INDIA

Hirakud Hydroelectric Project

Date of Report: June 2002
Date of Survey:September 2001

Location Map of the Project

Hirakud Dam and Burla Powerhouse

1.1 Background

Orissa State is located in the eastern part of the India, has a population of 22 million[1], and encompasses an area of 155.8 thousand km^2. The state was one of the most under-developed areas in the country and had a per capita energy consumption of 117.98 kWh in 1978/79, which was lower than the national average of 131.34 kWh in the same period. A lack of generation capacity in the state had also suppressed energy demand, which had increased by 1.5% in FY 1976, rising to 4.6% by 1980/81. Nevertheless, these figures were lower than the nationwide percentage of increase for the same period.

Hirakud dam, with a reservoir covering 743 km^2 at its maximum level, was built in 1958 across the River Mahanadi about 15 km up stream of Sambalpur town in the state of Orissa. The Hirakud dam project was a multipurpose scheme intended for flood control, irrigation and power generation. The Hirakud hydropower project consisted of two powerhouses named Burla (Hirakud I) and Chiplima (Hirakud II), and a 25 km power channel to carry the tailrace water from Burla powerhouse to Chiplima powerhouse. At the time of appraisal, Burla powerhouse had 6 generating units, amounting to 198 MW of rated capacity. These units were commissioned from 1956 to 1964. During the construction period for these projects, the penstock and excavation work for an additional generating unit were completed.

1.2 Objectives

To cope with the power shortage of Orissa State by constructing a hydro power station with 37.5MW at Burla powerhouse (Hirakud I), and using water[2] coming from the existing dam.

1.3 Project Scope

1. Installation of a Kaplan-type hydraulic turbine and generator (37.5MW)/1KV terminal installation (Unit 7)
2. Installation of transformers and switching devices
3. Extension of tail race and overflow control work

(Other equipment and civil works were to be financed by OSEB's budget.)

1.4 Borrower/Executing Agency

The President of India / Orissa State Electricity Board (OSEB)

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[1] As of year 1980 (at the time of appraisal)

[2] At the time of appraisal, certain amount of water was released without serving the purpose, particularly in monsoon season.

1.5 Outline of Loan Agreement

Loan Amount Loan Disbursed Amount	1,500 million yen 1,500 million yen
Exchange of Notes Loan Agreement	September 1981 October 1981
Terms and Conditions Interest Rate Repayment Period (Grace Period) Procurement	 2.75 % p.a. 30 years (10 years) Partially Untied
Final Disbursement Date	November 1990

2.1 Relevance

At the time of appraisal, Orissa State was facing a shortage of energy, even though the state has abundant water resources. In view of the considerable energy shortfall in the state, and in order to avail the state of the maximum benefit from its abundant water resources, Orissa State Electricity Board (OSEB) planned for implementation of the project in 1979. Responding to the proposal, the planning commission approved the project after due consideration in 1982. Consequently, the project was consistent with development policy at the time.

OSEB was the original operation and maintenance agency for the project, but it was unbundled in 1996, separately forming two generation companies, one transmission company, and four distribution companies. The project facilities were transferred to a hydro generation company named Orissa Hydro Power Corporation (OHPC). Since then, a privately owned power-generating company has entered the energy market in Orissa State. Even with this entry, however, OHPC and its power plants, including Hirakud, are sufficiently competitive in the energy market, and the power plant has been utilized to meet the increased energy demand in the state, at a reasonable price.

In addition, according to the assessment made by Central Electricity Authority (CEA), it was estimated that the power requirements of the state would rise to 2,150 MW by the end of 2001-02. During 1999-00, the state sector and central sector projects generated only about 1,091 MW of power for the state. Meeting the increased demand would require further additions to capacity, and consequently OHPC is planning to construct a new hydro power station. Thus the present power development plan for the state is still proceeding along the same lines as envisioned at appraisal of this project.

When taking into account the above-mentioned matters, the project objective has been and still is quite relevant to Orissa State's power development plan.

2.2 Efficiency in Project Implementation

2.2.1 Project Scope

According to the project report prepared by OSEB prior to JBIC's appraisal, most of the excavation work for installation of the generating unit was completed during the former phase of the project. However, the first phase had left as much as 6m of depth or 2,680m^3 in unexcavated bedrock, resulting in an unexpected amount of further excavation work. Aside from this deviation, however, the original project scope at appraisal was implemented as envisioned.

2.2.2 Implementation Schedule

The project was completed in September 1990, representing a delay of approximately six years beyond the originally scheduled completion date of September 1984. JBIC sent a mission to the project site in November 1985 in order to monitor the progress of the implementation and minimize delays in completion. From that point onwards, JBIC also maintained contact with the executing agency in a further effort to expedite project completion. Delay was brought about by the following factors:

i) The planning commission needed more time to examine the technical issues presented by CEA & Central Water Commission as part of its approval process for the project.
ii) The site of the excavation work was located near operating generation units, and was too narrow for an excavation machine, which prevented conventional excavation by blasting and machine. The work was therefore done manually, causing a 22-month delay.
iii) Additional dredging work was required because of heavy rains during the 1986 rainy season.
iv) Budget constraints on the part of OSEB resulted in a two- to three-year delay in paying customs duties for imported equipment.
v) There were considerable delays in the necessary concrete placing work, resulting from a lack of experience on the part of the contractor, a failure in the concrete pump and frequent rains.

2.2.3 Project Cost

At appraisal, the estimated project cost was 3,956 million yen equivalent, comprised of a Japan's ODA loan portion of 1,500 million yen in foreign currency and 2,456 million yen equivalent in local currency. The actual project cost, however, escalated to 9,890 million yen equivalent, comprising 1,500 million yen in foreign

currency and 8,390 million yen equivalent in local currency. There was a substantial cost overrun in local currency of 5,934 million yen equivalent, or 342% of the appraisal estimate. There were two major reasons for the cost overrun in local currency: i) the amount of excavation work and dredging work was much more than originally estimated, ii) the delay in completion brought about an increase in local currency owing to price escalation.

2.3 Effectiveness

2.3.1 Net Energy Production of Unit 7

a) Monthly Generation Pattern

The Burla powerhouse generates energy by utilizing water discharged from the Hirakud dam. The water in the dam is used, in order of priority, for flood control, drinking water, irrigation, and generation. Water levels begin rising in July, the beginning of monsoon season in the region, and began declining in October, the end of season.

Generation data and the reservoir level for the last four water years[3] are shown in the following figures. The 1998-99 period figures represent normal levels, while 1997-98 and 2000-01 periods indicate periods of plentiful rain and drought, respectively. Net energy production is naturally high during the monsoon period. In 1997–1998, the region experienced unusually heavy rains in the dry season, which made generation possible throughout the year. During 2000-01, however, less water was supplied to the reservoir, which in turn resulted in less energy generated from the dam.

In November 1999, a main transformer in Unit 7 suddenly broke down due to mechanical trouble, necessitating its replacement. Accordingly, although the Unit itself had been kept in good condition, it could not operate at all from that time until July 2000[3]. In addition, Unit 7 was sometimes forced shutdown due to troubles of air/oil coolers. All of the air/oil coolers were replaced with another type of cooling system by

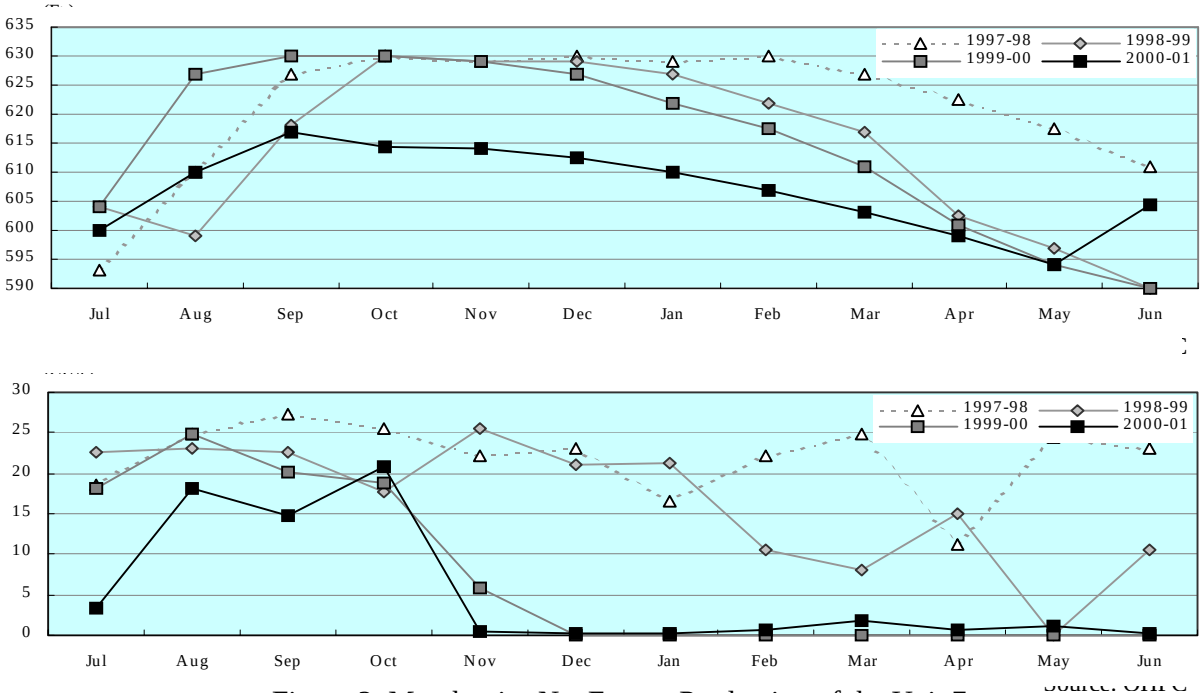

Figure-2: Month-wise Net Energy Production of the Unit 7

January 2001; since then no problems have been reported.

b) Annual Energy Production Since Commissioning

The actual generation capacity of Unit 7 has been far above the target level of 75.23 GWh established at commissioning, with the exception of the two year period discussed above.

Although the original target level was established on the assumption that Unit 7 would be operated only during the monsoon period, in actuality it was utilized even during the dry season since it had a higher operating priority because of its high efficiency and reliability, in comparison with that of other units. After

[3] The damaged transformer was investigated by the original supplier for its cause of broke down. After that the OHPC tried to repair it, but it resulted in failure. As a consequence, existing old transformer, which had been stored in warehouse of the site, was rehabilitated and installed for the Unit 7. The damaged transformer has already been repaired by the original supplier, and is stored in the warehouse for future replacement.

rehabilitation work on Units 1 & 2[4], operational priority was temporarily transferred to these units. In addition, in FY 2000, Unit 7 was suffering from the aforementioned mechanical problems and could not reach its target generating level. However, since these troubles have been successfully settled, there is, at present, no obstacle to the Unit's smooth operation.

Table-1: Annual Operational Data of the Unit 7 and Burla Total

		1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
Net Energy Production (GWh)	Unit 7	183.0	196.0	175.1	223.4	213.9	211.2	186.8	254.3	197.9	91.3	43.6
	Burla Total	880.2	719.8	671.1	798.3	859.7	765.6	685.0	823.9	926.3	939.0	416.9
Plant Load Factor[5] (%)	Unit 7	55.7 %	59.7 %	53.3 %	68.0 %	65.1 %	64.3 %	56.9 %	77.4 %	60.2 %	27.8 %	13.3 %
	Burla Total	50.7 %	41.5 %	38.7 %	46.0 %	49.6 %	44.1 %	39.5 %	47.5 %	53.4 %	48.3 %	21.4 %

Source: Orissa Hydro Power Corporation
Note: Above data was compiled by the fiscal year, which starts from April 1st and end on March 31st

2.3.2 Project's Positive Impacts on the Existing Units

The project scope included excavation work of the existing tailrace canal and construction of a discharge canal. These works were intended not only for discharging the additional water flow from Unit 7, but also for improving the performance of the existing 6 units.

According to the appraisal report, when the existing 6 units operate at their maximum load, discharged water reaches 29,000 cusecs[6]. Although the tailrace canal originally had enough capacity to discharge this amount of water volume, by the time of appraisal the safe discharge capacity of the tailrace canal had fallen off to 20,000 cusecs, owing to accumulation of debris. Thus, the available capacity for these units was reduced to 160 MW, as against the rated capacity of 198 MW. The project increased the discharged capacity to 35,000 cusecs, which is enough capacity for full operation of all seven units in the Burla powerhouse.

The discharged water that flows from the Burla powerhouse into the Chiplima powerhouse travels through the tailrace canal. Since the Chiplima powerhouse required only 12,500 cusecs of water even during full load operation, surplus water was not utilized and passed through the canal. After the project, this surplus water was discharged through the spillway and gate constructed as part of the project.

Owing to these works, the tailrace water level has been decreasing in spite of the installation of the new unit. The height of the waterfall is increasing along with the decline of the tailrace water level. Accordingly, generation efficiency has improved to some extent since the completion of the project.

There is no doubt that these works have contributed to improving peak availability and efficiency. However, as the existing units have deteriorated and have been frequently shut down, both before and after the project, it is difficult to grasp the quantitative effect of these works. Since the RM & U (Rehabilitation, Modernization and Up-rating)[7] works of existing units are being executed in a phased manner, the effect of the project will be much clearer in the future.

2.3.3 Re-evaluation of Financial Internal Rate of Return

The Financial Internal Rate of Return (FIRR) was re-evaluated, following a methodology similar to that adopted at appraisal and taking into account the changes in project cost, operational data and related variables, as well as realized and actual circumstances of the power sector in Orissa. The newly calculated FIRR is 8.57%, while the FIRR estimated at the time of appraisal was 20%.

At appraisal, the benefit was worked out by multiplying incremental energy production generated from the project, by the electricity tariff to the consumers after due consideration of transmission and the distribution loss.

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[4] Detail of rehabilitation work of the Unit 1 & 2 will be given in the section of "2.5 Sustainability".

[5] Plant Load Factor: The ratio of the electrical energy produced by a generating unit for a year to the electrical energy that could have been produced at continuous full-power operation during the year.

[6] A unit of measurement used to indicate the flow of one cubic foot per second.

[7] In order to improve the performance of the selected old hydro power stations, a RM&U Program (phase I) was launched by the Government in late 80's. Based on the recommendations of the National Committee and subsequent reviews a program for RM&U was formulated by CEA in which 55 schemes were identified. Out of 55 schemes, work on 25 schemes, including the Unit 1 and 2 of the Hirakud, at an estimated cost of 4.65 billion rupees and an expected benefit of 1,313 MW/ 3,263 GWh have been completed in June 2000.

Under this formula, all incremental revenue generated by the project was considered a benefit of the project. However, the incremental benefit is derived not only from the generation project, but also from the transmission and distribution system.

Accordingly, in re-evaluating the FIRR, benefit was worked out by the following methodology; i) Before establishment of OHPC (1990/91– 1995/96): Average Electricity Tariff to Consumers x 0.192[8] x Incremental Energy Production, ii) After establishment of the OHPC (from 1996/97 onwards): Unit Selling Price to Grid Corporation of Orissa (GRIDCO) x Incremental Energy Production.

As a consequence, the unit price of energy was calculated, by weighted average, at 20.97 Paisa/kWh[9], as against 65.89 Paisa/kWh at appraisal. A decrease in unit price was partly offset by the increase in energy production, even though the gross benefit derived from Unit 7 decreased from 4,759.2 million rupees to 2,847.2 million rupees. In addition, considerable cost overruns and completion delays negatively affected the FIRR.

2.4 Impact

2.4.1 Contribution to the improvement of the demand-supply balance in the Orissa State

Following the program of economic reforms launched by the Government of India, the Government of Orissa reformulated its Industrial Policy in March 1996 with a view to improving the investment climate in the State and to promoting opportunities for the growth of certain industries and related sectors. The Policy offers a comprehensive package of incentives to encourage investment in the State.

The new Industrial Policy seeks to attract investment in priority industries through a scheme of special incentives. These industries include electronics, telecommunication, agro and food processing, aluminum- based industries, automobile components, petrochemicals and 100% export-oriented industries.

Generally speaking, stable electricity supply is a prerequisite for attracting industries. However, at the time of the appraisal, the state suffered from energy shortages, and rate at which energy demand increased during the fiscal years between 1976-77 and 1980-81 was lower than the national average. Now, the state has enough generation capacity; in fact, during 2000- 2001, surplus peaked at 42 MW.

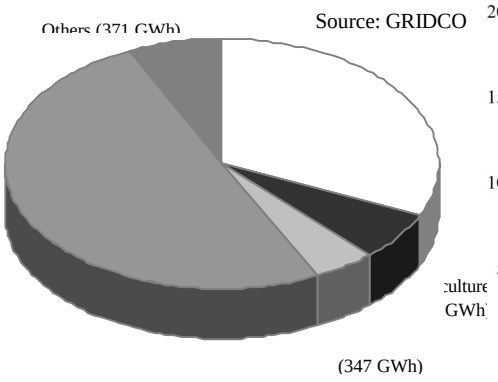

Figure-3: Consumer Category wise Sales

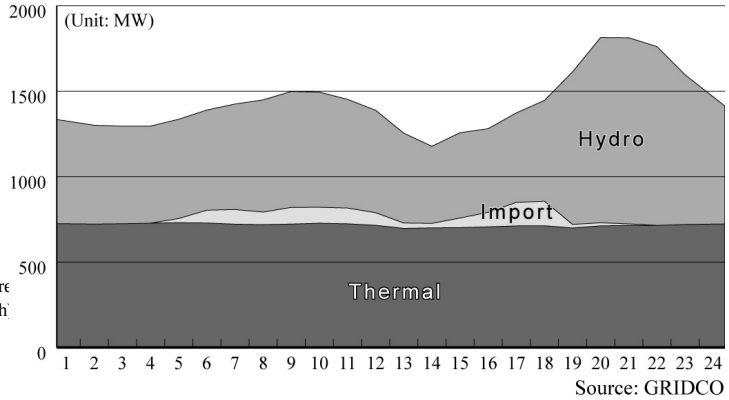

Figure-4: Typical Demand Curve in Orissa

According to the Economic Survey 1999-2000, issued by the Ministry of Finance - Government of India, the net value added by manufacture and the share of the manufacturing sector in Orissa have been rising over the years. The net value added by manufacture, at constant (1980-81) prices, was Rs.3,581 million in 1980-81, increasing to Rs.4,869 million in 1990-91 and to Rs.7,270 million in 1997-98. In 1998-99, industrial consumers used as much as 50% of the available energy in the state (see Figure-3). The chief industries in the state are steel, aluminum, oil refining, and chromium production, all of which require lot of electricity.

Given these conditions, stable electricity supply in the state is considered quite important for development of the state and for industrial consumers.

The electricity generated by the Burla powerhouse is transmitted to Orissa through a 132 kV transmission line. The hydro power stations in the state, including Unit 7, see particularly heavy utilization during peak times, as shown in Figure 4.

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[8] Estimated contribution ratio of generating project against the electricity tariff, which was worked out by following formula; Selling Price to GRIDCO in 1998-99 (0.49 Rs/kWh) / Average Electricity Tariff in Orissa in 1998-99 (2.56 Rs/kWh)= 0.192

[9] All prices in this sentence are based on 1991 price levels.

The project has improved the demand- supply balance in the state and helped attract industry by providing an additional 75.5 MW[10] of generation capacity.

2.4.2 Land Acquisition/ Relocation

The land for the project was already acquired during the construction period of Hirakud dam. Accordingly, land acquisition and resettlement/ relocation was not necessary for this project.

2.4.3 Environmental Impact

There was no significant impact on pollution and natural environment since the scope of project was mainly installation of a generator in the powerhouse that had already been operated. The powerhouse, while it does not emit contaminants, does make some noise. However, since there are no residences in the vicinity of the powerhouse, noise pollution has not been reported. Although the project includes canal dredging, as well as construction of a spillway and its gate, the riverbank has not been severely eroded by the project.

2.5 Sustainability

2.5.1 Change in the O&M Agency with the Restructuring of Energy Sector in Orissa

The project facility belonged to the state government-owned OSEB, which was responsible for the majority of generation, as well as all transmission and distribution within the state. Operation and Maintenance of the project facility was also done by OSEB. However, along with the power sector's restructuring in Orissa, OSEB was dissolved. Subsequently, all hydro power stations within the state were transferred to OHPC.

a) Restructuring of Energy Sector in Orissa

To correct the chronic weakness of the sector, the Orissa state government and OSEB agreed on a reform program of institutional restructuring and private sector involvement in 1993. On April 1, 1996, Orissa Electricity Regulatory Commission (OERC) was constituted under the Orissa Electricity Reform Act of 1995 to regulate the Orissa power sector; to help ensure the operational, managerial, and financial autonomy of new utilities and companies; to promote transparency and operational efficiency; and to seek private capital for power sector development. Also in April 1996, GRIDCO and OHPC became the successor companies of OSEB.

OHPC has taken over the power stations previously owned and run by the state government and OSEB. In line with the policy, the Burla powerhouse was transferred to OHPC on April 1, 1996.

GRIDCO is now responsible for transmission, coordination of system planning and operations and procurement and supply of bulk power. Retail distribution had been handled by GRIDCO at the intial stage. However, GRIDCO has divided the distribution operations among four companies (DISCOs) which have already been privatised as follwos: WESCO, NESCO, SOUTHCO on April 1, 1999, and CESCO on September 1, 1999.

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[10] Rated capacity of the unit 7 (37.5 MW) + Estimated improved capacity of existing 6 units (38.0 MW)

[11] Orissa Power Generation Corporation Ltd (OPGC): Earlier the entire share capital of the company was owned by the Government of Orissa. After restructuring, Government of Orissa has divested 49% of its stake in favor of a private investor.

[12] National Thermal Power Corporation (NTPC): A public sector generating company wholly owned by Govt. of India

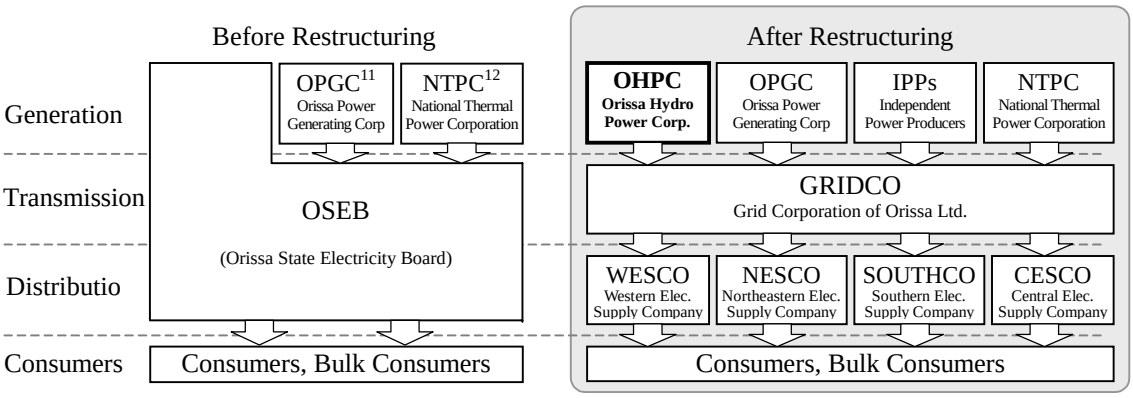

Figure-5: Change in the Structure of the Power Sector in Orissa

b) Financial Viability of OHPC

At present, OHPC sells its energy only to GRIDCO. The selling price is decided by OERC. As the selling price is determined to covers the cost of generation, depreciation, financial cost and 12% Return on Equity, OHPC has been making a profit since its establishment.

However, since the bill collection ratio[13] was no more than 65% on average, the accounts receivable from GRIDCO has been accumulating year by year owing to GRIDCO's financial difficulty. In order to improve the financial health of the power sector in Orissa, the following measures are being taken: i) Rehabilitation and Modernization work of the transmission and distribution line[14], ii) installing a new electricity meter and calibrating the existing meter, iii) amendment of electricity tariff to reasonable levels, and iv) institutional development, training and technical assistance, with the help of World Bank.

When OHPC's financial viability is taken into consideration, it is indispensable in improving the financial conditions of GRIDCO and DISCOs through the above-mentioned efforts.

Table-2: Financial Related Indicators of the OHPC since Establishment(unit: Million rupees)

	1996-97	1997-98	1998-99	1999-00	2000-01
Total Revenue	1,377.9	1,754.6	1,643.1		
Total Expenditure[15]	679,3	965.1	1,004.5		
Net Profit for the year	698.6	789.5	638.6		
Net profit to Gross sales	50.70%	45.00%	38.87%	Under Requesting	
Asset Turn Over[16]	6.73%	7.35%	6.11%		
Current Ratio[17]	152.0%	155.7%	141.7%		

Source: Orissa Hydro Power Corporation

Table-3: Accounts Receivables from GRIDCO (unit: Million rupees)

	1996-97	1997-98	1998-99	1999-00	2000-01
Opening Balance	0.00	444.76	1,063.72	1,173.57	2,702.25
Add. Billing	1,362.38	1,729.35	1,607.30	2,201.50	2,452.54
Add. Penalty Tax	28.04	80.26	194.71	225.76	410.22
Less. Collection	891.00	1,130.00	1,630.00	841.44	1,699.94
Less. Adjustment	54.66	60.65	62.16	57.14	58.80
Closing Balance	444.76	1,063.72	1,173.57	2,702.25	3,806.27
Billing Collection Ratio	65.4%	65.3%	101.4%	38.2%	69.3%
Receivables to Billing	32.6%	61.5%	73.0%	122.7%	155.2%

Source: Orissa Hydro Power Corporation

[13] Billing Collection Ratio= Amount of Received from the GRIDCO / Amount of billing to the GRIDCO

[14] Transmission & Distribution Loss in the state during 1997-98 was reached 49.2 %

[15] Including operation and maintenance expense, employee cost, administrative and general expense, depreciation, and financial charge

[16] Asset Turn Over= Net Sales during the fiscal year / Total Assets of the end of fiscal year

[17] Current Ratio= Current Assets of the end of fiscal year / Current Liabilities at the end of fiscal year

2.5.2 Capability of Operation and Maintenance

OHPC has introduced a computer-assisted Maintenance Management System (MMS) in the Burla powerhouse to support operation and maintenance activities. It was introduced as an asset management system at the initial stage, and its scope had been extended progressively, with the result that it is now used as a procurement/inventory management tool for spare parts and other consumable items, as well as a tool for the effective coordination of day-to-day maintenance. Operational & maintenance procedures and annual preventive maintenance requirements have been rationalized by MMS.

Also, a training center was established in Bhubaneshwar, the capital city of Orissa, with the help of a foreign consulting company in January 1999, after the restructuring. During the period of 1999-00, 53 staff members were trained at the center. It provides various courses, such as organizational development, trainer training, turbine and hydraulic oil procedure, maintenance procedure and material management.

Unit 7 experienced the air/oil cooler and transformer outage problems in 2000-01, but they were successfully resolved by OHPC with the help of domestic supplier. At present, Unit 7 is working and has no particular problems. In addition, given the improvement after the restructuring detailed above, OHPC's capability in executing operation and maintenance of the powerhouse is deemed satisfactory.

2.5.3 Present Conditions of Other 6 Units and Future Expansion Plan

The Burla powerhouse (Hirakud I) has seven generating units. The first six units were commissioned between 1956-1963, and were set to expire after their normal project life of 35 years; accordingly, their performance has deteriorated considerably.

In order to improve the efficiency, reliability, and performance of the units, and to extend the plant life for another 25 years while up rating the capacity by more than 25%, OHPC is now taking up the phased RM&U of the units.

The RM&U works will be completed over a period of 9 years, under the financing of the PFC[18]. The RM&U of Units 1 and 2 were completed in April 1998. Consequently, each unit recovered 7.5 MW of capacity and were up-rated by 12MW of capacity as their available capacities were improved from 30.0 MW to 49.5 MW. The modernization and up-rating work for Units 3 and 4 has been initiated under the RM&U Program Phase II, and the finalization of the tendering process is in progress. The work for Units 5 and 6is in planning stage, and will be taken up after completion of Units 3 and 4.

Iit is expected that the Burla powerhouse will contribute to fulfillment of the energy requirement in Orissa for the foreseeable future. In addition, in order to secure the demand-supply balance of the state, OHPC has proposed the development of two additional powerhouses, Burla-B (4 x 52 MW) and Chiplima-B (4 x 50 MW), which will run alongside the existing ones.

[18] Power Finance Corporation Ltd., wholly owned by the Government of India, established in July 1986 as a Development Financial Institution dedicated to the Power Sector

Comparison of Original and Actual Scope

Item	Original Plan (At the time of OECF Appraisal)	Actual
(1) Project Scope		
1. Generating Unit	37.5MW×1	As Planned
2. Other Related Equipment and Service	a. Hydraulic Hoist for Intake Gate	As Planned
	b. Extension of Power House Building	As Planned
	c. Widening of Power Channel and Surplus Water Escape Structure	As Planned
(2) Implementation Schedule		
1. Tender closed	Dec.1979	Dec.1979
2. L/A singing	Oct.1981	Oct.1981
3. Civil Work	Oct.1981 - Feb.1983	Oct.1982 - Aug.1990
4. Manufacture & Supply	Oct.1981 - Feb.1983	Oct.1981 - Mar.1983
5. Erection	Jun.1983 - Jun.1984	Jun.1983 - Sep.1990
6. Commissioning	Jul. 1984 - Sep.1984	10th Sep.1990
(3) Project Cost		
Foreign currency	1,500 million yen	1,500 million yen
Local currency	92.9 million rupees	307.0 million rupees
Total	3,956 million yen	9,890 million yen
ODA Loan Portion	1,500 million yen	1,500 million yen
Exchange Rate	1 Rs = 26.44 yen	1 Rs = 27.33 yen

Independent Evaluator's Opinion on Hirakud Hydroelectric Project

M.C. Gupta, Director,
Indian Institute of Public Administration

1. The Post Evaluation Study done by JBIC is excellent.
2. The project funded by JBIC met its objectives though there was a serious time and cost over run. It also meets the requirements of the target group and the needs of the recipient clients.
3. The delay occurred mainly on account of inadequate study of the soil strata which led the much larger escalation of costs. The other problem seems to be financial constraint of OHPC and the State Government of Orissa which led to insufficient funding resulting in time and cost over run.
4. Orissa's full power potential is yet to be realized. As on 31.3.1999 against the Hydroelectric potential, at 60% load factor, of 1983 MW only a potential of 1271.92 MW had been developed. Fortunately additional development for 66 MW is in hand.
5. The operation and maintenance needs to be improved. As indicated in the report of the Post Evaluation Study the PLF of the total Burla project had been oscillating between 38.7% and 53.4% between 1999-2000. Unfortunately in 2000-2001 it has dropped to 21.4%. Some drastic measures and some management support would be needed
6. The Orissa Government does lay stress on the energy sector having made an allocation of 46.27 billion rupees during the 9th Plan period i.e. 1st April 1997 to 31st March 2002 which comprises 30.85% of their total plan outlay. Unfortunately, however, the actual investment has been much less which indicates either shortfall in the availability of funds or the inability of the project authorities to utilise the funds available to them.
7. The overall hydroelectric situation in India as a whole as on 31.3.2002 was as follows:

   Total Installed Capacity 101,630MW: Thermal 72% Hydro Electric 25% Nuclear 3% In fact, Hydro Electric potential of whole country at 60% load factor works to 84,044MW which means that there is lot of scope for such projects.

Lessons Learned:

1. Fuller investigation should be done before executing such projects and there should be close monitoring.
2. Time and cost over-run should be avoided.

Recommendations:

1. JBIC can consider supporting the R& M (Rehabilitation & Modernization) projects of OHPC.
2. The social impact of such projects should also be studied in depth.