Petroleum Development in China

Between 1982 and 1986 the Bank made five loans to help Chinese petroleum enterprises introduce new technology for the exploration and production of oil and natural gas. Loans for the five projects totaled $418 million, of which $387 million was disbursed. Recent OED audits* find that the goals of introducing modern technology, training staff in its use, and using the new technology to improve oilfield productivity and safety were successfully met. They highlight the difficulties encountered when the Bank starts operations in a country that has limited experience with foreign suppliers and is unfamiliar with the Bank’s procurement procedures.

Lending for oil

China’s petroleum production increased from 10 million tons a year in 1960 to nearly 110 million tons in 1980, but declined during 1981-82. There had been no major discoveries in the 1970s and it was unlikely that future large discoveries could augment production during the 1980s. Increased output would have to come largely from expanded production in and around existing oilfields, and this could only be accomplished by the introduction of modern production and exploration technology. In this framework the Chinese government approached the Bank for assistance in rehabilitating and modernizing China’s petroleum sector.

The Bank’s lending for oil in China had three basic goals: to develop the known hydrocarbon-bearing structures; to provide a vehicle for introducing modern technology; and to upgrade the operating, technical, and managerial skills of China’s oil industry personnel. The Ministry of Petroleum Industries targeted three regions for the modernization of petroleum operations: Daqing, Zhongyuan, and Karamay. The Bank financed a project in each of these areas.

Daqing is China’s largest petroleum field. The introduction of modern technology was critical here because the oilfield had already been fully developed and, despite extensive secondary recovery efforts, production was beginning to decline. Modern technology was also critical in the Zhongyuan oilfields because the unexploited oil reservoirs were quite deep, high pressure gas zones made drilling very difficult, and the primitive seismic equipment being used made it hard to identify the best drilling locations. In Karamay, where existing technology had been unable to develop the massive reserves of heavy oil, the project sought to develop and enhance the heavy oil recovery program, in addition to updating technology for the exploration and production of light oil.

The three projects were highly successful in introducing modern production and exploration technology, in training staff at all levels in the use of this technology, and in using this technology to improve the productivity and safety of oilfield operations:

- In Daqing, production in 1989 was 40 percent higher than appraisal estimates due to the implementation of recommendations made by project-financed studies on reservoir engineering, well drilling, and well completion practices.

- In Zhongyuan, the new technology introduced through the project resulted in the completion of 120 deep wells, where none had been successfully completed before. Production from the deep reservoirs allowed Zhongyuan to reach all its production targets.

- In Karamay, small-scale pilot programs proved the applicability of new technology for producing heavy oil. When it was determined during implementation that the light oil exploration program was less promising than anticipated, funds were shifted to the development of heavy oil reserves. A greatly expanded heavy oil program was initiated, us-


Project facts and figures

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In November 1984, the Bank introduced a new policy on petroleum lending. This policy, still in force, states that the Bank will not normally finance exploration and/or appraisal drilling by a national oil company operating on its own, without a private sector partner. Instead, the Bank will support efforts that enhance the prospects for joint-venture undertakings between national companies and international oil companies (IOCs).

After the introduction of the new policy, the Bank virtually stopped supporting national oil development and shifted its focus towards developing natural gas resources for domestic use, and helping national companies promote joint oil exploration and production ventures. These activities were consistent with the new guidelines because IOCs were unlikely to invest in the development of natural gas fields for the domestic market.

During the mid-1980s, the Bank financed two technical assistance projects for gas: one for the rehabilitation of the Weiyuan gas field, the largest gas field in the Sechuan Province, and the other for the development of an offshore gas condensate field in the Liaodong Bay, northwest China. These projects involved loans totaling $55 million, of which $39 million was disbursed.

The Weiyuan project originally called for a large and comprehensive $150-200 million rehabilitation program for the Weiyuan oilfield, whose production had recently declined sharply. To minimize technical and economic risks, the Bank proposed a two-phase investment program: first, a reservoir-diagnostic study and the design of an optimal rehabilitation program, supported by the technical assistance project; and then, an investment program for rehabilitation. The reservoir study concluded that excessive production during the early years of development had so damaged the field that a full-scale rehabilitation and resuscitation program was not technically feasible. Instead, the study recommended a limited investment program to increase production slightly by rehabilitating some of the existing wells. While the study’s conclusions did not increase gas production in the Weiyuan oilfield to the desired level, they did help the project executing agency avoid an outlay of $150-200 million for a program that would have proved unsuccessful. In this sense, the study should be considered successful.

The second natural gas project covered the first phase of a two-phase program for appraising and developing a small offshore oil and gas condensate field in the Bohai gulf in Liaodong Bay that was operated by the Bohai Oil Corporation (BOC). It included technical assistance for appraising the reservoir, and for improving BOC’s technical, financial, and managerial capabilities in offshore petroleum operations which, in turn, would strengthen BOC’s position as a joint-venture partner in this kind of operation. When the new wells were drilled, the data showed that the reservoir contained natural gas and gas liquids but very little oil. Hence the potential profitability of the field was substantially reduced, particularly from a foreign investor’s viewpoint. Under these circumstances, BOC proposed to combine testing with the first-phase development of the field in order to avoid flaring gas during long-term testing. The Bank declined to assist with this alternative approach, largely because the consultant’s estimates of reserves showed that development would be marginal. Eventually, BOC went ahead with its plan and successfully developed the field. The project transferred considerable know-how to BOC, even though it did not lead to a joint venture with a foreign partner.

Issues and recommendations

Sector work

The projects were appraised without any significant sector review or sector policy dialogue. By sidestepping these issues, the Bank was able to speed up the rate of technical progress at a critical juncture in China’s petroleum development efforts. This flexible approach appears to have greatly enhanced the Bank’s impact on China’s technical progress.

China is now moving rapidly towards a more market-oriented, decen-
entralized economy, and, as a result, the petroleum industry is likely to see significant structural reform in the next few years. Recently, the Bank and the government have been looking at ways to restructure the sector to increase competition among the many existing companies and expand opportunities for foreign service and operating companies.

Transfer of technology and staff training

The transfer of advanced oilfield operating technology and know-how, achieved primarily through training, was the most important achievement of these projects (see box). For the first time formal technical training centers were established for each oilfield region to train both workers and engineers in modern oilfield drilling, production, and exploration techniques. The new technology significantly enhanced the capabilities of operating companies, and its long-term impact on the development of China's petroleum sector is expected to be high.

The Bank should consider a similar approach to technology transfer in other countries with large but technically isolated petroleum industries.

In an effort to improve China's ability to teach all aspects of petroleum technology at the university level, the Weiyuan Gas Field Technical Assistance Project included a diagnostic study of all Chinese undergraduate and graduate petroleum engineering schools. Based on the recommendations of this study, the government reorganized its academic facilities, integrating them into five institutions with campuses in four provinces (including Beijing). The expanded curriculum, with an emphasis on practical experience, gives graduates a broader framework within which to work. The educational training program also supported the growth of the intellectual leadership by expanding personal contacts with foreign academic and research institutions, and the training of a new academic generation.

The continued growth of university educational facilities for all petroleum projects is a worthwhile goal, particularly in countries with a large national petroleum sector. Attention should concentrate on programs that incorporate the maximum amount of "learning by doing," in order to ensure that participants can work with counterparts who provide on-the-job training. The Bank should also include training in modern economic and financial management practices.

The relative lack of fluency in European languages was one of the major obstacles to the use of foreign training programs, particularly those established by equipment manufacturers and those provided in foreign universities.

When language training is needed to effectively transfer technology, it should be included as a specific project component. This language training program, which must be implemented early, should train management and business staff, in addition to technical staff, since the latter rarely have time to translate materials when they return.

Procurement

China's inexperience in working with Bank procurement procedures resulted in significant delays in project implementation. Such problems can, of course, be expected to arise with all new borrowers. China's own cumbersome procurement approval process, which involved a 27-step approval process and five government agencies, greatly increased delays. These internal processing problems were identified only after substantial delays had already occurred. Yet even after identification, the Bank was unable to organize an effective inter-agency working group to facilitate the process. Sector dialogue on follow-up projects does not appear to have sufficiently emphasized the need to resolve this problem.

Training programs for Bank procurement and loan disbursement practices
Technology transfer

The main sources of China's impressive progress in transferring oilfield technology were:

- Permanent training institutions for engineers and skilled workers within each oilfield region. A core of instructors were trained abroad in the use of curricula and methods for teaching advanced oilfield operation techniques and practices.
- A national program for petroleum-related education. The scope and content of the courses taught were expanded, and overseas training programs for their staff were established.
- Training in China and abroad, provided by the suppliers of modern and sophisticated equipment purchased under the project. This training was explicitly specified in the bidding documents for equipment.
- Interaction between implementing agency staff and consultants, both in China and at the consultant's headquarters, on the various consultant studies, particularly those related to reservoir analysis, oilfield operations, and safety practices.
- The consultants' assistance, at the oilfields, with the initial implementation of the recommendations from their studies, particularly in the areas of drilling and oilfield practices and safety standards.

should be part of any project with a new borrower or new executing agency. This is particularly important when the country itself has only recently joined the Bank, and is unfamiliar with international bidding and Bank procedures. A special procurement seminar should be given for all agencies involved in the procurement process, so as to foster the teamwork needed for efficient project implementation.

Environment

All of the China petroleum projects were appraised before environmental assessments became an integral part of Bank project appraisal practices. Environmental issues, however, did become a serious concern during implementation of the Zhongyuan and Weiyuan projects.

In Zhongyuan, early supervision missions noted that corrosion from untreated water was producing environmental pollution and increasing production costs. Following recommendations from the Bank, the project's scope was amended to include the design and construction of a water treatment facility. The facility successfully addressed the water pollution problems and the recommendations for upgrading water handling techniques were disseminated to and applied in oilfields throughout the country.

In the Weiyuan project, environmental issues were not addressed, primarily because it was thought that the project, which was to finance a study of production enhancement technologies, would be environmentally neutral. The project was not intended to support investments that would directly increase production, and no new enhanced recovery technology was going to be introduced until the diagnostic study was completed. At the completion of the diagnostic study, a second stage investment project was to be considered after completion of the study. However, the Bank later agreed to use unallocated funds to purchase new production technology to try to enhance gas output. Production with this new equipment had a negative impact on the environment. The environmental problems associated with the continued operation of the Weiyuan gas field could have been identified by the appraisal, and could have been included in the terms of reference for the diagnostic study. Awareness of these problems would have limited Bank exposure to actions that were inimical to the environment.

Technical assistance projects or components should not be allowed to ignore potential environmental problems.

Bank policy

Operational Manual Statement (OMS) 3.82, which was designed in 1984 to shift the risks of petroleum exploration to the private sector, provides a reasonable approach to the development of petroleum resources in countries with limited petroleum expertise, and to exploration programs, whose high risks are ill-suited to the use of borrowed funds. For these activities, the technical know-how of international companies gives them a clear advantage.

In cases where privatization is not yet politically feasible, and petroleum production is an important factor in macroeconomic policy, the Bank needs to help in ways that will improve the sector's operating efficiency. The Bank was very successful in doing this with these early projects in China. The strict application of OMS 3.82, however, has recently constrained the Bank's involvement in countries where large public enterprises handle massive petroleum production.

The case for the current policy framework which encourages IOC participation is not in dispute. But within this framework the Bank should consider a more flexible approach to petroleum lending. It should not be excluded from supporting local, 

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