utilities account for 78 percent, or 515,000 kw, leaving 22 percent, or 142,000 kw, to other management.

Table 2* shows an accelerating increase in installed capacity in Manchuria from 1952 through 1955. There are several good reasons for this trend. China received a large loan from the USSR in 1950 which was to be used for equipment for electric power stations among other things. The average time lag between firm orders for major electric equipment and their delivery in the Soviet Bloc is between 2 and 3 years. Thus equipment ordered for new power plants in 1950, which was as soon as the Chinese Communist Party had effective control of China, would be in process of delivery in 1953. The most logical place to install this new equipment would be in the already existing structures which had been stripped of their equipment by the Russians in 1945, because in this way the equipment could be operable in only about 1 year after delivery. Admittedly, the Russians stripped some of the industrial facilities, but they did not strip them to the extent that they stripped the electric power production facilities. 14/ Furthermore, there had been a heavy demand for electric power, as is shown by the fact that there was a sufficient number of diverse industrial facilities to have required in 1944 a total production of 4,589,538,000 kwh, 15/ in spite of considerable material shortages. Much of this demand for electric power had been created by light industry, which the Chinese Communists could restore from their own manufacturing resources. Thus it is reasonable to presume that the first new large generating equipment received in Communist China would be installed in Manchuria. This opinion is supported by a recent report of a new 20,000-kw unit installed at Fou-hsin 16/ late in 1952. A report in March 1953 refers to the "Number 170 Power Station, the largest in the Northeast," recently completed through "the unparalleled friendship of the Soviet Union, which not only supplied the station with machinery but also sent a contingent of experts to help with installation" 17/ (no information on the exact location of this plant is now available).

Another public statement to support the accelerated rate of expansion was that "in 1953, funds will be invested in the capital construction of electric power enterprises surpassing those invested in 1952 by fourfold." 18/ Presuming that China's international relations do not change drastically, it is entirely probable that an increasing amount of electric power plant equipment will be furnished China by the Russians and that much of this new equipment will be installed in Manchuria.

* P. 18, below.

B. Transmission Facilities.

A tabulation prepared at Mukden (Shen-yang) in 1948 indicated that the previous maximum total length of power lines in Manchuria had existed in 1944, at which time there were at 44 kv and 66 kv a total of 6,375 miles; at 110 kv, 219 miles; at 154 kv, 1,004 miles; and at 220 kv, 561 miles. 19/ The Russians removed an unknown but considerable amount of transformer and associated substation equipment between August 1945 and May 1946. During the period of divided control in Manchuria from 1946 through 1948 the transmission lines were made inoperable at locations where control changed from Nationalist to Communist hands. Lines were still down in many places in 1950.

In 1950 the most economical way to increase the amount of available electric power in Manchuria was to restore the transmission network and thus to permit all equipment to be utilized to the maximum. It is presumed that by 1952 all that portion of the transmission lines connecting operable power plants had been restored. In this connection, the fact that Communist China could supply most of the necessary wire, insulators, and transformers is important. Some parts had to be imported, but by and large the restoration of transmission lines could be managed without use of foreign exchange.

The transmission network is the result of careful engineering and permits the hydroelectric plants to supply the main load centers. It also permits the large steam plants to complement one another and the hydroelectric plants.

C. Utilization of Production and Transmission Facilities.

The production of electric power in Manchuria in 1952 is estimated to have been 3.9 billion kwh (see Table 2*). It is reasonable to presume that here, as in other areas of the world, the hydroelectric portion of the facilities averaged a somewhat higher utilization than the steam. The major portion of the cost of operating a steam plant is the cost of fuel, and there is no comparable expense in operating a hydroelectric plant. The cost of maintenance and operating personnel for a hydroelectric plant is also lower. It is therefore presumed that the hydroelectric facilities were exploited to a greater degree, and it is estimated that, although comprising only 37 percent of the total capacity, they produced 42 percent of the

* P. 18, below.

total production, or 1.6 billion kwh. It follows that the steam portion, 63 percent of the total capacity, produced only 58 percent of the total production, or 2.3 billion kwh.

All estimates of electric power production include all station losses, transmission and distribution losses, and other nonproductive disposition of power regardless of the administrative control of the facilities.

With regard to imports or exports* of electric power, no significant amounts of electric power appear to have been interchanged, and there is no evidence that facilities for any appreciable interchange of power between Manchuria and any other area are now available or are planned for the immediate future.

It must be recognized that all the electricity generated cannot be made available to the ultimate users. Some electric power may be used to drive the auxiliaries in the generating plant itself. These auxiliaries often include coal-handling, pulverizing, stoking, and ash-removing equipment; forced- and induced-draft fans; and boiler feed water, condensate, and cooling water pumps. This equipment may be operated by steam or electricity. The present trend, however, is to drive such equipment electrically. In addition to this use of electric power in the generating plant, every piece of equipment -- every transformer, every voltage regulator, and every length of line -- has some resistance which converts a portion of the electricity flowing through it to heat which is wasted to the atmosphere, thus reducing the amount of electric power available at the end of the line. In a normal system, electricity will go through at least 3 and often 5 and 6 transformers, each of which adds to the losses. The sum total of these various decrements may range from 20 percent to 30 percent of the electricity generated. An estimate of these total losses under Japanese operation placed them at 25 percent, and a more accurate current figure is not available. Assuming that 25 percent of the total 1952 production was accounted for by losses, 2.9 billion kwh remained for consumption in Manchuria.

* The electric power from the plant at Sup'ung (Suiho) Reservoir sometimes has been considered as imported. This plant is located immediately on the Korean border, was built partially from Manchurian funds, and the portion of the plant that supplies Manchuria is treated in this report as an integral part of the Manchurian system.

III. Input Requirements.

The major input to the electric power industry in Manchuria is coal. Specific coal consumption -- that is, kilograms of coal consumed per kilowatt hour produced (kg/kwh) -- varies, depending on the quality of the coal, the possible efficiency of the equipment, and the skill of the operators. In the US, this specific consumption, for a composite average of public utility plants, has decreased from 0.644 kg/kwh in 1937 to 0.517 kg/kwh in 1951. These figures are for generally modern facilities and good grades of coal. Figures for Communist China vary from 0.56 kg/kwh to 3 kg/kwh, 4 kg/kwh, and even more for small obsolete plants. The government standard in 1950 was 1.37 kg/kwh. For the plants in Manchuria, the use of an average of 1 kg/kwh for estimating is considered reasonable. Since the estimated output of steam plants in 1952 was 2.3 million kwh, the coal requirement would then be about 2.3 million metric tons, or about one-seventh of the estimated total Manchurian production of 15 million metric tons. 20/

Whereas the USSR has a real and compelling reason to use the peats and lignites which are available near the large industrial centers because the better grades of coal are available only at considerable distances, Manchuria has comparatively good-quality coal available in reasonable proximity to almost all the industrial centers. The Chinese Communists, however, have attempted to emulate the Russians in the use of low-grade fuels. The result has been that plants in Manchuria have been experimenting with the burning of fines and slack that formerly has been considered as waste at the coal-processing plants. 21/ It was stated in July 1952 that in Manchuria 70 percent of the electric power plants were using some inferior-grade coal and 38 percent were using only low-grade coal and that 40 to 50 percent of the cost of operation was the cost of fuel, 22/ thus indicating that this use of low-grade fuel was an attempt to reduce this cost of operation. It is possible that the lower-grade fuels may be economically used in Manchuria where labor is a very cheap commodity.

Because of the planned expansion of the electric power industry, equipment for new facilities will be a major requirement. Such equipment will be almost entirely a matter of imports.

There is another class of requirements, that of repair and replacement parts, which is most important in Manchuria, where almost all the equipment now in use was manufactured in countries which no longer maintain normal trade relationships with Communist China. In all mechanical equipment there are parts which require periodic replacement. In an automobile these include tires, oil filter cartridges, and, less frequently, piston rings and bearing inserts. In an electric power plant there are many more parts which require periodic replacement, and, just as is the case with automobile tires, the frequency of replacement depends on the quality of the original part, the time it has been in use, and the care which was exercised in using it. The main equipment in an electric power plant is usually capable of long service without any major replacement of parts, but the auxiliaries are not so durable. Stoker parts and other parts of fuel- and ash-handling equipment require rather frequent replacement. Boiler tubes are an almost continuing requirement, very much dependent on the care in treating the boiler feed water, the impurities in the fuel fired, and the care in operation of the boiler. Bearing inserts and packing seals for all equipment wear out and require periodic replacement, and such parts as the turbine blades also must be replaced from time to time. Thus any new electric power plant is routinely stocked with quite a store of spare parts, and the requirement for replacement parts continues, increasing from year to year throughout the life of the equipment. Since China's domestic capability to produce many of these parts is severely limited, a continuing import of a wide range of replacement parts is essential to the satisfactory operation of the electric power facilities.

The requirement for these replacement parts in Manchuria at present is undoubtedly much higher than it is in the US because replacements were almost totally unavailable during World War II and the period which followed and because failure to replace one part as it became worn very much accelerated the wear on the other parts. It is probable that this requirement for replacement parts has been and will be met largely by imports from the USSR and the European Satellites.

The electric power industry requires transportation of fuel from the mine to the plant. In Manchuria this transportation has been almost exclusively by rail, and most of the plants are within a maximum distance of 300 miles from operating coal mines. As mentioned,

the input requirement for coal was about 2 million metric tons, not all of which had to be moved by rail, since some large plants are located immediately adjacent to the mines. Rail transportation does not appear to be a limiting factor.

The manpower required to operate the electric power facilities is a factor which varies considerably with the mechanization of the fuel- and ash-handling equipment. In the US the number of power plant employees per 1,000 kw of installed capacity varies from 1 to 2 in steam plants and from 1/3 to 1/2 in hydroelectric plants. A Manchurian steam plant with a capacity of 8,400 kw had 80 workers and 4 technicians, or about 12 employees per 1,000 kw. Another, with 22,500 kw installed, had 100 workers and 5 technicians, or about 5 employees per 1,000 kw. It is not known what, if any, portion of the total number of employees in jobs other than those in the actual power stations are included in these Manchurian estimates. Such employees as those concerned with the servicing of transmission and distribution facilities, those involved in management, and those involved in commercial activities may or may not have been included. No valid data exist to estimate the total labor requirement, but it is certainly not a significant fraction of the Manchurian labor force.

The need for personnel to act as technical supervisors creates another manpower requirement. The electric power plants were installed and operated mainly by the Japanese, who used local labor. Many of these Japanese stayed on after the war, and it appears that the last significant fraction of them was in the process of repatriation during the spring of 1953. The Russian emigrés after World War I and their descendents, so-called White Russians, had provided much of the supervisory personnel. Now the Chinese Communist administration is returning the last of the Japanese and discharging the last of the White Russians, presumably because of domestic security considerations. There is available to the present government a small body of natives with a technical education received abroad, but they, too, are largely suspect. The present government, being aware of the shortage of technicians, has been registering all those with technical education and ability and reassigning them so as to make maximum use of their ability. It also has shortened the course of instruction in most of the engineering schools to expedite the availability of technical personnel and has opened schools giving both full-time and part-time technical instruction. For example, at Fu-shun, technical schools and classes for 1,700 full-time and over 4,500 part-time students

were recently opened, and electrical engineering is mentioned first among the courses offered. 23/ It is probable that for at least the immediate future adequate technical supervision will be a real problem in the Manchurian electric power industry.

IV. Capacity and Production Estimates.

As used in this report, in broad definition, capacity measures the size or extent of facilities available for the making of electric power, and production indicates the output from these facilities. Table 2* presents estimates of capacity and production in Manchuria from 1949, the first full year under complete Communist control, projected through 1957. In the course of research, only a very few definitive figures were found which could be reasonably supported, and they have been used with some qualification in constructing the table. Such figures apply in the period 1949-53. The figures for the succeeding years through 1957 were reached by making certain assumptions regarding new equipment to be added and the utilization of the total installed capacity. It is recognized that this method, coupled with the questionable reliability of the few definitive figures and a total lack of announced Five Year Plan figures to 1957, may lead to a rather wide range of error.

The values presented for 1952 are believed to be reasonably accurate: that is, within a range of error of plus or minus 10 percent. Because of the tenuous information, however, on which they are founded, the values for 1957 and the interim years are less reliable. The installed capacity in 1957 may be as much as 0.5 million kw above or below the stated figure of 2.35 million kw. Production, however, in 1957 may be as much as 3.0 billion kwh above or below the stated figure of 10.5 billion kwh. The somewhat greater range for production results from a lack of information on the probable improvement in the rate of utilization of capacity.

V. Consumption.

The consumption of electric power in Manchuria has continually increased during the last 20 years with the exception of the years 1945-46, when the Russians removed electric generating equipment and other industrial equipment. Although a general increase in consumption

* Table 2 follows on p. 18.

Table 2 a/

Capacity and Production of Electric Power in Manchuria
1949-57

Year	Installed Capacity (Million Kilowatts)	Production (Billion Kilowatt-Hours)
1949	0.90 b/	1.4 24/
1950	0.92 25/	2.0 c/
1951	0.99 d/	2.7 e/
1952	1.12 f/	3.9 g/
1953	1.35 h/	5.1 i/
1954	1.60 h/	6.4 j/
1955	1.85 h/	7.7 j/
1956	2.10 h/	9.1 j/
1957	2.35 h/	10.5 j/

a. Tabulated figures have been rounded to the nearest tenth and hundredth.
b. Extrapolated.
c. Manchurian output during the first half of 1950 was 954 million kwh 26/; the 1950 Plan was 2 billion kwh 27/; the production in 1950 overfulfilled the production target. 28/
d. Interpolated.
e. The 1951 production was 134.1 percent of that of 1950. 29/
f. This figure includes the 1,036,060 kw of installed capacity tabulated in this report (see Appendix A), plus an allowance for plants of less than 1,000-kw installed capacity and a larger allowance for recently completed and unreported plants.
g. The output in 1952 will be near the highest prewar levels 30/; electric power production in Manchuria in 1952 exceeded 1951 output by 45 percent. 31/
h. Capacity figures for 1953 and subsequent years have been arrived at by arbitrarily estimating 225,000 kw to be added to the installed capacity in 1953 and 250,000 kw to be added each year from 1954 to 1957. The basis for these estimated increments is presented in the section on expansibility.*

* See VI, p. 24, below.

Table 2
(Continued)

i. In February 1953, announcement was made that for the whole of Communist China during 1953, electric power production was planned to be 27 percent greater than in 1952. 32/ At about the same time, it was announced that the increase in production in Manchuria alone for 1953 over 1952 was to be 44 percent. 33/ In early May 1953 a different National Plan was announced, which called for an increase in 1953 over 1952 of only 18.3 percent 34/ rather than the 27 percent as noted previously. Because the electric power produced in Manchuria in 1952 was more than half the total production of the country, it is obvious that the 1953 planned production in Manchuria has also been revised downward, since an increase in this area of 44 percent would be more than the total planned national increase. No new information on planned increase in Manchuria, however, has become available. It is estimated that the Manchurian Plan will be reduced in the same proportion as the National Plan. Thus the planned increase for Manchuria is estimated to be 29.8 percent.
j. The methodology used in arriving at the production figures for 1954-57 is explained in Appendix B.

of electric power has been world-wide, it is surprising that this increase has occurred in Manchuria, an area continually under strife. First, the Japanese seized the area from China and set up a puppet state. Then, as a Japanese-occupied territory, Manchuria was a target of air attacks during World War II. Following World War II, the Russians occupied the area for several years before withdrawing, leaving the Chinese Nationalists and Communists to fight among themselves. It is a safe presumption that, with the emphasis on heavy industry in future plans, the use of electric power by this sector of the economy will continue to increase and represent an important portion of the total consumption. It does not appear likely that for some time to come the electric power facilities will expand at a rate which would permit relaxation of present restrictions on use. In the future, just as in 1952, the supply of electric power to all but the most essential users probably will be curtailed.

No recent information is available on the breakdown of the use of electric power between the various classes of consumers. Tables 3* and 4*, however, reflect the use pattern for 1944. No attempt has

* Table 3 follows on p. 20; Table 4, on p. 21.

Table 3 35/

Contracted Capacity and Sales of Electric Power in Manchuria
1944

Type of Consumption	Contracted a/ Capacity (Kilowatts)	Total Sales (Kilowatt-Hours)
Electric Lighting (6,873,892 Lights)		354,312,144
Electric Heating	85,741	48,239,469
Industries Using Electric Power		
Spinning	38,334	64,526,538
Flour Milling	23,965	24,590,452
Machine Tool	96,962	123,469,233
Chemical	105,950	295,558,989
Mining	214,339	833,402,272
Metallic	213,031	941,596,733
Ceramic	44,756	104,360,625
Agriculture, Forestry, and Marine Products	7,935	15,442,861
Printing and Publishing	5,051	2,517,046
Food Processing	57,678	50,391,323
Lumber and Woodworking	35,887	21,407,057
Electric Installation b/	18,760	43,923,857
Other	75,973	229,188,380
Total	1,024,362	3,152,926,979

a. Contracted capacity is the maximum demand estimated by an industrial establishment when it makes its contract with the electric power plant.
b. This term is presumed to refer to the manufacture of electrical equipment.

Table 4 36/

Consumption of Electric Power in Manchuria
1944

Million Kilowatt-Hours

Industrial Use	Location	Amount
Industry		
Coal Mining	Fu-shun, Fou-hsin, Pei-feng, Pei-p'iao, Chiao-ho, etc.	600
Aluminum Refinery	Fu-shun	480
Magnesium Refinery	Ying-k'ou	36
Iron and Steel Manufacturing	An-shan a/	170
	Pen-ch'i (Pen-chi-hu)	120
	T'ung-hua	18
Special Steel Manufacturing	Chin-chou	2
	Dairen (Ta-lien)	16
Fuel Liquefaction	Fu-shun	88
	Fu-shun	30
	Ssu-p'ing-chieh	16
Nitrogen	Dairen (Ta-lien)	116
Carbide	Kirin (Chi-lin)	35
Soda	Dairen (Ta-lien)	13
	K'ai-yuan	10
	Mukden (Shen-yang)	14
Miscellaneous		350
Total		2,114

a. The consumption of 320 million kwh in normal times has been reduced to 170 million kwh because of bombing damage.

Table 4
(Continued)

Industrial Use	Location	Million Kilowatt-Hours Amount
Domestic Use		
Electric Lighting (6,870,000 Lights)		358
Electric Heating		43
Total		401
Commercial Use		
Total		684
Grand Total		3,199

been made to reconcile these tables, because many of the categories are ambiguous and it is not known on what basis the figures were compiled. They are, however, in quite close agreement as to the total use of electric power and as to the amount for lighting and heating. In both tables it appears that the industrial categories accounted for about two-thirds of the total, a proportion which approximates that found in nations having preponderantly industrial economies.

It is believed that these tables for 1944 approximately represent the conditions in 1952. This belief is rationalized as follows: Peiping announced in September 1952 37/ that the total industrial output of Manchuria would in 1952 amount to 10 percent above the 1943 output, which was said to be the prewar maximum. It was stated that in Manchuria the production of steel, machinery, electrical appliances, chemical products, textiles, rubber, paper, and glass would exceed the highest levels of prewar years and that the production of coal, iron, and electric power would be near the highest prewar totals. Thus because the total industrial output appears roughly equal to the maximum prewar output, and with this apparent equivalence extended

to the various components, it may be presumed that the electric power furnished the various industries in 1952 was about the same as in 1944.* If this reasoning is accepted, it leads to the conclusion that electric power for nonindustrial uses must have been sharply curtailed in 1952 because the total amount sold to all consumers in 1952 is estimated to have been 0.3** billion kwh less than in 1944. The validity of this conclusion is supported by the various published regulations restricting uses, which are discussed subsequently in this report.

Another indication of consumption is seen in the data on per capita production of electric power in Manchuria which in 1952 was about 91 kwh, based on an estimated population of 43 million. This is to be compared with the following 1951 per capita production figures: Egypt, 60 kwh; Spain, 255 kwh; USSR, 475 kwh; Australia, 1,619 kwh; US, 2,850 kwh; and the world average, 438 kwh. 38/

The Chinese Communist government in general and the administration of Manchuria to an even greater degree have been using every known device to increase the utilization of existing facilities: that is, to get more production per year out of the installed capacity. One statement, published in the spring of 1952, on the techniques intended to achieve this aim contained the following seven regulations 39/:

1. All two-shift factories which consume electric power are requested to reschedule production so that the shift from 6:00 p.m. to 12:00 p.m. is changed to 12:00 p.m. to 6:00 a.m., when the demand for electric power during the former period is high.

2. In factories which consume electric power, the equipment which does not have to be operated continuously should be stopped from 5:00 p.m. to 9:00 p.m., the period of peak consumption.

3. One-shift factories are requested to schedule production earlier in the day to avoid working in the evening, when electric power is most needed for lighting purposes.

4. Because private factories have very little equipment which must be operated continuously, their electric power supply is cut off during the period of peak load, 5:00 p.m. to 9:00 p.m.

* According to all available information there was very little change in industrial production from 1943 to 1944.

** Production in 1952 as shown in Table 2 was 3.9 billion kwh, less 25 percent losses. Thus a total of 2.9 billion kwh was sold in 1952, whereas Tables 3 and 4 show that a total of 3.2 billion kwh was sold in 1944.

5. Factories with three shifts working day and night continuously are requested to rearrange schedules so that the part of the production process which consumes the least electric power occurs between 5:00 p.m. and 9:00 p.m.

6. Static condensers are installed to improve the transmission system and to stabilize the electric power transmitted.

7. Electric equipment at factories is to be inspected and repaired to increase efficiency and to reduce waste.

In July 1952 the same restrictions were republished in somewhat different form. 40/ Another effort to increase the electric power available to industry is seen in the restrictions on domestic use. No bulbs bigger than 25 watts are permitted, only 1 bulb to a room is allowed, and no electric appliances may be used. It is obvious that the cumulative effect of these measures is to spread the load more evenly through the 24 hours of the day and the 7 days of the week. It was further stated in July of 1952 that these measures during the previous winter had prevented the need for installing 30,000 kw of new capacity. From this small saving it may be concluded that the regulations had not been stringently enforced and that a determined effort to tighten the enforcement of these restrictions may well permit much of the gain in the planned 1953 output to come from the existing facilities in Manchuria.

VI. Expansibility.

The Chinese Communists are now short of electric power, but they intend to expand their power production facilities. This subject of expansibility is presented for Communist China as a whole rather than with reference only to Manchuria because, without detailed information of the present government's intentions, it is not possible to segregate from total plans and capabilities the portion which will be assigned to Manchuria, although it apparently will be a major portion.

To place primary emphasis on the building of an adequate supply of electric power as a prerequisite to the building of the Communist industrial economy in general is in accordance with Lenin's writings.

The Soviet emphasis on electric power in the early Five Year Plans further emphasizes to the Chinese planners the primacy of this sector among the other sectors of their planned economy. As early as 22 July to 9 August 1950, the Ministry of Fuel Industry conducted in Peiping a national hydraulic engineering conference to discuss and develop a Five Year Plan for hydroelectric power development throughout the whole of China. 41/ In the report on the State budget for 1953 at Peiping on 16 February 1953, Finance Minister Po I-po states that 9 steam plants will be built and that 3 hydroelectric and 12 steam plants will be expanded. He further stated that electric power production will be expanded by 27 percent in 1953 over 1952 and that 20 percent of this expansion will come from the increased use of the present facilities, thus implying that sufficient new installed capacity will be available in 1953 to produce 7 percent of the power produced in 1952. 42/ The goal for 1953 was cut back in May 1953 to 18.3 percent, and it is probably intended to achieve much of it through increased utilization of existing facilities.

The Chinese Communists have limited facilities available for the manufacture of equipment for electric power plants. It has been estimated that they can manufacture over 50,000 kw in a year but that they must import certain essential parts and auxiliary equipment required for the installation of even this limited capacity. 43/ With an installed capacity of about 2 million kw in Communist China, it is obvious that the addition of 50,000 kw will not increase production appreciably. This leads to the conclusion that an appreciable import of generating equipment is necessary to permit fulfillment of the plan.

Since the Chinese Communists took over the country, they have imported boiler tubes in quantities amounting to hundreds of tons a year. They also have imported other parts essential to the rehabilitation of the facilities over which they took control. This is in accord with the practice in the Soviet Bloc, of repairing and rebuilding an item, even though it might be cheaper to replace it. Frequent references have appeared in the Chinese Communist press citing groups for their achievement in reconditioning equipment which has been inoperative for years. The much smaller requirement for machine tools in the rebuilding of electric power equipment as compared with the requirement for the initial manufacturing of the

same pieces of equipment is important. The initial fabrication of a large turbine and generator calls for very large lathes, boring mills, and like equipment which are available in only a few places even in the US. This electric power equipment, however, can frequently be totally rebuilt and reinsulated, thus restoring it to its original capacity or better, without removal from the building in which it is installed and with no machinery requirement other than an adequate crane and adequate hand tools. It may be presumed that after 3 to 4 years of concentrated effort, most of the electric power equipment was operable at or near capacity by the end of 1952.

It is doubtful that in the immediate future many plants will be erected at new locations in Manchuria. There still remain the structures erected for about 700,000 kw of hydroelectric and 700,000 kw of steam equipment, a total of 1.4 million kw, of which 0.4 million kw was in process of erection in August 1945. In the same year the Russians removed equipment from the structures on these locations which had been tied into the transmission network. Because there is real emphasis on speed and economy in this effort to expand the production of electric power, it is logical that this equipment will be replaced before any number of new plants requiring new buildings, new roads and railroads, and additional transmission and distribution facilities are started.

There has been a considerable emphasis on the application of Soviet methods of maintenance in order to increase the availability of equipment. There have been many commendations in the Chinese Communist press citing teams for performing overhauls in a small fraction of the time formerly required. This may, in part, represent increased efficiency, or it is more probable that it represents a less complete job. It is certain from the amounts of time cited that in some cases they are not doing what would be called a thorough job by US standards. Such maintenance will eventually lead to additional breakdowns.

Plant efficiencies in terms of kilograms of coal per kilowatt-hour of output have received considerable attention, but, although an improvement in efficiency may reduce the requirements for railroad transportation and fuel, it will not increase importantly the total output of electric power. Work on the improvement of the transmission and distribution system has been continuing, however, and the amount of power available to customers undoubtedly has increased.

The principal deterrent to expansion of the electric power industry is the difficulty of procuring the equipment required. This equipment is not plentiful anywhere, and most of the members of the Soviet Bloc can, themselves, use more than they can produce. This means that even though Communist China may have the foreign exchange, it can procure equipment for major electric power stations only in accordance with whatever priority is granted by the Russians.

In summation, more than ample good coal is available in Manchuria as are numerous satisfactory hydroelectric sites. A large portion of the equipment required for any new plants must be imported, and the willingness of other nations to furnish it is a controlling factor. Little can be gained from additional work on present generating facilities, but continuing work on the transmission and distribution system will increase the power available to various customers.

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APPENDIX A

TABULATION OF ELECTRIC POWER PLANTS IN MANCHURIA

All plants of 1,000 kw capacity and larger believed to exist in Manchuria at the end of 1952 are listed in Table 5.* Only plants whose existence has been reasonably confirmed have been included, and the intention has been to preclude any duplication of listings because of varying names and dates of information.

The locations of plants listed in Table 5 are cross-referenced to the accompanying map, Manchuria: Major Electric Power Facilities,** through serial numbers, geographic coordinates, and place names. The serial numbers are assigned by letter (indicating province) and by number (serially assigned within individual provinces). The geographic locations are indicated either by approved Board of Geographic Names (BGN) or by approved conventional names. The column entitled Plant Name or Alternate Name includes specific plant or locality names that have appeared in the majority of sources used for this study. The current usage of the listed titles is uncertain. The coordinates in Table 5 are, in most cases, those of the locality as given by BGN in the Preliminary NIS Gazetteer. The capacity figure tabulated is the total installed capacity of the generating equipment in the plant. The source given is the most complete and authoritative, although not necessarily the latest source used in the preparation of the table. The year of information is as given in the cited source. All plants have been indicated as either public utility plants or captive industrial plants, although it is quite possible that some of the plants indicated as captive industrial plants are now operated as public utility plants. All plants in this tabulation are steam plants except for three which have been indicated as hydroelectric.

25X1A2g [redacted]

* Table 5 follows on p. 31.
** Inside back cover.

[redacted]

The Industrial Register (IR) number is the number under which information relative to the installation is filed by the Industrial Register of CIA.

Table 5

Electric Power Plants in Manchuria

25X1A2g

Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	[redacted]	Remarks
Antung	A 1	An-tung	Manchuria Electric Company (MEC), South Manchurian Railway Company	40°06'N-124°22'E	22,000 44/	1945	PU	8017705		
	A 2	An-tung	An-tung Cement Company	40°08'N-124°24'E	5,800 45/	1946	CIP	9062452		Possibly all equipment removed by the Russians in 1945-46.
	A 3	Sup'ung (Suiho) Reservoir (Hydroelectric)	Sup'ung-dong Plant, Shui-feng Plant, Suiho Plant	40°30'N-125°05'E	400,000 46/	1950	PU	9063586		Originally installed: six 100,000-kw generators (two 60-cycle, two 50/60-cycle, two 50-cycle). Two 50-cycle generators removed by the Russians in 1945-46. Less than 200,000 kilovolt-amperes (kva) can be transmitted to Manchuria.
	A 4	T'ieh-ch'ang-tzu	MEC Plant	41°40'N-126°12'E	1,000 47/	1945	PU	8017648		One 1,000-kw generator. 48/
	A 5	Erh-tao-kou	Erh-tao-chiang Plant, MEC Plant	41°44'N-126°02'E	55,000 49/	1952	PU	9066174		Two 15,000-kw generators, 50/ one 25,000-kw generator.
Heilungkiang	B 1	Pei-an	MEC Plant	48°16'N-126°36'E	3,900 51/	1946	PU	8017498		
	B 2	Sun-wu	MEC Plant, Sun-wu New Plant	49°25'N-127°22'E	4,500 52/	1946	PU			One 4,500-kw generator. 53/
	B 3	Sun-wu	MEC Plant, Sun-wu Old Plant	49°25'N-127°22'E	2,100 54/	1945	PU	8017824		One 500-kw generator, 55/ two 800-kw generators.
Hokiang	C 1	Chia-mu-ssu	MEC Plant	46°50'N-130°21'E	22,500 56/	1948	PU	8017624		Supplies: coal mines, Hao-kang, I-lan, Chia-mu-ssu, and T'ang-yuan. 57/ One hundred workers including five technicians. 58/
	C 2	Ch'ien-chen	MEC Plant	46°15'N-130°34'E	3,300 59/	1945	PU	8017626		Two 1,500-kw generators, 60/ one 300-kw generator.

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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Table 5
(Continued)

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Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	Remarks
Hokiang (Continued)	C 3	Chi-hsi	Chi-ning Plant, MEC Plant	45°18'N-130°58'E	30,000 61/	1946	PU	8017665	Two 15,000-kw 50-cycle generators. 62/
	C 4	Hao-kang (Railroad Station)	MEC Plant	47°21'N-130°16'E	7,300 63/	1945	PU	8017617	Three 1,500-kw generators, 64/ one 2,800-kw generator. One 880-kw generator, 66/ one 5,000-kw generator. One 3,600-kw generator, 68/ one 1,250-kw generator, one 1,000-kw generator. Interconnected with plant at Lu-pin, probably at 3,300 volts (v). 69/
	C 5	Ti-tao-shan	MEC Plant, Titao Plant	45°22'N-130°48'E	5,880 65/	1946	PU	8017717	
Hsingan	D 1	Cha-lai-no-erh	MEC Plant, Coal Mine Power Plant	49°27'N-117°42'E	5,850 67/	1946	PU	8017591	
	D 2	Hailar (Hai-la-erh)	MEC Plant	49°12'N-119°42'E	3,640 70/	1945	PU		Supplies only local area.
	D 3	Lu-pin	Manchouli Plant	49°36'N-117°26'E	1,000 71/	1946	PU		Supplies the town of 200 72/ and oil pumps and electric cranes at railroad transfer point (change of gauge).
	D 4	Ya-lu	Cha-lan-tun Plant, MEC Plant	48°00'N-122°43'E	2,800 73/	1948	PU	8017575	
Kirin	E 1	Ch'ang-ch'un	MEC Plant	43°55'N-125°21'E	37,000 74/	1947	PU	8015131	Uses Fu-shun and Pei-feng coal.
	E 2	Chiao-ho	MEC Plant	43°22'N-127°19'E	10,880 75/	1945	PU	8017727	
	E 3	Kirin (Chi-lin)	Ta-t'ung Cement Company	43°51'N-126°33'E	8,240 76/	1945	CIP	8017593	Possibly all equipment removed by the Russians in 1945-46.
	E 4	Ta-feng-man (Hydroelectric)	Ta-feng-man, Kirin Hydroelectric Plant, MEC Plant, Yungchi Plant, Haisofengman Plant, Sungari Plant No. 2	43°43'N-126°41'E	143,000 77/	1946	PU	9063434	Transmission lines to Ch'ang-ch'un, 113 km of line at 154 kv using aluminum cable steel reinforced (ACSR) 37/2.9-millimeter (mm) wire; Harbin, 265 km, 154 kv, ACSR 37/2.9-mm wire; Kirin, 27.7 km, 44 kv, hard-drawn copper 7/2.6-mm wire; Fu-shun, 350 km, 220 kv, ACSR 61/2.9-mm wire. 78/

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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Table 5
(Continued)

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Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	Remarks
Kirin (Continued)	E 5	Tun-hua	Nickiman Pulp Company, Tunhua Pulp Factory, Japan-Manchukuo Pulp Manufacturing Company, CCF Arsenal	43°21'N-128°13'E	1,000 79/	1946	CIP	8017673	
Liaoning	F 1	An-shan	Anshan Steel Works, Showa Steel Company	41°07'N-122°57'E	32,500 80/	1947	CIP	8017891	Equipment presumed to be two 10,000-kw 25-cycle generators, one 12,500-kw 50-cycle generator, two 18,000-kw generators, two 25,000-kw generators. Two 18,000-kw and two 25,000-kw generators removed by the Russians in 1945-46. Supplies only the steel plant. Power of 25 cycles is probably for the electric railroad to mines.
	F 2	Chin-chou	Manchu Asano Cement Company, Chin-hsien Cement Works	41°07'N-121°06'E	6,000 81/	1946	CIP		
	F 3	Chin-chou	Synthetic Fuels Company, Synthetic Oil Refinery, Chin-hsien Refinery	41°07'N-121°06'E	5,000 82/	1946	CIP		One 5,000-kw generator and three 30-tons-per-hour boilers.
	F 4	Lien-shan (Chin-hsi)	Army Fuel Depot	40°54'N-120°36'E	15,000 83/	1945	CIP	9062461	One 15,000-kw generator. 84/
	F 5	Lien-shan (Chin-hsi)	Manchuria Asano Cement Company	40°54'N-120°36'E	1,800 85/	1946	CIP		
	F 6	Fu-shun	Fu-shun Electric Plant, MEC Plant, Taikanton Plant (two adjacent but separate plants)	41°51'N-123°50'E	95,000 86/		PU	8017402	Two 25,000-kw generators, 87/ two 12,500-kw generators. Other generators totaling 20,000 kw. Four 18-tons-per-hour boilers, seven 50-tons-per-hour boilers, two 100-tons-per-hour boilers.

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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Table 5
(Continued)

25X1A2g

Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	Remarks
Liaoning (Continued)	F 7	Liao-yang	Manchuria Cement Company, Manchu Iwaki Cement Company	41°17'N-123°11'E	4,400 88/	1946	CIP	8017596	Two 2,200-kw generators. 89/ Supplies cement plant and Fang-man Hemp Textile Company. 90/
	F 8	Pen-ch'i	Manchu Iron Works No. 2, Pen-ch'i-hu Coal and Iron Works No. 2	41°20'N-123°45'E	28,500 91/	1946	CIP	8015170	One 1,500-kw generator, one 2,500-kw generator, one 3,000-kw generator, two 4,000-kw generators, two 14,000-kw generators, two 20,000-kw generators (the two largest units and several smaller ones removed by the Russians, leaving an operable capacity as shown)
	F 9	Pen-ch'i	Pen-ch'i-hu Plant, Manchu Iron Works No. 1, Pen-ch'i-hu Coal and Iron Company Plant No. 1.	41°19'N-123°46'E	7,000 92/	1946	CIP	8015453	One 1,500-kw generator, one 2,500-kw generator, one 3,000-kw generator.
	F 10	T'ien-shih-fu	MEC Plant	41°17'N-124°22'E	3,000 93/	1946	PU		
	F 11	Mukden (Shen-yang)	Mukden Arsenal	41°48'N-123°29'E	10,000 95/	1946	CIP	8017562	Two 1,500-kw generators. 94/
	F 12	Mukden (Shen-yang)	Mukden Cotton Mill, Mukden Cotton Spinning Company	41°48'N-123°27'E	1,250 96/	1946	CIP	8017560	
	F 13	Ying-k'ou	Yingkou Spinning Company	40°40'N-122°17'E	1,000 97/	1946	CIP	8017669	
Liaopeh	G 1	Mu-shih	MEC Plant	43°48'N-123°31'E	3,000 98/	1946	PU		Two 1,500-kw generators. Supplies Mu-shih and Pang-ch'ui-kou.
	G 2	Pei-feng	Hsi-an Plant, MEC Plant	42°55'N-125°09'E	30,000 99/	1946	PU	8017439	Two 15,000-kw generators.
	G 3	T'ao-an	MEC Plant, Pai-ch'eng-tzu Plant	45°37'N-122°49'E	1,500 100/	1945	PU	8017630	

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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Table 5
(Continued)

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Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	Remarks
Liaopeh (Continued)	G 4	T'ung-liao	MEC Plant, Payintala	43°37'N-123°16'E	2,100 101/	1946	PU	8017702	One 1,400-kw generator, 102/ one 500-kw generator, one 200-kw generator.
Nunkiang	H 1	Ch'i-ch'i-ha-erh	Tsitsihar Plant, Lung-chiang Plant, MEC Plant	47°22'N-123°57'E	8,400 103/	1947	PU	8017507	Three 2,800-kw generators. 104/ 80 workers and 4 technicians.
Sungkiang	J 1	Harbin (Ha-erh-pin)	MEC Plant at Pinchiang, Ma-chia-kou Plant	45°45'N-126°39'E	38,000 105/	1946	PU	8017819	Two 2,000-kw generator, 106/ one 6,000-kw generator, two 14,000-kw generators.
	J 2	Hai-lin	Manchu Pulp Company	44°35'N-129°25'E	3,000 107/	1946	CIP	8017522	
	J 3	Hun-ch'un	MEC Plant	42°52'N-130°21'E	5,600 108/	1946	PU	9062445	
	J 4	K'ai-shan-t'un	Toman Pulp Company, Kaishantung Plant	42°43'N-129°43'E	1,800 110/	1946	CIP	8017598	Two 2,800-kw generators. 109/
	J 5	Lung-ching-ts'un	Lung-ching Plant, MEC Plant	42°46'N-129°24'E	11,000 111/	1946	PU	8017090	One 7,000-kw generator, 112/ one 4,000-kw generator.
	J 6	Mu-tan-chiang	MEC Plant	44°35'N-129°36'E	13,320 113/	1945	PU	8017495	One 1,000-kw generator, 114/ one 2,320-kw generator, one 2,800-kw generator, one 3,000-kw generator, one 4,200-kw generator.
	J 7	Shis-hsien	Oriental Pulp Company	43°05'N-129°47'E	2,700 115/	1946	CIP	8017554	One 2,700-kw generator.
	J 8	Sui-fen-ho	MEC Plant	44°24'N-131°10'E	1,600 116/	1946	PU	8017763	One 1,600-kw generator.
	J 9	Tu-hsi	MEC Plant	43°55'N-131°01'E	2,700 117/	1946	PU	8017644	One 1,200-kw generator, 118/ one 1,500-kw generator.
	J 10	Ching-po Hu (Lake) (Hydroelectric)	Ching-po Hu (Lake) Plant, Pilting Plant, Tung-ching-ch'eng Plant	44°09'N-129°07'E	36,000 119/	1946	PU	9062446	
	J 11	Wang-ch'ing	Toyo Pulp Company	43°18'N-129°47'E	2,000 120/	1946	CIP		
Kwantung Leased Territory	K 1	Dairen (Ta-lien)	Kan-ching-tzu Plant of MEC	38°55'N-121°39'E	23,000 121/	1949	PU	8015437	Two 4,000-kw generators, one 15,000-kw generator. Interconnected with city at 22 kv and 66 kv. 122/ 200 employees. 123/

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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Table 5
(Continued)

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Province	Serial Number	Place Name	Plant or Alternate Name	Coordinates	Installed Capacity (kw)	Year of Information	PU a/ or CIP	Industrial Register Number	Remarks
Kwantung Leased Territory (Continued)	K 2	Dairen (Ta-lien)	Amanogawa Plant of MEC	38°55'N-121°39'E	15,000 124/	1949	PU	9062841	One 15,000-kw generator. Interconnected with city at 22 kv and 66 kv. 125/
	K 3	Dairen (Ta-lien)	Onoda Cement Company, Kwantung Cement Plant	38°55'N-121°39'E	5,200 126/	1946	CIP	8017579	One 1,600-kw generator, 127/ one 3,600-kw generator.
Jehol	L 1	Fou-hsin	MEC Plant	42°06'N-121°42'E	22,000 128/	1952	PU	9063660	One 15,000-kw generator. Supplies coal mines, Pei-p'iao, and Ch'ao-yang.
	L 2	Pei-p iao	MEC Plant	41°48'N-120°44'E	15,000 129/	1945	PU	8015455	Two 1,500-kw generators, one 3,000-kw generator.
	L 3	Luan-p'ing	MEC Plant, Shuang-t'ou-shan Plant	40°56'N-117°42'E	6,000 130/	1946	PU		

a. Public utility (PU) or captive industrial plant (CIP).
b. World aeronautical chart (WAC).

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APPENDIX B

METHODOLOGY

The estimates of installed capacity were arrived at by establishing the best available list of generating facilities and comparing it with published totals. This installed capacity and various statements of production were used in conjunction with world-wide data on utilization to arrive at production figures. Consumption estimates were made by comparing 1944 figures relative to consumption under Japanese management with present consumption on a base of the announced comparison of production in 1952 with "preliberation" production for various classes of products.

The estimates presented for future production are on an extremely tenuous base. An estimate was made of China's domestic capability to produce the equipment required for an expansion, and to this was added a rough estimate of the quantity of such equipment China will probably be able to import. This total amount of equipment available to increase installed capacity was then apportioned between China proper and Manchuria. The efforts being made to increase the utilization of equipment were appraised, and an estimate of the increased rate of utilization during the next several years was made. This new rate of utilization was then applied to the total facilities estimated to be available, and an annual production figure for the next several years was calculated.

In order to arrive at the rate of utilization of the equipment, an average installed capacity was estimated for the years from 1949 to 1952 and, in conjunction with the annual production figures, was used to calculate a figure representing kilowatt-hours per installed kilowatt of capacity per year. This figure, given in hours, is an indication of the rate of utilization of the equipment. It ranged from about 1,500 hours in 1949 to about 3,800 hours in 1952. This factor for electrical utilities in the US was about 5,000 hours in 1950, and no record exists of appreciably higher factors. It was estimated that in Manchuria this factor would reach 4,700 hours by 1957, with progressively smaller increments. Factors for the intervening years were interpolated, and average annual installed capacities for the years to 1957 were estimated. The production given is the product of these two factors.

Detailed methodology has been included in the text where pertinent.

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APPENDIX C

GAPS IN INTELLIGENCE

The absence of any source of complete data since 1944 naturally characterizes the conclusions in this report as tentative. The following broad gaps exist in reasonably confirmed information about electric power in Manchuria.

1. Complete listings of the electric generating equipment operated as part of industrial facilities by municipality, province, and area, as of any date.

2. Information on removals by the Russians from southern Manchuria in 1945-46.

3. Information on specific lines and the total transmission network since 1944.

4. Information on the present condition of the electrical equipment presumed to have remained in place.

5. Information on new equipment and plants installed since 1950.

6. Information on domestic manufacture and import of electric generating equipment since 1950.

7. Concrete data since 1944 on total capacity, production, and use pattern.

8. Information as to the absolute magnitude of the "preliberation" base as used by the present government for announced percentage achievements.

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APPENDIX D

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

In preparing this report, the following sources were found to be the most important.

The report prepared by E.A. Locke, Jr., Principle Electric Power Facilities of Manchuria as of July 1945, Army Map Service, March 1946, mainly from sources in Japan, during late 1945 provided what is believed to be a complete list of public utility plants in Manchuria as of late 1944, and a series of maps which indicated the status of the transmission network as of June 1944. This report also includes a tabulation of most substation transformers. The only errors which may exist in this report would have resulted from inaccuracies in Japanese records or accidental mistakes.

The Pauley Report -- Report on Japanese Assets in Manchuria to the President of the United States, July 1946 -- prepared by Edwin W. Pauley and compiled between 17 May and 15 July 1946, was an effort to assess the Soviet removals from Manchuria during late 1945 and 1946. Personal inspections were made of the facilities in Chinese Nationalist control and of some northern Manchurian properties. Japanese records and interviews were also used. Time was not available for an extremely careful report, and the sources of information relative to southern Manchurian properties were all subject to rather strong bias. Subject to possible inaccuracies as noted, this report provides a complete list of public utility plants and a fragmentary list of captive industrial plants, with information on the equipment and condition as of early 1946.

More recent information was found in translations of the Chinese Communist press and in interrogation reports. This information was fragmentary when pertaining to individual installations and vague when referring to over-all achievement and planning. Therefore, it was subject to varying interpretations.

Following is a brief statement in regard to other research on the electric power industry in Communist China.

US Army, Corps of Engineers, Engineer Strategic Intelligence Division (ESID), maintains records on electric power plants which include the location, size, and other data. Section 62, "Electric Power," of National Intelligence Survey (NIS) 39, China, was in process of compilation in the spring of 1953, but, as the work was coincident with that on this report, it was felt necessary and advisable not to make these efforts interdependent but rather to have the ESID contribution to NIS 39 serve as a cross-check upon completion.

US Air Force, AFOIN, Air Targets Division, Fuel and Power Branch, is currently preparing Air Targets Sheets on certain large electric power installations in China and is issuing them as they are finished. These sheets also should provide a valuable cross-check with the plant list of this report.

Department of State, Office of Intelligence Research (OIR) has from time to time issued brief papers on the total electric power capacity and production as significant information has become available, but it is understood that no effort is made to maintain detailed records of plant installations.

2. Sources.

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
A - Completely reliable	1 - Confirmed by other sources
B - Usually reliable	2 - Probably true
C - Fairly reliable	3 - Possibly true
D - Not usually reliable	4 - Doubtful
E - Not reliable	5 - Probably false
F - Cannot be judged	6 - Cannot be judged

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation of the cited document.

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1. [redacted]
2. Edwin W. Pauley, Report on Japanese Assets in Manchuria to the President of the United States, Jul 1946. U. Eval. RR 2.
3. This section has been drawn largely from the following reports which present the story in somewhat greater detail, especially with regard to the financial organization, the dates of completion, and the ratings of the individual installations: JANIS 74, Joint Army-Navy Intelligence Study of Manchuria, Chapter IX, "Resources and Trade," Feb 1946. R. Eval. RR 2. E.A. Locke, Jr., Principal Electric Power Facilities of Manchuria as of July 1945, Army Map Service, Mar 1946. R. Eval. RR 2. Pauley, op. cit.
4. ECA, China Tientsin Regional Office, TRO-300, 9 Sep 1948 (CIA 461182). R. Eval. RR 2.
5. Pauley, op. cit.
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8. CIA FDD, Materials on the Economic Organization of China (1949-April 1952)(Working Paper), p. 45. S. Foreign Languages Press, A Guide to New China, 1952. U.

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9. Foreign Languages Press, op. cit. [redacted] CIA/RR 12, Economic Organization of Communist China, 21 Oct 1952. S.
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11. CIA FDD, Summary, No. 57, 28 Apr 1952. C. Eval. RR 3.
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13. Locke, op. cit.
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27. State, American Consulate General, Hong Kong, Survey of China Mainland Press, 23 Aug 1950, op. cit.
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28. State, American Consulate General, Hong Kong, Current Background, No. 163, 5 Mar 1951. U. Eval. RR 2.

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30. [redacted]

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33. [redacted]

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36. Locke, op. cit.

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37. [redacted]

38. Federal Power Commission.

39. Air, China Project Category No. 42 00000, Serial No. 1138 (Tientsin newspaper, 19 Apr 1952). U. Eval. RR 2.

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42. [redacted]

43. CIA estimate.

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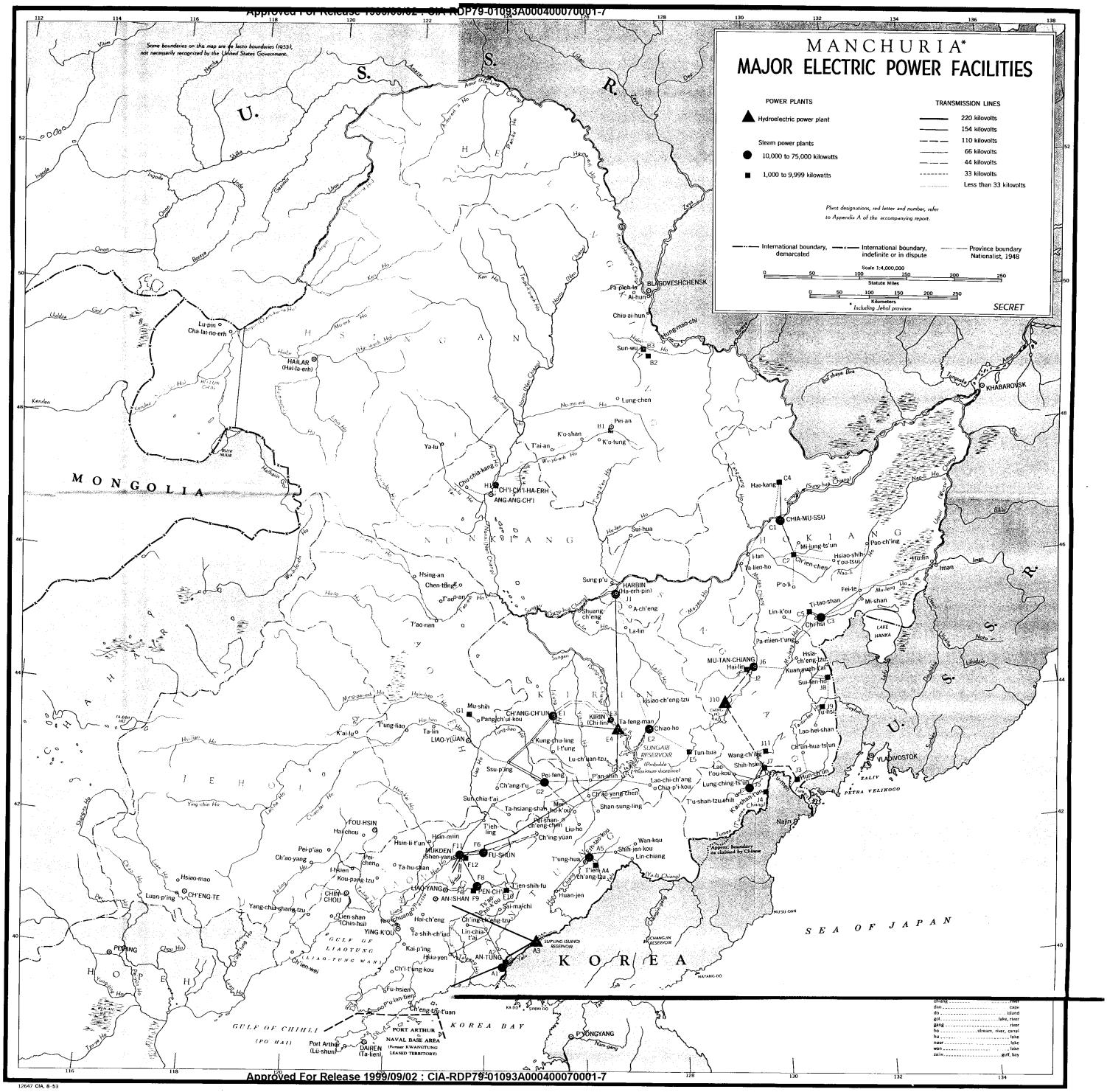

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