10 MAY 1982

Memorandum for: DDI

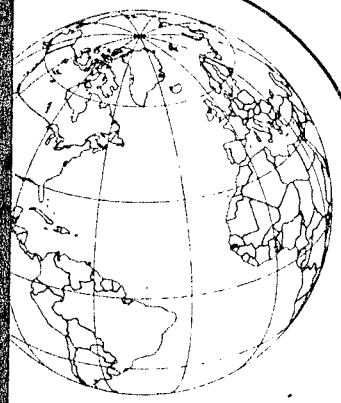
DDI- 3741-82/1

SUBJECT: State Department Request for Information on Chinese Coal Technology

This letter is in response to a request by Martin Prochnik at State Department [redacted] STAT STAT Mr. Prochnik is a frequent customer of the DDI for analytic support in alternative energy technology, where international negotiations are involved.

DDI
11 May 82

[redacted] STAT



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Office of Global Issues

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Central Intelligence Agency

Washington, D.C. 20505

11 MAY 1982

Mr. Martin Prochnik
Director, Office of Energy
Technology Cooperation
Department of State
Washington, D.C. 20520

Dear Mr. Prochnik:

In response to your request of 5 May 1982 for assistance in preparation [redacted] I am forwarding the enclosed material prepared by my staff which summarizes Chinese activity in the field of fluidized bed combustion of coal. The Agency would be pleased to provide all appropriate support for such discussions. As you are aware, [redacted] have examined this technology and the policies and plans of the PRC in its application. Should you require additional information or briefings, please contact [redacted] Chief, Energy Division, Office of Global Issues [redacted]

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Sincerely,

[redacted]

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Robert M. Gates
Deputy Director For Intelligence

Enclosure

[redacted]

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[redacted]

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SUBJECT: China is Aiming at Large-Scale Fluidized-Bed Combustion of Coal

Distribution:

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OGI/ED/TEC [redacted] 7 May 1982 25X1

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CHINA IS AIMING AT LARGE-SCALE FLUIDIZED-BED COMBUSTION OF COAL

SUMMARY

China currently leads the world in numbers of operating fluidized bed combustion (FBC) units, although most are small and of fairly simple design. Lack of air-pollution control equipment prevents use of these units in larger populated areas. Chinese technicians have shown great ingenuity in certain aspects of FBC technology, such as abrasion control. However, they need much assistance in the more sophisticated areas of FBC technology, such as automated control. While adequate for the rural power and heating applications now envisaged, if FBC is to find broader application in China, areas of automation, oxygen-enriched combustion, pollution control (through use of limestone in the bed to control sulfur, for example), and pressurized operation, will have to be investigated. These are possible areas for US-Chinese cooperation.

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DISCUSSION

China is making wide use of fluidized bed combustion (FBC) boilers for power and heating applications in the southern provinces, where reserves of high grade coal are limited. This technology is also being applied in Manchuria with the use of lignites. The steam generation capacity of these boilers range up to 35 metric tons per hour (mt/hr). China has two demonstration FBC boilers of 130 metric ton per hour steam capacity. If successful, such boilers will find considerable application in rural areas of China, enabling reduction in the consumption and rail transportation of high quality coal.

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China started its FBC research work in 1960. In 1969, Qinghua University and Guangdong Chemical Engineering Institute successfully completed China's first oil-shale-burning FBC unit with a steam capacity of 14.5 mt/hr. FBC units have been built in Beijing and Shanghai and in local centers in Huabei, Zejiang, Guangdong, and Huanan provinces. In order to reduce the need for coal transport, the FBCs utilize locally available anthracite tailings, stone coal, black shale and lignite.

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At present, China has about 2,000 FBC boilers with a total steam generation capacity of more than 10,000 mt/hr. These atmospheric pressure units use air for combustion, have little automation and no flue gas cleanup. Many have limited capacity on the order of 6 to 10 mt/hr of steam. The next most popular common larger size is 20 mt/hr.

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Some 40 percent of China's FBC units are associated with rural fertilizer plants which gasify coal to produce hydrogen for ammonia manufacture. The low-carbon ash resulting from this process is burned in FBC boilers to provide process and power-plant heat as well as by-product steam for district heating.

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[redacted] 25X1

Since almost every province has its own fertilizer production facility, the potential for FBC technology in this area is significant. Another 40 percent are used for space heating and as industrial boilers, while the remainder serve as power plants for mining operations. [redacted] 25X1

The goal is to standardize auxiliary power plant FBC applications by using boilers with steam capacities of 35 mt/hr. In Huanan Province, a medium scale FBC unit which generates 35 mt/hr of steam has already exceeded 6,000 hours of stable operation. It uses stone coal (900-1000 Kcal/Kg) to drive a 6 MW steam turbine. If it is operated 5,000 hours per year, as anticipated, 29,000 tons of bituminous coal can be saved annually. [redacted] 25X1

At present, 60 FBC power-generating boilers are operating in China with a total output of 730 mt/hr of steam and about 100 MW of electric-power generating capacity. The largest of these provides 130 mt/hr of steam. During the Cultural Revolution, the first such system employed six smaller boilers in parallel. Today, the design entails a single heating unit. To date, two of these 130 mt/hr boilers have been put into operation successfully. [redacted] 25X1

PROBLEMS OF FBC DEVELOPMENT

The Chinese admit that considerable developmental work remains to be done in order to bring their FBC technology to an acceptable level of development. Four main problems remain: 1) excessive carry over of carbon in the flyash; 2) consumption of electricity for pressurization of the air feed is significantly higher than in conventional boilers; 3) exposed steam tubes and heating surfaces in the boiler wall tend to abrade at an excessive rate, and 4) clumping of ash in the bed and clinker formation occur if the operation is not well controlled. [redacted] 25X1

Some 30 percent of the carbon content of the coal fed to an FBC unit tends to be lost in the flyash. This results in lower thermal efficiency of the unit, depending on the nature of the coal employed. A boiler using anthracite may exhibit an efficiency as low as 60 percent, while a very reactive brown coal may provide an efficiency of 80-90 percent. The problem lies with the very fine (less than 0.5 mm) grains of coal which may remain only a few seconds in the combustion zone; the larger grains may have residence time of 20 to 30 minutes. The Chinese are attempting three approaches to solve this problem: baffled sedimentation chambers in the outlet section, a larger cross section above the combustion zone to give greater residence time, and installation of a baffled high-temperature section above the combustion zone. They see this problem as the principal factor limiting their FBC development program. [redacted] 25X1

[redacted] 25X1

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Little can be done to reduce the consumption of electricity for pressurization, since the pressure drop across a fluidized bed is determined by the quantity of solids per unit cross section. A high concentration of solids is necessary to assure good volumetric heat release. [redacted] 25X1

The Chinese have shown ingenuity in overcoming the abrasion problem. They have installed replaceable secondary surfaces of abrasion-resistant ceramic materials on the steam pipes and at the upper outlet of the main combustion chamber. They continue to refine the application of this technique for extending the useful service life of heat-transfer surfaces. [redacted] 25X1

The Chinese make little use of automation in FBC unit operations. Automation is employed only in residual ash removal for small FBCs and in the utilization of residue heat from the ash of the FBCs for air-preheating in the boilers. An operator generally watches a unit and adjusts it in order to keep temperatures from becoming excessive with attendant clumping and clinker formation. While this approach is suitable for small equipment and is quite consistent with China's normal practices in industrial equipment operation, the need for automated control of larger-scale FBC units under development is obvious. [redacted] 25X1

The Chinese have identified several objectives that they would like to achieve by the 1990s:

* to stably utilize different kinds of coal (bituminous, lignite, anthracite, and stone coal) and oil shale for combustion.

* to achieve higher levels of efficiency (i.e. 90-95 percent for lignite; 85-90 percent for bituminous coal; 75-80 percent for anthracite; 78-82 percent for stone coal).

* to save on boiler construction material. Chinese FBCs require only 66-80 percent of the steel needed in pulverized coal boilers, and 50 percent of that in chain boilers, in terms of quantity of steel per metric ton of steam generated.

* to extract useful chemicals, metals and cement from the ash of FBCs.

* to achieve an 80 percent level of desulfurization. of the flue gas. [redacted] 25X1

[redacted] 25X1

Office of the
DEPUTY DIRECTOR FOR INTELLIGENCE

May 5, 1982

NOTE FOR: EO/OGI

Bobby

Bob would like you to take the lead in handling this request from State. Please coordinate your response with OSWR. Your response should be in the form of a letter, for the DDI's signature, to Prochnik. I will need your response by 1200 hours on 9 May in order to get it through the system and out to Prochnik by 10 May. Thanks.

STAT

DDI Action Officer

cc: D/OEAA; C/AG/ES/OSWR

ACTION