Document of

The World Bank

FOR OFFICIAL USE ONLY

Report No. 11604

PROJECT COMPLETION REPORT

INDIA

MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

JANUARY 29, 1993

Industry, Trade and Finance Division
Technical Department
South Asia Regional Office

CURRENCY EQUIVALENTS

Currency Unit	=	Rupees (Rs.)
Rs. 1.00	=	Paise 100
US. 1.00	=	Rs. 28.01
Rs. 1,000,000	=	US$ 35,702

(as of June 1992)

LIST OF ABBREVIATIONS

BPCL	Bharat Petroleum Corporation Ltd.
C_2/C_3	Ethane/Propane
EG	Ethylene Glycol
EIL	Engineers India Ltd.
EO	Ethylene Oxide
ERR	Economic Rate of Return
FCC	Fluidized Catalytic Cracking
FRR	Financial Rate of Return
GOI	Government of India
HAZOP	Hazards and Operability
HDPE	High Density Polyethylene
IPCL	Indian Petrochemicals Corporation Ltd.
ICG	Internal Cash Generation
LDP	Low Density Polyethylene
LLDPE	Linear Low Density Polyethylene
LPG	Liquified Petroleum Gas
MGCC	Maharashtra Gas Cracker
MPCB	Maharashtra Pollution Control Board
OGL	Open General License
ONGC	Oil and Natural Gas Commission
OSBL	Off Site Battery Limit
PCR	Project Completion Report
PP	Polypropylene

Fiscal Year

April 1 - March 31

THE WORLD BANK
Washington, D.C. 20433
U.S.A.

Office of Director-General
Operations Evaluation

January 29, 1993

MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

SUBJECT: **Project Completion Report on India**
Maharashtra Petrochemical Project (Loan 2505-IN)

Attached is a copy of the report entitled "Project Completion Report on India - Maharashtra Petrochemical Project (Loan 2505-IN)" prepared by the South Asia Regional Office, with Part II contributed by the Borrower.

The PCR is of very good quality. It concludes that the original project objective of constructing a technologically modern, economic-sized plant capable of producing olefins and other derivatives has been achieved and that adequate environmental standards have been ensured. The project was completed well below the estimated cost. However, cumbersome clearance procedures for project investments and an explosion in the feedstock receiving section in November 1990 delayed commissioning of the plant and prevented the company from taking advantage of better international market prices for derivatives. Insurance coverage did not provide for adequate compensation for the direct cost of the accident and the loss of income and, given lower-than-projected world market prices, the economic rate of return has been re-estimated at 11 percent compared to the appraisal estimate of 18 percent.

Although the project had satisfactory overall results and its sustainability is likely, further progress is required in creating a more competitive environment for the petrochemical industry in India. All in all, Bank as well as Borrower performance was good, although the decision to provide Bank finance for monopoly polymer imports under the project may have contributed to excessive trade protection for the public enterprise in charge of project execution.

The contribution received from IPCL substantially agrees with the Bank's PCR and highlights the benefits of Japanese cofinancing for the project. An audit of this project may be carried out, given its size, complexity and the safety issues raised.

Attachment

PROJECT COMPLETION REPORT

INDIA

MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

TABLE OF CONTENTS

PROJECT COMPLETION REPORT

INDIA

MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

PREFACE

This is the Project Completion Report (PCR) for the Maharashtra Petrochemical Project in India, for which Loan 2505-IN in the amount of US$300 million was approved on March 19, 1985. The loan was closed on September 30, 1991, one year behind schedule. The loan was fully disbursed before the closing date, and the last disbursement was on September 13, 1991.

The PCR was jointly prepared by the Industry, Trade and Finance Division of the Asia Technical Department (Preface, Evaluation Summary, Parts I and III), and Indian Petrochemicals Limited (IPCL) the project beneficiary (Part II). A copy of the PCR has been sent to the project co-financier, EXIM Bank of Japan, for its comment.

Preparation of the PCR was started during the Bank's final supervision mission in November 1991. This was followed by a project completion mission to India in May 1992. The PCR is based on the Staff Appraisal Report, the Loan and Project Agreements, the supervision reports, the project files in the Bank, and discussions held with the Ministry of Finance, Department of Economic Affairs, Ministry of Industries, Department of Chemicals and Petrochemicals, and during the missions in November 1991 and May 1992.

PROJECT COMPLETION REPORT

INDIA

MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

EVALUATION SUMMARY

Objectives

1. The main objective of the project was to improve the competitiveness and productivity of India's basic petrochemical sector through the introduction of modern, cleaner technologies, the adoption of economies of scale, and the use of gas (the most economical feedstock) for the manufacture of olefins and derivatives. The project also sought to stimulate the demand for olefin derivatives in India, through the development of products that could alleviate the pressures over the natural resource base of the country (para. 3.1).

Implementation Experience

2. There were some delays in project implementation requiring extension of the loan's closing date by one year. The main reasons for the project's slippage included: (i) inclement weather; (ii) delays in the supply of ethane/propane fractions produced at Uran; (iii) an explosion and fire in a section of the off-sites battery limits (OSBL) of the complex in November 1990; and (iv) delays in completion of the Linear Low Density Polyethylene (LLDPE/HDPE) plant which requires about half of the ethylene boiler plate capacity (para. 5.2). The project began commercial production at the end of July 1991.

3. Completion of the Uran gas separation facilities was postponed due to delays in securing an environmental clearance by Oil and Natural Gas Commission (ONGC) and implementation problems encountered by the contractor. However, these delays were partly offset by delays in the completion of the pipeline from Uran to Nagothane and the cryogenic storage tanks at Nagothane (para. 5.3).

4. During the commissioning activities in November 1990, the gas chilling and storage section of the projects' OSBL suffered extensive damage, explosion and fire which also caused 32 deaths. A GOI appointed technical committee investigated the incident and presented its report to the GOI which is still reviewing it. The study has not yet been made available to the Bank. However, the Committee is reported to have concluded that material failure was the most likely cause of the accident. In the meantime, IPCL has conducted a detailed design and safety audit, and rebuilt the plant. The estimated cost of repairs was about US$19.2 million; production loss was around US$86 million (paras. 5.7-5.8).

5. The LLDPE/HDPE plant was scheduled for completion in February 1990, but has not been commissioned yet. Possible delays were recognized early in contract implementation, but due to a lack of cooperation by the contractor, no remedial actions were taken for a timely completion. The contractor's constraints were due to (i) cost increases during implementation not covered in the initial quotation, and (ii) changes suggested during implementation by the process licensor based on more recent developments and experience (para. 5.11).

Project Results

6. Despite the substantial delays in project completion, and lower product prices, the project remains economically viable. The project was completed well within estimated costs, but has fallen short of fully achieving its physical targets as planned at the time of appraisal. The Financial Rate of Return (FRR) is, however, an attractive 18.8% due to the high domestic prices maintained through tariff protection. If, as a result of GOI's policy reforms, the tariffs are removed over time, the FRR could decline closer to the Economic Rate of Return (ERR) or may even be slightly lower given the higher financial capital costs of the project (paras. 6.1-6.7).

Environmental Aspects

7. The project has successfully met all requirements for environmental protection. It was designed with appropriate discharge standards and modern technologies for waste minimization and abatement. IPCL, which itself has been awarded numerous environmental (and safety) recognitions, commissioned and implemented detailed environmental impact studies. It also funded an ambitious program for the reforestation of extensive areas surrounding the Nagothane site, which is well under implementation (para. 6.3).

Project Sustainability

8. The Indian domestic market for petrochemicals is expected to exceed supplies for the foreseeable future, and the Asia regional market is expected to continue being the world's largest net importer of petrochemical products. However, major additions to installed capacity are being developed in India, as well as in the Asia region, using state-of-the art technologies. The advantages derived from the use of gas feedstocks and the employment of large economies of scale are expected to enable IPCL to remain competitive in an increasingly crowded regional market. Feedstock supplies are not expected to be a limiting factor in the foreseeable future. Prices will continue to fluctuate in the future but are not expected to fall below the long run marginal costs (para. 7.1). Under these conditions the Nagothane complex is expected to remain viable. The project's ERR, calculated under very conservative assumptions, is 11.4%. Moreover, the complex has been designed to minimize its long-term environmental impact and is not expected to have an adverse impact on the Nagothane area.

Findings and Lessons Learned

9. The project was a complex undertaking that engaged the best of the technical and management expertise at IPCL. Its successful completion places the company in a pre-eminent position in the Indian chemical industry and will

contribute to significant improvements in the competitiveness and productivity of the petrochemical sector. The project was well-conceived and thoroughly designed with the assistance of leading licensors and contractors. However, it faced difficulties during its implementation (paras. 5.2-5.14) and provides the following valuable lessons to the beneficiary, the borrower, and the Bank:

(a) foremost, coordination between the project entity and other agencies of the GOI Ministry of Environment and Forest, (ONGC), must be faulted for serious delays in permits and completion of infrastructure. Closer coordination for environmental permits and clearances is required in projects of this nature especially since the environmental regulations are likely to become more stringent in the foreseeable future;

(b) failure to prevent and anticipate extensive litigation for the rights of way, required by the ONGC, Bharat refinery and IPCL pipelines, resulted in the commitment of large financial resources from these entities. Although the delays did not directly affect the project, they did distract the top management of IPCL at a time when the project was nearing critical testing and precommissioning (para. 5.4);

(c) insufficient and perhaps inadequate insurance coverage resulted in financial losses for IPCL from equipment damaged during the explosion. The insurance policy should have been subjected to close scrutiny during project preparation both by IPCL and the Bank (para. 5.8);

(d) in terms of the LLDPE-HDPE plant, IPCL has expressed its complete dissatisfaction with the performance of the contractor and has pointed out to the Bank that at the time of the bid evaluation, it suggested award of the contract to the second lowest evaluated bidder (L2); in retrospect, doubts about the performance of lowest evaluated bidder (L1) should have been pointed out at the time of prequalification of bidders (para. 5.14).

10. Caveat. It is difficult to draw any lessons from the November 1990 explosion at the OSBL facilities, which occurred during project implementation. Until the GOI completes its review of the Mashelkar Committee report, it will not be released and the Bank will not have the benefit of the Committee's findings and recommendations. It is expected that the report would be released before the end of 1992. Once received, the Mashelkar report will be reviewed by staff, and an appropriate addendum to this PCR will be issued.

PROJECT COMPLETION REPORT

INDIA

MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

PART I: PROJECT REVIEW FROM BANK'S PERSPECTIVE

1. Project Identity

Name:	Maharashtra Petrochemical Project
Loan Number:	2505-IN
RVP Unit:	South Asia Region
Country:	India
Sector:	Industry

2. Background

2.1 The petrochemical industry is at the core of the manufacturing industry in developed nations and has repeatedly been pointed out as a key element of industrial strategies and the ability to export consumer goods. Worldwide, the Asia region is experiencing the fastest modernization and evolution of the industry and is the largest net importer of petrochemicals and derivatives. India has a large and growing domestic market for petrochemicals and has experienced significant increases in polyolefins imports. Domestic manufacture of ethylene and derivatives in India is justified by the availability of large reserves of natural gas liquids on the west coast and a domestic market of a size that permits setting up large production facilities. A recent World Bank analysis (1990) has pointed out that domestic manufacture of ethylene and derivatives in India is economically justified, provided that competitively priced feedstock is made available and economies of scale are achieved. The Maharashtra project was conceived to make use of the natural gas liquids available at Uran for the manufacture of ethylene using modern technologies of competitive size.

2.2 The Government of India (GOI) has made substantial progress over the last five years in reforming the sectoral policy environment. Involvement in the project has enabled the Bank to maintain a useful dialogue with GOI on developing and implementing appropriate policy reforms. The complex system of capacity licensing, which in the past constrained modernization and adoption of economic size plants, has been mostly eliminated. Competition is being encouraged throughout the sector. The rules governing foreign direct investment have been substantially liberalized, permitting joint ventures with foreign ownership. The prices of major primary feedstocks (C_2/C_3, benzene and naphtha) are roughly in line with their economic opportunity costs to India. Efforts are currently under way to establish a rational long-term feedstock pricing policy for the sector. Feedstock price adjustments in line with the proposed policy, necessitated by recent exchange rate changes, are expected to be implemented in the next few months. The trade regime for imports of major petrochemicals has been

liberalized considerably, and most of the important petrochemicals are now in the Open General License (OGL) category. These measures are in line with present favorable trends for economic policy reforms in India, which aim to improve allocative and operational efficiency within the sector and facilitate outward orientation of the Indian economy.

2.3 Though substantially lower than in the 1980's, current protective tariffs (basic and auxiliary) are still high by international standards. Together with the prevailing high countervailing duties and excise taxes levied on petrochemical products, the high protective tariffs have resulted in high domestic basic raw material prices. This in turn has resulted in high manufactured product costs. To promote domestic market demand growth and facilitate allocative and operational efficiency within the sector, additional reductions in tariffs are required. Such reductions are particularly important in view of the large investments envisioned in India for implementation in the next five years or so (1992 - 1997), which if implemented will double ethylene capacity in India to one million tons by 1996.

2.4 In early 1992 GOI disinvested about 20% of IPCL's paid up equity to bidders from state-owned financial institutions and mutual funds. These shares are expected to be ultimately sold to the public. IPCL is considering options for raising capital from nongovernment sources to finance its large investment programs, as a result of which GOI's shareholding will drop. GOI has not yet taken a decision as to whether its shareholding will drop below 51%, in which case IPCL would cease to be a government company.

3. Project Objectives and Description

3.1 Project Objectives: The main objective of the project was to improve the competitiveness and productivity of India's basic petrochemical sector through: (i) the introduction of modern, cleaner technologies; (ii) the adoption of economies of scale; and (iii) utilizing natural gas (the most economical feedstock) for the manufacture of olefins and derivatives. The project also sought to stimulate the demand for olefin derivatives through the development of products that could alleviate pressures on the natural resource base of the country (e.g. through the introduction of synthetic fibers and films).

3.2 Project Description: The Project included (i) setting up a large petrochemical complex at Nagothane, near Bombay-based on C_2/C_3 fractions recovered from Bombay High gas at Uran, and (ii) importing during construction, polymers of the type and quality grade to be manufactured by the facility to develop the market and processing capacity for plastic products in India. The Nagothane complex includes a cracker for the production of ethylene and propylene; a butadiene stream to be sold as fuel feedstock; and facilities for recovery of 37,000 tpy of propylene from the Fluidized catalytic cracking (FCC) gases from the Bharat Petroleum Corporation Ltd.'s (BPCL) refinery in Trombay. The project was planned for an initial capacity of 300,000 tpy of ethylene (which is being expanded to 400,000 tpy under the second Bank-financed project, Loan 3259-IN), 63,000 tpy of propylene and 2,200 tpy of acetylene. The project sought the creation of a plant to produce marketable products, Low Density Polyethylene (LDPE) -(80,000 tpy), Linear Low Density Polyethylene (LLDPE)/High Density Polyethylene (HDPE) -(135,000 tpy), and Polypropylene (PP) - (60,000 tpy) which

are polyolefin plastics to be sold to the conversion industry; and Ethylene Glycol (EG) - (50,000 tpy)/ Ethylene Oxide (EO) - (5,000 tpy), which are intermediates for synthetic fiber and synthetic detergent industries. Some surplus ethylene was expected to be marketed.

3.3 Moreover, the project included: (i) acquisition and installation of associated utilities; (ii) construction of offsite and other facilities; (iii) installation of infrastructure; and (iv) a wire and cable compounding plant of 12,500 tpy capacity, based on LDPE as feedstock. This plant would substantially add to product value, thereby improving the profitability of the project. The LLDPE/HDPE plant in Nagothane (swing plant process) has the capability to produce the special grade polymers required for wire and cable compounding.

4. Project Design and Organization

4.1 The project was conceived and designed by IPCL with the assistance of a public sector consulting group, Engineers India Limited (EIL). It sought to maximize the return on the higher molecular weight (C_2/C_3) hydrocarbons available at the Bombay High gas fields and to meet the expected demand for petrochemical feedstocks and derivatives from the domestic industry. The project was prepared by a group constituted by the GOI, with IPCL and EIL providing the major inputs; the scope was appropriate.

4.2 The project introduced for the first time in India more efficient and environmentally cleaner technologies for the manufacture of PP (slurry vertical reactor) and HDPE/LLDPE. The PP technology was introduced in a remarkable fashion with no delays and a quick start-up well ahead of schedule. However, the HDPE/LLDPE unit ran into problems first caused by the relative inexperience of the turn-key contractor, but also as a result of the novelty of the process and modifications required by difficulties encountered in the start up of a similar unit in China. Except for the HDPE/LLDPE plant - implemented on turnkey basis, other process plants have been engineered to international standards and EIL managed their construction efficiently.

5. Project Implementation

5.1 Loan Effectiveness and Project Schedule: Although the project was identified in the third quarter of 1980, the appraisal took place only in the third quarter of 1982, and the Bank's Board of Directors approved the loan in March 1985. The long gestation period was due to delays in: (i) ONGC obtaining certain environmental clearances; (ii) GOI evaluation and approval of project investment (April 1984); and (iii) selection and approval of selected technologies except LLDPE (January 1985). All these decisions were important for establishing the implementation schedule. The loan processing schedule was, therefore, in line with the progress of project preparation and did not result in project delays.

5.2 Implementation Schedule: The original project completion date was December 1989. The other project components were scheduled for completion to match completion of the cracker, except for utilities, which were to be completed

three to six months earlier. However, most of the project components were mechanically completed about one year behind schedule (para. 4 of Part III). The main reasons for the delays were: (i) inclement weather during the final stages of physical completion in the summer of 1989; (ii) delays in the supply of feedstock ethane/propane fractions produced at Uran; (iii) an explosion and fire in the OSBL of the complex on November 5, 1990, that caused considerable damage and 33 deaths; and (iv) a lack of understanding between the LLDPE/HDPE plant turnkey contractor and IPCL, resulting in delays in completion of the plant, which requires about half of the ethylene boiler plate capacity.

5.3 In July 1989 the Nagothane facilities were about to be completed when unusual rains and floods caused total work stoppage for about two months. Precommissioning of the cracker could only be completed in February 1990. However, IPCL could not proceed with further commissioning due to delays in completion of the Uran gas separation facilities, the pipelines between Uran and Nagothane, and cryogenic storage tanks at Nagothane. Completion of the Uran gas separation facilities, implemented by ONGC on a turnkey basis, was postponed due to delays in securing an environmental clearance by ONGC and implementation problems encountered by the contractor. The environmental clearance was obtained after ONGC met the discharge and other environmental conditions imposed by the Maharashtra Pollution Control Board (MPCB). The Uran facilities, therefore, become operational by September 1990. These delays were partly offset by delays in the completion of the pipeline from Uran to Nagothane (March 1990) and the cryogenic storage tanks at Nagothane (February 1990) -- both the responsibility of IPCL.

5.4 The difficulties at Uran and the delays in completion of the pipeline were beyond the control of the project implementation authorities. As the ONGC and Bharat refinery handed over the pipeline project to IPCL after one and a half year delay. IPCL, also experienced substantial delays by the extensive litigation that evolved from securing the right of way for the pipeline. In fact, IPCL's direct involvement in the process, although not originally under its responsibility, was instrumental in speeding up the completion of the C_3 pipeline from the Bharat refinery.

5.5 The cryogenic tanks and the pipeline were completed in February and March 1990, respectively. In April 1990 at IPCL's request, GOI allocated liquified petroleum gas (LPG) as a substitute feedstock, to enable IPCL to proceed with the commissioning. However, problems with pumps at Uran and the Nagothane waste heat boiler feed pump delayed commissioning to July 1990, Ethylene was finally produced on July 17, 1990 using LPG as feedstock. Due to domestic shortages, however, LPG allocation was discontinued shortly thereafter.

5.6 The cracker was commissioned by end October 1990, and ethylene based on C_2/C_3 fractions was produced. However, the commissioning activities were suspended following an explosion and fire on November 5, 1990, in the OSBL facilities of the complex. The cracker was restarted in July/August 1991 without using the OSBL facilities. By April 1992 all the process plants had begun commercial operation, except LLDPE and wire and cable compounding plants. The LLDPE plant, considerably delayed during construction, has since been commissioned. Also, the wire and cable compounding plant, taken up for implementation at a later date, is getting ready for commissioning.

5.7 Explosion at the OSBL facilities of the Complex: The Gas Chilling and Storage Section at the OSBL of Nagothane suffered an explosion and fire on November 5, 1990, resulting in extensive damage to the facilities and 32 deaths (Annex III for internal review only). The GOI appointed a high level technical committee, headed by Dr. Mashelkar (Director, National Chemical laboratories), to investigate the causes of the accident and evaluate measures to prevent similar occurrences. The committee's report was presented to GOI in late December 1991. The report was scheduled for review by a GOI Committee of Secretaries in June 1992. While the findings of the study, and GOI decisions on suggested actions, are not available to the Bank yet, it is stated to have ruled out negligence in design, engineering or operation as the cause of the accident and concluded that material failure was the most likely cause.

5.8 The accident is estimated to have cost IPCL about US$19.2 million for repairs, of which about 65% was covered by the insurers.[1] In addition, the accident alone resulted in delaying the commissioning of the project by about one year. The financial loss due to lost production is estimated by IPCL to be about US$86 million. Since the plants were still being commissioned, IPCL was not covered by insurance for loss of income. Furthermore, the delays caused by the explosion have caused IPCL to miss the peak in pricing of derivatives in the international market. Indications are now that prices of derivatives will continue to remain at the present low level in the near future.

5.9 Safety considerations were an important design criteria for the project from its inception. Modern technologies with state-of-the-art safeguards were obtained from leading licensors. Proven contractors with extensive basic engineering and construction experience were selected for implementation of the project. As part of the development of the project, IPCL conducted a thorough safety study prior to commissioning and an assessment of hazards and operability (HAZOP), the recommendations of which were communicated to the Bank and promptly implemented by IPCL. IPCL had developed a safety and environment department which conducted training and awareness programs among managers and future operators of the plant. Activities developed by its safety department have earned IPCL several safety awards in the recent past.

5.10 After the accident a new safety study was commissioned for the entire complex including a safety audit for the OSBL facilities where the accident took place. A leading safety specialist (Cremer & Warner U.K.) was retained who recommended changes in design and operational and maintenance procedures. These changes are under implementation.

5.11 Detailed engineering was undertaken by EIL for most of the basic engineering packages supplied by foreign licensors or contractors. Two units were contracted on a turnkey basis: (i) the LLDPE/HDPE plant, and (ii) the gas based captive power plant. The captive power plant was implemented ahead of schedule with no major difficulties. The LLDPE/HDPE contract was awarded to a

---

1/ The reason for only 65% recovery from the insurance company is due to under insurance of the same magnitude. Due to: (i) higher replacement cost of capital vs. original purchase price; and (ii) increase in price of imported equipment, because of devaluation of Rupees relative to other currencies.

foreign contractor bidding in association with an Indian subcontractor, but assuming total overall responsibility. The plant was scheduled for completion in February 1990, but was commissioned only in May 1992. Possible delays were recognized early in contract implementation. Howewver, it took extra effort on the side of IPCL -- rupee financing to the subcontractor -- which was in fact an obligation of the contractor and Bank intervention to expedite implementation. The contract implementation problems were possibly due to: (i) cost increases during implementation not covered in the initial quotation, (ii) reluctance of the foreign contractor to fully meet its contractual obligation, (iii) and changes suggested during implementation by the process licensor based on more recent developments and experience.

5.12 Part of the concern - especially for future projects - is the difficulties encountered by IPCL in staffing the complex. Due to IPCL's initial decision to delay investments on project housing and amenities, many experienced managers were reluctant to move from Baroda to Nagothane. Also, state regulations required all positions below senior levels to be filled with locally recruited and trained personnel. IPCL is taking special efforts to remove these constraints. It has, in addition, adopted several suggestions and recommendations to improve safety practices in the plant areas. Communication facilities with feedstock suppliers and nearby towns have been improved. IPCL has adopted a special program to educate the surrounding community on recommended safety measures in case of emergencies. It has also prepared an offsite disaster management plan identifying appropriate infrastructure facilities to be developed, and is discussing its adoption with the local authorities.

5.13 Procurement: The project was the first time IPCL was using World Bank funds, thus, both IPCL and EIL had initial difficulties understanding the Bank's procurement requirements. Therefore, an IPCL/EIL team visited the Bank headquarters to discuss procurement procedures and reach an understanding. There were also some initial difficulties in developing and agreeing on procedures appropriate for procurement of commodity plastics. These were solved through the implementation of a special procurement procedure which allowed for bidding by telex, with a validity period of 10 days and provision that, if in IPCL's judgement procurement had to be postponed, new bids could be invited at an appropriate time. This procedure was adopted in consideration of the volatile market situation prevailing in the commodities market. IPCL encountered major contract management problems with the LLDPE/HDPE turnkey contract, where the foreign contractor had overall performance responsibility, engaging Indian partners to carry out local procurement and construction services.

5.14 The major difficulty was caused by the procurement for the turnkey contract of the LLDPE/HDPE plant. The bids were received with less than 0.5% difference between the quotations supplied by the lowest evaluated bidder (L1) and second lowest evaluated bidder (L2) (after valuation of deviations). IPCL argued that L1 had no track experience in India and therefore wished to award the contract -- based on the small difference -- to L2. As both contractors were prequalified, the Bank insisted on awarding the contract to L1. However, the turnkey contractor was slow in developing a site team and soon experienced difficulties and misunderstandings with its Indian subcontractors. Subsequent delays in commissioning of the plant exceeded two years and have adversely affected the economic viability of the project. Inordinate delays were caused

by lack of understanding between the foreign contractor and the Indian subcontractors, and by the lack of cooperation from the foreign contractor adhereing to its contract in terms of overall responsibility for project execution. Direct Bank intervention was instrumental in forcing a compromise under which completion of the first stage of the unit has been finalized.

5.15 Project Costs and Financing: Actual installed costs of the project - excluding working capital and interest during construction -- are now estimated to be Rs.12,144 (US$809) million, compared with the appraisal estimate of Rs.15,144 (US$1,287) million, (para. 5 of Part III). The variance is mostly due to provisions for high price contingencies since at the time of preparing the SAR the costs of equipment were high, and there was anticipation of high inflation rates, which did not occur. The SAR identified the need for co-financing, for which, on the proposal of GOI, the arrangements were to be finalized during the procurement cycle. In October 1989 IPCL entered into a loan agreement with the EXIM Bank of Japan for the amount of ¥11.7 billion to close the financing gap of Rs.3.1 billion. The SAR had envisaged that the project would be financed by about 50% loans and 50% equity partly in the form of new shares and the rest from IPCL's internal cash generation (ICG). However, the project has been financed entirely through loans 69% and ICG 31%. As a result, the ratio of long-term debt to equity in FY91 was 65/35 -- against 60/40 stipulated in the Project Agreement. However, since the company has a good profitability and debt service coverage from a project point of view, this situation is not likely to cause problems (paras. 6.7-6.9).

5.16 Disbursements: The appraisal and actual loan disbursements are given in para. 3 of Part III. After some initial delays, the actual disbursements roughly matched the estimates. The loan was actually closed on September 30, 1991, after one year extension. The last disbursement was on September 13, 1991, and the loan was fully disbursed.

5.17 Loan Allocation: The original allocation and actual disbursements for Loan 2505-IN are shown in para. 5C of Part III. Disbursement for pre-production polyolefins was close to appraisal estimates. The original allocations were revised in September 1989 to reflect changes in financing for license, engineering and services, as well as the equipment, materials and spares.

6. Project Results

6.1 Project Objectives and Physical Results: Overall, the project has achieved its main objective through the introduction of modern, cleaner technologies for the manufacture of basic petrochemicals for domestic consumption. However, the project was mechanically completed about one year behind schedule and the commissioning has been further delayed (see para. 5.2 above). Consequently, there were considerable delays in achieving the physical targets of the project. Nevertheless, the project has been instrumental in developing an adequate market for its products through a successful seeding program. The main cracker and several of the downstream plants are already in successful operation and the others are being commissioned. The LLDPE/HDPE plants are in the final stages of commissioning of the OSBL facilities, although these are expected to become operational in the second half of 1992. The repaired and modified OSBL facilities are scheduled to be recommissioned during

August 1992. However, as a result of design modification of the operating procedures, it is possible to operate the complex without the chilling and storage area. Therefore, its completion is not a requirement for normal operation of the complex.

6.2 The LDPE, PP and EO/EG plants are now operating satisfactorily. The wire and cable compounding plant is also getting ready for commissioning. The volume of polymers produced since July 1991, and quantities and values of polymer imports, are summarized in para. 6A of Part III.

6.3 Environmental Aspects: The project was designed with appropriate discharge standards and modern technologies for waste minimization and abatement. IPCL, which itself has received numerous environmental (and safety) awards, commissioned and implemented detailed environmental impact studies. The project has successfully met all requirements set up by the MPCB under the Environment (Protection) Act. These standards compare favorably with the corresponding guidelines issued under legislation in industrial countries. A comprehensive wastewater treatment plant has been commissioned as well as measures to safely dispose of hydrocarbon emissions (via a venting flare). The power plant has been designed to meet the standards of MPCB on stack emissions. A large reforestation plan is well under way, far exceeding the statutory requirements.

6.4 Economic and Financial Rates of Return: The assumptions used in estimating the revised economic and financial rates of return are summarized in para. 6D of Part III. The project economic rate of return (ERR) is now estimated at 11.4% as against the base case of 18% estimated in the SAR. This variation is due to the following reasons:

(i) The Project has been delayed by over two years -- partly due to implementation delays, especially of the Uran gas separation facilities and of the LLDPE plant, and mostly due to the November 1990, explosion in the complex. IPCL has taken considerable time and effort to repair the facilities and bring them back to safe operation.

(ii) International petrochemical prices have dropped significantly from their levels of the late 1980s, as a result of large increases in production capacity, in particular in the Asia region, and the continuing economic recession in the US and other developed countries, and a subsequent reduction in margins.

6.5 The ERR and the sensitivity tests are shown in para. 6B of Part III. The ERR is most sensitive to (i) the level to which capacity utilization can be raised and maintained, (ii) the speed with which production can be raised to optimum levels, and (iii) the levels of international prices for polyolefin. In the unlikely event of the capacity utilization reaching only 80% level, the ERR may decline to 9.8%. If international prices of polyolefins increase by 20% over the present levels, the ERR will increase to 14.7%. If, as IPCL expects, production levels in the Nagothane complex reach 95% by FY95 (instead of by FY96), the project ERR will improve to 12.2%. Under reasonable scenarios the project ERR is acceptable, but would require IPCL's best efforts to achieve high production and efficiency levels.

6.6 The project financial rate of return (FRR) is now estimated to be 18.8% compared with the SAR estimate of 11.4%. The variance is mainly due to savings in project capital costs and the high prices that IPCL now realizes in the protected Indian market. The FRR and the sensitivity tests are presented in para. 6C of Part III. The project FRR is most sensitive to domestic prices and production levels. Feedstock prices are presently at international levels. However, with GOI's present liberalization policies and the expected growth in domestic petrochemical capacity -- substantially in the private sector -- a significant decline in domestic prices can be expected, which could lead to FRR declining to lower than ERR if the market is completely opened up.

6.7 Financial Performance: The financial position of IPCL has been reviewed taking into account: (i) delays in commissioning of the Nagothane Project, (ii) delays in implementation of the Second Petrochemicals Development Project caused by delays in securing GOI approvals, and (iii) the potential impact of the recently announced economic liberalization measures. Financial projections of the company, as estimated during staff appraisal, are given in Annex I. Present projections are summarized in Annex II. The overall financial position of IPCL continues to remain good in spite of the various adverse factors. This has been mainly due to IPCL's substantially improved revenues compared with appraisal estimates. Because of high tariff protection against imports, IPCL has been able to set domestic prices at levels significantly higher than international prices.

6.8 If domestic petrochemical prices continue at present levels, IPCL is expected to generate about Rs.30 billion of cumulative internal cash during the next five years. It is estimated that IPCL will require about Rs.20 billion to complete the Bank-financed Second Petrochemicals Development Project, and to service their debt and equity during the period. This would leave about Rs.10 billion for other investments. As part of GOI's economic liberalization program, IPCL intends to reduce GOI's shares in the corporation to as low as 51%. In considering various options for the purpose, IPCL should keep in mind its need for raising adequate capital of suitable blend for its future investment program.

6.9 As part of its overall economic and trade liberalization measures, GOI is expected to reduce import tariffs on petrochemicals -- though in a phased manner. If domestic petrochemical prices are reduced on the average by about 15% during the three year period 1994 to 1997, the ICG of IPCL could be lower by about Rs.10 billion. This would constrain IPCL's ability to pursue future large investment program without resorting to heavy borrowing. If this were to happen, IPCL's cash flow position would be tighter and probably would not be able to maintain its debt/equity ratio at better than 60/40.

6.10 Impact of Project: The main impact of the project must be seen in the context of the modernization of the basic petrochemical industry in India. Development of the project occurred against the background of gradual liberalization of the economy and removal or modification of trade and license barriers. The development of a modern production infrastructure will enable domestic producers to compete under the new economic environment in the domestic market and meet the growing demand of the Indian chemical industry. The project has also enabled the use of gas fractions in the manufacture of petrochemicals,

which represents the highest netback value of this natural resource. In the long term the use of gas is expected to provide Indian olefin manufacturers a competitive edge in the regional market.

6.11 Indirect project impacts will be felt in the generation of jobs and creation of new businesses in the downstream industries. Downstream processing of basic petrochemical products is a labor-intensive manufacturing sector that pervades many areas of the economy. Products manufactured by the project will constitute raw materials for the textile industry, for agro-industry, the transportation sector and construction. Many of these activities are in the hands of small-and medium-sized enterprises. The competitive manufacture of basic petrochemicals will enable cost competitiveness of downstream manufacturers.

Project Sustainability

7.1 The Indian domestic market for petrochemicals is expected to exceed supplies for the foreseeable future (Figure 1). Likewise, the Asia regional market is expected to continue being the world's largest net importer of basic petrochemical products. However, major additions to installed capacity are being developed in India and in the Asia region by experienced producers using state-of-the-art technologies. The advantages derived from the use of gas feedstocks and the employment of large economies of scale are expected to enable IPCL to remain competitive in an increasingly crowded regional market. The financial projections prepared for the project (para. 6.7) have taken into account the cyclical nature of petrochemical prices through adoption of lower margins for the price forecast. Prices will continue to fluctuate in the future but are not expected to fall below the long-run marginal costs. Under these conditions the Nagothane complex is expected to remain viable. Feedstock supplies are not expected to be a limiting factor in the foreseeable future, as the conversion to olefins represents a high netback value for these resources.

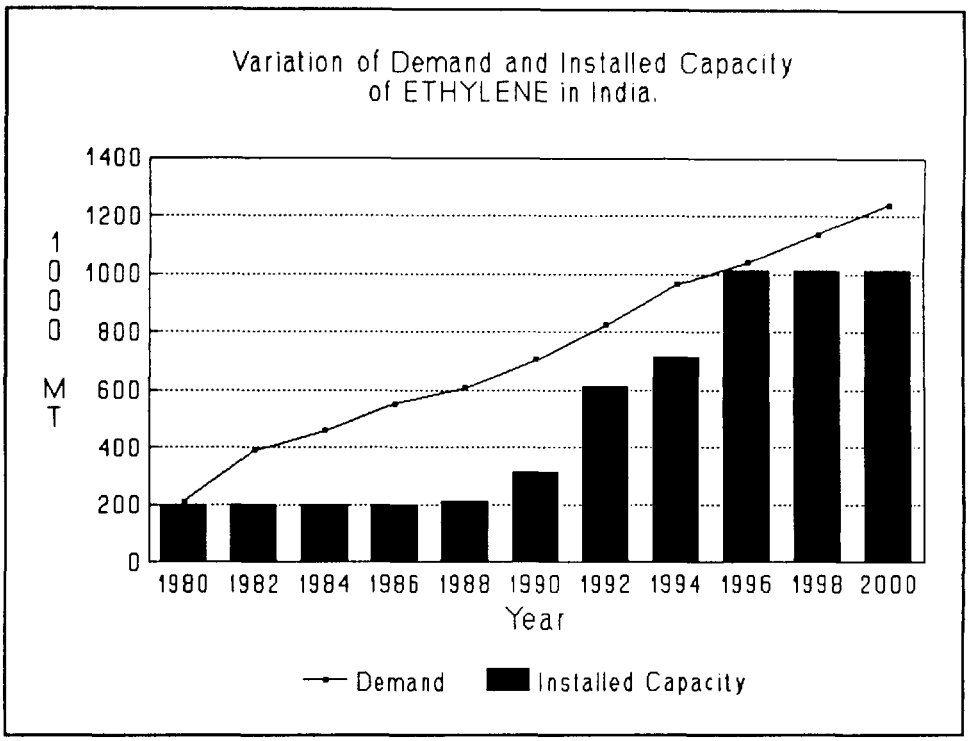

Figure 1

7.2 The ERR of the project has been considerably affected by delays in project completion. Nevertheless, under reasonable assumptions used in estimating the ERR, it is acceptable (para. 6.4). The complex has been designed to minimize its long-term environmental impact and is not expected to have an adverse impact on the Nagothane area (para. 6.3). Feedstock supplies (gas from Bombay High and propylene from the Bombay area) are not expected to be a limiting factor in the foreseeable future, as their conversion to olefins represents a high netback value for these resources. The expansion of the cracker and two of the downstream units under the Second Petrochemicals Development Project (Loan 3259-IN) will further improve the economic viability and sustainability of the complex.

7.3 The high FRR of the project is mainly due to the high domestic prices compared with import parity, supported by high protective tariffs. In line with the present favorable trend for economic policy reforms, the GOI is expected to further reduce protective tariffs, to promote market growth and to facilitate allocative and operational efficiency within the sector. As a result, average output prices could be forced down by 10 to 20 percent. At the same time input prices may be raised to reflect changes in exchange rates. These changes can push down the FRR to about 12%.

7.4 Following the accident at the OSBL, the residents of the community around the project have become conscious and concerned of the environmental impact of similar large projects. IPCL has been aware of the projects implications and has embarked on a program to keep the community informed. IPCL

is also developing a disaster management plan with the cooperation of local authorities. All these measures should help to minimize the risks of plant closure due to environmental concerns.

8. Bank Performance

8.1 Bank involvement was instrumental in developing the project scope, including choice of alternative technologies/products. Through the Project, the Bank has maintained constructive dialogue with the GOI on the petrochemical sector, its policy environment and its investment program. Throughout implementation the Bank has cooperated with IPCL in identifying issues adversely affecting project implementation and developing solutions to their issues. The Bank's involvement in this project has resulted in a significant strengthening of the domestic petrochemical industry in India.

8.2 The difficulties experienced in the execution of the turn-key contract for the LLDPE/HDPE plant, call into attention the suitability of strict application of procurement procedures. Although the pre-qualification procedure should have taken into account any doubts on the performance of L1, it did not. Close quotations with large deviations requiring subjective estimates represent a difficult judgement call.

9. Borrower Performance

9.1 The borrower (IPCL, the beneficiary) provided the project with an experienced, professionally competent team which managed the project relatively effectively. The project was completed well within costs and some components were on schedule. IPCL handled the aftereffects of the explosion maturely and brought back the facilities into operation without undue delay.

10. Project Relationship

10.1 The Bank' relationship with the GOI and IPCL during project implementation has been excellent. IPCL generally maintained constructive relationships with its consultants and contractors.

11. Consulting Services

11.1 The project obtained process technologies for the various plants from well known international firms. The engineering and construction management services for all plants other than LLDPE and the captive power plant were provided by EIL. EIL engineered the utilities and offsite facilities. Overall, the consultants performed satisfactorily.

12. Project Documentation and Data

12.1 The loan agreement for Loan 2505-IN was adequate and appropriate for achieving the project objectives in all the key areas. The staff appraisal report -- along with documentation in the project files -- provided adequate background to the Bank missions for efficient review of project implementation. IPCL provided all the project-related information requested by the Bank. A Bank supervision mission in November 1991 carried out the preparatory work (including

financial and economic analysis, and rate of return computation) for the PCR. This Project Completion Report was prepared by a Bank completion mission in May 1992 consolidating the above information.

PART II: PROJECT REVIEW FROM BORROWER'S PERSPECTIVE

Following are the verbatim comments of IPCL, responding on the Borrower's behalf:

Confirmation of Information in Part III

The information in Part III of PCR is in order.

Comments on Analysis in Part I

We find the report exhaustive and factual.

Bank's Performance

The Bank's performance has been very good both in terms of speedy clearance of the proposals and disbursements. However, for a large turnkey contract of LLDPE plant, where the difference of evaluated price of deemed L1 and L2 was marginal and could be attributed to error of estimate, the project authorities had requested for World Bank's permission to negotiate with both L1 and L2. But the Bank strictly followed the procedure. In retrospect it is felt that the proposal for negotiation might have resulted in selection of a better performer.

Borrower's Performance

The project authorities were exposed for the first time with the World Bank procedures for procurement and initially had difficulties in conforming to the expectations of the World Bank in full in following the ICB procedure. This was resolved amicably at an early meeting with World Bank. Since then the people who had been trained in the procedures for the 1st loan are no longer available and project authorities will take special efforts to train the officers for smooth utilisation of the IInd loan.

Project Relationship

The Bank's attitude has always been positive and this was borne out by the fact that the emergency requirements were agreed to readily in time. This helped in speedy implementation of the project.

Any Other Comments

We have obtained co-financing facility of 11.722 billion yen from EXIM Bank of Japan for implementation of the MGCC. They were very cooperative during the negotiation and finalisation of loan agreement. Drawal procedures were simple and disbursements were effected timely.

PART III: STATISTICAL INFORMATION

1. **Related Bank Loans and/or Credits:** Loan 2505-IN is the first Bank Group operation in India in the petrochemical subsector. The other operation in the subsector in India is summarized below.

Loan/Credit Title	Purpose	Year of Approval	Status
Loan 3258/59-IN Second Petrochemicals Development Project	Expand ethylene capacity at MGCC to 400,000 tpy, LLDPE/HDPE capacity by 75,000 tpy and 2nd phase wire/cable plant at Nagothane. Setting up of a new 60,000 tpy pp plant, a new 75,000 tpy engineering polymers processing facility, revamping expansion of PBR to 50,000 tpy in Vadodara. TA component for financing training & analytical equipment for CIPET; and imports of polymers for market development.	1991	in progress

2. Project Timetable

Item	Date Planned	Date Revised	Date Actual
Identification	Sept./Oct.1980	-	Sept./Oct.1980
Appraisal	Jan./Feb.1981	Oct./Nov.1982	Oct./Nov.1982
Post Appraisal		-	August 1984
Board Presentation	June 1981	June 1983	March 1985
Loan Signature			May 1985
Loan Effectiveness			August 1985
Loan Closing	Sept.30, 1990	Sept.30, 1991	Sept.30. 1991
Loan Completion			Sept.13, 1991

Planned dates are as in the Project Brief. Revised dates are as in the Issues Paper. Delay between identification and post appraisal was due to time taken by government for project approval and decision on ownership. Post appraisal, among other issues, reviewed technology selection.

3. **Loan Disbursements**

Bank Fiscal Year and Semester ending		(Disbursements in US Dollars Million)		
		Estimated	Actual	Actual % of Estimated
1986	December 31	-	6.3	-
	June 30	18.9	9.9	52
1987	December 31	32.7	20.0	61
	June 30	51.6	41.3	80
1988	December 31	85.4	71.8	84
	June 30	134.5	147.0	109
1989	December 31	208.4	214.1	103
	June 30	253.5	242.4	96
1990	December 31	274.7	245.4	89
	June 30	289.1	282.4	98
1991	December 31	300.0	288.9	96
	June 30	-	293.8	98
1992	September 30	-	300.0	100

Loan amount was fully utilized with the last disbursement on September 13, 1991.

Project Implementation

Project Components	Mechanical Completion	Commissioning

SAR assessment:

Process Plants	October 1989	December 1989
Utilities Plant	August 1989	End 1989

Actual Performance:

	Contract	Actual	
Gas Cracker	Feb. 1989	Oct 1989	July 1991
LDPE	Dec 1988	Oct 1989	Sep 1991
PP	Dec 1988	Mar 1989	April 1989
EO/EG	Nov 1988	Oct 1989	Nov 1991
LLDPE/HDPE	Feb 1990	Apr 1992	Being commissioned
Utilities	Mid 1988	Sep 1989	Dec 1989

5. Project Costs and Financing

A. Project Costs
(Rs. million)

Category / Costs	Estimated Costs			Actual Costs		
	Foreign Costs	Local Costs	Total Costs	Foreign Costs	Local Costs	Total
1. Equipment, Materials & Spares						
Gas Cracker	726	1,010	1,736	787	1,575	2,362
EO/EG	185	250	435	156	365	521
LDPE	243	267	510	338	395	733
LLDPE	210	299	509	470	610	1,080
PP	161	214	375	216	226	442
Propylene Recovery	26	63	89	-	-	-
Butene	-	-	-	13	38	51
Wire and Cable				73	138	211
Acetylene Black	14	29	43	24	59	83
Utilities and Offsites	808	1,580	2,388	731	1,466	2,197
General Facilities	50	271	321	73	326	399
Spare Parts	147	49	196	-	-	-
Ocean Freight & Insurance	280	-	280	-	-	-
	2,850	4,032	6,882	2,881	5,198	8,079
2. License, Basic Engineering & Exp. Assst.	570	144	714	849	304	1,153
3. Detailed Engineering & Proj. Services	12	408	420	-	363	363
4. Land, Civil Works and Buildings	38	781	819	-	636	636
5. Erection	33	482	515	10	413	423
6. Start-up and Commissioning	-	200	200	-	-	-
7. Township	10	394	404	-	535	535
8. Temporary Facilities	33	109	142	52	511	563
9. Management and Training	12	99	111	-	392	392
10. Infrastructure Facilities	126	729	855	-	-	-
Basic Cost Estimate (BCE)	3,684	7,378	11,062	3,792	8,352	12,144
Physical Contingencies	368	738	1,106	-	-	-
Price Contingencies	1,078	2,198	3,276	-	-	-
Total Installed Cost	5,130	10,314	15,444	3,792	8,352	12,144
Working Capital	716	1,078	1,794	-	200	200
Interest During Construction	1,961	1,166	3,127	1,265	2,741	4,006
Project Financing Required	8,887	12,558	21,455	5,057	11,293	16,350

B. **Project Financing**
(Rs. million)

Sources	Expected			Present		
	Foreign	Local	Total	Foreign	Local	Total
Long Term Debt						
World Bank	2,520	-	2,520	2,729	-	2,729
GOI/Cofinancing	5,286	2,414	7,700	2,328a/	4,728	7,056
Medium Term Loans			-	1,420	1,420	
Total	7,806	2,414	10,220	5,057	6,148	11,205
Equity						
GOI	-	6,001	6,001	-	-	-
IPCL	-	2,400	2,400	-	-	-
Internal Cash	-	1,742	1,742	-	5,145	5,145
Total	-	10,143	10,143	-	5,145	5,145
Total Project Financing	**7,806**	**12,557**	**20,363**	**5,057**	**11,293**	**16,350**

a/ Funded out of foreign exchange loans totalling Rs.3,060 million, with the rest used for local cost financing.

C. **Bank Financing**
(US$ million)

Category	SAR Estimate	Actual
Equipment, Materials and Spares	180.0	182.9
License, Engineering and Services	20.0	27.3
Preproduction Polyolefins	90.0	89.8
Unallocated	10.0	-

6. **Project Results**

A. **Direct Benefits**

The Nagothane Maharashtra Gas Cracker complex (MGCC) facilities suffered a serious explosion on November 5, 1990 in the gas chilling and storage section of the complex. This accident resulted in substantial plant damage and several deaths. The complex could be commissioned only in July/August 1991 after repairs and modifications, and has not yet fully established its production capabilities. It is expected that the operation of the MGCC facilities will be stabilized in FY93 and will reach 95% of its rated capacity beyond 1995. Production of the various products in the second half of FY92 and in April 1992 are summarized below.

(in product tons)

Products	FY92	April 1992	Total
Ethylene	34,352	13,169	47,521
Propylene	20,851	4,681	25,469
Polypropylene	24,100	4,227	28,327
LDPE	12,021	5,614	17,635
EO/EG	1,778	1,105	2,883

The Project included provision of foreign exchange funds for the import of polymers as seeding materials to develop the market for products proposed to be produced at Nagothane. The import of polymers under the Project and their value are summarized below.

(Quantity in tons)
(Value in US$ millions)

Year		LDPE	LLDPE	PP	Total
1985/86	Q	-	-	3,000	3,000
	V	-	-	2.99	2.99
1986/87	Q	-	-	-	-
	V	-	-	-	-
1987/88	Q	28,991	9,306	-	38,297
	V	26.12	8.85	-	34.97
1988/89	Q	8,993	11,602	1,800	22,395
	V	11.64	14.32	2.33	28.29
1989/90	Q	-	11,188	-	11,188
	V	-	10.02	-	10.02
1990/91	Q	-	17,909	-	17,909
	V	-	14.40	-	14.40
Total	Q	**37,984**	**50,005**	**4,800**	**92,789**
	V	**37.76**	**47.59**	**5.32**	**90.67**

The small difference in value compared with the Bank disbursement is due to slightly different exchange rates used.

B. Economic Benefits

Based on the assumptions summarized in Section D. below, the project's ERR is 11.4%. The ERR is sensitive to capacity utilization, the speed with which it is achieved and international petrochemical prices as summarized below.

Variations	ERR %
Maximum Capacity build up to	
95% (Base Case)	11.4
90%	10.9
85%	10.4
80%	9.8
Higher International Prices	
Base Case	11.4
+10%	13.2
+20%	14.7
Capacity Buildup	
Base Case	11.4
95% achieved one year earlier	12.2

C. Financial Impact

The project's FRR is still an attractive 18.8%. The sensitivity tests on FRR are presented below:

Variations	FRR%
Maximum Capacity build up to	
95% (Base Case)	18.8
90%	18.2
85%	17.7
80%	17.1
Revenue down by	
Base Case	18.8
-10%	16.5
-20%	13.8
80% Capacity Utilization and	
Revenue less by 20%	12.0

D. Assumptions Used in ERR and FRR Sensitivity Analysis

Capital Cost. The total project financing, as now estimated by IPCL is Rs.16,354 million. Excluding pre-production interest of Rs.4,010 million and margin money (working capital not financed by short term commercial borrowing) of Rs.200 million, the total installed cost is estimated at Rs.12,144 million. By converting local costs into dollars using average official exchange rates prevailing during the period in which expenditures were incurred, the project cost is estimated at US$809 million. Economic capital cost has been estimated by subtracting duties and taxes from the above capital cost and using a conversion factor of 0.8 to convert rupee costs into dollars. All costs have been brought to constant FY92 terms using an average U.S. dollar price escalation

of 5% per year from FY86 to FY92. The total economic capital cost of the project is US$712 million in FY92 prices. The analysis uses a plant operating life of 15 years.

Revenues. For purposes of estimating revenues, the facilities are expected to be commissioned in FY93 after completing all repairs. The complex is expected to operate at 50% capacity in FY93, 65% in FY94, 80% in FY95 and 95% thereafter. Financial revenues have been computed at existing Indian prices, assuming that they will remain constant in real terms. Economic prices are based on current international prices, appropriately adjusted for shipping costs and expected trends in the international petrochemical market.

Operating Costs. Financial costs are based on actual prices being paid by IPCL and are expected to remain constant in rupee terms. Economic costs have been estimated using international prices for traded items. The economic price of C_2/C_3 was estimated at US$130 per ton (FY92 prices). This was derived by using a fuel oil price of US$85 per ton, which on calorific content basis corresponds to a natural gas price of US$100 per ton. To this was added a separation charge of US$30 per ton. The other major raw material - FCC C_3, was priced at US$210, about 1.6 times the price of crude oil at US$18 per barrel (FY92 prices).

E. Studies

Studies	Purpose as defined at Appraisal	Status	Impact of Study
Pricing & Trade Policies for the Project Products	To make domestic industry efficient and competitive	Complete	Impact awaited
Export Market Potential for Selected Finished Products	To develop an export market for finished products based on the Project petrochemicals	Complete	Export markets iden.
Detailed Safety Audit of the Project	To assess impact of risks to the Project Area and the surrounding community	Complete	Findings being adopted

7. Status of Covenants

Section Loan/ Project Agreement	Covenant	Deadline	Status
Loan Sch.4	The Borrower shall:		
	(a) establish and maintain a training and TA unit for the purposes of disseminating information on technical developments and meet the needs of skilled personnel in the plastics processing industry in India;	4/86	In compliance
	(b) give necessary clearances to IPCL for timely import of polymers starting in fiscal year 1985/86;	85/86	"
	(c) carry out by Dec. 31. 1985 a study on export market potential for selected finished products under a TOR agreed upon between the Borrower and the Bank.	12/85	"
Loan 4.03	GOI shall take adequate measures to ensure that the gas development plans are consistent with Project requirements, and that physical facilities for feedstock separation and supply to the project shall be established.		in compliance with considerable delays
Proj. 2.06	IPCL shall implement and operate the Project according to environmental safety standards satisfactory to the Bank.		in compliance
Proj. 2.07	For the purpose of carrying out the program of pre-production plastics imports under Part E of the Project, the Corporation shall, by January 31 each year, furnish to the Bank its annual market development plan for the following fiscal year, and shall implement said program as shall be agreed upon between the Bank and the Corporation.	Annually	"
Proj. 3.03	The Corporation shall take out and maintain with responsible insurers, or make other provisions satisfactory to the Bank for, insurance against such risks and in such amounts as shall be consistent with appropriate practice.		"
Proj. 3.04	The Corporation shall, by June 30, 1988, enter into long-term supply contracts satisfactory to the Bank for feed-stock and fuel gases for the Project.	6/88	Entered with BPCL Negotiating with ONGC
Proj. 3.06	IPCL shall: (i) employ qualified managers during project implementation; and (ii) prior to making any appointment to senior management positions, shall furnish to the Bank the details of qualifications and experience of the proposed nominees.		Employed qualified officers but did not consult with the Bank in filling vacancies
Proj. 4.02	IPCL shall: (i) have its annual financial statements and accounts audited each fiscal year in accordance with appropriate auditing principles consistently applied, by independent auditors acceptable to the Bank; (ii) furnish to the Bank the audited accounts and the auditor's report within six months after end of each fiscal year.	Annually	in compliance

Proj. 4.04	Except as the Bank shall otherwise agree the Corporation shall: (i) Not incur any debt that would raise aggregate debt of the corporation to greater than 1.5 times the company equity; (ii) After completion of the Project, maintain current ratio of not less than 1.3; (iii) not incur additional debt over level necessary for Project, if, as a result the debt service coverage will fall below 1.3; (iv) not prepay any debt if, as a result, the current ratio will fall below 1.5.	in compliance

8. Missions

Stages in Project Cycle	Month/ Year	Persons	SW in Field	Specialization represented	Performance Rating	Problems
Through Appraisal						
Preparation	9/80	2	2	Eng, FA		
Appraisal	10/82	4	5	Eng, Eco, FA Sector Spec.		
Post Appraisal	7/84	4	3	Eng, Eco. FA	Updating, Technology review	
Supervision						
1	3/86	1	1	Eng	1	
2	9/87	1	3	Eng	1	
3	10/88	3	2	Eng, FA	1	
4	9/90	1	2	Eng	2	Explosion, LLDPE
5	5/91	3	3	Eng, Eco, FA	2	delays
6	11/91	3	2	Eng, Eco, FA	3	
Project Completion						
1	4/92	1	2	Eng		

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

IPCL - Projected Income Statement - SAR Estimate
(current Rs. million)

	1990/91	1991/92	1992/93	1993/94	1994/95
Total Sales Revenue	21,781	25,248	30,406	31,066	32,770
Variable Cost					
Feedstock/Energy	7,772	9,132	11,234	11,659	12,295
Materials & Others	3,311	3,776	4,552	4,628	4,881
Total Variable Cost	11,083	12,908	15,786	16,287	17,176
Fixed Cost					
Depreciation	2,160	2,150	2,120	2,100	2,007
Others	1,319	1,399	1,483	1,571	1,666
	3,479	3,549	3,603	3,671	3,673
Total Operating Cost	14,562	16,457	19,389	19,958	20,849
Corporate Overhead	415	488	556	590	625
Operating Income	6,804	8,303	10,461	10,518	11,296
Financial Expenses					
L-T Debt Interest	1,488	1,429	1,297	1,114	931
S-T Debt Interest	359	402	35	1	-
Total Financial Expenses	1,847	1,831	1,332	1,115	931
Other Income	12	148	460	1,607	
Income Before Tax	4,957	6,484	9,277	9,863	11,972
Corporate Tax	2,902	3,320	4,499	4,577	6,217
Income After Tax	2,055	3,164	4,778	5,286	5,755

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

IPCL - Projected Balance Sheet - SAR Estimate
(as of March 31, current Rs. million)

	1990/91	1991/92	1992/93	1993/94	1994/95
Current Assets					
Cash	167	188	226	232	244
Accounts Receivable	4,789	5,466	6,583	6,687	7,049
Inventory					
Raw Materials	2,006	2,303	2,813	2,886	3,034
Work in Process	416	470	553	570	596
Finished Goods	2,849	3,195	3,814	3,864	4,068
Total Inventory	5,271	5,968	7,180	7,320	7,698
Total Current Assets	10,227	11,622	13,989	14,239	14,991
Surplus Cash	122	1,480	4,648	10,398	14,973
Fixed Assets					
Gross Fixed Assets	29,652	29,652	29,652	29,652	29,652
Acc. Depreciation	8,357	10,507	12,627	14,727	16,734
Net Fixed Assets	21,295	19,145	17,025	14,925	12,918
TOTAL ASSETS	31,644	32,247	35,662	39,562	42,882
Current Liabilities					
Accounts Payable	1,071	1,223	1,481	1,523	1,602
S-T Debt	2,299	201	8	-	-
Current Portion of LT Debt	615	1,420	1,420	1,420	1,420
Total Current Liabilities	3,985	2,844	2,909	2,943	3,022
Total Long Term Debt	10,922	9,502	8,082	6,662	5,242
Equity					
Share Capital	7,861	7,861	7,861	7,861	7,861
Retained Earnings	8,876	12,040	16,810	22,096	26,757
Net Worth	16,737	19,901	24,671	29,957	34,618
TOTAL LIABILITIES & EQUITY	31,644	32,247	35,662	39,562	42,882
Ratio					
Current Ratio	2.6	4.1	4.8	4.8	5.0
Debt/Equity Ratio	39/61	32/78	25/75	18/82	13/87

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)

IPCL - Projected Funds Cash Flow Statement - SAR Estimate
(current Rs. million)

	1990/91	1991/92	1992/93	1993/94	1994/95
Sources					
Profit After Tax	2,055	3,164	4,778	5,286	5,755
Depreciation	2,160	2,150	2,120	2,100	2,007
Internal Cash Generation	4,215	5,314	6,890	7,386	7,762
Share Capital	-	-	-	-	-
Long Term Debt	-	-	-	-	-
Short Term Debt	249	-	-	-	-
Total Debt	249	-	-	-	-
TOTAL SOURCES	4,464	5,314	6,890	7,386	7,762
Applications					
Capital Expenditure	-	-	-	-	-
Loan Repayments					
Long Term Debt	298	615	1,420	1,420	1,420
Short Term Debt	-	2,098	193	8	-
Total Repayment	298	2,713	1,613	1,428	1,420
Dividend	-	-	-	-	1,094
Increase (Decrease in Working Capital	4,044	1,243	2,109	208	673
TOTAL APPLICATIONS	4,342	3,956	3,722	1,636	3,215
Surplus (Deficit)	122	1,358	3,168	5,750	4,575
Acc. Surplus (Deficit)	122	1,480	4,648	10,398	14,973

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)
IPCL PROJECTED INCOME STATEMENT, 1992/93-1996/97
(current Rs. million)

	1992/93	1993/94	1994/95	1995/96	1996/97
Total Sales(metric tons)	526462	663656	684304	672874	748485
Gross Sales Revenue	24004.1	25659.0	30719.1	33043.5	40562.0
Less:					
Excise Duty	4188.9	4637.9	5848.1	6681.9	8379.8
Sales Tax	923.2	1027.4	1282.3	1440.1	1766.5
Net Sales Revenue	18892.0	19993.8	23588.8	24921.6	30415.7
Other Income	90.0	90.0	90.0	90.0	90.0
Total Revenue	18982.0	20083.8	23678.8	25011.6	30505.7
Costs of Sales:					
Feedstock	5761.6	6304.1	7797.2	8554.8	10055.8
Catalysts & Chemicals	1055.9	1162.9	1411.4	1672.6	1961.5
Utilities	1644.2	1769.0	2117.0	2305.9	2587.9
Selling Expenses	902.8	1014.6	1240.1	1384.0	1685.4
Salaries & Wages	857.1	898.8	952.3	1058.7	1163.6
Repair & Maintenance	832.2	901.3	1045.0	1244.5	1387.8
Insurance	367.7	382.1	437.9	503.7	519.9
Admin. Overhead	823.6	890.6	974.6	1088.1	1200.1
Depreciation	2115.1	2119.8	2611.5	3245.4	3273.5
LTD Interest	1754.7	1653.9	1436.7	1606.2	1511.7
STD Interest	277.5	277.5	277.5	277.5	138.8
	16392.4	17374.7	19851.1	22499.3	25058.9
Income Before Tax	2639.6	2789.1	3907.6	2592.2	5526.8
Corporate Tax	0.0	0.0	1030.0	0.0	0.0
Income After Tax	2639.6	2789.1	2877.6	2592.2	5526.8
Income Before Tax/Net Sales(%)	14.0	13.9	16.6	10.4	18.2
Return on Capital Employed(%)	14.4	16.5	20.7	11.2	18.5
Contribution to the Exchequer	5112.1	5665.3	8160.4	8122.0	10146.3

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)
IPCL PROJECTED BALANCE SHEET, 1993-1997
(As of March 31, current Rs. million)

Current Assets	1993	1994	1995	1996	1997
Cash & Bank Balance	860.5	283.4	618.0	1220.7	5104.1
Inventories:					
Stores (Incl.Cat.& chem.)	1360.2	1482.8	1750.7	2080.8	2368.6
Raw Materials	240.1	262.7	324.9	356.4	419.0
Work-in- Progress	295.0	316.2	370.3	421.5	476.1
Finished Goods	995.5	1067.3	1249.9	1422.6	1606.9
Accounts Receivable	1086.9	1150.3	1357.2	1433.8	1749.9
Loans & Advances	2379.6	2542.5	2873.3	3209.0	3630.9
Total Current Assets	7217.6	7105.2	8544.2	10144.9	15355.6
Fixed Assets					
Gross Fixed Assets	24037.1	25407.1	30433.0	36830.4	37910.6
Less Accumu. Deprecia.	9497.2	11617.0	14228.5	17474.0	20747.5
Net Fixed Assets	14539.9	13790.1	16204.5	19356.4	17163.0
Capital Work-in-Progress	5490.0	8131.2	6769.3	2323.4	2273.4
Other Investment	248.5	708.5	1358.5	1608.5	1608.5
Deferred Expenses	30.0	25.0	20.0	15.0	10.0
Total Assets	27526.0	29760.0	32896.5	33448.2	36410.5
Current Liabilities					
Accounts Payable	1784.5	1859.2	2059.6	2176.9	2382.8
Other S.T. Liabilities	178.4	185.9	206.0	217.7	238.3
Advances from Customers	377.8	399.9	471.8	498.4	608.3
Interest Payable	79.2	79.2	79.2	79.2	79.2
Dividend Payable	186.0	372.0	372.0	372.0	372.0
Short Term Debt	1500.0	1500.0	1500.0	1500.0	-
Total Current Liabilities	4106.0	4396.2	4688.6	4844.2	3680.6
Long Term Debt	13958.0	13484.6	13823.2	11999.1	10970.0
Equity					
Paid-up Capital	1860.0	1860.0	1860.0	1860.0	1860.0
Retained Earnings	7602.0	10019.1	12524.8	14745.0	19899.8
Net Equity	9462.0	11879.1	14384.8	16605.0	21759.8
Total Liabilities & Equity	27526.0	29760.0	32896.5	33448.2	36410.5
Current Ratio	1.76	1.62	1.82	2.09	4.17
LT Debt/	60	53	49	42	34
Equity Ratio	40	47	51	58	66

PROJECT COMPLETION REPORT
INDIA
MAHARASHTRA PETROCHEMICAL PROJECT
(LOAN 2505-IN)
IPCL PROJECTED FUNDS FLOW STATEMENT, 1992/93-1996/97
(current Rs. million)

	1992/93	1993/94	1994/95	1995/96	1996/97
Sources					
Net Income	2639.6	2789.1	2877.6	2592.2	5526.8
Depreciation	2115.1	2119.8	2611.5	3245.4	3273.5
Internal Cash Generation	4754.7	4908.9	5489.2	5837.7	8800.4
Share Capital	0.0	0.0	0.0	0.0	0.0
Borrowings	861.3	1289.2	1240.6	592.7	13.4
Others					
Total Sources	5616.0	6198.1	6729.7	6430.4	8813.7
Applications					
Capital Investment	3547.6	4011.3	3664.0	1951.5	1030.1
Increase in Other Investment	170	460	650	250	0
Debt Repayment	358.5	1762.6	902.0	2416.8	1042.4
Dividend	186.0	372.0	372.0	372.0	372.0
Increase of Deferred Expenses	-5	-5	-5	-5	-5
Increase in Working Capital:					
Cash Increase	151.8	-577.1	334.6	602.7	3883.4
Other Than Cash Increase	1207.1	174.4	812.1	842.4	2490.8
Total Applications	5616.0	6198.1	6729.7	6430.4	8813.7
LTD Service Coverage	3.0	1.9	2.7	1.8	4.0
Self-financing Ratio(%)	76	68	66	70	99