CHAPTER 5

POWER SECTOR

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5.1 Present Situation of Power Sector

5.1.1 Power Supply Utilities

(1) Organization of Power Authority of East Timor (PAET)

Following the direct referendum on the independence of East Timor which was implemented on August 30, 1999, the People's Consultative Assembly of Indonesia gave its approval to the separation and independence of East Timor on October 20, and independence became a reality.

However, the electric power supply utility in East Timor before independence was managed by the Indonesian public power company PLN (Perusahan Listrik Negara), and most of the major posts within this organization (including important jobs at power plants) were filled by Indonesian nationals dispatched from PLN headquarters. Accordingly, as a result of the conflict which ensued the referendum, most of the major PLN personnel returned to Indonesia while a few escaped to other countries as refugees, the power utility in East Timor was broken up, and power supply, which is vital element of the social infrastructure, was interrupted.

In response to this situation, the leaders of the National Council of Timor Resistance (CNRT) establish the Power Authority of East Timor (PAET) with support from UNTAET and the British DFID, and currently organizational strengthening consisting of the re-employment of engineers, etc. is being advanced mainly by the general coordinator, Mr. Bonaparte and the secretary, Mr. Simenes. In spite of these efforts, the present number of employees is 242 including regional staff (as of the end of June 2000), which is roughly 2/3 of the number of approximately 360 that existed before the conflict. The tentative organization structure of PAET is shown in Figure 5.1.1 and personnel in major departments are as shown below. These figures do not include staff from regional power stations.

- Headquarters	Mr. Bonaparte Soares (General Coordinator)	
- Administration department	Under Mr. J. Pereira	8
- Accountant & Personel	Under Mr. Da Silva	5
- Komoro Power Station	Under Mr. T. Antonio	18
- Caicoli Power Station	Under Mr. FM Drago	10
- Generation & workshop	Under Mr. M. Ismael	10
- Distribution Department	Under Mr. A. Guteres	28

- Customer Services	Under Mr. E. Sarmento	5
- Procurement & Store	Under Mr. DA. Costa	8
- Construction Department	Under Mr. B. Soares	11
- Fuel Procurement Department	Under Mr. D. Pinheiro	12
Total		126

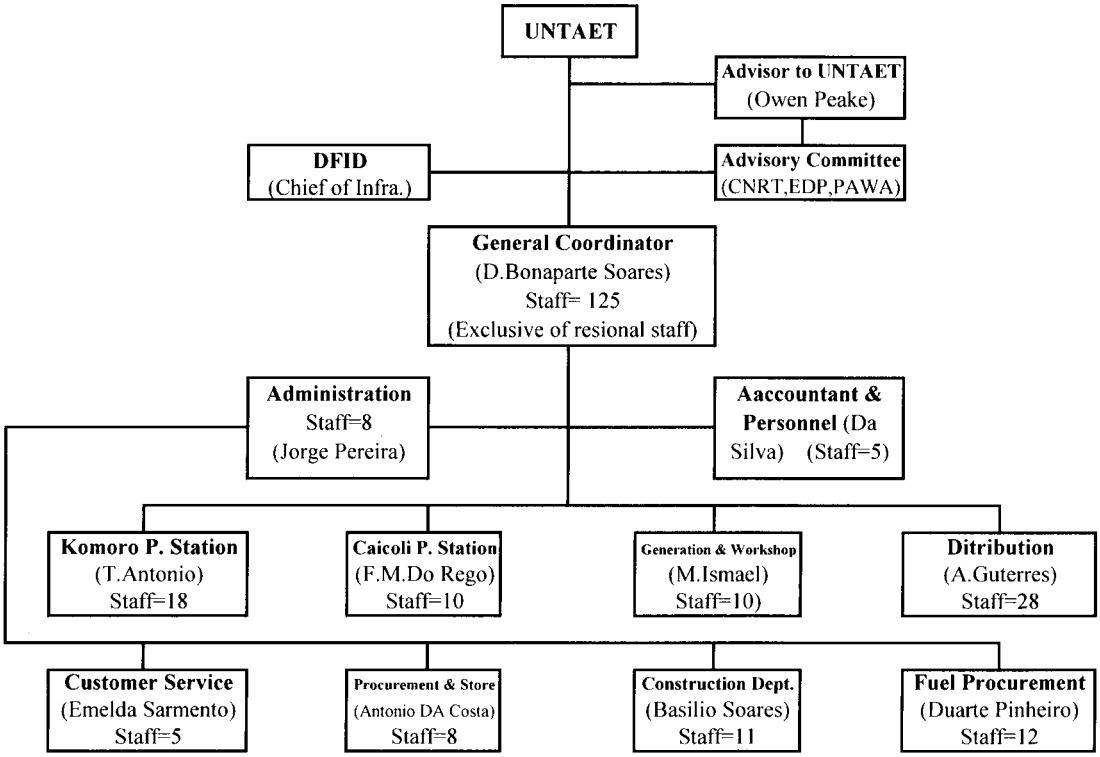


Figure 5.1.1 Power Authority of East Timor Interim Management Structure

(2) Budget

The Power Authority of East Timor (PAET), with support from UNTAET and DFID, has just started operation of power facilities, but they are not collecting electric tariffs from consumers as of the end of June 2000. This is because the PAET tariff system has not yet been established and, although work is being advanced under the guidance of UNTAET with a view to quickly establishing this system, it is currently unclear as to when this can be achieved. Moreover, since Portugal is set to provide US $ 1,000,000 aid for implementation of an institutional development study of PAET including the tariff system, it is thought that a system will be established in line with progress of this study. (The study is scheduled for implementation for 10 months from March through December 2000).

Accordingly, PAET currently has no budget of its own but its operation is totally dependent on support from UNTAET. Incidentally, all costs ranging from the purchase of plant fuel oil to staff salaries are paid by UNTAET.

However, UNTAET itself is financed by contributions from each country and is finding it difficult to secure its own annual budget. The following table shows the part of the UNTAET budget allocated to the power sector for the three-month period from April to June 2000.

Table 5.1.1 Power-related Budget of UNTAET (April-June, 2000)

Item	Amount	Remarks
1. Power plant fuel	US$ 1,000,000.-	
2. Salaries	US$ 500,000.-	Including consultant expenses
3. Vehicle purchase and rental costs	US$ 500,000.-	
4. Facilities and equipment repair costs	US$ 500,000.-	Payment to contractor
5. Other costs	US$ 200,000.-	
Total	US$ 2,700,000.-	

(Source: UNTAET)

Meanwhile, UNTAET has made an appropriation for power facility restoration based on the assistance of each donor country and agency for the coming three years as shown in the following table. However its specific title of restoration plan has not been approved, moreover, the sum total of the budget of each sector will considerably exceed the total amount of aid declared by each donor country at present. It is therefore requested more assistance from each country and agency in order to materialize the plan.

Table 5.1.2 Power Facility Restoration Budget of UNTAET (FY 2000/01-FY2002/03)

	FY2000/01	FY2001/02	FY2002/03	Total
1. Trust fund	US$ 1,730,000.-	US$ 1,030,000.-	-	US$ 2,760,000.-
2.Bilateral fund	US$ 3,725,000.-	US$ 3,800,000.-	US$ 4,000,000.-	US$11,525,000.-
Total	US$ 5,455,000.-	US$ 4,830,000.-	US$ 4,000,000.-	US$14,285,000.-

(Source: UNTAET)

(3) Future Plans

As was described above, the PAET was established under technical and economic support from the DFID, etc. in the wake of the referendum and disturbances, and it has only just started the operation of existing facilities. Accordingly, in a similar way to the fact that no national development plan has so far been compiled for East Timor, no future plans have been formulated for the electric power utility of PAET.

PAET is currently faced with the following kinds of problems: how to procure diesel fuel for power generation, how to pay staff salaries, how to replace the engineers who returned to Indonesia, and how to collect a tariff for power, and so on. Consequently, it is hoped that, within the institutional development study of PAET to be conducted under assistance from Portugal, a future vision and plans for the electric power utility will be formulated.

5.1.2 Assistance Trends of Each Country and Agency

(1) DFID (United Kingdom)

The British DFID (Department for International Development) waited for the conflict following the referendum to die down before commencing immediate assistance to East Timor. Concerning the electric power utility in particular, the PAET was established in cooperation with main members of CNRT, and they have held de facto control of PAET until now. The main contents of assistance are:

- Project name: Operation and power supply
- Related districts: 21 power plants
- Period: End of March 2000
- Contents of assistance: i) Supply of fuel for power generation
  ii) Supply trucks for power material transportation
  iii) Pay staff salaries
- Amount of aid: Unknown

DFID's assistance to the power sector was terminated in March 2000 as scheduled, however, no agency has yet decided to continue providing aid after this and according to the PAET general coordinator, Mr. Bonaparte, in reality there is little choice but to rely on UNTAET. Incidentally, according to estimation made by

UNTAET power engineers, approximately US $ 1,000,000 will be required from March through December 2000 simply to purchase fuel for power generation. In reality much of the UNTAET budget described above (Section 1.1.2) is provided by the DFID.

(2) Portugal

Portugal, operating through UNDP, is about to implement a study of institutional development in PAET. For this reason, Portugal pays 3% of clerical expenses to UNDP, and a Portuguese consultant has concluded a direct contract with UNDP. An outline of this aid plan is given below.

- Name of project: Institutional Study
- Related districts: All districts of East Timor
- Period: March-December, 2000 (10 months)
- Main objectives of study: Which of the following organizational forms should PAET adopt?
  i) Nationalization
  ii) Public corporation
  iii) Privatization
- Amount of aid US $ 1,000,000

In addition to the above assistance, Portugal is to restore small power stations for 4 rural areas as shown in the table 5.1.3; and two stations are already in operation.

Table 5.1.3 Rural Power Stations Restoring by Portugal

(As of 24June.'00)

District	Power Station	Generator Capacity	Present Situations
Baucau	Quelicai	50 kW x 2 sets	In operation
Lospalos	Luro	50 kW x 2 sets	Under restoration
Manatuto	Laclubar	50 kW x 2 sets	In operation
Manatuto	Natarbora	50 kW x 2 sets	Under restoration

(3) Australia

Australian has provided assistance to the power sector by dispatching of engineers to carry out the restoration of power stations and repair of distribution lines. An outline description of the assistance is given below.

- Project name: Restoration of Power Stations
- Related districts: All districts of East Timor
- Period: 8 months until June 2000
- Contents of assistance: i) Dispatch of repair engineers for power stations and distribution lines (4-5 engineers)
  ii) Supply of repair materials for power stations and distribution lines
- Amount of aid: Aus. $ 20,000-30,000/month for materials

Moreover, at the power stations in Baucau, the second largest city in East Timor, the operation had been suspended in four out of six units. The power supply was previously rationed to six hours a day due to lack of facilities maintenance following the conflict. However, following dispatching said engineers, output of the power stations was restored and power supply returned to 24 hours per day as of April 2000. The next schedule is for repair works to be carried out at Manatuto power station and Gleno power station, etc.

(4) Asian Development Bank

The Asian Development Bank (ADB) plans assistance for the roads, ports, and power sectors using trust fund. Preliminary study for this aid is scheduled from April through September (study period), while the period from October through to June 2002 is the implementation period. The total amount of assistance to the power sector is US $ 2,760,000 of the trust fund as shown in Table 5.1.1.-2, and the contents of the assistance plan are as follows:

• Emergency repairs to 15 regional power stations	US $ 1,280,000
• Distribution network repair plan	US $ 480,000
• Replacement of medium voltage distribution panel at Komoro power station	US $ 120,000
• Repair of radio equipment for emergency communications	US $ 80,000
• Office equipment supply plan	US $ 800,000
Total	US $ 2,760,000

Moreover, 15 power stations have been targeted for emergency repairs by the ADB; these power stations are different from the 13 regional power stations targeted for

emergency grant aid by Japan (described later). There is thus no overlapping of ADB aid with Japan's aid.

ADB has also studied a marginal cost power tariff for PAET to return to profitability. This study proposes a tariff system to be instituted according to the category of consumers, receiving voltage level and daily time period of power use based on the actual operation results of the year 1998 by PLN, pre-conflict Power Utility. Although a conclusion has not yet made as of June, 2000, the tariff proposed is likely to be fixed at a fairly high level.

(5) Other

Various countries and agencies including NGO are providing aid to numerous sectors in East Timor however; there is no more aid to the power sector apart from that mentioned above.

5.1.3 Power Supply Facilities

(1) Power Supply Conditions

Residents in East Timor engaged in dairy farming, which is the main industry, are found distributed through regional district because of topological restrictions. In contrast, almost all commercial and industrial facilities are concentrated in Dili and surrounding areas. For this reason, apart from a few areas (Dili, Manatuto, etc.), independent power sources are used in each district.

Accordingly, there are 60 power stations throughout the country and these are all diesel generators. However, output from individual units varies greatly from 25 kW to 3.0 MW. The table 5.1.4 shows all power stations in each district, presents output as of the end of May 2000, and operating conditions as of the end of June 2000. Moreover, 39 power stations had been suspended their operations as of March 2000 for some reason. However, their power stations adjusted to 32 power stations including 3 power stations in Ambino district by the end of June 2000. The 31 small power stations are located in rural areas and Ainaro. This progress includes resuming operation of seven (7) power stations due to UNTAET's restoration activities. These (5) power stations were restored by Engineers from the Northern Territory Government in Australia and two (2) power stations were restored by engineers from Portugal.

Table 5.1.4 Outline of Power Generation Facilities in East Timor

No.	District Name	Power Station	Present Output (kW)	Current Conditions		Remarks
				Operating	Not Operating	
1	2	3	4	5	6	7
1	Dili	Caicoli	1,200	x		
2		Komoro	11,000	x		
3		Atauro	48	x		
4	Baucau	Baucau	640	x		Restored by UNTAET
5		Venilale	64	x		
6		Baguia	40	x		
7		Quelicai	80	x		Restored by Portugal
8	Lospalos	Lospalos	580	x		
9		Tutuala	32	x		
10		Iliomar	0		X(J-1)	To be restored by Japan
11		Luro	0		X(P-1)	To be restored by Portugal
12		Lautem	25	x		
13	Manatuto	Manatuto	550	x		Under restoring
14		Laclubar	25	X		Restored by Portugal
15		Soibada	80	x		
16		Natarbora	0		X(P-2)	To be restored by Portugal
17		Manelima	0		X(A-1)	To be restored by ADB
18	Aileu	Aileu	170	x		
19		Maubisse	20	x		
20		Remexio	0		X(J-2)	To be restored by Japan
21		Lequidoe	0		X(A-2)	Restored by UNTAET
22	Viqueque	Viqueque	580	x		
23		Ossu	40	x		
24		Uatu Lari	80	x		
25		Uatu Carbau	0		X(N-1)	To be restored by UNTAET
26		Lacluta	0		X(J-3)	To be restored by Japan
27	Same	Same	400	x		
28		Fatuberliu	24	x		
29		Alas	40	x		
30		Turiscai	40	x		Restored by UNTAET
31		Betano	0		X(A-3)	To be restored by ADB
32	Ainaro	Ainaro	0		X(A-4)	To be restored by ADB
33		Hato udo	0		X(J-4)	To be restored by Japan
34		Hato bilico	0		X(J-5)	To be restored by Japan
35		Fatululic	0		X(J-6)	To be restored by Japan
36	Ermera	Gleno	180,0	x		Restored by UNTAET
37		Letefoho	0		X(A-5)	To be restored by ADB
38		Hatolia	30	x		Restored by UNTAET
39		Atsabe	0		X(J-7)	To be restored by Japan
40		Railako	0		X(N-2)	Under restoration by UNTAET
41		Ermera	30			Temporary

No.	District Name	Power Station	Present Output (kW)	Current Conditions		Remarks
				Operating	Not Operating	
42	Maliana	Maliana	1,358	x		
43		Bobonaro	0		X(A-6)	To be restored by ADB
44		Batugade	0		X(A-7)	To be restored by ADB
45		Atabae	0		X(J-8)	To be restored by Japan
46		Balibo	0		X(A-8)	To be restored by ADB
47		Lolotoe	0		X(A-9)	To be restored by ADB
48	Suai	Suai	285	x		
49		Zumalai	0		X(J-9)	To be restored by Japan
50		Fohorem	0		X(A-10)	To be restored by ADB
51		Tilomar	0		X(A-11)	To be restored by ADB
52		Beco	0		X(J-10)	To be restored by Japan
53		Raimean	0		X(J-11)	To be restored by Japan
54		Fatumean	0		X(A-12)	To be restored by ADB
55	Oecusse	Oecusse	150	x		Restored by UNTAET
56		Passabe	0		X(A-13)	To be restored by ADB
57		Nitibe	0		X(A-14)	To be restored by ADB
58		Oesilo	0		X(A-15)	To be restored by ADB
59	Liquica	Loes	0		X(J-12)	To be restored by Japan
60		Bazartete	0		X(J-13)	To be restored by Japan

Source: UNTAET/PAET (including partial corrections made by the Study Team in the site surveys)
Note: X(J-1) to X(J-13) : Target power stations for urgent grant aid by Japan
X(N-1) to X(N-2) : Target power stations for restoration by UNTAET
X(A-1) to X(A-15) : Target power stations for restoration by ADB
X(P-1) to X(P-2) : Target power stations for restoration by Portugal

As shown above, 39 out of 60 power stations, including 4 power stations in Ambino district, have suspended their operations because of vandalizing and burning during the conflict from September 1999. This lower capacity not only prevented the supply of energy to local residents, it also hindered the operation of social welfare facilities and development of the local economy.

Even at those power plants, which are still operating, maintenance of facilities is well behind schedule due to the exodus of PLN employees (PLN was the utility operator before the disturbances) to Indonesia. This lack of trained personnel is leading to major reductions in generator output and higher fuel consumption, etc.

Moreover, adequate fuel procurement is not available and power stations only operate from 17.30 to 23.30 at night in almost all districts apart from Dili, Baucau and its environs.
(Refer to Appedix-APP.5.1.3)

(2) Power Stations

1) Power Stations in Dili

Peak power demand in Dili, the capital of East Timor, and its environs (estimated benefiting a population of approximately 160,000) is 6.2 MW and 6.5MW as of February and June 2000 respectively. This power is equivalent to 73% of power demand in all East Timor. Yet, this power demand is satisfied by two power stations: one at Komoro Power Station located along the Komoro River roughly 5 km to the west of the city center, and the other is the Caicoli Power Station located in the city center. The outlines of each plant are given below.

Table 5.1.5 Outline of Power Generation Facilities at Komoro Power Station

No.	Engine	Generator	Country of Origin	Rated Capacity	Present Output	Remarks
1	MAK	Siemens	Germany	2.5 MW	1.8 MW	'84
2	MAK	Siemens	Germany	2.5 MW	1.8 MW	'84
3	Niigata Tekko	Meidensha	Japan	3.0 MW	2.6 MW	'88
4	PAL-MAK	PINDAD	Indonesia	2.8 MW	2.4 MW	Licensed production in Germany in 1990?
5	PAL-MAK	PINDAD	Indonesia	2.8 MW	2.4 MW	Licensed production in Germany in 1990?
Total output				13.6 MW	11.0 MW	

Source: PAET

Table 5.1.6 Outline of Power Generation Facilities at Caicoli Power Station

No.	Engine	Generator	Country of Origin	Rated Capacity	Present Output	Remarks
1	ENGLISH	BRUSH	United Kingdom	1.6 MW	0.8 MW	'73
2	ENGLISH	BRUSH	United Kingdom	1.6 MW	scrap	'73
3	LISTER	BRUSH	United Kingdom	0.5 MW	scrap	'68
4	UNKNOWN	BRUSH	United Kingdom	1.0 MW	scrap	'73
5	MWM	AVK	Germany	1.0 MW	scrap	'73?
6	Daihatsu Industries	Fuji Electric	Japan	0.9 MW	scrap	'81
7	UNKNOWN	BRUSH	United Kingdom	1.0 MW	0.4 MW	'73
Total output				7.6 MW	1.2 MW	

Source: PAET

As shown in Table 5.1.5 and 5.1.6, the combined maximum present output of both power stations is 12.2 MW and produces a combined rated output of 21.2 MW. And the firm capacity is 7.2 MW, which is more than the peak demand (6.2MW) in Dili and its environs as of the end of February, 2000. Even the combined present output meets the peak demand (8.7MW) as of the end of June, 2000. It could be determined whether this stable supply takes breakdown and periodical maintenance times into consideration.

Moreover, an increase rate in power demand of 1.3% per month is forecast according to UNTAET. A power supply rationing will have to be applied for both power stations by October, 2000. Breakdowns or inspection of equipment will decrease the maximum generating capacity of both power stations. Each power station is described below:

Komoro Power Station

- Replacement parts have not been supplied to the Komoro power station since the conflict, and stocks of spare parts are significantly small.
- Moreover, maintenance tools are in short supply following the conflict.
- Therefore, it is not possible to carry out periodic inspections including overhauls and it is assumed that there will be difficulty in sustaining the present output into the future.
- Moreover, there are serious shortages of both repair materials for oil purifiers and reagents for water softeners, etc. Not only do these shortages lower the output of facilities, but they also leads to environmental deterioration.
- Therefore, in order to sustain present output levels and maintain the supply of power to Dili (the capital city of East Timor), it is vital that spare parts, consumable materials and tools, etc. be procured as soon as possible.

Power House

Generator Unit (#2)

Caicoli Power Station

- This power station was constructed by Portugal (the former sovereign nation) 32 years ago. Five out of the seven installed power generators have already been scrapped due to secular deterioration, while the remaining two units are only operating at 46% of rated output.
- Since the manufacturer of two operating units has suspended production of spare parts, it is difficult for this operation to be continued.
- Even now the plant is used for limited purposes only during nighttime.
- The power station is situated in the residential area, so location conditions are inadequate.
- Therefore, it would be more advantageous in terms of maintenance to stop operations if this plant and unify operations at Komoro Power Station.

East Timor is currently ruled by UNTAET, however, in line with establishment of the new government, it is clear that government-related facilities and equipment, etc. will be constructed and that work will start on the repair and new construction of commercial and industrial facilities and social welfare facilities which were destroyed in the conflict. Thus it is expected that the increase in demand for power in and around Dili will be large.

Therefore, unless immediate countermeasures are implemented at both power stations, not only will the surge in demand quickly exceed rated output, but also there is a risk that the output of power generating equipment will fall rapidly and that emergency measures such as planned power interruptions will need to be taken.

Generator Unit (#1)

Generator Unit (#3)

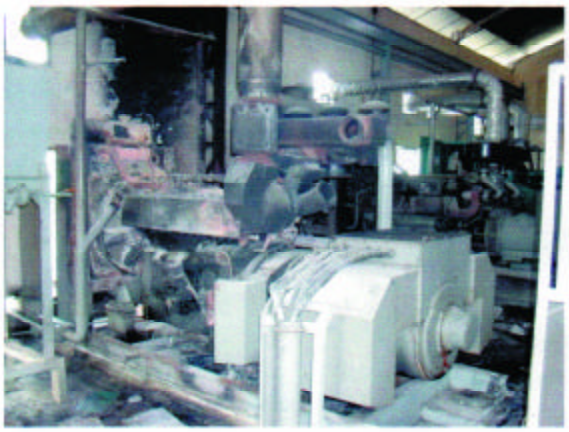
2) Power Stations in Major Cities

The 11 power stations indicated in Table 5.1.7 are the facilities located in major cities in East Timor. Capacity of a single unit of all these stations is more than 100 kW, indicating that the these power stations are large scale facilities compared to the equipment rapidly in towns and villages as described later. Since these power stations are predominantly located in seats of provincial government, demand for power as part of the basic infrastructure of core cities is large and there is a strong desire to see the early restoration of output, which declined during the conflict.

In particular, no commercial operation is being performed at Ainaro power station at all as of the end of June, 2000, and this is creating major problems in citizen's lives and the associated activities of social welfare facilities. At the other ten power stations, too, operating time is limited to six hours from 17.30 to 23.30, and this a major impact on daytime socioeconomic activities. The reasons for this, limited activity as shown in Table 5.1.7. Since present output is lower than rated output at each power station, operating time is limited in order to extend the service life of equipment and cuts the expenditure of fuel.

Table 5.1.7 Outline of Generation Facilities at Power Stations in Major Cities

No.	Name of Power Station	Rated Output (kW)	Present Output (kW)	Remarks
1.	Baucau	2,572.0	640.0	Repairs are being advanced under assistance from the Northern Territory Government of Australia. 24 hour operation is scheduled to start from April 2000.
2.	Lospalos	2,048.0	580.0	
3.	Manatuto	1,3480	550.0	Repairs are being advanced under assistance from the North Territory Government of Australia.
4.	Aileu	680.0	170.0	
5.	Viqueque	1,060.0	580.0	
6.	Same	615.0	400.0	
7.	Ainaro	549.0	0.0	Repairs are being advanced under assistance from the North Territory Government of Australia, but operation has not yet been resumed as of the end of June,2000.
8.	Gleno	1,920.0	150.0	Repairs are being advanced under assistance from UNTAET. Operation is scheduled to start at the end of April 2000.
9.	Maliana	1,508.0	1.358.0	
10.	Suai	1,198.0	285.0	
11.	Oecusse	440.0	150.0	Repairs are being advanced under assistance from the North Territory Government of Australia.



Gleno Power Station (Vandalized Units)

Baucau Power Station

(3) Regional Power Stations

There are 60 power stations located throughout the country. The Komoro and Caicoli power stations in Dili are described in (1) and the 11 power stations in major cities are described in (2). That leaves 47 regional power stations, and almost all of these are located in large towns and villages to form the focal points of the country's 39 sub-districts. However, as indicated in Table 5.1.4, 31 out of these 47 power stations do not currently operate due to vandalism that took place during conflict, occurring- at the time of the referendum on independence. PLN employees working at the power stations prior to the conflict were ordered by headquarters in Jakarta to burn or destroy all equipment before fleeing to Indonesia. Accordingly, the villages which had received power from these 31 power stations currently have no electricity at all, and residents use candles or oil lamps for lighting and firewood for cooking purposes. The current conditions at each power station are indicated in the appendices.

These regional power stations are small-scale facilities originally consisting of one to three small units with a single unit capacity of 20-50 kW. These power stations do not satisfy all demand in the towns and villages of location, but they supply power to general residences, local government buildings, public facilities and some consumers living nearby the power stations. Moreover, supply time is limited to a maximum of six hours from 17.30 to 23.30 for similar reasons given for the medium scale power stations described in (2), i.e. operation is limited in order to extend the service life of facilities and expenditure of fuel.

PAET is eager to reconstruct those regional power stations, which were destroyed in the conflict, and to restore power supply to local residents, and it is strongly requesting an assistance implementation for this purpose from Japan, UNTAET and ADB.

Remexio Power Station (Vandalized)

Bazartete Power Station (Vandalized)

(4) Transmission and Distribution Facilities

1) Electricity System

As described in Section 5.1.3 (2), East Timor adopts independent power sources for 60 power stations. There are no transmission lines that link cities, and power is supplied to consumers by the following distribution networks.

Table 5.1.8 Electricity Systems Adopted in East Timor

Type	Electricity System	Distribution Voltage	Target Districts
Medium voltage	3 phase, 3 wire	22 kV	This is adopted in the distribution network of large and medium cities such as Dili, Baucau and Ermera, etc.
Medium voltage	Same as above	6.6 kV	This is adopted in limited medium scale cities such as Lospalos, but such cases are extremely rare.
Low voltage	3 phase, 4 wire	415/240V	This is adopted in the regional distribution network consisting of small scale units. This is the voltage level used for connections to consumers following stepping down.

2) Present Conditions of Distribution Lines

Since the generation voltage of power generation facilities in most of the large and medium cities is 6 kV, voltage is stepped up to 22 kV at each power station before it is fed to the 22 kV distribution network in large and medium cities.

Most of the 22 kV distribution network consists of overhead lines which use steel poles and bare aluminum wire, and power is stepped down to 415/240 V by pole-mounted transformers before being supplied to individual consumers. Therefore, there is no need to establish substations in towns and the system is extremely simple. Having said that, on distribution lines where the distribution distance is more than 60 km and voltage drop is large, voltage regulators are installed.

Overhead lines are also adopted on the 415/240 V low voltage distribution network, and vinyl insulated stranded wire is chiefly used. Systems located close to the distribution lines are added to these systems.

Damage to the distribution lines as a result of the conflict was small. A few cases were observed in Dili and regional cities where insulating oil was leaking from holes caused by gunfire in pole-mounted transformers or where distribution lines

have been cut. These damages are not interrupting power supply to any great extent. Currently, as was mentioned in Section 5.1.2.(3) engineers of UNTAET dispatched through assistance from Northern Territory Government in Australia, are carrying out repairs of distribution line disconnections and transformers.

However, when one considers the upcoming three years, reconstruction of East Timor will be done under a new government of East Timor. In large and medium cities construction of government-related facilities, public welfare facilities, and private commercial and industrial facilities will take place together with the strengthening of power stations. Accordingly, in line with these developments, it is inevitable that construction of new distribution networks and bolstering of existing distribution lines will be necessary. (Refer to Appendix-APP.5.1.3)

5.2 Formulation of the Three-Year Plan for Urgent Rehabilitation

5.2.1 Basic Concept of the Three Year Urgent Rehabilitation Plan

Following the direct referendum on the independence of East Timor implemented on August 30, 1999, the People's Consultative Assembly of Indonesia approved the separation and independence of East Timor on October 20. Independence became a reality. However, much of the social infrastructure (basic infrastructure) was destroyed in the conflict that followed the referendum.

In the electric power sector, too, many facilities and equipment were destroyed. Moreover, power supply capacity has been greatly reduced as a result of inadequate maintenance following the conflict. This decrease in power supply is having a major impact on the lifestyles of citizens and socioeconomic development.

The Project in hand aims to survey the current conditions of power facilities and formulate a plan for restoration of power facilities requiring urgent repair. The Project is highly feasible in East Timor based on the requirement:

1) Urgent rehabilitation for facilities destroyed in conflict (Resumption of power supply)

2) Ensuring power supply in Dili (Maintenance of performance for facilities in operation)

3) Upgrading facilities to supply power needed by anticipated development for upcoming three years.

5.2.2 Formulation of Three Year Urgent Rehabilitation Plan

(1) Plan for Restoration of Rural Power Stations (Restoration Plan No.1)

The first priority of the power facilities restoration plan in East Timor is to restore each power station to pre-conflict conditions by resuming operations to 32 power stations. The 60 power stations located throughout the country are shown in Table 5.1.4. From a total of 47 power stations three in the major cities of Oekusse (rated output: 440 kW), Gleno (rated output: 1920 kW) and Ainaro (rated output: 549 kW) were destroyed in the conflict. Thirty two (32) power stations including Ainaro have suspended their operations as of the end of June, 2000. For this reason, in districts where power stations are idle, major inconvenience are suffered by citizens including reduced activities of social welfare facilities such as schools, health centers, district centers and churches, etc. Accordingly, the greatest requirement placed on PAET, which is the power utility operator in East Timor, is that the minimum necessary power supply to local citizens be restored immediately including ensuring power supply to the capital, Dili.

Moreover, as described in the section 5.1.2 restorations of these rural power stations are to be implemented by UNTAET, ADB and the Portugal and Japanese government in a coordinated effort shown in Table 5.1.4. Partial restoration work has already commenced. Accordingly, there is no overlap in the plan of each donor country and agency. Also two power stations in the core city, Oekusse and Gleno, whose operations were completely suspended, have resumed operations by the end of May, 2000. Ainaro power station is also scheduled to resume operation, but no specific target is indicated as of the end of June, 2000.

(2) Plan for Maintaining Performance at Komoro Power Station (Restoration Plan No. 2)

Komoro Power Station satisfies, at the End of May 2000, power demand for the metropolitan area of Dili, which is equivalent to 73% of all demand throughout the country. The role to be played by this power source will become more and more important in line with the restoration of government-related facilities, commercial and industrial facilities, and social welfare facilities. However, as shown in Section 5.1.3, Komoro Power Station is unable to implement periodic inspections and/or

maintenance and overhauls due to shortages of spare parts and tools. There is no way of knowing how long present output can be maintained or when breakdowns will occur.

Meanwhile, Caicoli Power Station located in the city of Dili was constructed 32 years ago and about to terminate its role due to its long life span as well as its location situated in the center of residential area.

Accordingly, it is decided to urgently rehabilitate to ensure the total present output (11.0 MW) of Komoro Power Station in this plan. The plans is to and urgently implement a 16,000 hours-inspection (overhaul) as well as supplying necessary spare parts and tools for the next 16,000 hours-inspection (overhaul), in order to supply stable power to the consumers in Dili and its environs.

(3) Komoro Power Station Strengthening Plan (Restoration Plan No. 3)

According to a survey conducted by UNTAET, power demand in Dili and its environs has increased 1.3% per month (16% per year) over the period from January to June 2000. Moreover, as East Timor achieves greater independence and advances with the restoration and construction of government-related facilities, commercial and industrial facilities and social welfare facilities, it is thought that this growth in demand will continue.

Meanwhile, even if the overhaul described in Section 5.2.2(2) is implemented at Komoro power station, the closure of Caicoli Power Station is imminent and there is no planned increase in the firm capacity of Komoro Power Station, which supplies power to Dili and its environs. Table 5.2.2 shows the relationship between projected increase in demand and firm capacity over the next three years.

Table 5.2.2 Peak Power Demand and Firm Capacity in Dili

Year	End of Feb. 00	End of Feb. 01	End of Feb. 02	End of Feb. 03
Projected peak power demand	6.2 MW	7.2 MW	8.3 MW	9.6 MW
Annual growth rate	(Now)	16 %	16 %	16 %
Firm capacity	7.2 MW	6.0 MW	6.0 MW	6.0 MW

(Note 1) Firm capacity is calculated assuming that Caicoli power station will cease its operation in the spring of 2001.

(Note 2) Firm capacity occurs when the present output of Komoro power station (11 MW) is secured and the two largest units (2.6 MW, 2.4 MW) have ceased operation due to inspection/maintenance and breakdown, etc.

From this relationship between peak power demand and firm capacity, it works out that generator output will be deficient by 3.6 MW roughly three years from now at the end of March 2003. Therefore, in the current situation even if an emergency overhaul is implemented at Komoro power station and present output is maintained, there is a risk that periodic inspections/maintenence are impractical. At that time output will decline, planned power cuts, etc. will need to be implemented.

Consequently, in addition to raising the present output of Komoro Power Station as described in section 5.2.2(2), it has been decided to provide additional power generation facilities of 3.6 MW in another urgent restoration plan.

(4) Output Power Strengthening Plan in Major Cities (Restoration Plan No. 4)

No development plans have yet been compiled for the regions. However, as restoration and development of East Timor advances, construction of local government facilities, social welfare facilities and commercial facilities will take place mainly in the provincial capitals, and industrial development centering around agriculture will also take place. The present output is far below on rated output at all provincial capital power stations, and operation was only just started from the end of April at Oekusse, and Gleno (see Section 5.2.2.(1)). Therefore, it is hoped that restoration of rated output to pre-conflict levels can be immediately carried out at all power stations in major cities. However, in this Project, a restoration plan shall be compiled which targets three power stations in Baucau and Ermera, which are the second and third largest cities in East Timor. In addition Manatuto located between Dili and Baucau is expected to prosper with the development of these two cities.

A brief description of target power stations on the plan is shown in Table 5.2.2.

Table 5.2.2 Rated Output & Present Output of Target Three Power Stations

No.	Power Station	Rated Output (kW)	Present Output (kW)	Present Situation
1	Baucau	2,572.0	640.0	
2	Manatuto	1,3480	550.0	
3	Gleno	2,100.0	180.0	Restored under the assistance of UNTAET, commissioned on the end of May,2000.

(5) Plan for Restoration and Strengthening of Medium Voltage Distribution Lines

(Restoration Plan No. 5)

As is described in Section 5.1.3(3), the damage was small for the 20 kV distribution network of large and medium cities in East Timor. However, when the restoration of power stations in Dili and other large and medium cities is implemented in line with the advancement of restoration and recovery in the country, it will be necessary to construct new distribution lines and repair existing distribution lines. This expansion will supply new consumers such as newly constructed or rehabilitated government facilities, social welfare facilities and commercial facilities, etc.

Since, no distribution network expansion and repair plans have so far been compiled in PAET. There are approximately existing 700 km of 20 kV distribution lines in all East Timor. New construction or repair is necessary on at least 10% (roughly 70 km) over the next three years. A plan to restore and strengthen medium voltage distribution lines shall be compiled in the Project.

5.2.3 Preliminary Design of Restoration Plans

(1) Plan for Restoration of Rural Power Stations (Restoration Plan No.1)

1) Outline of Plan

As indicated in Section 5.2.1, this plan aims to rebuild 31 small scale rural power stations which were destroyed or burned in the conflict following the referendum on independence and currently operating. The purpose of this restoration of power stations is to resume the stable supply of power to citizens living in regional villages and surrounding areas.

2) Target Power Stations

The planned sites for reconstruction of power stations in this plan are at the location of 31 power stations indicated in the following table. Donors and agencies scheduled to implement restoration works as of the end of June, 2000 are also shown in the Table 5.2.3.

Table 5.2.3 Outline of Target Rural Power Station for Restoration

No.	District Name	Power Station	Present Output (kW)	Donor & Agency for Restoration				Present Condition
				UNTAET	PORTUGAL	ADB	JAPAN	
1	Lospalos	Iliomar	0				★1	Requires replacement
2		Luro	0		★1			Repairable
3	Manatuto	Natarbora	0		★2			Repairable
4		Manelima	0			★1		
5	Aileu	Remexio	0				★2	Requires replacement
6		Lequidoe	0			★2		
7	Viqueque	Uatu Carbau	0	★1				Repairable
8		Lacluta	0				★3	Requires replacement
9	Same	Betano	0			★3		Repairable
10	Ainaro	Ainaro	0			★4		Repairable
11		Hato udo)	0				★4	Requires replacement
12		Hato bilico	0				★5	Requires replacement
13		Fatululic	0				★6	Requires replacement
14	Ermera	Letefoho	0			★5		Repairable
15		Atsabe	0				★7	Requires replacement
16		Railako	0	★2				Repairable
17	Maliana	Bobonaro	0			★6		Repairable
18		Batugade	0			★7		Repairable
19		Atabae	0				★8	Requires replacement
20		Balibo	0			★8		Repairable
21		Lolotoe	0			★9		Repairable
22	Suai	Zumalai	0				★9	Requires replacement
23		Fohorem	0			★10		Repairable
24		Tilomar	0			★11		Repairable
25		Beco	0				★10	Requires replacement
26		Raimean	0				★11	Requires replacement
27		Fatumean	0			★12		Requires replacement
28	Ambino	Passabe	0			★13		Requires replacement
29		Nitibe	0			★14		Requires replacement
30		Oesilo	0			★15		Requires replacement
31	Liquica	Loes	0				★12	Requires replacement
32		Bazartete	0				★13	Requires replacement
Total				2	2	15	13	

Source: UNTAET/PAET ((including partial corrections made by the Study Team in the site surveys)

3) Basic Specifications & Quantity of Equipment and Materials at Each Power Station

The actual load at each power station is approximately 35-40 kW. In order to shorten the design period and provide for the compatibility of spare parts, etc., the following common equipment are adopted.

① Diesel engine generators: 2 units (ordinary use and backup)

② Generator output:	Short term (emergency) output capacity approximately 50 kW, Prime output capacity 40 kW or more.
③ Electrical system	3-phase 4-wires, 415/240 V, 50 Hz
④ Cooling system:	Air cooling
⑤ Synchronized operation:	Manual synchronization
⑥ Fuel oil:	Diesel oil
⑦ Fuel tank:	Main tank and Daily tank
⑧ Distribution panel:	Self-standing or wall-mounted type, branch circuit breaker 4P-100AF x 3, 4P - 50AF x 1
⑨ Civil & architectural works:	Foundations and roof for the generating facilities, etc.
⑩ Piping & wiring:	1 lot
⑪ Spare parts:	2-year supply

4) Preliminary Design drawings

Preliminary design drawings are attached in Appendix-APP.5.2.3.

(2) Plan for Maintaining Performance at Komoro Power Station (Restoration Plan No. 2)

1) Outline of Plan

This plan to maintain the present output capacity of Komoro Power Station and provides stable power supply to Dili and its environs, entails implementation of an overhaul, supply of spare parts and restoration of auxiliary equipment.

2) Objective Equipment

The objective power generation equipment to overhaul consists of five generators installed at Komoro Power Station as shown by the following table (Table 5.2.4).

Table 5.2.4 Objective Power Generation Equipment

No.	Engine	Generator	Country of Origin	Rated Capacity	Present Output	Year of Manufacture
1	MAK	Siemens	Germany	2.5 MW	1.8 MW	1984
2	MAK	Siemens	Germany	2.5 MW	1.8 MW	1984
3	Niigata Tekko	Meidensha	Japan	3.0 MW	2.6 MW	1988
4	PAL-MAK	PINDAD	Indonesia	2.8 MW	2.4 MW	1990 ?
5	PAL-MAK	PINDAD	Indonesia	2.8 MW	2.4 MW	1990 ?
Total output				13.6 MW	11.0 MW	

Source: PAET

3) Contents of Work and Basic Specifications

In order to maintain the present output capacity of the above five generator units, the equipment supplier provides the following.

① Implementation of an 16,000 hour inspection (overhaul), and supply of spare parts and consumable materials sufficient to last until the next 16,000 hour inspection

② Supply of special tools and general tools required for daily & periodic inspections and repair works.

③ Supply of equipment and materials necessary for repair of existing fuel oil purifiers and lubricating oil purifiers

④ Supply of chemicals for the existing cooling water softeners for one year

⑤ Supply of an 11-ton tank lorry for transporting fuel oil

⑥ Analysis instruments for daily inspections of cooling water and fuel oil

⑦ Supply of auxiliary equipment and materials necessary for the implementation of items ① through ⑥ above

⑧ Dispatch of technical advisors:

a. For implementation of item ① above, dispatch at least three engineers for a minimum of two months and carry out technical guidance and transfer periodic inspections maintenance techniques to PAET maintenance staff.

b. In addition, carry out technical guidance concerning the methods of use and inspection for the tools to be supplied in item ② above.

c. In order to provide technical guidance concerning the methods of use and inspection for the tools to be supplied in item ⑥ above to the responsible PAET staff, dispatch at least two engineers for a minimum of one month.

4) Basic Design of Equipment

The basic layout plans of equipment at Komoro Power Station for the project are shown in Appendix-APP.5.2.3.

(3) Plan for Strengthening of Komoro Power Station (Restoration Plan No. 3)

1) Outline of Plan

This plan has been compiled with the objective of securing enough firm capacity at Komoro Power Station and achieving a stable supply of power to consumers in line with the increase in demand for power over the next three years in Dili. For this reason, the plan aims to construct a 3.6 MW diesel engine power plant within Komoro Power Station.

2) Construction Site

The new diesel engine generator, mechanical auxiliaries and electrical system for new generating equipment shall be installed on the east side of the existing power house (engine room and control room) within Komoro Power Station.

3) Contents of Work and Basic Specifications

① Procurement and installation of the diesel engine generator (output capacity 3.6 MW per unit)

② Procurement and installation of the following mechanical auxiliaries required for the above ①:

a. Fuel supply equipment
b. Oil purification and supply equipment
c. Cooling water supply equipment
d. Compressed air equipment
e. Waste oil treatment facilities
f. Necessary piping

③ Procurement and installation of the following electrical equipment required for the above ①:

a. Generator control and monitoring panel
b. Generator protective relay panel
c. DC power supply equipment
d. Low voltage power panel
e. Necessary cabling and wiring

④ Procurement and installation of the following electrical equipment required for distribution facilities, etc.:

a. 22 kV high voltage panel
b. 6.6/22 kV step-up transformer (4 MW, 1 set)
c. 6.6 kV high voltage distribution panel
d. Transformer protective relay panel
e. Control and monitoring panel
f. Auxiliary transformer and distribution line equipment

⑤ Procurement of spare parts and tools for maintenance and inspection of the generating equipment and auxiliary equipment.

⑥ Procurement of operation, maintenance inspection and overhaul manuals, and implementation of OJT, for the power plant equipment, auxiliary equipment and electrical equipment

⑦ The following civil engineering and building works required for construction of the power plant are:

a. Extension of a generator room and operation control room
b. Construction of foundations for the generator, backup unit, radiator and transformer, etc.

4) Preliminary Design Drawings

Related drawings are attached in Appendix-APP.5.2.3.

(4) Plan for Resumption of Operation in Major Cities (Restoration Plan No. 4)

1) Outline of Plan

This is a plan for restoration of three power stations in the cities of Baucau and Gleno, which are provincial capitals possessing the second and third largest populations in East Timor, and Manatuto, which is located between Dili and Baucau. Restoration is expected to be necessary in line with the development of these two urban centers. It is expected that construction of local government facilities, social welfare facilities and commercial facilities, etc. and development of industry based around agriculture will take place in these cities. Thus power supply should be resumed as soon as possible.

Output of the units constructed in each power station shall be 1.0 MW. These units shall be constructed as temporary substitute units for the generators as shown below, which were completely destroyed in the conflict. It is assumed that new equipment currently not in operation can undergo emergency repair through assistance from UNTAET, etc.

① Baucau Power Station: substitute facilities for three units, i.e. Unit No. 3 (output 528 kW), Unit No. 4 (output 240 kW), and Unit No. 5 (output 260 kW)

② Gleno Power Station: substitute facilities for three units, i.e. Unit No. 3 (output 240 kW), Unit No. 4 (output unknown), and Unit No. 5 (output unknown)

③ Manatuto Power Station: substitute facilities for three units, i.e. Unit No. 3 (output unknown), Unit No. 4 (output 260 kW), and Unit No. 5 (output unknown)

2) Construction Sites

Construction shall be implemented on land adjacent to the existing generators at the following three power stations:

① Baucau Power Station

② Gleno Power Station

③ Manatuto Power Station

3) Basic Design of Equipment (Common to Each Power Station)

① Procurement and installation of diesel generators (1.0 MW)

② Procurement and installation of following mechanical equipment necessary for the generators:

a. Fuel supply equipment
b. Oil purification and supply equipment
c. Cooling water supply equipment
d. Compressed air equipment
e. Waste oil treatment facilities
f. Necessary piping

③ Procurement and installation of the following electrical equipment required for the power plant:

a. Generator control and monitoring panel
b. Generator protective relay panel
c. DC power supply equipment
d. Low voltage power panel

④ Procurement and installation of the following electrical equipment required for distribution facilities, etc.:

a. 22 kV high voltage panel
b. 6.6/22 kV step-up transformer
c. 6.6 kV high voltage distribution panel
d. Transformer protective relay panel
e. Control and monitoring panel
f. Auxiliary transformer and distribution line equipment

⑤ Procurement of spare parts and tools for maintenance and inspection of the power plant equipment, auxiliary and electrical equipment

⑥ Procurement of operation, maintenance, inspection and overhaul manuals, and implementation of OJT, for the power plant equipment, auxiliary and electrical equipment

⑦ The following civil engineering and building works required for construction of the power plant are:

a. Extension of a generator room and control room

b. Construction of foundations for the generator, backup unit, radiator and transformer, etc.

4) Preliminary Design

Related drawing is attached in Appendix-APP.5.2.3.

(5) Plan for Restoration and Strengthening of Medium Voltage Distribution Lines (Restoration Plan No. 5)

1) Outline of Plan

Out of approximately 700 km of 20 kV distribution lines in all East Timor, since it is assumed that new construction or repair is necessary on at least 10% (roughly 70 km) over the next three years. A plan to restore and strengthen medium voltage distribution lines shall be compiled in the Project.

In addition to conducting a survey of current conditions of the 20 kV distribution network, based on the findings of studying facilities restoration plans and new development plans, the plan to restore and strengthen medium voltage distribution lines shall be compiled based on the supply of equipment and materials.

2) Target Districts

The target districts are cities where the 20 kV distribution network are in place. However, districts and cities where it is certain that new development will be started by the end of 2002 are also included.

3) Preliminary Design of Equipment

Procurement of the following equipment and materials are required for construction of approximately 70 km of 22 kV distribution line (quantities include a 10% contingency consisting of a 5% works contingency and a 5% pure contingency)

① Pole-mounted distribution transformers (22 kV/415/240 V, 100 kVA and 50 kVA)

② Conductor for 22 kV overhead distribution lines (steel-cored aluminum cable)

③ 22 kV lightning arresters (for single phase)

④ Cutout switches with fuses (for distribution transformers and lines)

⑤ 22 kV insulators and findings (suspension insulators and pin insulators)

⑥ Steel poles (h = 12 m and 15 m)

⑦ Assembling materials (cross arms, arm ties, step bolts, spikes, earth wires and rods, etc.)Automatic voltage regulators (20kV ± 10%/20kV, 2MVA, Pole mounted type)

⑧ Procurement of power tools for 22 kV distribution line works and maintenance and inspection

⑨ Procurement of three elevated work wagons

⑩ Procurement of three trucks with cranes (crane capacity: 5 tons)

⑪ Procurement of operation, maintenance, inspection and overhaul manuals and implementation of OJT

4) Basic Design of Equipment

Related drawing is attached in Appendix-APP.5.2.3.

5.2.4 Project Cost

(1) Plan for Restoration of Rural Power Stations (Restoration Plan No. 1)

The project cost required for restoration of 32 suspended power station is estimated to be US $ 5.18 million in total as shown in Table 5.2.5 and table 5.2.6 below.

Table 5.2.5 Construction Cost of Each Power Station

No.	Item	Unit	Quantity	Unit Rate (US $)	Amount (unit: US $)
1	Equipment for each power station				
	1. Diesel generator	set	2	34,000.-	68,000.-
	2. Main fuel tank (10 ton)	set	1	13,000.-	13,000.-
	3. Fuel supply equipment	lot	1	12,000.-	12,000.-
	4. Operation and distribution panel (including manual synchronizer)	panel	1	12,000.-	12,000.-
	5. Spare parts and power tools	lot	1	4,500.-	4,500.-
	6. Roof and foundation works	lot	1	10,500.-	10,500.-
	Sub-Total				120,000.-
2	Transportation (marine and inland) cost and insurance cost	lot	1	12,000.-	12,000.-
3	Installation works cost	lot	1	12,000.-	12,000.-
	Construction cost per power station				144,000.-

Table 5.2.6 Total Construction Cost of 32 Power Stations

No.	Item	Unit	Quantity	Unit Rate (US $)	Amount (unit: US $)
1	Total construction cost for 32 power stations	site	32	144,000.-	4,608,000.-
2	Consultant cost	lot	1		572,000.-
	Total				5,180,000.-

(2) Plan for Maintaining Performance at Komoro Power Station (Restoration Plan No. 2)

The project cost for implementing this plan is estimated to be US $ 2.91 million as shown in Table 5.2.7 below.

Table 5.2.7 Cost of Plan for Maintenance of Performance at Komoro Power Station

No.	Item	Unit	Amount (unit: US $)
1	Spare parts procurement cost (including dispatch of technical instructors)	1 set	1,750,000.-
2	Procurement of maintenance power tools	1 set	150,000.-
3	Procurement of materials for repairing fuel oil and lubricating oil purifier	1 set	200.000.-
4	Procurement of water softener chemicals	1 set	20,000.-
5	Procurement of 11 tank lorries (including a 2 year supply of spare parts)	1 vehicle	140,000.-
6	Procurement of fuel oil and cooling water analysis equipment	1 set	300,000.-
	Sub-Total		2,560,000.-
7	Consultant cost	1 set	350,000.-
	Total		2,910,000.-

(3) Plan for Strengthening of Komoro Power Station (Restoration Plan No. 3)

The project cost for implementing this plan is estimated to be US $ 7.2 million as shown in Table 5.2.8 below.

Table 5.2.8 Construction Cost for Strengthening of Komoro Power Station

No.	Items	Unit	Q'ty	Amount (US$)	Remarks
1	Diesel Engine and Generator (Rated output 3.6 MW)	set	1	2,280,000.-	
2	Electrical system (Step-up transformer 3.6MW, switchgears, distribution panel, DC supply equipment, etc)	lot	1	1,060,000.-	
3	Mechanical system (Fuel feeding system, purifiers, cooling water system, radiator, etc)	lot	1	680,000.-	Utilize existing main fuel storage tank
4	Transportation, packing cost	lot	1	270,000.-	
5	Civil & architectural cost (expansion of the building)	m^2	120	1,200,000.-	Including equipment foundation, cable pits and external works
6	Installation work cost	lot	1	360,000.-	
7	Spare parts, tools, manual	lot	1	520,000.-	Spare parts for 2 years
8	On the Job Training	lot	1	120,000.-	2 engineers for 3 month
	Sub-Total			6,490,000.-	
9	Consultant fee	lot	1	710,000.-	
	Total			7,200,000.-	

(4) Plan for Resumption of Operation in Major Cities (Restoration Plan No. 4)

The project cost required for restoration of 3 power stations is estimated to be US $ 7.63 million in total as shown in Table 5.2.9 and Table 5.2.10 below.

Table 5.2.9 Cost of Plan for Each Power Station

No.	Items	Unit	Q'ty	Amount (US$)	Remarkd
1	Diesel Engine and Generator (Rated output 1.0 MW)	set	1	620,000.-	
2	Electrical system (Step-up transformer 1.2MW, switchgears, distribution panel, DC supply equipment, etc)	lot	1	300,000.-	
3	Mechanical system (Fuel feeding system, purifiers, cooling water system, radiator, etc)	lot	1	180,000.-	Utilize existing main fuel storage tank
4	Transportation, packing cost	lot	1	70,000.-	
5	Civil & architectural cost (expansion of the building)	m^2	100	800,000.-	Including equipment foundation, cable pits and external works
6	Installation work cost	lot	1	150,000.-	
7	Spare parts, tools, manual	lot	1	150,000.-	Spare parts for 2 years
8	On the Job Training	lot	1	40,000.-	2 engineers for 1 month
	Total			2,310,000.-	

Table 5.2.10 Cost for Restoration of Three (3) Power Stations

No.	Items	Unit	Q'ty	Unit Rate (US$)	Amount (US$)
1.	Total construction cost at 3 power stations	site	3	2,31,000.-	6,930,000.-
2.	Consultant fee	lot	1	700,000.-	700,000.-
	Total				7,630,000.-

(5) Plan for Restoration and Strengthening of Medium Voltage Distribution Lines (Restoration Plan No. 5)

The project cost required for restoration and strengthening of 20kV distribution lines is estimated to be US $ 5.5 million in total as shown in Table 5.2.11 below.

Table 5.2.11 Cost of Plan for Restoration and Strengthening of Medium Voltage Distribution Lines

No.	Items	Unit	Q'ty	Unit Rate (US$)	Amount (US$)	Remarks
1	Materials for 20kV distribution lines					
	1) ACSR 150mm2	km	210	4,000.-	840,000.-	
	2)Steel poles (H=15m)	Pc	1,000	1,000.-	1,000,000.-	
	3)Pole transformers(20kV/415/240V, 100kVA)	set	150	10,000.-	1,500,000.-	
	4)Assembling materials, insulators, section switches, arrestors, grounding wires, etc	km	75	8,000.-	600,000.-	
	Sub-Total				3,940,000.-	Including engineer dispatching fee
2	Automatic voltage regulators (20kV ± 10%/20kV, 2 MVA, pole mount type)	set	1		70,000.-	
3	Elevated work wagons (for two persons or 200kg)	set	3	50,000.-	150,000.-	
4	Trucks with cranes (crane capacity: 5 tons)	set	3	50,000.-	150,000.-	
5,	Testing with related equipment, power tools, Manuals for installation, operation, maintenance	Lot	1		50,000.-	
6	Transportation, packing and insurance cost	lot	1		640,000.-	
	Sub-Total				5,000,000.-	
7	Consultant fee	lot	1		500,000.-	
	Total				5,500,000.-	

5.2.5 Construction Planning

The following items are considered in the construction planning to implement the Three Year Urgent Rehabilitation Plan of electric power facilities.

(1) Transportation of Equipment and Materials

1) Dili Port

The heaviest equipment to be procured on this three-year urgent rehabilitation plan is a diesel generator of 3.6MW, assumed to weight a max. of 50tons, which is scheduled to be supplied for the Komoro Power Station Strengthening Plan. As for Dili port with its 240m wharf length and 7 to 8m water depth, it is capable of anchoring large cargo ship without significant problems. However, a cargo ship shoud be the equipped with a large crane since there are no adequate unloading facilities at Dili port.

2) Road Conditions

The road leading to Komoro power station from Dili port is paved and having enough width to accommodate a trailer truck. Thus, there is no difficulty in transporting a large generator.

However, minor roads branching from main roads, access rural power stations. These roads lie in the mountainous region and are narrow without pavement. Accordingly, it makes even a four-wheel drive vehicle passing difficult. In order to solve this problem, it shall be considered that a 3 ton-dump truck or four wheel vehicle be used for transportation. Also an improvement of access road by UNTAET is to be expected.

(2) Procurement of Equipment and materials

1) Equipment and materials for Power Facilities

Since no equipment and materials for power generation and distribution line facilities are available in East Timor, it is necessary to procure from overseas in order to implement the Three Year Urgent Rehabilitation Plan. Accordingly, the supply of spare parts required in the event of breakdowns and daily-use consumable materials etc, should be for one year minimum (preferably 2 to 3 years) and shall be incorporated into each plan.

2) Materials for Civil and Architectural Works

As far as the materials for civil and building work are concerned, locally produced aggregate, sand and timber and imported cement, reinforcing bars are readily available in the domestic market and can, therefore, be procured in East Timor.

However, such materials as steel structures, roofing materials, paint, fitting, building service materials (lighting fixture, air-conditioner, sanitary porcelain, etc) are difficult to procure locally. These materials have to be procured from overseas for the above power facilities.

3) Local Contractor and Workforce

There is no competent local contractor in East Timor who can subcontract electrical work and install power generating equipment. Yet, there are several foreign contractors registered to UNTAET. However, their decision on adoption or rejection of employment will be made in line with the guidelines of the United Nation and donor countries for each plan of this Three Year Urgent Rehabilitation Plan.

Not many electrical engineers and technicians are available in East Timor, therefore, an operation and maintenance at Komoro Power Station is being managed by small number of personnel, about 18 persons as of the end of June, 2000. Accordingly, dispatching engineers or technicians from overseas by contractors to carry out installation, testing, commissioning and adjustment under this Three Year Urgent rehabilitation Plan are unavoidable. However, since a number of general workforces are available in East Timor, the contractors shall recrut their expertise when necessary.

(3) Work contents of East Timor Side

In order to complete the Three Years Restoration Plan successfully, it is necessary to note that the implementation of the Project shall not be done by donor country alone but also require the following items as minimum requirements of the East Timor side based around PAET.

① Leveling and cleaning of construction sites, and removal of existing equipment if necessary.

② Securing and construction of access roads to the construction sites

③ Provision free of charge of land for equipment and materials yards and temporary facilities

④ Appointment and securing of operation and maintenance staff

⑤ Arrangement of local laborers (wages to be paid by the equipment suppliers)

⑥ Appoint personnel to receive technical guidance implemented by the equipment supplier.

⑦ Secure storage areas for equipment supplied by the equipment supplier.

⑧ Provide free of charge any information and data, etc. which may be required by the supplier in the course of its work.

⑨ Secure the safety of staff dispatched by the equipment supplier and provide all necessary conveniences such as the acquisition of visas and permits for stay, etc.

5.3 Implementation of Urgent Rehabilitation Projects Funded by Japan

The following two (2) projects were already requested officially to the Government of Japan to extend it from the study stage to the execution stage under the urgent rehabilitation projects funded by Japan. These two (2) projects were formulated as "Power sector 3 Years Plan for Urgent Rehabilitation" under this study and the Government of Japan is now, as of the end of June 2000, under application of administration matters;

- Restoration of 13 rural power stations
- Maintaining of present output capacity of Komoro Power Station

5.3.1 Implementation Agency

It is assumed that the implementation agency of East Timor side for the urgent rehabilitation projects funded by Japan will be the Power Authority of East Timor (PAET), which organized as a sub unit of Utilities Branch of the Infrastructure Department of UNTAET, UNOPS or UNDP with consulting services from Japanese consulting firm(s) undertaking detailed design, preparation of tender documents and construction supervision.

5.3.2 Implementation schedule

Table 5.3.1 and table 5.3.2 indicate implementation schedules of each project after the Notes exchanged by the Government of Japan and the Implementation agency from

East Timor side (the E/N), which shows the required periods for selection of consultant, detailed design, tendering activities, construction supervision, etc.

Table 5.3.1 Implementation schedule for Restoration of 13 Rural Power Stations

No.	Work items	Required period (Month)	Notes
1.	Selection of the Consulting Services Firm	1.5	Through open tender among Japanese consultant firms.
2.	Preparation of detailed design and tender documents	2.5	Including detailed site survey
3.	Tendering, Tender evaluation and Concluding equipment supply contract	1.5	At the consultant office in Japan
4.	Fabrication and procurement of equipment and materials	4.0	
5.	Transportation	1.0	Ocean and inland
6.	Installation, testing and commissioning of equipment and materials	2.5	Including technical transfer of O & M technique
	Total Construction period after the E/N	13.0	

Table 5.3.2 Implementation schedule for Maintaining of Present Output Capacity of Komoro Power station

No.	Work items	Required period (Month)	Notes
1.	Selection of the Consulting Services Firm	1.5	Through open tender among Japanese consultant firms.
2.	Preparation of detailed design and tender documents	2.0	Including detailed site survey
3.	Tendering, Tender evaluation and Concluding equipment supply contract	1.5	At the consultant office in Japan
4.	Fabrication and procurement of equipment and materials	5.0	
5.	Transportation	1.0	Ocean and inland
6.	Installation, testing and commissioning of equipment and materials	2.0	Including technical transfer of O & M technique
	Total Construction period after the E/N	13.0	

5.4 Operation and Maintenance Plan

5.4.1 Operation and Maintenance Plan for Generating Facilities

Four (4) out of five (5) rehabilitation plans prepared in this study are those for diesel power generating facilities. However, most of diesel generators to be installed/repaired at rural areas have a small output capacity ranging from 25 kW to 50 kW and their daily operation hour is limited to 6 hours in maximum (from 5:30 to 11:30 p.m.). Therefore, the following is the operation and maintenance plan for

diesel engine generating facilities, which are normally operating 24 hours/day as base load equipment.

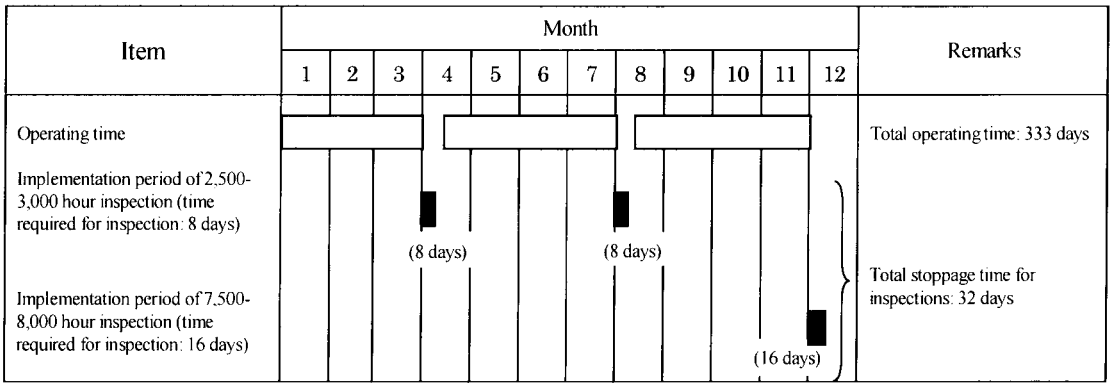
(1) Operating hour and operating rate

Concerning proposed operation plans for diesel power generating facilities such as Komoro Power Station, it is common for the following conditions to be specified:

- Annual operating rate: Approximately 90%
- Annual operating hours: Approximately 8,000 hours

Moreover, periodic inspection/maintenance items necessary for achieving the appropriate operation of diesel power generation facilities are recommended in Table 5.4.1. The annual operation plan for this power station, which takes the above periodic inspection/maintenance items and operating conditions into account, is as indicated in Figure 5.4.1. Specifically speaking, each facilities and equipment require three periodic maintenance inspections per year, meaning that operation must be suspended for approximately 32 days in all. Furthermore, since these inspections become more detailed from the second year onwards, the inspection carried out after 16,000 hours is generally regarded as an overhaul. The standard period of operation stoppage in each periodic inspection are as shown below.

- Inspection every 2,500-3,000 hours: 7-8 days/inspection
- Inspection every 7,500-8,000 hours: 15-18 days/inspection
- Inspection every 16,000 hours: 20-25 days/inspection



Note: This assumes an annual operating rate of 90%.

Figure 5.4.1 Annual Operating Plan for Diesel Generator (First Year)

(2) Standard Periodic Inspection Items

Inspection items for standard periodic inspection are as indicated in Table 5.4.1-1. Concerning power supply during this period, it is necessary to utilize other equipment and stand-by generators.

Particularly, without any changing/replacement of malfunctions and/or aged parts/consumables, which are found during the periodic inspection, it could lead to end up a fatal accident.

The total output capacity guaranteed in case two (2) generators are suspended their operation by the periodic inspection and/or trouble/accident at a time, is defined as "firm capacity" and it's capacity is expected more than maximum power demand.

Table 5.4.1 Standard Periodic Inspection Items

	Inspection Area	Main Work Items
Diesel Engine	Daily inspection	- Fuel level, oil sump tank level - Confirmation of jacket water level - Confirmation of start-up air chamber pressure
	1,000 hour inspection	- Confirmation of tightening of nuts and bolts - Cleaning of fuel and oil filters
	2,500-3,000 hour inspection	- Confirmation of the operating state of air supply and exhaust valves, starting air valves, fuel valves, fuel pumps, pistons and liners, etc., check of oil leaks, etc., analysis of oil in lubricating oil sampling tank
	7,500-8,000 hour inspection	- Confirmation of the operating state of pistons and liners, etc., check of oil leaks, etc., replacement of gaskets - Replacement of piston rings, O-rings, etc. - Disassembly of cylinder heads and replacement of gaskets and O-rings - Inspection of air supply and exhaust valves and replacement of O-rings - Inspection of fuel injection valves and replacement of nozzles - Inspection and necessary replacement of crank bin bearings - Disassembly and inspection of supercharger and replacement of bearings, etc. - Analysis of oil in lubricating oil sampling tank and oil replacement if necessary
	16,000 hour inspection	- The 7,500-8,000 hour inspection indicated above - Inspection of main bearings and replacement if necessary - Inspection of exhaust valve rotator and replacement if necessary - Disassembly inspection of lubricating oil pump with engine, and replacement if necessary
Generator	Daily inspection	- Visual inspection of each area and checking for strange noises and temperature in each area
	Monthly inspection	- Abnormal vibrations - Confirmation of lubricating oil flow conditions and oil leaks on bearings - Necessary cleaning of parts
	Annual inspection	- Insulation resistance measurement and inspection of leads and terminals - Visual inspection of space heater and other attachments - Visual inspection of bearings and cleaning where necessary

(3) Fuel oil and Spear Parts Procurement Plan

In order to carry out the operation and maintenance works of generating facilities as planed, PAET shall procure fuel oil and spare parts including consumables without any delay and troubles other than arranging staff's salaries.

According to the calculation result made by an engineer from UNTAET, total fuel oil amount necessary from March to December 2000, is approximately US$ 1 million for Komoro and Caicori Power Stations. And spare parts cost for one (1) year is normally expected as 3% of equipment capital cost (in case of Komoro Power Station, it is estimated as US$ 0.5 million).

Therefore, PAET shall not only depend on assistance by donor countries and organizations, strongly requested to commence the collection of the electric tariff from consumers in order to find a way of self-reliance and self-development.

5.4.2 Maintenance plan for distribution lines

One of the most important consumer services is the maintenance of distribution lines by means of detecting breakdowns and damage through regular patrolling and immediate repair works. In addition, if short-circuiting or any other accident is envisaged due to the contact of tree, etc. with a distribution line, it is essential to take prevention measures, including the felling of tree. The major check items for patrolling inspection are listed below.

① Breakdown of conductor
② Damage to insulator
③ Contact between conductors and trees
④ Damage to electric poles
⑤ Straightness of electric poles
⑥ Conditions of pole mounted transformers
⑦ Abnormal temperature increase of pole mounted transformer
⑧ Operational status of circuit switches

5.5 Implementation Plan

Table 5.5-1 describes the implementation schedule for 5 project formulated under this study as "Power sector 3 Years Plan for Urgent Rehabilitation" together with aid projects planed ADB and Portugal for the power sector.

Total capital cost necessary for the projects shown in the implementation schedule including ADB and Portugal projects, is approximately 29.8 million US$, which is almost double to the allocated UNTAET's budget (14.4 million US$) for the power sector shown in Table 5.1.1-2 (approximately 15.5 million US$ shortage).

However, all of the projects shown in the implementation schedule shall be implemented within coming 3 years. Because, rehabilitation works of the power supply facilities, which is one of most important infrastructure to be rehabilitated, may be delayed and it will be interfered and delayed with the development of East Timor, in case projects within the allocated budget may only be implemented.

On the other hand, as described clause 5.1.1(2), the revenue collection by the Power sector has ceased for the time being and will be introduced during coming fiscal year. PAET has no tariff system yet and is continuing power supply to consumers only depending upon the assistance by donor countries and organizations.

The Power Authority of East Timor (PAET) shall establish tariff system and shall commence the collection of charges from consumers in the possible shortest timeframe. And PAET shall cover and maintain the operation cost such as salary, fuel, spear parts, deprecations, etc. by the collected revenue and shall try to reduce assistance amount from donor countries and organizations.

Furthermore, the revenue shall be used for the future development and rehabilitation projects as much as possible, which are even necessary large capitals.

Therefore, the implementation schedule for power sector shown in Figure 5.5.1 is prepared under the condition that PAET will commence the collection of revenue from the coming fiscal year and will cover and maintain the shortage of amount (15.5 million US$) between allocated budget (14.3 million US$) and planed capital cost (29.8 million US$) by a part of the revenue.

In case 5 cent/kWh out of the total revenue collected from consumers at Dili and surrounding areas can apply to cover the capital cost shown above, it is estimated that approximately 1.9 million US$/year can be used for repayment.

No.	Project Name	Capital Cost (Million US$)	2000		2001		2002		2003		Committed Agencies
			1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	
1	Restoration of rural power stations	5.18									Rehabilitation Plan–1
	(1) Two (2) P/S funded by UNTAET	0.30		0.30							UNTAET
	(2) Fifteen (15) P/S funded by ADB	2.33		1.33	1.00						ADB
	(3) Two (2) P/S funded by Portugal	0.30		0.30							PORTUGAL
	(4) Thirteen (13) P/S funded by Japan	2.25		1.25	1.00						JAPAN
2	Maintaining of present output capacity of Komoro power	2.91		1.50	1.41						Rehabilitation Plan–2 JAPAN
3	Institutional study for PAET by Portugal Consultant	1.00	0.50	0.50							PORTUGAL
4	Rehabilitation of Switchgears of Komoro P/S, etc	0.43			0.43						ADB
5.	Upgrading of Komoro power station	7.20			2.40	2.40	2.40				Rehabilitation Plan–3 (JICA
6	Upgrading of three(3) major power stations	7.63				2.63	2.50	2.50			Rehabilitation Plan–4 (JICA
7	Reinforcement of 20kV distribution networks	5.50					2.00	2.00	1.50		Rehabilitation Plan–5 (JICA
	Total of Capital Cost	29.85	0.50	5.18	6.24	5.03	6.90	4.50	1.50		
*	(JICA STUDY) * does not mean a commitment of funding for D/D and construction works of the above projects.			5.68		11.27		11.40	1.50		

Figure 5.5.1 Implementation Plan of Power Sector