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IMPLEMENTATION COMPLETION REPORT

MYANMAR

**GAS DEVELOPMENT AND UTILIZATION PROJECT
(CREDIT 1840-BA)**

JUNE 20, 1995

Infrastructure Operations Division
Country Department I
East Asia and Pacific Region

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CURRENCY EQUIVALENTS

Currency Unit	=	Kyat (K)
K 5.99	=	US\$ 1.00

FISCAL YEAR

April 1-March 31

WEIGHTS AND MEASURES

1 barrel (bbl)	=	0.159 cubic meters
1 cubic foot (CF)	=	0.028 cubic meters
1 kilometer (km)	=	0.621 miles
BCF	=	billion cubic feet
bpd	=	barrels per day
MCF	=	thousand standard cubic feet
MMbbl	=	million barrels
TCF	=	trillion cubic feet

ABBREVIATIONS AND ACRONYMS

CNG	Compressed Natural Gas
ERR	Economic Rate of Return
GOM	Government of Myanmar
GUS	Gas Utilization Study
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IOC	International Oil Companies
MOGE	Myanmar Oil and Gas Enterprise
MOU	Memorandum of Understanding
OED	Operation Evaluation Department of the Bank
PSC	Production Sharing Contract/ Contractors
SAR	Staff Appraisal Report
UNDP	United Nations Development Program

IMPLEMENTATION COMPLETION REPORT
MYANMAR
Gas Development and Utilization Project
(Credit 1840-BA)

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Map IBRD 19766R

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IMPLEMENTATION COMPLETION REPORT

MYANMAR

GAS UTILIZATION AND DEVELOPMENT PROJECT
(1840-BA)

Preface

This is the Implementation Completion Report (ICR) for the *Gas Utilization and Development Project* in Myanmar, for which credit in the amount of SDR 48.3 million (equivalent to US\$63 million) was approved on *July 21, 1987* and made effective on *January 5, 1988*.

The credit was closed on *July 6, 1993* compared with the original closing date of *December 31, 1993*. Final adjustment to disbursement took place on *July 6, 1993*, at which time a balance of SDR 32.45 million (equivalent to US\$42 million) was cancelled. Cofinancing for the project was provided by UNDP.

The ICR was prepared by U.S. Kirmani of MN2PI (Task Manager) and P. Venugopal (Consultant), reviewed by Vineet Nayar, Chief of Infrastructure Division of the East Asia and Pacific Region (EA1IN) and Mohammad Farhandi, Project Adviser, Country Department I, East Asia and Pacific Region. The borrower has given its comments on the ICR, which have been incorporated in the report.

Preparation of this ICR was begun during the Bank's completion mission to Myanmar during *December 12-20, 1994*. It is based on material in the project file. The borrower contributed to the preparation of the ICR *by preparing their own evaluation of the project's execution and initial preparation*.

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GAS UTILIZATION AND DEVELOPMENT PROJECT Credit 1840-BA

Evaluation Summary

Introduction

1. This was the first and only IDA operation in the petroleum sector of Myanmar. It established the framework for: (i) pursuing the IDA's sector policy recommendations resulting from the joint World Bank/United Nations Development Program (UNDP) Energy Assessment of June 1985; and (ii) building further on the petroleum sector dialogue that had resulted in positive shifts in the Government of Myanmar's (GOM) development policy for the sector. As a consequence of GOM's keenness to reform the sector, a review of the "Energy Sector Investment and Policy" was conducted jointly by the Bank and UNDP and a report issued on March 16, 1992.

Project Objectives

2. The main objectives of the project were as follows:

(a) alleviate shortages of petroleum by developing further the Payagon gas field which was under partial production, by helping to add about 35 million cubic feet per day (MMCFD) to the 30 MMCFD under production; appraise for further augmentation of production; and provide for transmission to Yangon and neighborhood and distribution of the increasing volumes of the gas;

(b) provide technical assistance and training opportunities for Myanmar Oil and Gas Enterprise (MOGE);

(c) support sector policy objectives of introducing gas pricing reform, initiate steps to improve MOGE's finances and strengthen capabilities for gas investment planning.

3. In pursuance of the sector policy objectives, GOM/ MOGE agreed to carry out studies concerning the financial viability of MOGE; for firming up gas supply estimates and preparing a master plan for gas utilization; and improving oil recovery in two declining oil fields. A re-evaluation of the objectives now, shows that while the objectives were appropriate, the expectations from Payagon gas field (the center-piece of the project investment) were too sanguine. It delivered about one-tenth of the quantity of gas expected of it from pre-project and project wells (Phase I) i.e., 41 Billion Cubic Feet (BCF) were produced as compared with estimated gas recovery of 400 BCF. Payagon ceased

to produce in 1994, whereas according to appraisal estimate it was expected to produce until after 2008.

Implementation Experience and Results

4. In the development of Payagon field, the drilling component had provided for the drilling of 12 development wells (for Phase I production) and five appraisal wells (for appraising additional reserves to be exploited in a subsequent Phase II). In all, 16 wells were drilled and only six had gas finds, all of which together with the pre-project producing wells ceased to produce by or before March 1994. Nevertheless, Payagon's incremental gas production under the project (8 BCF) in the period FY1989 to FY1994 came at a critical time of high international petroleum prices and paucity of foreign exchange in Myanmar and helped reduce import of petroleum products, particularly diesel oil in the country.

5. Although Payagon failed to deliver as expected, MOGE has developed a gas field (Apyauk, not part of the project) close to Yangon discovered by an international oil company (IOC) in 1991, but relinquished by it in September 1993. It is currently producing 90 MMCFD, more than what Payagon was expected to produce under the original estimates. Apyauk has a potential to produce 120-150 MMCFD, when fully developed. It will significantly contribute to meet the gas requirement earlier expected to be met from Payagon.

6. The sector policies advocated by the Bank in its dialogues with GOM/MOGE have had the beneficial effect of Myanmar opening its exploration areas to IOCs. Some 20 consortia spent over US\$500 million and although only four companies out of the consortia have not pulled out, one of these group has achieved significant success in developing a giant offshore gas field (6 TFC of proven gas) which was discovered by MOGE in 1980. This field will be developed primarily for exporting gas to Thailand commencing from 1998 and supplying some gas quantities to meet domestic gas requirements in Myanmar by year 2000. One group of Production Sharing type Contract (PSC) company comprised of TEXACO, PREMIER and Nippon Oil Company discovered one sizable gas condensate field (Yetagun Field) in Panintharyi offshore area and further exploration efforts are taking place.

7. The objective of technical assistance and training has been adequately fulfilled, with UNDP providing the bulk of the funds (US\$2.7 million). The recommendations of the studies made under the project led to the turning around of MOGE. By increasing gas prices, MOGE turned around from a losing to a profit making entity since FY1990, MOGE also invited bids for PSCs for improving oil recovery (e.g., for chauk field) and in developing capability to plan for investments in the gas subsector.

8. The project costs which were estimated at US\$100 million were reduced to US\$40 million as a result of cancellation due to unavailability of sufficient gas. In January 1988, it was clear that Payagon reserve estimates had to be scaled down drastically from the optimistic assumptions made at appraisal in December 1986, consequently, the supervision mission requested MOGE to hold in abeyance the laying of the gas pipeline to Yangon and construction of the distribution network. In due course, this component was not proceeded with. IDA disbursements were also curtailed and finally limited to the equivalent of US\$21 million against the credit allocation equivalent to US\$63 million.

9. At identification the objectives were appropriately selected. But during preparation and appraisal, too much reliance was placed on MOGE's overoptimistic assumptions and estimation of the reserves. MOGE had not anticipated that the sands in the reservoir could be severely lenticular and not continuous and gas bearing all through. It would have been prudent for IDA to have asked for an independent assessment by consultants early on. It was belatedly done in November 1988. The Borrower's performance is, however, rated as satisfactory as MOGE fulfilled all its obligations with due speed and diligence in drilling the wells, in producing efficiently what there was to produce, absorbing new technology and inviting the private sector to assist in exploration and development to the best possible extent.

10. The outcome of the project as a whole is characterized as unsatisfactory: Payagon gas reserves were found to be drastically reduced (41 BCF against appraisal expectation of about 400 BCF). With IDA's close supervision and timely intervention to modify the project and stop further expenditure under the credit, only US\$21 million out of a total credit of US\$63 million were utilized.

Findings, Future Operations and Key Lessons

11. Myanmar offers scope for continued IDA role provided the political climate is acceptable and with advise and assistance as necessary, in domestic gas projects such as Apyuak to be further developed and the offshore gas field to be developed for transmission of Myanmar's share of the gas for domestic utilization. More immediately, Myanmar could benefit by advice and assistance on environmental protection, avoidance of pollution, safety and standards in operation and maintenance, especially in the offshore activities of IOCs. The key lessons from the project, which has not been met in its main target of production from Payagon, is that greater caution is required in the assessment of hydrocarbon reserves, more time has to be devoted to studying data and checking on assumptions than is possible in the spot reviews by the IDA missions; and it is advisable that experienced consultants, be used at appraisal or before negotiations than after the project implementation has started. The soundness of the enduring advice by IDA to developing countries to invoke interest in exploration by IOCs is substantiated by the Myanmar experience.

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GAS DEVELOPMENT AND UTILIZATION PROJECT **(CREDIT 1840-BA)**

PART 1. PROJECT IMPLEMENTATION ASSESSMENT

A. Introduction

1. A joint Association/UNDP Energy Assessment Study had been conducted in June 1985 resulting in a petroleum sector dialogue with the Government of Myanmar (GOM). Myanmar had large hydrocarbon reserves, however, oil production was low and was declining. Gas development was at an early stage. A major opportunity available to the country was to increase the role of the sizable natural gas reserves to meet the energy demand. Accelerated development and utilization of the onshore Payagon gas reserves, (which were under partial production then), appeared to provide an immediate and least-cost supply option. Additional gas was to be delivered to Yangon and to southern Myanmar.

B. Statement/Evaluation of Objectives

2. The main objectives of the project were:

(a) alleviate the chronic shortages of petroleum by developing further Payagon gas field-drilling development wells and adding 35 MMCFD to the ongoing production of about 30 MMCFD; and by drilling appraisal wells for proving more reserves to further augment production in due course;

(b) expand and upgrade the transmission facilities from Payagon to Yangon and design a basic distribution network for Yangon;

(c) provide technical assistance and training opportunities for the Myanmar Oil and Gas Enterprise (MOGE); and

(d) support sector policy objectives of introducing gas pricing reform based on full cost recovery, initiate steps to improve MOGE's finances, and strengthen GOM's capabilities for gas subsector investment planning in petroleum subsector.

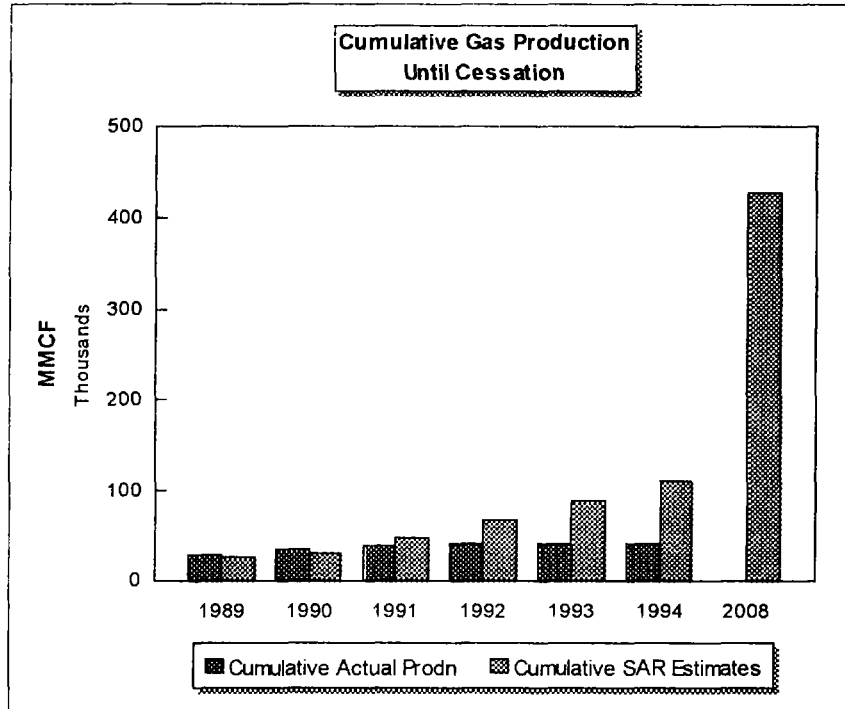
3. Re-evaluating the project objectives, it is found that Payagon failed to deliver gas as expected (total gas production was about one-tenth of expectations and production ceased some 14 years before anticipated cessation), and appraisal estimates of gas recovery proved too optimistic. An analysis of the basis for such optimism and how that optimism was engendered is presented in a detailed note (Appendix A). The subsector objec-

tives, which were well conceived, were important by themselves. These included pricing gas to avoid subsidies, making MOGE financially viable, and improving of GOM's capabilities for investment planning.

C. Achievement of Objectives

4. The main objective of supplying gas from Payagon to alleviate petroleum shortages in and around Yangon was realized only to a small measure (see graph of cumulative production).

However, the limited supplies were used at a critical time of high petroleum prices and paucity of foreign exchange for imports, yielding a satisfactory economic rate of return. Interestingly, what Payagon failed to do, namely to provide a sustainable source of gas to Yangon and the vicinity, was compensated by a new discovery by a foreign company in 1991, Apyauk gas field (not



part of the project), located 50 miles from Yangon. On relinquishment of this field in September 1993 by an international oil company (IOC), MOGE took up the field development. It salvaged some material and equipment from the Payagon gas field (to the tune of about US\$4 million of IDA supplies to Payagon) and used it at Apyauk field, which is now producing 90 MMCFD of natural gas. This is more than the 65 MMCFD which Payagon would have been producing if the appraisal expectations were fulfilled. Apyauk is likely to reach a plateau production of 120-150 MMCFD, if MOGE can find the external finances to develop the field further and transmit and distribute the gas.

5. As supervision missions became increasingly skeptical of the production potential of the Payagon gas field, decisions to curtail disbursements for some components of the project were taken. In January-February 1988, GOM was advised not to lay the new 18" pipeline to Yangon. In March 1991, GOM was requested to stop all work and request the IDA to close the Credit. In consequence, expansion and upgradation of the transmission facilities from Payagon to Yangon and designing of a basic distribution network for Yangon were not proceeded with. Although GOM did not immediately move to close the Credit as advised in March 1991, disbursements were not made and the Credit was finally

closed on July 6, 1993, about six months before the original closing date of December 31, 1993.

6. The objective of extending technical assistance and training for MOGE personnel was achieved except for items connected with expanding and upgrading the transmission and distribution of gas in Yangon. Technical assistance included assistance for consultant studies for an improved oil recovery program in two fields (Chauk and Tetma) and for gas utilization (a master plan covering onshore and offshore). Both studies were carried out competently. These studies were also used in preparing the UNDP/IDA's "Myanmar: Energy Sector Investment and Policy Review" (Review) which was issued on March 16, 1992. MOGE has recently received bids for production sharing type of contracts for improving oil recovery from seven fields including Chauk. Tetma was considered by consultants as not economic for improved recovery. The gas utilization study together with the UNDP/IDA's recommendations in the Review have resulted in GOM awarding a production sharing contract for its offshore Moattama structure to a consortium of foreign oil companies. Appraisal work completed by the consortium has determined proven gas reserves at around 6 TCF. A Memorandum Of Understanding (MOU) for export from 1998 of about 500 MMCFD of gas by pipeline to Thailand commencing in 1982, has been signed. GOM hopes to utilize its share of the gas, for domestic use in Myanmar, by year 2000.

7. The training of MOGE personnel was successfully completed under a well - designed program comprising training abroad (30 staff benefited, six of whom were deputed as post graduate fellows) and seminars by foreign experts in Myanmar (six were held). The transfer of technology helped in enhancing the skills of the staff concerned. A trained body of Myanmar personnel was thus available for discussions with the 20 or so international oil consortia who were awarded production sharing contracts in Myanmar.

8. UNDP cofinanced as grant (Program MYA/86/013) the bulk of the technical assistance and training, with US\$2.71 million. IDA implemented the program on behalf of UNDP. UNDP organized an independent review of UNDP programs in Myanmar. Its comments on both MYA/86/013 and the UNDP/Bank's Review are given as under : All in all we would rate these two projects as being of high value in both their immediate and longer term development in a critical sector of the economy. For that reason, and because of the close link between the training provided by a committed group of experts and its continuing use, the sustainability of the projects is very high.

9. The financial viability study of MOGE was conducted in-house. GOM had agreed with the Association that the price for gas should be raised from 2.5 kyats to 7.5 kyats (US\$1.13 at official exchange rates) per MCF so as to cover costs. The price of crude oil was also raised from 65 kyats/barrel to 110 kyats/barrel effective October 1988. GOM also made adjustments in the equity capital of MOGE by assuming liabilities for MOGE's net dues to the Myanma Economic Bank. These measures and some more increases in gas (to 10 kyats/MCF) and oil prices (to 126 kyats/barrel) from August 4, 1994 have turned round MOGE from a losing to a profit-making entity since FY1990, showing satisfactory

financial indicators and ability to self finance a part of its capital expenditure. But its greatest constraint is foreign exchange and GOM's allocations to it are far from sufficient. The recommendations made in the Review concerning commercialization and corporatization of the institution have not been carried out.

10. Following the recommendations made in various studies, the Ministry of Energy and the Directorate General of Energy Planning have developed and implemented a clear strategy for development of the energy sector. Unfortunately of the 20 production sharing contracts (PSC) operations, (18 onshore and 2 offshore), only 2 onshore and 2 offshore are making progress, the others having been unsuccessful. Until 1994, the international oil companies had spent upwards of US\$500 million on exploration and appraisal. One offshore operation has been successful in discovering additional gas reserves as mentioned earlier and the other offshore operation appears headed for success. The ongoing move by MOGE to invite PSCs for improved oil recovery is a prudent approach to take the best advantage of the state of the art technology. That gas, oil and petroleum product prices have been revised significantly by August 4, 1994 to eliminate subsidies is to be commended, but the continued adoption of an unrealistic official exchange rate of \$1=6 kyats, (when the open market rate is currently \$1=107 kyats) is a distortion which should be remedied.

11. A component of the Project was the experimental introduction of Compressed Natural Gas (CNG). The pilot scheme for establishing three stations to serve about 400 vehicles was successfully implemented. MOGE plans to extend the scheme and set up five more stations, to use in all 1.35 MCFD of gas. Myanmar has thus a working model in the Far East for use of CNG which could be studied by other countries in the region. Nevertheless, the economics may not be attractive, since each CNG station is said to cost about US\$1.8 million to establish (grant elements cloud the actual costs), but is helping to save gasoline only to the extent of about US\$0.13 million per year. MOGE has been advised to study the economics carefully before undertaking a major expansion of the pilot project.

12. Economic Rate of Return: A re-estimation of the Economic Rate of Return (ERR) for the project is not a meaningful exercise, given that the eventual productive life of the gas field fell significantly short of original expectation. However, an ERR was estimated for the incremental costs and benefits associated with the revised complete project. Namely, for the Payagon gas supply, the SAR had estimated the return for the field as a whole over a period of 1988 to 2008, taking into account investments under the IDA project only, but all production of gas arising from the IDA project as well as pre-1988 investments. The ERR obtained thus was given as 72% under one scenario of future international prices for diesel oil and fuel oil (that would be substituted by the Payagon gas) and 46% under a conservative scenario of such prices. The official exchange rate was used for conversion. In practice, however, gas from the Payagon field was produced between FY1984 and FY1994. Investments were made and operating expenditure incurred from FY1982 to FY1994, with the IDA project investments being made between FY1989 and FY 1993. Based on the actual data over the entire life of the field from FY1982 to

FY1994, ERR has been calculated at 29.4%.¹ The ERR of 29.4% is explained by the fact that only about US\$21 million of IDA Credit was utilized against US\$63 million that was available, and the incremental production under the IDA project commenced two years earlier than foreseen. The SAR methodology did not consider the ERR exclusive for the IDA incremental project (for the incremental production added by the project with reference to the costs and benefits relevant to it). This has now been done, and based on the assumptions outlined in Appendix F, the ERR for the IDA project works out to 28%.

D. Implementation Record and Major Factors Affecting the Project

13. The project was implemented satisfactorily by MOGE. Drilling results were reviewed with IDA, and after the reserves audit indicated lower than expected gas reserves, project components were reviewed and further expenditures curtailed in time. The actual project cost was US\$40 million with 59% as the foreign currency component. The SAR had provided for the drilling of 12 development wells and 5 appraisal wells. In fact, 12 appraisal wells and 4 development wells were drilled, of which 6 wells found gas for short term production of a total quantity of about 8 BCF (SAR estimate, about 200 BCF) out of the 41 BCF (SAR estimate, about 400 BCF) which was the total gas production from the Payagon field.

E. Project Sustainability

14. In view of the fact that 41 BCF of natural gas was produced as compared with appraisal estimate of about 400 BCF, the project can not be considered sustainable as appraised. However, with prudent action taken to maximize the benefits from the available gas resources, and curtail expenditure from the IDA credit (US\$21 million out of a total credit of US\$63 million), the modified project is sustainable.

¹ In fact, if the SAR estimates were adjusted for the whole life of the field (instead of the period 1988-2008), the expected return would have been 37% in the high future petroleum prices scenario and 25% under the low prices scenario.

F. Bank Performance

15. The overall assessment of Bank performance is rated satisfactory even though the production from the Payagon gas field was far below the appraisal estimates and a substantial part of the Credit amount could not be utilized. At identification, the IDA mission correctly felt that gas development was the key to energy and economic growth. While development of the Payagon gas field was the main element in the strategy, the other components of the project, especially the studies, technical assistance and training, and planning for oil and gas development which then appeared to be subsidiary objectives actually became the anchor of the energy (particularly gas) take-off currently in progress. Thanks to these subsidiary objectives, which were pursued diligently, buttressed by the recommendations in the UNDP/IDA's "Myanmar: Energy Sector Investment and Policy Review", GOM resorted to a number of PSCs with the international private sector in exploration of oil and gas in Myanmar. In the project preparation, it appears that IDA staff should have been more cautious with reference to one component and an essential one at that, relating to Payagon gas development. The appraisal mission apparently relied too much on the assumptions of MOGE regarding reserve estimates. An independent evaluation of the reserves by consultants, which was found necessary during project implementation, should have been carried out prior to appraisal/ negotiations. Normal practice for the Bank/IDA has rarely been to depend on the Borrower's analysis and estimates of reserves and limit the verification to an on the spot review. There were four supervision missions between FY1988 and FY1991 (virtual stoppage of the project works at Payagon had occurred by March 1991). The performance of these missions was satisfactory.

G. Borrower Performance

16. The performance of the Borrower (GOM and MOGE) is rated as satisfactory at all stages of the project cycle. The project was prepared to the best of the then technical capacity of MOGE, which was limited at that time but has been enhanced since. An efficient project directorate guided the implementation and monitored the progress with due care. The periodic reports on performance to MOGE's management and Association were satisfactory. Sixteen wells under the project were drilled speedily on force account (an average of 5 months from spudding to completion for a well with an average depth of 8,000 ft) and the six wells which discovered gas were put on production efficiently. GOM/MOGE had not moved to request for the closing of the credit by September 1991, as suggested by the IDA supervision mission in March 1991. They had delayed the request until October 1992. However, all future expenditures were suspended during this period.

17. The Borrower's satisfactory performance is explained in paras. 5-9. Nevertheless, in the area of utilizing gas in the domestic economy, progress is likely to be constrained in the absence of external finance. It is interesting to note that in the attached Borrower's Evaluation Report, a key lesson learnt is stated as "External financing is invaluable and development agencies have a big role to play. Continued interest of IDA and UNDP

would significantly contribute towards efficient development of energy sector in Myanmar.”

H. Assessment of Outcome

18. The overall outcome as regards the original project and its objectives is rated as unsatisfactory. However, benefits, direct and indirect, such as enhancement of technical skills and of planning capabilities (in MOGE/GOM), opening of the country to private sector exploration and production have been worthy of achievement.

I. Future Operations

19. As the Payagon operations have ceased, an action plan is not called for. The other objectives in the subsector which were achieved, are sustainable.

20. Myanmar offers scope for a continued role by IDA, provided the political climate is acceptable and whenever circumstances would so allow. Meanwhile, MOGE has expressed concern with the aspects of environmental protection, avoidance of pollution, protection against hazards in operation and safety, prescribing standards and framing necessary regulations, particularly offshore where large gas finds, would be developed. An IDA mission could study the requirements and such a mission would be welcomed by GOM/MOGE.

21. The Borrower's Evaluation Report presents a critical evaluation and additional data provided by the Borrower is in the project files. With the abandonment of the Payagon gas field, all personnel connected with it have been dispersed and key staff have retired from service. It is to the credit of MOGE that pending the visit of the ICR mission (17 months after closing) nucleus staff was maintained, a compendium of data had been prepared as early as September 1992 and was updated during the ICR mission's visit.

J. Key Lessons Learnt

22. Assessment of proven reserves and production profiles must be done with extreme care. If adequate data, on well behavior and performance (pressure maintenance, water entry, etc) is lacking, projects should be designed in such a way that data is collected prior to finalization of the project scope. In this project, the appraisal mission had come to a tentative, but highly optimistic conclusion about the extent of the gas reserves during appraisal in December 1986, but had no further discussion with MOGE on the reserves until late January 1988. MOGE had gathered valuable additional information during 1987 and, had IDA made a review of this data during negotiations in May 1987 or before Board presentation July 1987 or even by Credit Effectiveness on January 5, 1988, the project description might have been different with more realistic production objectives.

23. Besides scrutiny by the IDA's staff of the reserve data, it is prudent to seek independent opinion of consultants, who have facilities to analyze data in depth and interpret

and carry out various laboratory tests, do modeling etc., and suggest specific and experimental field operations to substantiate tentative inferences.

24. The Bank/ IDA's advice on incentives to attract foreign investors' interest in exploration and development yielded gratifying results in Myanmar as IOCs spent over US\$500 million by 1994 in exploration, both onshore and offshore. Above all, Myanmar has a rich gas field offshore at present, being developed for gas export by a consortium of IOCs.

Table 1: Summary of Assessments

<u>A: Achievement of objectives</u>	<u>Substantial</u>	<u>Partial</u>	<u>Negligible</u>	<u>Not applicable</u>
Macroeconomic policies				*
Sector Policies		*		
Financial objectives		*		
Institutional Development		*		
Physical objectives			*	
Poverty reduction				*
Gender concerns				*
Other social objectives				*
Environmental objectives				*
Public sector management				*
Private sector development		*		
<u>B. Project sustainability</u>	<u>Likely</u>		<u>Unlikely</u>	<u>Uncertain</u>
Payagon gas field			*	
Other objectives	*			
	<u>Highly Satisfactory</u>		<u>Satisfactory</u>	<u>Deficient</u>
<u>C. Bank performance</u>				
Identification			*	
Preparation assistance				*
Appraisal				*
Supervision	*			
<u>D. Borrower performance</u>				
Preparation			*	
Implementation			*	
Covenant compliance			*	
<u>E. Assessment of outcome</u>	<u>Highly Satisfactory</u>	<u>Satisfactory</u>	<u>Unsatisfactory</u>	<u>Highly Unsatisfactory</u>
			*	

Table 2: Related Bank Loans/ Credits

Loan/credit title	Purpose	Year of approval	Status
<i>Preceding operations</i>			
None			
<i>Following operations</i>			
None			

Table 3: Project Timetable

Steps in project cycle	Date planned	Date actual
Identification	February 1986	February 1986
Preparation	June 1986	June 1986
Appraisal	December 1986	December 1986
Negotiations	April 1987	May 4-8, 1987
Board presentation	May 1987	July 21, 1987
Signing		October 10, 1987
Effectiveness	October 13, 1987	January 5, 1988
Project completion	June 30, 1993	March 31, 1991
Loan closing	December 31, 1993	July 6, 1993

Table 4: Credit Disbursements: Cumulative Estimated and Actual
(US\$ thousands)

	FY1988	FY1989	FY1990	FY1991	FY1992	FY1993
Appraisal estimates	13900	35500	51300	62700	62900	63000
Actual	5036	15971	21504	21504	21504	21062*
Actual as % of estimate	36	45	42	34	34	33
Date of final disbursement	* July 6, 1993 on which date IDA received refund of \$441,938, the unspent amount out of the initial deposit in the special account.					

Table 5: Key Indicators for Project Implementation

Key implementation indicators in SAR (Chart 3)	Estimated	Actual
1. Gas Field Development	Sep. 1991	Nov. 1990
2. Gas Transmission & Distrbn.	March 1992	Not done
3. Tech. Assistance, Studies & Training	March 1993	Dec. 1992
4. CNG Pilot Scheme	Sep. 1992	Dec. 1990

Table 6: Key Indicators for Project Operations

Key operating indicators in SAR	Estimated	Actual
1. Commence production	Oct. 1990	Mar. 1989
2. Reach plateau production	Apr. 1993	Apr. 1990
3. Maintain full production	till Mar. 2008	Mar. 1994 (ceased)

Table 7: Studies Included in Project

Study	Purpose as defined at appraisal	Status	Impact of study
1. Improved oil recovery	Address production difficulties in two oil fields	Completed	MOGE has received bids for prodn. sharing type of contracts to improve recovery in seven oil fields
2. Gas utilization study	Firm up gas supply estimates and develop a master plan for gas use	Completed	A major gas find offshore was appraised by a consortium of IOCs and a MOU has been signed for export of gas to Thailand. An onshore gas field near Yangon (Apyauk) is serving Yangon's needs.
3. Financial viability /MOGE	To recommend measures for MOGE to become a profit making entity	Completed	MOGE has been making profits since FY1990

Table 8A: Project Costs

Items	Appraisal estimate (US\$MM)			Actual cost (US\$MM)		
	Local costs	Foreign costs	Total	Local costs	Foreign costs	Total
1. Gas filed development	20.5	13.0	33.5	13.4	17.4	30.8
2. Gas transmiss & distrbn	19.0	9.0	28.0	2.1	2.9	5.0*
3. Tech assist & training	4.7	1.2	5.9	0.1	2.7	2.8
4. Appraisal drilling Ph.II	5.0	3.0	8.0	0.0	0.0	0.0
5. CNG pilot scheme	1.5	0.5	2.0	0.5	0.7	1.2@
6. Physical contingencies	11.7	2.9	14.6			
7. Price contingencies	3.1	5.0	8.1			
Total	65.5	34.6	100.1	16.1	23.7	39.8

* Some equipment and materials were procured and partially used before the decision not to lay the pipeline was taken.
 @ Some equipment was gifted, the value of which is not estimated.

Table 8B: Project Financing

Source	Appraisal estimate (US\$MM)			Actual financing (US\$MM)		
	Local costs	Foreign costs	Total	Local costs	Foreign costs	Total
IDA		63.0	63.0		21.0	21.0
UNDP		2.5	2.5		2.7	2.7
GOM/MOGE	34.6		34.6	16.1		16.1
Total	34.6	65.5	100.1	16.1	23.7	39.8

Table 9: Economic Costs and Benefits ²

SAR estimate (time slice FY88-FY2008) for Payagon field as a whole with Phase I	46% to 72% depending on international petroleum prices
SAR estimate above, adjusted for field from initial investment in FY1982 to FY2008	25% to 37% depending similarly on international petroleum prices
Actual economic rate of return for field as a whole from FY1982 to FY1994, when production ceased	29.4%
Actual economic rate of return for the project,	28.4% (not calculated in SAR)

² See para 12 of text.

Table 10: Status of Legal Covenants

Agreement	Covenant type	Present status	Fulfillment date	Description of covenant	Comments
<u>Credit 1840-BA</u>					
Section 3.04	Implementation	C	1987	Create project implementation unit	
Schedule 5	Implementation	C	1988 1989 & 90	- plan for CNG pilot - plan for wells/ seismic surveys	
Section 4.01	Accounts/audit	C	Each year	Submission of accounts - unaudited in 9 months - audited in 12 months	
Section 4.03	Sector policy- other	C	Time to time	Exchange views on energy assessment (1985 report)	
Schedule 5	Studies		Planned		
	- Gas utilization	CD	- Mar 1991		3 months delay
	- Improved oil recovery	CD	- June 1991		TOR revised causing a short delay
	- Financial viability	C	- May 1990		
C: Complied					
D: Delayed					

Table 11: Compliance with Operational Manual Statements

Complied

**Table 12: Bank Resources: Staff Inputs
(In Staff Weeks)**

Stages of project cycle	Planned	Actual
Through appraisal	100	129.9
Appraisal-Board	15	14.7
Board-Effectiveness	10	10.0
Supervision	80	77.3
Completion	7	9.0
TOTAL	212	240.9

Table 13: Bank Resources: Missions

Stage of project cycle	Month/year	Number of persons	Days in field	Specialized staff skills represented (see note*)	Performance rating		Types of problems
					Implement- ation status	Develop- ment impact	
Through appraisal	2/1986	4	9	1,2,3,4			
	6/1986	5	9	1,2,3,5,6			
	12/1986	6	9	1,2,3,5,6,7			
Appraisal through Board approval							
Board approval through effectiveness	8/1987	2	9	3,8			
Super- vision	1/1988	5	15	1,2,8,9,10			
	8/1989	5	9	8,9,11,12,13			
	5/1990	3	12	8,11,14			
	3/1991	3	10	12,15,16			
Comple- tion	12/1994	2	8	15,16			

*Note

1. A.El Mekkawy (Pet. engineer) 2. A. Smit (Geophysicist) 3. S.Khwaja (Gas engineer) 4. J.P. Pinard (Fin. analyst) 5. Manibog (Economist) 6. Snook 7. Sergio (Fin. analyst) 8. Bertelsmeir (Fin. analyst) 9. Mian 10. Duncan 11. Fitzgerald (Geologist) 12. Kirmani (Pet. engineer) 13. Montes (Pet. engineer) 14. Malhotra (Energy specialist) 15. Venugopal (Fin. analyst) 16. Zubair (Pet. engineer)

Aide Memoire

MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT

IMPLEMENTATION COMPLETION MISSION

DECEMBER 1994

1. A World Bank mission consisting of Messrs. U. Kirmani (Senior Petroleum Engineer)¹ and P. Venugopal (Consultant) visited Yangon from December 12 to 20, 1994 to prepare the Implementation Completion Report of the Gas Development and Utilization Project (CR 1840-BA) including the UNDP financed Petroleum T.A. and Training component.
2. The mission met with the representatives of the Ministry of Energy (MOE) and Myanmar Oil and Gas Enterprise (MOGE) and liaised closely with UNDP.
3. The mission expresses its appreciation of the excellent cooperation and hospitality extended to it by its Myanmar hosts. It also wishes to acknowledge the excellent cooperation it received from the UNDP.
4. The findings and conclusions of the mission on the Project are as follows.
 - (a) The main objective of developing the Payagon gas field with a view to provide Yangon and its contiguous areas with natural gas was not fully fulfilled due to far lower as well as far briefer production of natural gas than had been expected at appraisal. Nevertheless, the small production of natural gas from the field was valuable to the extent (and the critical time) it was realized helping to substitute petroleum products, specially diesel oil in power generation. Further, the outlay on the project was curtailed as soon as it was known- about three years before the due date for closing of the credit- that the gas reserves would be well below original estimates. In the event, IDA credit of SDR48.3 million (US\$63.0 million) was availed of upto SDR15.85 million (US\$21.0 million) only by mutual understanding.
 - (b) The studies under the Project were successfully carried out. The Financial Viability Study resulted in MOGE turning from a losing to a profit making enterprise. The Gas Utilization Study and the Study for Improved Oil Recovery made useful recommendations which have been followed up. During the Project, World Bank's 'Myanmar: Energy Sector Investment and Policy Review Study' was also issued on March 16, 1992 and the recommendations made therein were

¹ Mr. Kirmani was present at Yangon until December 16, 1994.

also taken into consideration in planning the energy strategy of the country. The training component, where the bulk of the fund requirements came from a UNDP grant, was fully implemented and upgradation of professional skills was achieved.

(c) The evolving strategy for gas has been paying off. In spite of Payagon's disappointing performance, the present position is not bleak in that a new gas field (Apyauk) close to Yangon has, since late 1993, been producing natural gas more than replacing Payagon and exceeding the original expectations from it; and, the development of the offshore fields is progressing very satisfactorily, with targets for exporting gas to Thailand and in due course of landing Myanmar's share of the gas in Myanmar.

(d) The CNG pilot adopted on a reduced scale to provide for three stations and 450 vehicles has been technically successful and has saved gasoline, but the financial and economic rates of return remain to be calculated (With the data MOGE is collecting, this will be done in the ICR). MOGE is proposing to extend the pilot to add five more stations.

5. The mission was pleased to find that MOGE had, as early as September 1992, prepared a Project Completion Report (PCR), which is a compendium of comprehensive data on the several aspects of the Project. MOGE is updating the report. MOGE is preparing a short critical review of the Project as discussed with the mission to be sent to IDA together with the updated PCR before January 15, 1995 as the borrower's contribution to the ICR.

6. No operation plan for the future of the Project has been considered necessary since Payagon has ceased to produce gas. Action on the other objectives has been taken.

7. A list of officials met is attached as annex 1.

GAS DEVELOPMENT AND UTILIZATION REPORTIMPLEMENTATION COMPLETION MISSION (DECEMBER 1994)List Of Officials Met²Ministry of Energy

- | | | |
|----|--------------|------------------|
| 1. | U Tin Tun | Deputy Minister |
| 2. | U Soe Myint* | Director General |

Myanmar Oil and Gas Enterprise (MOGE)

- | | | |
|----|---------------|---------------------------|
| 1. | U Pe Kyi* | Managing Director |
| 2. | U Kyaw Nyein* | Director (Planning) |
| 3. | U Win* | Director (Engineering) |
| 4. | U Than Tin* | Director (Planning) |
| 5. | U Nyunt | General Manager (Explrn.) |
| 6. | U Sein Win | Sr. Transport Engineer |
| 7. | U Win Myint | Sr. Transport Engineer |

United Nations Development Program (UNDP)

- | | | |
|----|-------------------------|-------------------------|
| 1. | Mr. Douglas W. Gardner* | Resident Representative |
| 2. | Mr. Maurice Dewulf | |

² Aide Memoire is circulated to the officials whose names are marked with an asterisk and U Thein Aung Lwin, Director General, FERD.

(Provisional pending FERD's/Myanmar Confirmation)

Appendix B

SUMMARY OF BORROWER'S EVALUATION REPORT
MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT
CREDIT 1840-BA

PROJECT OBJECTIVES

1. This first World Bank/IDA operation in the petroleum sector was intended to help alleviate chronic shortages of petroleum, which has hindered growth of Myanmar economy. This was to be achieved by assisting in the future development of the onshore Payagon gas field as well as the introduction of modern petroleum technology and latest advance in the international petroleum engineering and production practices.

To achieve the overall objective, the project would support:

- (i) a development and appraisal drilling component for the Payagon gas field;
- (ii) a gas transmission and distribution component that would deliver Payagon gas to large customers in Yangon;
- (iii) technical assistance and training to assist in the implementation of the various project components as well as studies to identify options for enhancing oil recovery and to strengthen investment planning capabilities in the gas subsector.

2. The PGUDP's fundamental objective was to transfer Myanmar's natural gas wealth into a major driving force for economic growth. It consisted of two phases. For phase I, to produce an additional 35 MMCFD for the Yangon area and for phase II, another 35 MMCFD or more to serve areas beyond Yangon. Total peak production from the Payagon field by the late 1990 would reach around 80 MMCFD, serving Yangon as well as Sittaung, Thaton and Myaingalay.

ACHIEVEMENT OF PROJECT OBJECTIVES

3 The main objective of supplying from Payagon to Yangon and surrounding areas was only partially achieved. The gas production from the field was far lower than expected and the production also ceased in 1994. But while it lasted, it provided a valuable source of energy and substituted for diesel oil which would otherwise have been used in the electric power generation. Although Payagon gas position was such that, MOGE has commenced production from a new gas field called APYAUK in September 1993 which is about 60 miles north west of Yangon and its daily production is more than the expected

Payagon's production. As a result new gas turbines will be brought into operation in the very near future.

4. The second objective of the technology transfer was successfully achieved. Staff were trained abroad and seminars were conducted in Yangon.
5. Studies for gas utilization and secondary recovery of oil were also completed and the recommendations are being acted on. The Financial Viability Study helped to improve MOGE's financial position.

IMPLEMENTATION RECORD AND MAJOR FACTORS AFFECTING THE PROJECT

6. The seismic survey of Payagon was completed as planned. It was in the drilling that most wells expected to have gas turned out to be dry or water bearing. While the plan was to drill 12 development wells and 5 appraisal wells, it so happened that 16 wells were drilled, 12 became appraisal and 4 development wells. Of these 16 wells, 6 were producers of gas and the production from them, amounting to about 8 BCF, did not last beyond 2 or 3 years. The entire field ceased production after producing a total of 42 BCF.
7. Six MOGE staff qualified for petroleum related fellowship courses in UK, Canada and the United States of America. Thirty staff were trained abroad in Workshop type of courses. Six seminars were held in Yangon.
8. BEICIP conducted the Gas Utilization study and gave an assessment of the potential for gas production. One of the recommendations on offshore gas appraisal and development was pursued by MOGE with success and the process of exporting gas to a neighboring country is under way.
9. K and A made recommendations on secondary recovery for one oil field. At present, MOGE is accepting the international bids for operation of not only this field, but other similar fields on production sharing basis.

PROJECT SUSTAINABILITY

10. Since Payagon field had ceased production, the question of sustainability does not arise. All other objectives, having been achieved, are fully sustainable.

BANK PERFORMANCE

11. MOGE appreciates all the assistance given by the several Bank missions and also the assistance provided by Bank staff at Washington who handled disbursements and procurement.

BORROWER PERFORMANCE

12. Borrower comprising the government and MOGE acted with due enthusiasm to achieve all the objectives. There were no constraints within the organizations involved to delay or affect achievement. ICB procedures were fully complied with. There was some delay in acting on the advice of IDA in 1991 to close the credit and special account due to the hope that the large unutilized balance of the credit could be applied to the project after a modification of the description of the project, but within the overall objectives. Unfortunately, the opportunity to develop Apyuak gas field came too late.

ASSESSMENT OF OUTCOME

13. By and large, the project is rated as satisfactory. While Payagon gas field failed to meet expectations in gas production, the project contributed towards the technical and technological enhancement of MOGE. Combined with factors like MOGE signing several PSCS, onshore and offshore, during the project period, MOGE considers that it has a sophistication higher today than when the project was identified in 1986.

FUTURE OPERATIONS

14. MOGE has a number of projects in view, many of which were identified in World Bank's own Energy Assessment in 1992. If financing from external sources can be secured, there is scope for implementation of many of these projects. In particular, much work has to be done to develop Apyuak gas find to its full maximum. The offshore gas export to a neighboring country has also a component for bringing a share of the gas to shore in Myanmar.

KEY LESSONS LEARNED

15. MOGE has refined its tools for assessment of reserves and is unlikely to be over optimistic as it was with Payagon's expected gas supply.

16. External financing is invaluable and development agencies have a big role to play. Continued interest of IDA and UNDP is necessary for achievement of meeting energy requirements.

COFINANCIER- UNITED NATIONS DEVELOPMENT PROGRAM (UNDP'S)
CONTRIBUTION
MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT
CREDIT 1840-BA

1. The following is an extract from an independent review organized by UNDP on its fifth country program for Myanmar. The review was carried out during October-December 1992, under the leadership of Mr. Shiv K. Kapur, senior consultant.

Quote:

(viii) Oil and Gas Development

2. The Energy Sector, which is at the heart of Myanmar's economic development, has experienced severe shortages. After increasing at an annual rate of 8% between 1983-84 and 1985-86, production of commercial energy declined by 5% in 1986-87 and by over 13% in the period 1987-89. The production of crude oil was the hardest hit; declining at an average of 10% which accelerated in the late 1980s, as much of the drilling equipment became obsolete. In contrast to the steady decline in oil production, natural gas output increased by 20% annually during 1983-84 to 1987-88, before declining in 1988-89.

3. A number of interlinked investment and technical assistance efforts have been mounted by IDA, AsDB, IBRD and UNDP to assist Government in overcoming the above mentioned critical shortages. The assessment below relates to UNDP/IBRD project MYA/86/013: Petroleum Technical Assistance and Training and UNDP/IBRD project MYA/89/009: Energy Sector Investment and Policy Review Study. MYA/86/013 was designed in support of the Payagon Gas Development and Utilization project financed by IDA with a credit of US\$ 63 million. The other sequential UNDP projects included MYA/82/005: UNDP/AsDB Umbrella II project of Pre-investment and Investment assistance; UNDP/AsDB project MYA/86/015: Institutional Strengthening of the Ministry of Energy; UNDP/GOM project MYA/92/004: Strengthening Energy Planning Department and MYA/89/009: Energy Sector Investment and Policy Review.

4. MYA/86/013 has three components; a gas utilization study, enhanced oil recovery studies and training program for Myanmar Oil and Gas enterprise. The studies and the training program were competently carried out. Among its objectives, the gas utilization study was intended to provide firm estimates of natural gas reserves, both associated and non-associated, and assess the production over time. The study was completed in July 1991, and partly as a result of this study the French Oil Company Total signed an exploration/exploitation agreement for the Gulf of Martaban gas fields. The conclusions of the enhanced oil recovery studies, on the other hand, were not very promising and the Government has decided instead to focus its intention on the rehabilitation of some old oil wells. The training took the form of a series of seminars attended by 147 participants. Some 30 trainees benefited from short term programs overseas, and 7 fellows were

enrolled in post graduate diploma courses in Canada, the United States and the United Kingdom.

5. The linkage between the project for Petroleum Technical Assistance and Training and the Energy Sector Investment and Policy Review Study was particularly close, as a World Bank mission in April/May 1990 prepared aide memoires and fact finding studies for both projects in parallel. The diffusion of the conclusions of the energy sector and policy review was undertaken through a symposium held in January 1992, and 200 copies of the study were provided to various energy related government agencies. The report is continuing to make a substantial contribution to the government's recent initiatives for the development of the oil and gas resources. Although an Executing Unit has not yet been set up in the Energy Planning Department, the value of the study to the government was repeatedly stressed at our meeting with the Director General of the Energy Planning Department who referred to the study as his "bible" in reference to the Government's planning for the future development of the sector, and as a basis for discussion with foreign investors.

6. All in all we would rate these two projects as being of high value under both of their immediate and longer term development objectives in a critical sector of the economy. For that reason, and because of the close link between the training provided to a committed group of experts and its continuing use, the sustainability of the projects is very high.

Unquote.

IMPLEMENTATION COMPLETION REPORT
MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT
COMMENTS ON THE PAYAGON GAS RESERVES

1. Geologically, Payagon area is characterized by draping of younger formations over old basement highs. The main structures are identified by the seismic surveys. However, the individual reservoir sands are discontinuous due to their depositional characteristics in the deltaic sedimentation environment. These sands are generally not clearly delineated in the seismic data analysis. In the case of Payagon, significant structures identified were A, B, C, D, E, F and the Hteinkyun area.

GAS RESERVOIRS

2. In the above mentioned structures, MOGE had identified 'D' and 'A-E' structures which had gas discoveries at appraisal and were considered promising for commercial exploitation of the gas reserves, in addition to some contribution from the other structures. However, within these structures, the sand bodies were discontinuous; with different reservoir characteristics, limited vertical and aerial extent. In fact, in every structure there were many 'mini-reservoirs' in various sand bodies with alternating sands and impermeable shales existing within the distinct sands identified by MOGE as (a) 4660 ft sand and (b) 5100 ft sand in 'D' structure; (a) 5300 ft sand, (b) 7700 ft sand, (c) 8200 ft sand (upper), (d) 8200 ft sand (lower) and (e) 8500 ft sand in 'A-E' structures in sedimentary Miocene reservoir. In addition, MOGE had expected gas deposits in volcanic sands below 10,000 ft. Similar sands in 'B', 'C' and 'F' structures were considered gas bearing.

RESERVES

3. At Appraisal, MOGE was already producing about 30 MMSCFD of gas from Payagon area, mainly from 'D' structure. The additional development program agreed by IDA and MOGE focused at producing an additional 35 MMSCFD of gas for supply to Yangon on a sustained basis.

4. MOGE estimated 'Proven and Probable' reserves at about 800 bcf. Of these, IDA mission accepted 208 bcf as proven reserves and 629 bcf as probable reserves. The proven reserves at 208 bcf were considered adequate to supply an additional 35 MMSCFD to Yangon area. In addition, with further drilling, probable reserves could be converted to proven reserves (Industry practices show that about 50% of probable generally get converted to proven, but this is not axiomatic).

5. Based on the above considerations, IDA agreed with a program of 12 development wells (assuming all would be producers in Phase I) and 5 appraisal wells for establishing

Phase II of Payagon Development in due course. The relative downstream project components were based on these assumptions of gas supplies.

6. Out of 16 wells drilled in various structures, however, only 7 wells found gas, and the others were either dry or encountered water bearing sands. 11 wells were plugged and abandoned and their equipment was recovered.

7. Only one well (well no. PYGN-19) was a producer in 'A-E' structures (cumulative production was 968 MMSCF-abandoned in April 1990). 4 wells (nos. 20, 21, 24 and 27) produced gas from 'D' structure. Of these, well no.20 was the most prolific producing 3,611 MMSCF. Two wells (nos. 30 and 32) produced from 'B' structure and one well from Hteinkyun area. It is quite clear from the production history that each of these wells produced from sand bodies which were discontinuous and were not part of a main reservoir.

8. All MOGE reserve calculations assumed reservoir continuity average sand thickness and uniform reservoir characteristics. These factors were based on few test results in the earlier discovery wells and should not have been generally applied over the entire Payagon area. In the course of the project cycle, MOGE downgraded the reserves as under:

	Proven	Probable	Possible	Total BSCF
October 1, 1986 (basis for SAR)	208	629	----	837
January 29, 1988	144	9	500	653

The appraisal mission's estimates were obviously highly optimistic as they did not verify various assumptions made by MOGE, but developed the entire project on these gas supply assumptions.

9. During subsequent supervision missions, the reserves and gas producibility became a major issue. During 1989, IDA suggested and MOGE agreed to a reserves audit by independent consultants, who determined the reserves as follows:

	Initial Gas in Place BCF	Balance Recoverable BCF
Proven	34.5	9.1
Probable	52.9	44.0
Possible	166.5	133.0
Total	253.9	186.1

The actual production history from Payagon wells has more or less confirmed the consultants' analysis.

10. An analysis of proven reserve as on the dates indicated yields the following comparison.

<u>Proven Reserves- Estimates & Actual Production</u>			
Structure	MOGE estimates in January 1988 Gas in Place/BCF	Consultant est. in May 1989 Gas in Place/BCF	Actual Production BCF
D	41.7	33.5	29.5
A-E	81.0	0.0*	4.6
B-F	20.4	0.0*	6.0
Hteinkyun	1.2	1.0	0.9
Total	144.3	34.5	41.0

* Consultants had given 24.6 bcf and 11.0 bcf as probable in 'A-E' and 'B-F'.
As can be seen, the results in 'A-E' structures were most disappointing.

CONCLUSION

11. Of the total gas production of about 41 bcf, about 30.4 bcf was contributed by 'D' structure (about 73%), 6 bcf by 'B-F' structure (14.6%) and 4.05 bcf by 'A-E' structure (about 9.9%) out of the proven reserves of 62 bcf, as currently estimated by MOGE, which are generally in tune with the Reserve Audit study. 'A-E' structure has been most disappointing, considering that during appraisal most of the proven reserves plus probable were assumed to be in 'A-E' structures and next in 'D' structure. On hindsight, it appears that the appraisal mission should have been more careful in verifying the assumptions made by MOGE in reserve estimates. It is quite clear that bundling of proven and probable reserves together for the purpose of developing a capital intensive gas project with major downstream investment was not correct. It would have been better, if prior to appraisal, IDA had conducted a reserve evaluation study by independent consultants.

12. The timely monitoring by IDA missions and steps taken for (a) reserves audit (b) suspension of all activities on gas transmission and distribution helped in preventing wasteful expenditure on Payagon gas supply to Yangon.

13. One significant outcome of a thorough reservoir investigation and monitoring of test results during supervisions has been that MOGE has become familiar with modern reservoir engineering and gas industry practices and is currently applying these in the development of Apyauk gas (50 miles NW of Yangon) field, discovered by Shell in 1991 and under development by MOGE following relinquishment by Shell in September 1993. The gas supply objectives which could not be achieved from Payagon are expected to be achieved from Apyauk gas field estimated to produce 120-150 MMSCFD on a sustained basis.

IMPLEMENTATION COMPLETION REPORT
MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT
CREDIT 1480-BA

BORROWER'S COMMENTS ON THE ICR

GOVERNMENT OF THE UNION OF MYANMAR

MINISTRY OF ENERGY

Mr. Darayes Mehta
 Acting Chief
 Infrastructure operations Division
 Department 1 East Asia and Pacific Region
 1818 H Street N.W.
 Washington, DC 20433

Dear Mr. Darayes Mehta,

We are in receipt of the final draft copy of Implementation Completion Report (ICR) sent to us vide your letter dated 12th May 1995, for Gas Utilization and Development Project which was implemented with the credit offered by IDA.

We appreciate very much for preparing this ICR by your esteemed organization and we agree with the comments you have made in the ICR with regard to the findings, future operations and key lessons learnt.

We have the same view with you that although this project failed in contrary to the expectation, the Apyauk Gas field, discovered by an international oil company and relinquished on its own had been developed successfully by using some of the salvaged materials and equipment from the Payagon Gas field. This had significantly compensated and contributed to meet the country's domestic gas requirement in time.

In reviewing your draft ICR, we take the opportunity to confirm that the salient points of the objectives of this

project and the recommendations made by the World Bank, have been diligently pursued and carried out by M.O.G.E under close supervision by the Ministry of Energy. This had resulted in the successful achievement in training of technical personnel of M.O.G.E. The Technical Assistance Studies for an improved oil recovery had been carried out successfully in two oil fields. The training of M.O.G.E. personnel was successfully completed under a well designed programme. The transfer of technology had helped in enhancing the skills of the staff concerned. The Financial Viability Study of M.O.G.E. was conducted in-house and the Government of Myanmar had agreed with your esteemed Association in that gas, oil and petroleum product prices and also the electricity tariff rates had been revised significantly in August 1994. These measures have turned round both M.O.G.E. from a losing to profit making entities.

In conclusion, the Ministry of Energy acknowledged with thanks the credit offered by the World Bank/IDA for the Payagon Project in conjunction with Technical Assistance Programme provided by UNDP. We welcome the continued interest and support of IDA and UNDP mentioned in the ICR, for further development of Energy Sector of Myanmar and we earnestly hope for the support of the World Bank/IDA to renew its contribution towards efficient development of the energy sector as it would enhance the economic growth of the country as Myanmar has now not only adopted and followed the market oriented economic system but also encourages the infusion of foreign private investments.

We have enclosed some substitutes to be made in the ICR for consideration at your end.

With best regards,

Yours sincerely,

for Deputy Minister

(Soe Myint - Director General)

Enclosures (4) sheets.

Implementation Experience and Results

4. In the development of Payagon field, the drilling component had provided for the drilling of 12 development wells (for Phase I production) and five appraisal wells (for appraising additional reserves to be exploited in a subsequent Phase II). In all, 16 wells were drilled and only six had gas finds, all of which together with the pre-project producing wells ceased to produce by or before March 1994. Nevertheless, Payagon's incremental gas production under the project (8 BCF) in the period FY1989 to FY1994 came at a critical time of high international petroleum prices and paucity of foreign exchange in Myanmar and helped reduce import of petroleum products; diesel oil in the country .

5. Although Payagon failed to deliver as expected, MOGE has developed a gas field (Apyauk (not part of the project) close to Yangon discovered by an international oil company (IOC) in 1991, but relinquished by it in September 1993. It is currently producing 90 MMCFD, more than what Payagon was expected to produce under the original estimates. Apyauk has a potential to produce 120-150 MMCFD, when fully developed. It will significantly contribute to meet the gas requirement earlier expected to be met from Payagon.

6. The sector policies advocated by the Bank in its dialogues with GOM/MOGE have had the beneficial effect of Myanmar opening its exploration areas to IOCs. Some 20 consortia spent over US\$ 500 million and although only four companies out of the consortia have not pulled out, one of these group has achieved significant success in developing a giant offshore gas field (6 TCF of Proven gas) which was discovered by MOGE in 1980. This field will be developed primarily for exporting gas to Thailand commencing from 1998 and supplying some gas quantities to meet domestic gas requirements in Myanmar by year 2000. One group of PSC company comprised of TEXACO, PREMIER, and Nippon Oil Company discovered one sizeable gas - condensate field (Yetagun Field) in Panintharyi offshore Area and further exploration efforts are taking place.

IMPLEMENTATION COMPLETION REPORT
MYANMAR GAS DEVELOPMENT AND UTILIZATION PROJECT
COMMENTS ON THE PAYAGON GAS RESERVES

1. Geologically, Payagon area is characterized by draping of younger formations over old basement highs. The main structures are identified by the seismic surveys. However, the individual reservoir sands are discontinuous due to their depositional characteristics in the deltaic sedimentation environment. These sands are generally not clearly delineated in the seismic data analysis. In the case of Payagon, significant structures identified were A, B, C, D, E, F and the Hteinkyun area.

GAS RESERVOIRS

2. In the above mentioned structures, MOGE had identified 'D' and 'A-E' structures which had gas discoveries at appraisal and were considered promising for commercial exploitation of the gas reserves, in addition to some contribution from the other structures. However, within these structures, the sand bodies were discontinuous; with different reservoir characteristics, limited vertical and aerial extent. In fact, in every structure there were many 'mini-reservoirs' in various sand bodies with alternating sands and impermeable shales existing within the distinct sands identified by MOGE as (a) 4660 ft sand and (b) 5100 ft sand in 'D' structure; (a) 5300 ft sand, (b) 7700 ft sand, (c) 8200 ft sand (upper), (d) 8200 ft sand (lower) and (e) 8500 ft sand in 'A-E' structures in sedimentary Miocene reservoir. In addition, MOGE had expected gas deposits in volcanic sands below 10,000 ft. Similar sands in 'B', 'C' and 'F' structures were considered gas bearing.

RESERVES

3. At Appraisal, MOGE was already producing about 30 MMSCFD of gas from Payagon area, mainly from 'D' structure. The additional development program agreed by IDA and MOGE focused at producing an additional 35 MMSCFD of gas for supply to Yangon on a sustained basis.

4. MOGE estimated 'Proven and Probable' reserves at about 800 bcf. Of these, IDA mission accepted 208 bcf as proven reserves and 629 bcf as probable reserves. The proven reserves at 208 bcf were considered adequate to supply an additional 35 MMSCFD to Yangon area. In addition, with further drilling, probable reserves could be converted to proven reserves (Industry practices show that about 50% of probable generally get converted to proven, but this is not axiomatic).

5. Based on the above considerations, IDA agreed with a program of 12 development wells (assuming all would be producers in Phase I) and 5 appraisal wells for

establishing Phase II of Payagon Development in due course. The relative downstream project components were based on these assumptions of gas supplies.

6. Out of 16 wells drilled in various structures, however, only 7 wells found gas, and the others were either dry or encountered water bearing sands. 11 wells were plugged and abandoned and their equipment was recovered.

7. Only one well (well no. PYGN-19) was a producer in 'A-E' structures (cumulative production was 968 MMSCF-abandoned in April 1990). 4 wells (nos. 20, 21, 24 and 27) produced gas from 'D' structure. Of these, well no.20 was the most prolific producing 3,611 MMSCF. Two wells (nos. 30 and 32) produced from 'B' structure and one well from Hteinkyun area. It is quite clear from the production history that each of these wells produced from sand bodies which were discontinuous and were not part of a main reservoir.

8. All MOGE reserve calculations assumed reservoir continuity average sand thickness and uniform reservoir characteristics. These factors were based on few test results in the earlier discovery wells and should not have been generally applied over the entire Payagon area. In the course of the project cycle, MOGE downgraded the reserves as under:

	Proven	Probable	Possible	Total BSCF
October 1, 1986 (basis for SAR)	208	629	---	837
January 29, 1988	144	9	500	653

The appraisal mission's estimates were obviously highly optimistic as they did not verify various assumptions made by MOGE, but developed the entire project on these gas supply assumptions.

9. During subsequent supervision missions, the reserves and gas producibility became a major issue. During 1989, IDA suggested and MOGE agreed to a reserves audit by independent consultants, who determined the reserves as follows:

	Initial Gas in Place BCF	Balance Recoverable BCF
Proven	34.5	9.1
Probable	52.9	44.0
Possible	166.5	133.0
Total	253.9	186.1

The actual production history from Payagon the wells has more or less confirmed the consultants' analysis.

10. An analysis of proven reserve as on the dates indicated yields the following comparison.

<u>Proven Reserves- Estimates & Actual Production</u>			
Structure	MOGE estimates in January 1988 Gas in Place/BCF	Consultant est. in May 1989 Gas in Place/BCF	Actual Production BCF
D	41.7	33.5	29.5
A-E	81.0	0.0*	4.6
B-F	20.4	0.0*	6.0
Hteinkyun	1.2	1.0	0.9
Total	144.3	34.5	41.0

* Consultants had given 24.6 bcf and 11.0 bcf as probable in 'A-E' and 'B-F'.
As can be seen, the results in 'A-E' structures were most disappointing.

CONCLUSION

11. Of the total gas production of about 41 bcf, about 30.4 bcf was contributed by 'D' structure (about 73%), 6 bcf by 'B-F' structure (14.6%) and 4.05 bcf by 'A-E' structure (about 9.9%) out of the proven reserves of 62 bcf, as currently estimated by MOGE, which are generally in tune with the Reserve Audit study. 'A-E' structure has been most disappointing, considering that during appraisal most of the proven reserves plus probable were assumed to be in 'A-E' structures and next in 'D' structure. On hindsight, it appears that the appraisal mission should have been more careful in verifying the assumptions made by MOGE in reserve estimates. It is quite clear that bundling of proven and probable reserves together for the purpose of developing a capital intensive gas project with major downstream investment was not correct. It would have been better, if prior to appraisal, IDA had conducted a reserve evaluation study by independent consultants.

12. The timely monitoring by IDA missions and steps taken for (a) reserves audit (b) suspension of all activities on gas transmission and distribution helped in preventing wasteful expenditure on Payagon gas supply to Yangon.

13. One significant outcome of a thorough reservoir investigation and monitoring of test results during supervisions has been that MOGE has become familiar with modern reservoir engineering and gas industry practices and is currently applying these in the development of Apyauk gas (50 miles NW of Yangon) field, discovered by Shell in 1991 and under development by MOGE following relinquishment by Shell in September 1993. The gas supply objectives which could not be achieved from Payagon are expected to be achieved from Apyauk gas field estimated to produce 120-150 MMSCFD on a sustained basis.

MYANMAR GAS DEVELOPMENT & UTILIZATION PROJECT CREDIT 1840-BA Payagon Gas Field Economic Rate of Return- All field production							
(\$ Figures in thousands)							
FY	Gas Sale MMCF	Condensate 000 IG	Investment 1991\$	O&M 1991\$	Revenue Gas 3.15 per MCF	Revenue Condensate 0.60 per IG	Net Cash Flow
1982			138				(138)
1983			748				(748)
1984	143		5488	91	450		(5,129)
1985	291	1711	11577	442	917	1027	(10,075)
1986	3894	846	12699	787	12266	507	(713)
1987	7695	340	7874	1082	24239	204	15,486
1988	6798	174	3793	1411	21415	104	16,316
1989	6482	164	24089	1397	20417	98	(4,971)
1990	7897	170	11886	1616	24875	102	11,474
1991	2957	104	5410	1690	9314	62	2,276
1992	1544	98	1722	1692	4864	59	1,509
1993	985	74	1648	1692	3103	44	(193)
1994	310	20		1692	975	12	(705)
Total	38995		87074			ERR=	29.4%

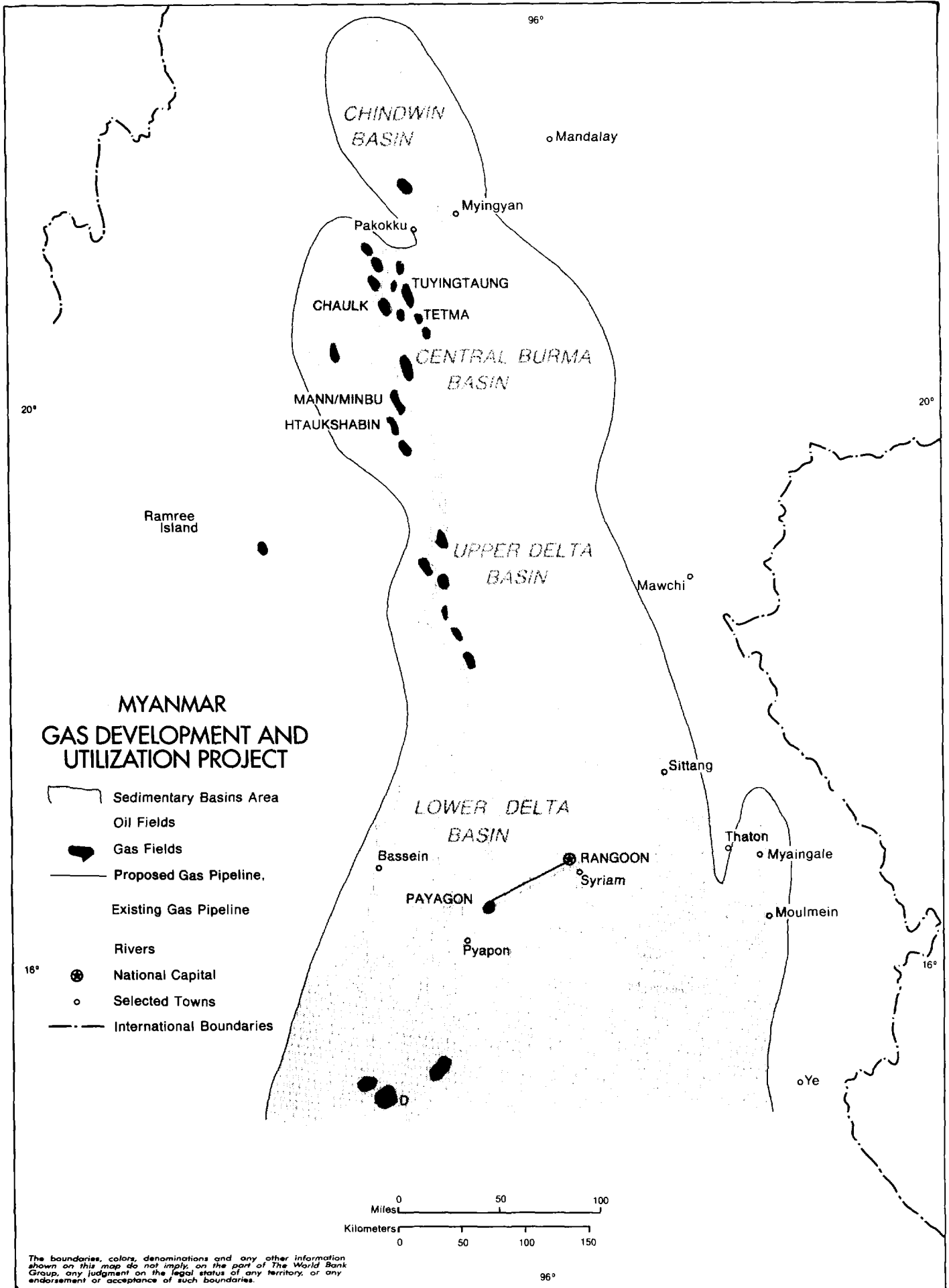
Local costs converted to US\$ at official exchange rates as in SAR. The economic value of gas is derived from a mix of border prices for diesel oil and fuel oil; in effect it becomes the equivalent price of crude oil. This again follows the SAR.

MYANMAR GAS DEVELOPMENT & UTILIZATION PROJECT CREDIT 1840-BA Payagon Gas Field Economic Rate of Return- IDA Project Part Only							
(\$ Figures in thousands)							
FY	Gas Sale MMCF	Condensate 000 IG	Investment	O&M	Economic value of gas \$5.10 per MCF	Econ value Condensate \$0.60 per IG	Net Cash Flow
1989	84	11	13658	1366	429	7	(14,589)
1990	4867	633	7054	2071	24821	380	16,075
1991	1433	186	1988	2270	7307	112	3,161
1992	746	45	166	2287	3803	27	1,377
1993	482	17	166	2303	2457	10	(2)
1994	108	10		2303	553	6	(1,745)
Total	7719.48	901.88	23033	12600		ERR=	28.4%

Local currency costs of investment taken at the open market exchange rate of \$1=65 kyats. Fuel displaced by gas was diesel oil, the border price of which ranged around an equivalent price for natural gas of \$5.10/MMCF.

All of the new Payagon gas during the period FY1994 substituted diesel oil (not a mix of diesel oil and fuel oil) in power plants, obviating imports of diesel oil to that extent. Further, the open market exchange rate in that period was US\$1 = 65 kyats, and it is but appropriate that this shadow exchange rate be used.

SAR estimates compared with actual results			
	SAR Assumptions	SAR corrected for omitted pre-1988 operations	Actual Results
<u>ERR for Phase 1</u>			
[High crude price scenario	72.0%	36.6%]	29.4% whole field
[Low crude price scenario	46.2%	25.3%]	
Gas Production MMCF	397,000	409,000	41,900
<u>Investments \$ million (1986 const.)</u>			
Whole field-Phase 1	71.2	109.1	69.6
IDA Project only within Phase 1	71.2	71.2	31.7
<u>Economic value of gas \$/MMCF</u>			
[High crude price scenario	4.35	4.35]	3.15
[Low crude price scenario	2.13	2.13]	
<u>Conclusion</u>			
<p>Although gas production was 10% of the estimates for the field as a whole, the lower investments and earlier production from the IDA financed wells (earlier by two years, 1989 in place of 1991 both made a positive effect on net present value of benefits. An ERR of 29.4% was achieved. A direct comparison of this figure with the SAR estimate of 46 to 72% is not possible, since the SAR calculations ignored the investments other costs and benefits during 1982-1987, took into account investments and costs relating to the IDA project between 1988 and 2008, but benefits in total including those attributable to investments prior to the IDA project. The SAR estimates were therefore reworked to include the prior period costs and benefits; in the result, the adjusted SAR economic rates of return calculate between 25.3% and 36.6% in the two scenarios of high and low petroleum prices. While the ERR for Payagon field, as a whole at 29.3%, thus was satisfactory it should be more appropriate to examine if the IDA project- constituting an incremental sub-project- within the then producing Payagon field yielded a reasonable ERR by itself. In spite of producing about 8 BCF only out of about 42 BCF that the Payagon field as a whole produced during 1982-1994, the IDA incremental project had also a satisfactory ERR at 28.4%. The methodology adopted, however, is different. Primarily, a shadow exchange rate of US\$1=65 kyats* has been used, being more realistic than the official exchange rate of US\$1= 5.99 kyats currently and slightly higher earlier. Also, the gas from the IDA wells did obviate import of diesel oil for power generation and so, the value of the gas is determined by the border price of diesel oil.</p>			
<p>* Discussed in Myanmar Energy Sector Investment & Policy Review Study- Report No.10394-BA of 3.16.1992 vide para 32 of Executive Summary.</p>			



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IMAGING

Report No: 14629
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