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Central Intelligence Agency

Washington, D.C. 20505

10 AUG 1982

Mr. Eugene Lawson
Deputy Assistant Secretary for
East Asia and the Pacific
Department of Commerce
Washington, D.C. 20230

Dear Mr. Lawson:

In response to your request of June 1982 for information about electric power transmission technology in China, I am forwarding the enclosed material prepared by [redacted] which summarizes China's technical capabilities and requirements in electric power transmission. [redacted] is also arranging a special JPRS report which will contain unclassified information on Chinese plans and priorities in this area. [redacted]

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The Agency would be pleased to provide additional support for you [redacted] If you have further questions or comments, please contact [redacted] Chief, Science and Technology Division, Office of Scientific and Weapons Research [redacted]

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Sincerely,

[redacted]

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Richard J. Kerr
Acting Deputy Director for Intelligence

Enclosure:
As Stated

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Central Intelligence Agency

Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

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5 August 1982

China: Technical Requirements for Electric Power Transmission

Summary

China's leaders are aware that modernization of industry and agriculture depends on a steadily expanding power supply in all parts of China. The lack of a well-developed long-distance transmission network is the most serious shortcoming in China's electric power industry. Based on reports from Beijing Review, the power industry will continue to get top priority in the allocation of state funds to industry. 25X1

In the near term China will continue to seek favorable loan terms from the World Bank and developed nations for the development of 500 kV transmission lines. According to officials of the Ministry of Water Resources and Electric Power, China will seek to purchase high voltage transmission equipment including transformers, control equipment, materials, construction machinery, power generating and associated machinery. We believe that China will continue to diversify its sources of foreign technology and equipment so as to avoid being too dependent on one source. They will attempt to acquire adequate but not necessarily state-of-the-art technology and try to achieve eventual replacement of foreign participation with domestic resources. 25X1

By the late 1980s to the early 1990s, we expect China to seek extensive foreign technical assistance in both ultra high voltage alternate current and high voltage direct current transmission technology since the planned development of large-scale hydroelectric plants will require an extensive long-distance transmission network. This will depend on offshore oil development being able to provide the needed foreign exchange to pay for the imported technology. 25X1

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This memorandum was prepared by 25X1 *Office of Scientific and Weapons Research, and coordinated with the Office of East Asian Analysis. Comments or questions may be directed to the Chief, Science and Technology Division, OSWR,* 25X1

Introduction

China has the ninth largest electric power industry in the world, but its per capita output of power remains very low, on a level with that of India, Zaire and Bolivia. Chinese newspapers have repeatedly reported that China's policymakers have assigned high priority to the development of its power industry in an effort to relieve industrial power shortages. As much as 20-30 percent of China's industrial production has been idled by the serious shortage of power. Demand continues to exceed supply, which, together with inadequate transmission facilities, creates difficulties for China's industrial sectors. For example, the Guangzhou heavy machinery industry has such an acute power shortage that the plant has to be closed down on Thursday each week. Night shifts have to be routinely used to compensate for serious power shortages during the day time.

China has made substantial progress in electric power generation, with capacity almost tripling in the past decade, reaching 68,000 MW in 1981. Output is growing at an annual average rate of 9 percent. As of late 1981, China had 73 large power stations (around 250 MW) and 300 medium ones (around 50 MW), with most of their equipment manufactured domestically.

the Chinese government hopes to have 100,000 MW of installed generating capability by 1985. Many power stations have not been able to use all the electricity they produce due to the lack of adequate transmission networks. During 1980, 5812 km of mainly 110 kV transmission lines were built. In 1981, 28% of the Chinese power industry's outlay was allocated to constructing transmission lines and transformer substations. Since modernization of industry and agriculture depends on a steady expanding power supply in all parts of China and since the lack of a well-developed long-distance transmission network is the most serious shortcoming in China's electric power industry, the power industry will continue to get top priority in the allocation of state funds and resources.

Most of China's hydropower resources are located in the western part of the country with few good sites on the industrially developed eastern seaboard. The construction of 500 kV high voltage power transmission lines would allow long-distance transmission of electricity from the west to the east. Such lines also could ease the coal transportation problem by enabling coal-fired power stations to be built adjacent to major coal mines. A member of the

Ministry of Power Industry recently indicated that none of the foreign contracts in the power industry has been cancelled and that negotiations for new contracts are underway. We believe that China's power industry is receiving high priority in the allocation of state investments and that it will continue to develop and expand.

Power Grids

Every province and region in China except Xinjiang and Xizang (Tibet) has its own power grid. Twelve of these have capacities of 1 million kw or more. The five major provincial grids in the east, northeast, central, north and northwest regions of China have capacities ranging between 4 and 10 million kw. China's large territory and difficult terrain make it almost impossible to link every rural area into the major power grids during the next 20-25 years.

The East China power grid will be used to illustrate the problems encountered in China's power grids. The East China grid has a total installed capacity of 9 million kw, 1.5 million kw of which is generated at two fossil fuel power stations in Shanghai.

According to the Ministry of Electric Power Industry's director for foreign affairs, the Chinese state plan calls for an annual nationwide increase in generating capacity of 2 million kw, with 300,000 kw of that to be in the East China grid area. But engineers in the same organization could not identify new construction or planned expansion that could account for such an increase in generating capacity in the next five years. Shanghai now has a 10 percent deficiency in power during peak load hours. In addition to shortened day shift operations, many industries have to operate on night shifts.

Any increased demand will have to be met by juggling power allocations and by a hoped-for three percent annual increase in the efficiency of industrial energy use. In Shanghai there is an active program to replace inefficient existing transmission lines and transformers and to build additional substations which will reduce low voltage transmission distances.

the Ministry of Electric Power Industry has directed the Nanjing Automation Research Institute (NARI) to design a 500 kV

system to interlink China's main power grids. The Ministry tasked NARI to include as much domestic input to the project as possible. The Director of NARI said that the purchase of any needed foreign technology should not be a problem since the budget for this project is a major national priority. NARI's goal was to interlink main regional grids by the early 1990s.

500 kV Lines

China recently completed its first 500 kV power transmission lines in the central China region. The 600 km line connects a power plant in the Pingdingshan coal mining area of the Henan Province with the industrial city of Wuhan in neighboring Hubei Province. This computer controlled line started delivering electricity in December 1981. This line was not operational earlier because large quantities of angle iron, bracing wires, conducting cables and other materials were stolen from a section in Hubei Province. It will be connected to the 2.7 million kw Gezhouba hydroelectric plant in Yichang in the near future.

China's goal is to complete 2,000 km of 500 kV transmission lines by 1985. This will upgrade China's transmission system significantly since 500 kV lines can transmit 3 times as much power as 330 kV lines. Currently 110 and 220 kV lines are standard in China, but China also has two 330 kV lines. In contrast, the United States first used 500 kV lines in 1964, and now 750 kV lines are widely used.

Japan, France, and Sweden have provided assistance to China's efforts to manufacture 750,000 kva single-phase transformers, mutual inductance devices, protective relays, control instruments, and meters. China domestically manufactures towers, insulating porcelain and metal cables and structures.

China must overcome major obstacles before it can rapidly construct 330 kV and 500 kV transmission lines to interconnect power grids and deliver power from remote hydropower stations. The Chinese lack experience with high voltage lines. They also face a shortage of materials that are needed in the construction of power lines, such as steel for the towers, aluminum conductors, and construction equipment. In China, most foundation holes for towers and tower poles are dug manually. Even though there is a ready supply of laborers, the pace of construction is slow. In the US, a transmission line of 160 km can be constructed in a few months,

whereas in China, a comparable line would take more than two years to construct.

Another 500 kV lines is under construction in northern China. All necessary equipment for this line will be indigenously produced. There are also two more 500 kV lines planned. One of them will extend from Shuoxian to Beijing. It will link the existing transmission network of Beijing and will receive power from an expanded thermal power plant near Shuoxian and also from a new 1.2 million kw thermal power plant being built at Datong. The other planned 500 kV line will supply power to Nanjing and Shanghai from a 350 mw thermal power plant at Huaibei.

Shanghai Cable Research Institute focuses on 500 kV power cable development. Like many research institutes in China, it is not actually involved in research and development on new cable products but in the analysis of US and western cables for high electric power transmission. The Institute is responsible for identifying foreign production processes and cable configurations and for setting up pilot production operations to test the feasibility of domestic production.

research on automated power distribution in China is limited and lags behind that of the US and other developed countries. For example, the

In order to remedy existing deficiency, the Chinese have a continued effort to keep up with the current Western technology. In addition, they have purchased some representative Western instruments. For example, they have acquired items such as Hewlett-Packard radio spectrum analyzers, Tektronix Corporation oscilloscopes and Motorola electronic instruments. We believe the Chinese want to use these instruments to reproduce and to develop prototype 500 kV equipment for later manufacture in China.

The Chinese are interested in ultra high voltage alternate current (UHVAC) power transmission and high voltage direct current (HVDC) transmission technology in order to get higher efficiency in transmission and to transmit power to longer distances. But due to lack of funding and adequately trained manpower in the field of high voltage transmission technology, we do not expect China to develop UHVAC and HVDC until the late 1980s to the early 1990s. By then the planned development of large-scale hydroelectric plants such as the Hongshui River Project and the Three Gorges Project will require

extensive long-distance transmission networks. Extending the current power transmission networks, which consist mostly of the 110 kV and 220 kV power lines, will not handle transmission requirements of long distance and heavy loads. China's ability to meet these needs will mainly depend on offshore oil development being able to provide the needed exchange to pay for the imported technology.

Foreign Participation

In the near term, we believe China will continue to seek favorable loan terms from the World Bank and developed nations for the development of its 500 kV transmission lines. A cable from the US embassy in Beijing disclosed that, according to officials of the newly reorganized Ministry of Water Resources and Electric Power, China will seek to purchase high voltage transmission equipment including transformers, control equipment, materials, construction machinery, power generators and associated machinery.

China's First Ministry of Machine Building (FMMB) has been interested in acquiring US lightning arrestors since 1979. FMMB is also interested in licensing US technology for the manufacture of capacitors for HV shunting operations. In June 1981, the China National Technology Import Corporation, acting on behalf of the FMMB, signed a US $500,000 contract with a US power equipment company for arrestors. The contract will be fulfilled over a 3-year period. It includes training and manufacturing assistance for station arrestors, distribution arrestors, low voltage arrestors and discharge counters.

Surge arrestors currently produced in China can only handle up to 220 kV. US arrestor technology will provide China with the capability to handle long distance 500 kV lines.

The Xian Power Transformer Factory of the FMMB will be the first to use silicon carbide technology. Before it can implement this technology, the Xian plant also needs foreign assistance in developing new tooling, pressing, and tooling equipment. Since improving their current silicon carbide arrestors will adequately meet their transmission requirements, the Chinese have decided not to purchase the more advanced and more expensive zinc oxide disk surge arrestors.

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Although China has not disclosed any plans for specific HVDC transmission projects, 25X1 25X1 25X1 China is interested in HVDC transmission technology. The US, together with West Germany, Japan, Sweden and France, are the leading sources of technical assistance. HVDC transmission technology is very sophisticated, requiring a precise silicon production capability for manufacturing power thyristors. Complicated circuit boards have to be used in its electronic control panels and converters. Special transformer, arrestor, and assembly technology will also be required. We estimate that it would take 10 years to have one or more HVDC transmission lines in operation if China decides to seek foreign assistance and to develop a domestic manufacturing capability in this advanced technology. 25X1

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in 1980, China signed 25X1 an agreement to acquire 500 kV power transformer technology from the French firm of Merlin Giron. The French manufacturer Alsthom supplied China with the first shipment of 500 kV transformers. And FMMB factories were using design information obtained from the French to duplicate the Alsthom transformer. The Chinese have also talked to the West German firm of Brown Boveri and Siemens and US companies about acquisition of protective relay technology. 25X1

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Japan, with the most technologically advanced steel 25X1 industry in the world, is interested in providing China with steel materials for towers, cables and construction equipment. Japan is also planning to sell a microwave communication system for China's planned Fangshan Switching and Control Center. The Swedish firm ASEA has supplied China with a variety of advanced power equipment for its 500 kV network. Canada has offered to provide long range power line technology so that China can build generating stations near coal mines and then transmit electricity to distant cities.

We believe that China will continue to diversify its sources of foreign technology and equipment so as to avoid being too dependent on one source. Because they lack needed foreign exchange, the Chinese will attempt to acquire adequate but not necessarily state-

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of-the-art technology as in the case of their decision to purchase silicon carbide arrestors rather than the more advanced and more expensive zinc oxide arrestors. Although the Chinese are trying to replace and duplicate foreign technology with indigenous systems, their success in the near term is doubtful because of the backwardness of China's electric power transmission industry.

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