

## Myanmar

### Baluchung No. 2 Power Station Renovation Project

Report Date: May, 2002

Field Survey: September, 2001

#### 1. Project Profile and Japan's ODA Loan



Site Map



Site Photo : Control Room with Operators

#### 1.1 Background

Myanmar has the capacity to supply 833 MW of electricity, of which the Electric Power Corporation (EPC) can produce 636MW (installed capacity). The Baluchaung No. 2 Power Station (hydro type), one of EPC's major power stations, was implemented in two phases: the first phase, consisting of 3 units of 28MW each, constructed in March 1960 and the second phase, of identical scope, in February 1974. However, until the implementation of this renovation project, no large scale inspection, repair, or parts replacement had taken place. Significant deterioration and fatigue due to aging were recognized, and it was concluded that the station risked failure. Electric power generated at this plant is sent to the Yangon and the Mandalay region; thus Baluchang No. 2 Power Station plays a significant role in the supply of electric energy in Myanmar.

Under such conditions, it was determined that repair work on this power station, ensuring a reliable supply of electric power, was essential for industrial development and civil life in Myanmar.

#### 1.2 Objectives

To execute renovation works at Baluchaung No. 2 Power Station, which had deteriorated due to superannuation or aging and also purchase spare equipment and materials in advance to prevent loss due to failure and damage. And also, it was intended to ensure the long-term, reliable supply of electric energy.

#### 1.3 Project Scope

The project scope consisted of the following works:

- 1) Overhaul of the first three units and the second three units;
- 2) Replacement of major and consumable parts in the first three units;
- 3) Replacement of consumable parts in the second three units and major parts in Generator No. 6;
- 4) Procurement of common spare parts and tools; and
- 5) Consulting services.

## 1.4 Borrower/Executing Agency

Electric Power Corporation (EPC)

## 1.5 Outline of Loan Agreement

Loan Amount	3,530 million yen
Loan Disbursed Amount	3,460million yen
Exchange of Notes	September 1987
Loan Agreement	November 1987
Terms and Conditions	
Interest Rate	2.50% p.a.
Repayment Period (Grace Period)	30 years ( 10 years )
Procurement	Partially Untied
Final Disbursement Date	May 1995

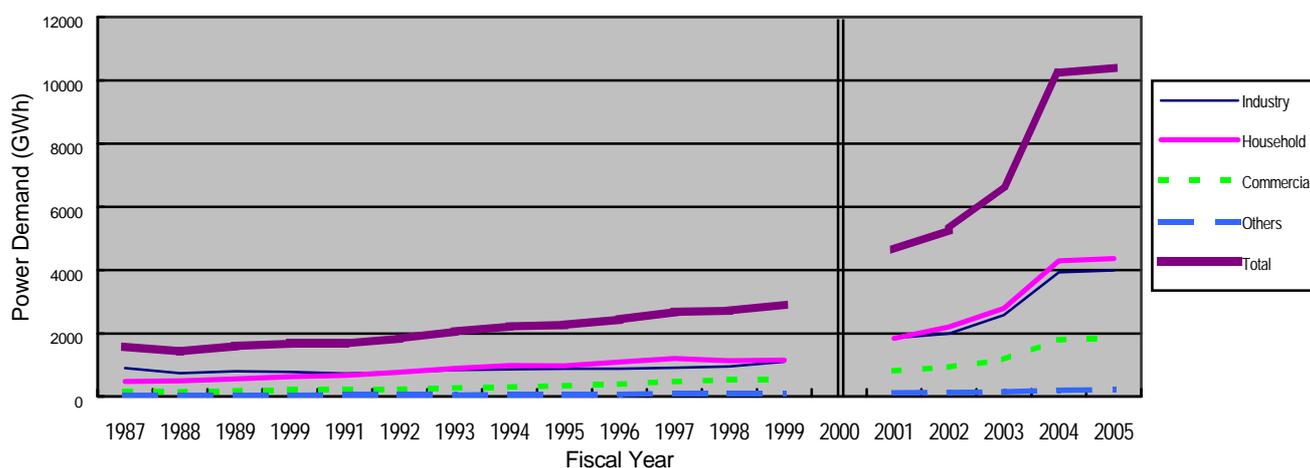
## 2. Results and Evaluation

### 2.1 Relevance

Through the 1980s, growth in electricity use in Myanmar remained low. In an effort to improve public welfare and to promote industrial development, the government placed a high priority on the development of power resources task. In the Fifth 4-year Economic Development Plan (1986-1989), it decided to increase of power supply through the construction of a hydroelectric power plant.

As shown in Figure 1, the total demand for power during 1990s nearly doubled; from 1,500 GWh in 1987, it shot up to 3,000 GWh in the year 1999. This trend in power demand is evidence of the relevance of this project.

**Figure 1: Trend in Power Demand**



Source : Myanmar Electric Power Enterprise

The Government of Myanmar still places high priority on hydro power generation. As shown in Table 1, hydroelectric power continues to be a very important energy resource. Therefore, the project is considered relevant at the time of post-evaluation.

**Table 1: Electric Power Installation Capacity (Unit:MW)**

Fiscal Year	1985	1990	1992	1993	1994	1995	1996	1997	1998	1999
Hydel	226	258	289	291	299	317	327	328	340	360
Total	684	804	807	809	837	982	1033	1042	1055	1196
Hydel %	33	32	36	36	36	32	32	31	32	30

Source: Statistical Year Book 2000 published by Central Statistical Organization, Myanmar

## 2.2 Efficiency

### 2.2.1 Project Scope

The actual scope was essentially same as that of the original plan, except for the Stator and Field Coils for the Generator in Unit No. 6, which were not replaced, but retained as spares. Without replacement of these coils, even so, the generation capacity of Unit No. 6 improved to 28MW (Nameplate Capacity) through the project, and it maintains that level at the time of post-evaluation. The coils are retained as common spare parts for all six units.

### 2.2.2 Implementation Schedule

The renovation work for each of the six units was completed with four years delay. The delay in the works was mainly due to political unrest during the latter part of the project implementation period.

### 2.2.3 Project Cost

The actual project cost regarding foreign and local currency portions was within budget.

## 2.3 Effectiveness

### 2.3.1 Generation Capacity

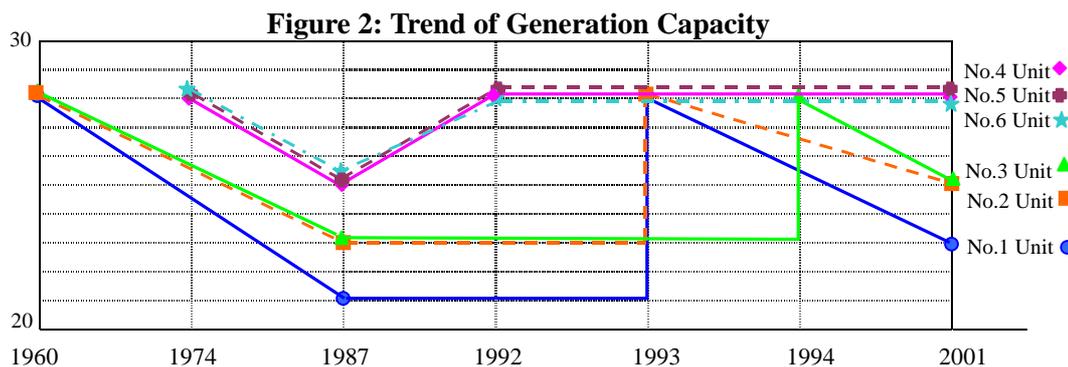
Before the renovation, the net generation capacity of each Unit was less than its rated capacity (28MW), with the result that total net generation capacity at Baluchaung No. 2 Station was 142 MW, while total rated capacity is 168 MW. The renovation project restored all six units to 28 MW, and total capacity to 168 MW (see Table 2). Thus, the renovation project is considered effective.

Note: At the time of post-evaluation, the net generation capacity of units No. 1, 2 and 3 was down to 23, 25 and 25MW, respectively.

**Table 2: Generation Capacity before/after Renovation**

	Before Renovation Date : 1987	After Renovation Testing Date	Present Date : Sep. 2001
No.1 Unit	21	28 : Oct. 1993	23
No.2 Unit	23	28 : Dec. 1993	25
No.3 Unit	23	28 : Sep. 1994	25
No.4 Unit	25	28 : Oct. 1992	28
No.5 Unit	25	28 : Dec. 1992	28
No.6 Unit	25	28 : Jan. 1993	28
	142	168	157

Source: No. 2 Hydro-Power Station at Baluchaung



Source: No. 2 Hydro-Power Station at Baluchaung

### 2.3.2 Volume of Net Production

The volume of actual net production from fiscal year 1987 to FY 2000 is shown in Table 3. The average volumes from 1987 to 1992, and from 1993 to 1997, were 920 and 1,197 GWh, respectively. The renovation project is considered effective.

**Table 3: Net Production in Baluchaung No. 2**

Fiscal Year	Net Production GWh	Output Capacity MW	Utilization Factor %
1987	908	142	73.0
1988	828	142	66.6
1989	864	142	69.5
1990	943	142	75.8
1991	1,013	142	81.4
1992	963	145	75.8
1993	1,172	156	85.8
1994	1,190	164	82.8
1995	1,224	168	83.2
1996	1,192	168	81.0
1997	1,205	165	83.4
1998	631	162	44.5
1999	672	161	47.6
2000	1,219	158	88.1

Source : Myanmar Electric Power Enterprise

The utilization factor, which includes such elements as demand, on-stream and rain, is calculated using the following formula:  $\text{Utilization Factor} = (\text{Net Production}) / (\text{Output Capacity} \times 365 \times 24)$ . In 1998 and 1999, the utilization factor was very low due to severe drought.

### 2.3.3 Function of Baluchaung No. 2 Power Station

From 1990 to 1999, peak demand outstripped firm power availability, as indicated in Table 4. It can be said that the renovation project made a valuable contribution to bridging this gap. The present function of the station is “Firm Power Station”.

**Table 4: Firm Power and Peak Load**

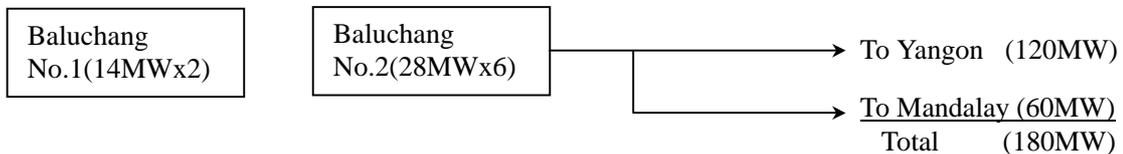
Unit: MW

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Firm Power	407	407	383	356	356	384	399	411	609	623	613	622	706
Peak Demand	359	332	373	407	430	460	483	485	581	680	750	845	897
Balance	48	75	10	-51	-74	-76	-84	-74	28	-57	-137	-223	-191

Source : Myanmar Electric Power Enterprise

#### 2.3.4 Present Transmission and Generation Pattern

The Baluchaung No. 1 and No. 2 Power Stations have a generation capacity of 28 (14 x2) MW and 168 (28 x 6) MW, respectively. Out of this, 120 MW of electric power is transmitted to Yangon and 60 MW to Mandalay, through the route illustrated in Fig. 3. The pattern of power generation at the two stations of day and night is indicated in Table 5.

**Figure 3: Transmission Route from Baluchaung No. 1 and No. 2**

Source: No. 2 Hydro-Power Station at Baluchaung

**Table 5: Present Generation Pattern**

Power Station	Generation	
	Day	Night
Baluchaung No.1	25 MW	27 MW
Baluchaung No.2	140 MW	153 MW
Total	165 MW	180 MW

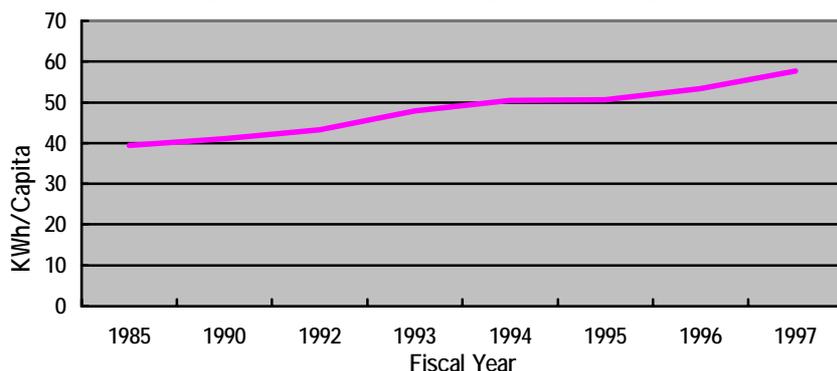
Source: No. 2 Hydro-Power Station at Baluchaung

## 2.4 Impact

### 2.4.1 Power Consumption Per Capita

Improvement in public welfare and well-being is closely linked to industrial development, in Myanmar as in any other country. This is commensurate with per capita consumption of power, which as can be seen in Fig. 4, rose nearly 50% from 1985 to 1997. The increases in demand for industrial, commercial and household sectors shown in Fig. 1 also reflect trend. The renovation project contributed to this trend.

**Figure4: Power Consumption per Capita**



Source : Statistical Year Book 2000 published by Central Statistical Organization, Myanmar

## 2.4.2 Other Impacts

### (a) Environment and Local Residents

No adverse impacts on the environment or on local residents have been reported from either the Myanmar Electric Power Enterprise or Baluchaung No. 2 Hydro-Electric Power Station.

## 2.5 Sustainability

### 2.5.1 Operation and Maintenance

Myanmar Electric Power Enterprise (MEPE), a central government organization, is the agency responsible for the operation and maintenance of the power station. Under MEPE, actual management of operation and maintenance is taken care of by Baluchaung No. 2 Hydro-Electric Power Station, which consists of 262 personnel headed by a Power Station Superintendent.

### 2.5.2 Condition of Equipment

Baluchaung No. 2 Power Station is one of Myanmar's older hydro-electric power stations, having been constructed in 1960 and 1974. Through the renovation project, the generation capacity of all six units was restored to design capacity, 28 MW.

However, at the time of post-evaluation, the generating capacities of units No. 1, 2 and 3 were down to 23, 25 and 25 MW, respectively. According to MEPE, repair or replacement of the needle, the nozzles and runner buckets is planned but the exact timing has not been fixed yet. As for the accumulation of the silt, MEPE may be able to clean up the penstock only after a new power station at Paunglaung starts operation in 2004. This drop might be caused by an accumulation of silt inside the penstock and by reduced efficiency of turbines due to wear of needle, nozzles and runner buckets.

It is recommended that MEPE conduct a study on the renovation of areas that were not included in the scope of this previous project, including the excitation system, transformer and switch gear, even though these areas are not causing any problem for time being.

### 2.5.3 Financial Status

It is difficult to evaluate the financial status of the Power Station, since the data on O&M were not available from the Myanmar Electric Power Enterprise at the time of post-evaluation. However, MEPE is a public-sector organization operating under the Ministry of Power and the financial status of the operating and maintenance agency may not be critical to the sustainability of the project.

## Comparison of Original and Actual Scope

Item	Plan	Actual
<b>Project Scope</b> (1) Overhaul (2) Replacement of Major and Consumable Parts (3) Replacement of Consumable Parts (4) Replacement of Major Parts (5) Procurement	(1) of the first three units and second three units (2) in the first three units (3) in the second three units (4) in Generator No.6 (5) of common spare parts and tools	(1) - same as Plan - (2) - same as Plan - (3) - same as Plan - (4) bought but not replaced and retained (5) - same as Plan -
<b>Implementation Schedule</b> (1) Start of Project (2) Overhaul Works - Overall - No.1 Unit - No.2 Unit - No.3 Unit - No.4 Unit - No.5 Unit - No.6 Unit	Oct. 1987 Jan. 1981 – Dec. 1985 Jul.1989 - Aug.1990 Sep.1989 Dec.1989 Feb.1990 Apr.1990 Jun.1990 Aug.1990	Oct. 1987 Jan. 1981 – Jan. 1991 Sep. 1992 - Sep. 1994 Jul. 1993 - Oct. 1993 Oct. 1993 - Dec. 1993 Jun. 1994 - Sep. 1994 Sep. 1992 - Nov. 1992 Nov. 1992 - Dec. 1992 Dec. 1992 - Jan. 1993
<b>Project Cost</b> Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	3,530 Million Yen 106,168 Thousand Kyats 5,972 Million Yen 3,530 Million Yen 1 Kyat = 23.0 Yen (as of August 1986)	3,460 Million Yen 59,963 Thousand Kyats 4,791 Million Yen 3,460 Million Yen 1 Kyat = 22.2 (average through 1990)