India

Ujjani Hydroelectric Project

Report Date: October 2002
Field Survey: August 2001

1. Project Profile and Japan's ODA Loan

Location Map of the Project

Ujjani Hydroelectric Power Station

1.1 Background

Maharashtra State, located in western India, was the third largest state in the country, with an area of 308,000 km^2 and a population of 63 million, at the time of appraisal in 1986. The state includes prominent industrial cities such as Mumbai, and is well-known for its well-developed commerce and industry. Nevertheless, 62% of the total working population in the state was engaged in agriculture. Thus, the state government had continuously pursued large-scale irrigation projects to develop agricultural land since the first 5-year plan (1951-56).

The state government had simultaneously striven to adequately supply power to commerce and industry, and to promote rural electrification and electrically pumped irrigation, in order to resolve a regional energy shortfall. However, in 1984, the power-demand gap reached 656 MW, and the state government was forced to execute load shedding[1].

At the time of appraisal, the state had power generating facilities with a total rated capacity of 6,229 MW, in which thermal power generation dominated, with 79% of the total. Furthermore, hydropower stations comprised only 15% of the power-generating installation (1,750 MW) being planned in the seventh five-year plan (1985-90). The plans for hydropower stations were limited because water resources for large scale power stations had been already fully developed.

Therefore, the government focused on the development of small-scale hydraulic power plants, which utilize existing irrigation-purpose dams, in addition to the construction of large-scale thermal power plants.

1.2 Objective

To meet increasing demand for electricity in Maharashtra State, particularly peak hour demand for electrically-pumped irrigation through construction of a 12 MW pumped storage hydroelectric power plant.

[1] Removal of pre-selected demand from electric system to maintain electric load below a certain level.

1.3 Project Scope

1. Storage pump, Turbine power generator (12MW×1)
2. Power plant building, Penstock, Tailrace Canal
3. Lower reservoir for pumping mode operation

The Japan's ODA loan (hereinafter refer to as the ODA loan) covers all of the foreign currency portion.

1.4 Borrower/ Executing Agency

The President of India / Maharashtra State Irrigation Department

1.5 Outline of Loan Agreement

Loan Amount Loan Disbursed Amount	1,500 million yen 1,312 million yen
Exchange of Notes Loan Agreement	September 1985 November 1985
Terms and Conditions Interest Rate Repayment Period (Grace Period) Procurement	 3.25% p.a. 30 years (10 years) Partially Untied
Final Disbursement Date	May1995

2. Results and Evaluation

2.1 Relevance

At the time of appraisal, Maharashtra State was suffering from a shortage of energy, resulting in load shedding during peak hours. Water resources for a large-scale hydropower station had been developed exhaustively, however, and consequently the state government placed great importance on constructing a large-scale thermal power station and small hydropower stations which use existing irrigation dams, in order to meet increasing demand. In line with this strategy, this project was given high priority in the 7th five-year plan of the state. It can be concluded that the project fulfilled the Maharashtra State's development policy as it was then delineated.

When taking the current composition of generating facilities and load profile into consideration, it can be seen that existing generating facilities are rather concentrated in the base load[2] facilities. In addition, the capacity addition planned for the state, especially IPPs[3], seems ill-suited to meet either middle or peak load[4] levels. However, the Maharashtra State Electricity Board (MSEB) predicts that, while growth of base load demand mainly consisting of industrial consumers may be low, and peak loads demand consisting of domestic and agricultural consumers will rise. With such an unbalanced composition of generating facilities, peaking facilities, including Ujjani hydropower station, will play an increasingly important role in the state. In this context, the project has been and still is quite relevant to Maharashtra State's energy development plan.

2.2 Efficiency

2.2.1 Project Scope

The overall plan and facility design described in the original project scope were substantially modified.

Originally, the powerhouse was to be connected to only one substation by means of a 11 kV transmission line. But since the future demand growth was predicted, in order to make the evacuation of energy more stable and secure, an additional line bay was constructed in the power station's switchyard. As a result, the size and location of the switchyard was reconsidered. Since the commissioning of the power station, only one of the two line bays has been utilized. In line with the increasing demand in the Jeur area, the transmission line to the Jeur substation was being constructed with an allocation from MSEB's budget (separate from the project)[5], and is scheduled to be completed in October 2001. Consequently, this project modification can be considered necessary.

During excavation in the project area, the ground was found to be not as firm as expected at the time of appraisal. Based on this site condition, design and construction activities were reviewed so as to make the structure more stable. Upon review, the length of the tailrace canal, the shape of the powerhouse, and the shape of the lower weir were modified, and these structures were strengthened by means of additional steel reinforcement and cement concreting. However, the lower weir and the tailrace canal[6] collapsed after

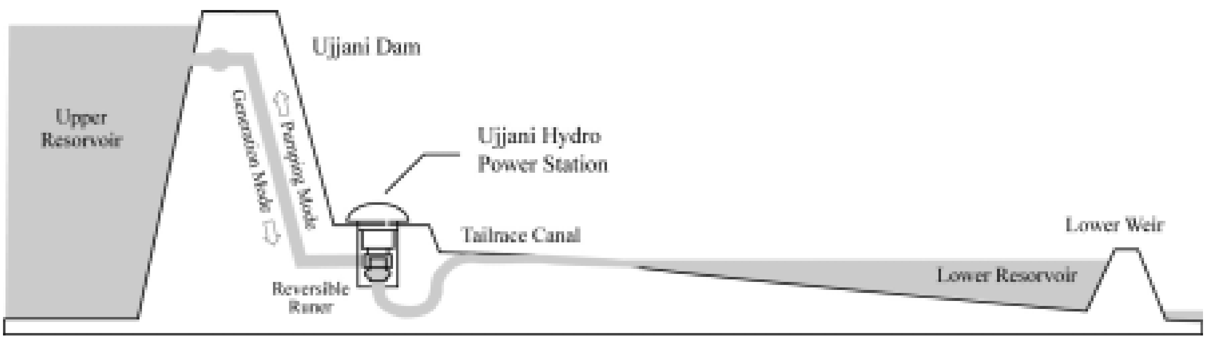

Figure-1: Schematic Lateral View of the Ujjani Hydro Power Station

2 The minimum power production needed during a season or year.
3 IPP (Independent Power Producer): A private entity that owns facilities to generate electric power for sale to utilities and end users.
4 The electric load that corresponds to a maximum level of electric demand in a specified time period

completion, mainly due to the flooding in 1997.

2.2.2 Implementation Schedule

The project was completed in January 1996, 75 months after the original completion date of October 1989. The delay was caused by the following factors:

a) Modification of the Design

As detailed previously, the modification of the design and additional civil works were required during the implementation of the project. Such modifications were one of the main reasons for the delay.

b) Flooding at Project Site

Flooding and continuous spillway releases from the Ujjani Dam caused frequent interruptions in the construction work. The powerhouse was completed in the middle of April 1994. Since the lower part of the tailrace canal was already completed, it was then commissioned in May 1994. Work on the tailrace was scheduled to resume after the rainy season, . However, while the powerhouse was being operated during the rainy season, from April 1994 to November 1994, the upper part of the tailrace canal was damaged by the intense pressure of water released from the dam at the time of flooding. As a consequence, a large quantity of debris accumulated inside and above the tailrace canal. Debris removal and cleaning work on the tailrace canal resulted in a further delay.

C) Low Performance of Contractor

Owing to the slow progress of the contractor, the required work was not completed on schedule. The original contractor was removed, but the contractor initiated a court. As a result, substantial time was required to obtain court permission for fresh tenders and secure new contractors.

2.2.3 Project Cost

At appraisal, the estimated project cost was 3,370 million yen equivalent, comprised of the ODA loan portion of 1,500 million yen, and a self-financed portion of 93.5 million rupees. The actual project cost was 4,499 million yen equivalent -- 1,312 million yen under the ODA loan portion, and 468.4 million rupees under the self-financed portion. A substantial total cost overrun, 1,129 million yen, equivalent to 133.5% of the appraisal estimate, resulted from a cost overrun in the local portion that amounted to 374.0 million rupees, or 500.1% of the appraisal estimate. The cost overrun in local currency occurred mainly because of: i) Soft ground conditions, which increased the amount of civil works and required related materials[7], and ii) a delay in completion, which, as a result of price escalation, led to an increase in the local currency portion.

2.3 Effectiveness

2.3.1 Annual Energy Production

The Ujjani Hydro power station is located beside Ujjani Dam, which was constructed in 1981, mainly for irrigation purposes, and runs on water released from the dam. The power station has a unique reversible generating unit, which can generate 12 MW when water is released from the dam and also functions as a water pump. When the water available for generation is low, the plant generates energy during peak-load periods by using water pumped into the Ujjani Dam during off-peak periods and releasing water from the dam through a penstock to a turbine generator.

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[5] The project facility was handed over from the Irrigation Department to MSEB in 1997, as described in 2.5.1.

[6] Detail will be mentioned in the section 2.2.2 and 2.3.1 in this report.

[7] E.g. the quantities of steel reinforcement increased from 862 ton in appraisal estimate into 1,174 ton of actual, the concrete quantities for foundation work; increase from 4,685 m3 to 17,019 m3, and the excavation work; increase from 23,652 m3 to 36,546m3.

At appraisal, the amount of water available for generation was considered to be decreasing year by year, becoming non-existent from 2001-02 onwards (see the Figure-2), in line with the progress of an irrigation project. Thus, the power station was supposed to operate conventionally for the first 10-year period as a base/ middle load facility, and subsequently change its role to that of a peaking facility.

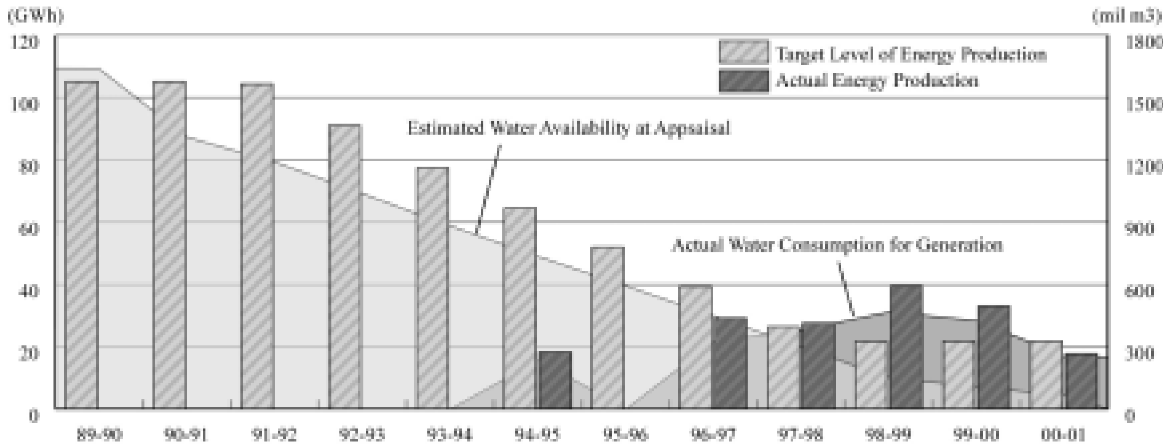

Figure-2: Comparison Original Target with Actual Source: MSEB

However, since the actual commissioning of the power station was delayed by 57 months, water availability was limited even in the first period of operation. Worse, the unit could not operate from November 1994 to March 1996, owing to the serious damage to the tailrace canal and the subsequent accumulation of debris, as detailed previously. Consequently, actual energy production, before 1996-97, was far below the original target level, as shown in Figure-2.

In addition, the lower weir collapsed because of flooding in July 1997; from then until the completion of restoration work in June 2000, the powerhouse could not operate in pumping mode and was operating only in generation mode. In spite of the accident, actual energy production exceeded the target level from 1997-98 to 1999-00. Owing to the slow progress of irrigation development, water was, to some extent, still available for generation. During the 2000-01 period, energy production was lower than in both the previous years, and lower than the target level. This low power generation level was not caused by the slow progress of irrigation development, but by the previous year’s drought.

Table-1: Dam Water Level, Annual Rainfall, and Pumping Mode Operation Hours

	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
Ujjani Dam Water Level on 1st June[8] (m)	492.932	490.957	488.772	491.887	491.702	492.183	489.72
Annual Rainfall in the Region (mm)	504.20	439.40	736.65	527.30	1137.00	372.50	647.80
Pumping Mode Operation Hours (hrs.)	8.0	0.0	523.9	0.0	0.0	0.0	497.9

Source: MSEB

2.3.2 Re-evaluation of Financial Internal Rate of Return

The financial rate of return (FIRR) was estimated to be 13.3% at the time of appraisal. The financial re-evaluation of the project was undertaken following a methodology similar to the one adopted at appraisal, and taking into account the change in project cost, actual energy production, actual electricity tariff, actual operation and maintenance cost, and other related variables. All cost and benefit streams used in the re-evaluation were expressed in 1994 prices, and denominated in local currency. Due to the cost overrun, the completion delay, and the subsequent low water availability, the recalculated FIRR is negative[9].

8 1st July is the beginning of the monsoon season in the area.

9 At appraisal, the project’s benefit was worked out by using incremental energy production generated from the project, and the unit electricity tariff to the consumers. Under the resulting formula, all incremental revenue generated by the project was considered as 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. In reality, two sections of the transmission line and two sets of line bays at Jeur and Indapur substations were newly-constructed as a separate project. In addition, existing transmission and distribution-related assets also contributed to the incremental revenue. Taking into

2.4 Impact

2.4.1 Project's Positive Social Impacts

a) Achievement of Original Assumed Impacts

At appraisal, the project was supposed to contribute to rural electrification, and to the supply of energy for use in electrically-driven regional irrigation pumping at base load and peak load operational levels. However, owing to the completion delay, the power station has instead been utilized as a peaking facility, and has, since commissioning, served mainly for evening peak hour usage. As a result, the power station has contributed its energy supply more to domestic consumers than to irrigation consumers. Although rural electrification within the state was completed in 1989, 5 years prior to project completion, this project has made contributions[12] to the stability of rural electrification.

b) Improvement of living standards in Indapur Region

At the time of appraisal, the state was suffering, because of lack of generating facilities, from load shedding during peak times. However, for the last 6 years (1996-2001), MSEB has not imposed any load shedding on consumers. With 9,097 MW of installed capacity in the state, the 12 MW contribution of the project facility could be considered small. However, the project facility has contributed significantly to fulfilling evening peak demand in the Indapur Region by feeding power to MSEB's 132kV Grid.

Also, a Synchronous Capacitor, which was installed in the switchyard as part of this project, has contributed to stabilization of the grid system and to the reduction of energy loss via the improved power factor. The Capacitor operates when the grid condition becomes unstable, and does so under the direction of the load dispatch center[13]. The facility was utilized to improve the unstable grid system, especially during the 1997-98 and 1998-99 periods.

Consequently, the project has contributed to improving the power-dependent quality of life of the population living in the Indapur Region.

Table-2: Synchronous Capacitor Operating Hours (Unit: hours)

1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
228.75	0.00	223.16	802.23	831.24	448.40	212.27

Source: MSEB

2.4.2 Land Acquisition/ Relocation

The land for the project was acquired during the construction of Ujjani Dam. Accordingly, land acquisition and resettlement/ relocation was not required for this project.

2.4.3 Project's Environmental Impacts

Since the power station has not established an environmental monitoring system, environmental impact cannot be evaluated quantitatively. However, according to MSEB, no negative impact has been reported so far.

2.5 Sustainability

2.5.1 Change in the Organization Responsible for Operation and Maintenance

The power station was constructed under the Irrigation Department of the state government, owner of the Ujjani Dam, and initially operated and maintained by the department. Subsequently, in October 1997, the project facility was handed over to MSEB, in keeping with the original plan. Since then, MSEB has

account such considerations for reevaluation, the resultant FIRR has become below the viable level.

10 The annual average exchange rate and the consumer price index used in the re-evaluation were quoted from the "International Financial Statistics", IMF

11 All the monetary figures mentioned in this section are expressed in 1994 price.

12 According to the MSEB's official, the project has contributed to change in ways of receiving the energy from isolated system to grid system at rural village.

13 Load Dispatch Center of the MSEB is located in Mumbai, and commands all the power stations/ the substations within the state in order to adjust the production and flow of power to meet the needs of the customers

executed operation and maintenance, and has also earned revenue from it, instead of just paying a rental fee to the Irrigation Department.

MSEB is in charge of generation, transmission and distribution of electric power within the state[14]. It has 111,724 personnel, and 38 power stations in operation, with installed capacity of 9,097 MW, as of 31st March 2000.

2.5.2 Performance and Financial Status of MSEB

The main problems common to all State Electricity Boards[15] (SEBs) are considered to be: i) tariff levels that are lower than supply costs, ii) high transmission and distribution loss, iii) low utilization of generating facilities, and iv) insufficient management structure, which leads to financial difficulties even when SEBs receive subsidies from state governments.

Table-3 compares MSEB's performance indicators with the national averages. These figures, except for the T&D loss during 1999-00, show that the performance of MSEB is consistently better than the national average. Based on these figures, the performance of MSEB was verified as follows:

Table-3: Comparison of MSEB Performance with the National Average

	MSEB			National Average
	1995-96	1997-98	1999-00	
Average Electricity Tariff (Paisa/ kWh)	170.96	210.56	253.10	185.48 (1998-99)
Plant Load Factor[16] (%)	64.89	68.17	71.77	64.60 (1998-99)
Availability Factor[17] (%)	84.4	85.0	84.59	80.30 (1999-00)
Transmission and Distribution Loss (%)	17.70	17.20	38.89	23.20 (1998-99)
No. of Employee per Energy Sold (GWh)	2.60	2.42	2.26	3.10 (1998-99)
Subsidy as Percentage of Revenue (%)	8.86	3.31	19.61	30.56 (1999-00)

Source: MSEB, Central Electricity Authority

a) Performance of MSEB's Facilities

MSEB has added about 1,372 MW in generating capacity since 1995. Over the last five years, from 1996/97 to 2000/01, the performance of MSEB's power stations improved steadily, as shown in the Table-2. The Plant Load Factor has increased steadily from 64.89% in 1995-96, to 71.77% in 2000-01. Plant availability has, in comparison with the national average of 80.3 %, remained high at around 85%. In addition, Maharashtra State is one of the few states in the country to achieve 100 % electrification of its towns and villages, which occurred in 1989. Large populations of rural households within other states still do not receive electricity. In comparison with the other SEBs, and for reasons already outlined, MSEBs' capability for managing power station is considered high.

However, when focusing on T&D loss, MSEB's recent figures are far above the national average T&D loss and it has apparently risen sharply, from 17.20 % in 1997-98, to 38.89% in 1999-00. This sudden jump[18] follows an assessment executed by the Maharashtra Electricity Regulatory Committee[19] (MERC) whose standard was severer than MSEB's own assessment. Thus, this loss is considered to be a persistent phenomenon rather than a sudden deterioration. Such unsustainable T&D losses should be ameliorated.

At present, the government of Maharashtra has requested that MSEB, with the help of MERC, undertake an energy audit and energy accounting at all levels, enhance its billing realization ratio, and reduce T&D losses to 18%. These objectives are to be achieved through the following measures: i) 100% metering on the 11 kV feeders, to be installed by 31st December 2001, ii) computerized billing at the sub-divisional level by March 2003, and iii) development of an effective distribution management information system.

b) Propriety of Tariff Level and its Realization

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[14] Unlike most other states, the responsibility for Transmission and Distribution in the state does not rest fully with MSEB. Its service area excludes the city of Mumbai and part of Ahmednagar district, where distribution licenses and a Rural Electricity cooperative provide service.

[15] State Electricity Boards (SEBs) are constituted as under the Electricity Supply Act of 1948, and entrusted with the job of energy supply within their respective area. The SEB of the Orissa, the Andra Pradesh, and the Haryana were recently restructured into generation, transmission, distribution companies and part of them were privatized. At present, 15 SEBs, including MSEB, are existed in respective state.

[16] 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.

[17] Availability Factor: The ratio of the operate-able hours of generation facilities to the period hours during the year.

[18] Similar position can be observed in case of Haryana, Orissa, Andra Pradesh States who opted for power sector reforms.

[19] Maharashtra Electricity Regulatory Commission (MERC) was established on August 1999 under the Central ERC Act of 1998.

The government of Maharashtra, like that of most other states in the country, has pursued a policy of cross subsidy, wherein agricultural and domestic activities are subsidized by commercial and industrial consumers. Though small and marginal farmers and people living below the poverty line deserve a degree of subsidy, many undeserving categories of consumers have gotten access as well.

Since the state has many commercial and industrial consumers, its average tariff is higher than the national average. However, upon closer examination it is found that the tariff level has been low in comparison with the average cost of supply, and that the billing realization ratio in 1999-00 was lower than the national average. Accordingly, the gap between average realization and cost of supply has widened recently, reaching 19.3% in 1999-00.

Table-4: MSEB's Cost of Supply and Average Tariff (Unit: Paisa/kWh)

	National Average 1999-00	MSEB				
		1995-96	1996-97	1997-98	1998-99	1999-00
Average Electricity Tariff	1.99	1.71	2.01	2.11	2.18	2.53
Average Realization	1.39	1.44	1.69	1.74	1.74	1.71
Average Cost of Supply	2.84	1.53	1.76	1.85	1.89	2.12
Billing Realization Ratio[20]	69.9%	84.21%	84.08%	82.46%	79.82%	67.59%
Gap per unit as % of Realization[21]	51.6%	5.88%	3.98%	5.95%	7.94%	19.34%

Source: MSEB, Central Electricity Authority

c) Financial Status of MSEB

As detailed above, low billing realization and high T&D losses are major constraints on the financial viability of MSEB. In addition, MSEB has suffered from the high cost of purchasing power from an Independent Power Producer (IPP)-owned power station. This cost had increased gradually from 20,500 million rupees in 1995-96, to 28,340 million rupees in 1998-99, and jumped sharply to 43,770 million rupees in 1999-00. From May 1999 to December 2000, the unit price of purchasing costs reached 4.67 rupees/kWh, against the average electricity tariff levied on consumers of 2.53 rupees/kWh during 1999-00. This gap is the result of various reasons, including the depreciation of the Indian Rupee vis-à-vis US Dollar and a steep rise in the price of Naphtha fuel.

Failure in MSEB's negotiation for reduction in power purchasing cost from the IPP companies resulted in the rejection of payment from MSEB to the IPP companies. The dispute over the power purchase agreement worsened, and both sides brought the case before the national high court. However, the outlook for the settlement of the issue is still vague.

Because MSEB receives a subsidy from the state government so that it could maintain its 4.50% of Rate of Return[22], there has been no adverse deterioration of the board's financial viability. However, taking into account the rapid subsidy increase, there are some uncertainties regarding the sustainability of the operation and maintenance of project.

2.5.3 Capability of Operation and Maintenance

At present, the power station and the 11kV switchyard are operated and maintained by MSEB, and there are 82 personnel for managing the project facilities. The operation and maintenance of the power station is being executed in three shifts by and operations staff of 16 operation and a maintenance staff of 11.

The Ujjani Dam, tailrace canal, and lower weir are maintained by the Irrigation Department. The tailrace canal and lower weir were heavily damaged by floods in 1995 and 1997. However, the structure of the facilities was strengthened during a subsequent period of restoration aimed at preventing further damage from future floods. Also, a daily patrol and a monthly inspection are executed in order to confirm structural integrity.

Maintenance and inspection of the facilities are carried out systematically, as per maintenance manuals supplied by the respective contractors. Maintenance was, more or less, executed on schedule. The annual overhaul, which is more costly than other maintenance activities, is also carried over a period of a month

[20] Billing Realization Ratio: Amount of Collected / Amount of Billing to the consumers

[21] Gap per unit as % of Realization: (Average cost of supply-average realization without subsidy) / Average cost of supply

[22] According to the Electricity Supply Act of 1948, the board is required to achieve a minimum surplus of 3% on its capital base. However, it is required to achieve a 4.5% return as per the covenants agreed to for loans from financial institutions such as the World Bank, Power Finance Corporation of India.

on an annual basis, prior to the start of the rainy season. Thus, there is no particular problem with the project facilities.

As of now, all the structural/ mechanical constraints have been resolved successfully by MSEB and the Irrigation Department. In addition, the durability of these facilities was strengthened by restoration. Consequently, despite past problems, the operation and maintenance capability of the power station is considered sufficient.

2.5.4 Future Prospect of Water Availability

At appraisal, water availability for generation was expected to fall, reaching zero in 2001, in line with the development of an irrigation scheme in the region. In reality, since the progress of the irrigation plan was revised downwards, water supply will be secured, to some extent, even in the future.

3. Lessons Learned

3.1 Importance of Geological Survey

If this project were completed on schedule, the power plant might have successfully operated as a base load facility, utilizing sufficient water during the initial operation period. In actuality, commissioning of the power station was delayed by about 5 years, so water availability had already been limited. The completion delay occasioned considerable deterioration of the financial viability of the project. The completion delay was indirectly caused from the unexpected geological conditions.

In the case of the hydropower project, the geological condition is one of the key factors in regulating cost, implementation period, and project scope. Given the importance of geological matters, detailed geological survey should be executed by the executing agency, as earlier as possible before the commencement of the project.

Comparison of Original and Actual Scope

Item	Original Plan	Actual
(1) Project Scope		
A. Installation of Power Generator	1×12MW	As Planned
B. Other equipments		
- Crane	60/10M.T., E.O.T. Crane	65/15M.T., Goliath Crane
- 11KV Power Cables	11KV×XLPE Cables 1) 1×630sq.mm-250M. 2) 3×70sq.mm.=100M.	11KV×XLPE Cables 1) 1×400sq.mm-2000M. 2) 3×70sq.mm.=160M.
- Auxiliary and Emergency Transformers	250KVA	315KVA
- D.C. Equipments	220V, 300A.H.	220V, 350A.H.
- 132KV Switchyard	132KV (size 35×15m)	132KV (size 56×26m)
- Drainage/Dewatering system	30H.P.V.T. Pumps (2 nos.)	30H.P.V.T. Pumps & 20HP Submersible Pumps (2 nos each)
- Power house lift		6 Passenger 408kg.
C. Civil Works		
- Power House	Rectangular 25.5×19.18×31.5m	Circular Diameter: 26.8m, Height: 34.50m
- Tail race	Length: 572m Bottom width: 6m	Length: 225m Bottom width: 7m
- Lower weir	L: 440m, H: 13.42m With stoplog gates	L: 620m, H: 8.62m With service gates
(2) Implementation Schedule		
A. Power Generator		
1) Tender & contract	Nov. 1985 - Aug. 1986	Oct. 1985 - Nov. 1986
2) Manufacture and shipment	Sep. 1986 - Aug. 1988	Dec. 1986 - Aug. 1988
3) Installation	Sep. 1987 - July. 1989	Jun. 1988 - Dec. 1993
4) Commissioning	Aug. 1989 - Oct. 1989	Mar. 1994 - May. 1994
B. Other Equipments		
1) Tender and contract	May. 1986 - Aug. 1987	Jun. 1986 - Dec. 1994
2) Manufacture & Shipment	Sep. 1987 - Nov. 1988	Jan. 1987 - Mar. 1995
3) Installation	Dec. 1989 - May. 1989	Jan. 1988 - Jan. 1996
C. Civil Works		
1) Power plant building	Feb. 1986 - Jan. 1988	Dec. 1985 - Feb. 1992
2) Lower weir	Sep. 1986 - July. 1989	May. 1986 - Feb. 1994
3) Tail race channel	Dec. 1985 - July. 1989	Dec. 1985 - Dec. 1995
(3) Project Cost		
Foreign currency	1,500 million yen	1,312.3 million yen
Local currency	93.5 million rupees	468.4 million rupees
Total	3,370.4 million yen	4,498.9 million yen
ODA Loan Portion	1,500 million yen	1,312.3 million yen
Exchange Rate	1 rupee = 20 yen (As of June 1985)	1 rupee = 6.80 yen (As of Year 1991)

Independent Evaluator's Opinion on the Ujjani Hydroelectric Project

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Maharashtra is one of the leading states of the Indian Union, having the highest per capital income among all states. Its growth rate continues to be impressive, thanks to many advantages like a long coastal line facilitating exports and imports, location of major industry and trading houses, and its capital Mumbai being India's main financial and economic center.

Maharashtra has a broad power generation base. As on 31st March 2001, it had a total installed capacity of 12760 MW: 9743 MW in the public sector and the rest in the private sector including that of Enron and Tatas. Its share in the Central Sector generation was another 2121 MW: 1774 MW in thermal units and 347 MW in Nuclear power stations.

Viewed against this background, the 12 MW Ujjani hydroelectric project funded by JBIC would appear to be a small component of a big network. However, its relevance can be appreciated by the fact in the year 2000-01, Maharashtra had a peaking deficit of 15.5% and an energy deficit of 10.5% (8.34). a hydel project, howsoever small, has a relevance as the fuel cost is nil and power generation would be pollution free.

Unfortunately, like many other power projects commissioned in India, there was a time and cost overrun on this project, thus reducing its impact somewhat. The factors causing delay in the implementation of the project have been enumerated at length in the post evaluation report of the Consultants and need not be repeated here. However, a 12 MW hydroelectric unit, at full capacity is capable of generating approximately 0.3 GWh a day (24hours) or 90 GWh over 300 days. During pumped storage operation the unit works as conventional generator during peak hours. During off peak hours, the turbine works as pump in the reverse direction and water stored in the lower reservoir is pumped through the same tail race and water conduit system into upper reservoir. The diameter of the penstock is 3.2 meter and its discharge is 50 cum/sec.

The future sustainability of the project depends on the volume of water available in the upstream dam. If the water availability falls, as envisaged, in line with the development of an irrigation scheme in the region, there will be a reduction on power generation. Nonetheless, as long as it is on, it will balance the power generation cycle in Maharashtra by chipping in during peak hours. In any case, the Japanese interest is further evident from the OECF support for the 2 x 125 MW Ghatgar PSS where the two reversible units will be installed in an underground powerhouse with a peak energy generation of 467 GWh per annum. That project is expected to be completed by March 2004.