Chapter 13 COST ESTIMATION

Chapter 13

COST ESTIMATION

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13. COST ESTIMATION

13.1 Construction Cost

13.1.1 Basic Policy

- The construction cost of this project comprises all costs for civil engineering works, electrical works, power transmission line works, cost for compensation, engineering fees, contingency and other costs involved with the construction of this project.

- The estimate of the construction cost has been calculated referring the unit costs recorded in construction of similar small scale hydro power plants of SEB and the unit prices presented by Public Works Department (PWD) of the State. The unit prices have been adjusted in an optimum manner so that they would match the local conditions of this project. Some of the special items of works have been estimated on the basis of unit prices in foreign countries as reference.

- This project is planned for a small-scale hydro power development. Therefore, a maximum effort has been made to reduce the overall construction cost by procuring the local materials.

- The numeric values pertaining to the quantity of works that were used for the estimate of the construction cost were calculated in accordance with the preliminary designed drawings.

13.1.2 Reference of Estimate

On the basis of consultations with SEB, the construction cost estimate has been calculated using the following reference:

- The referenced timing for the estimate of the cost of construction shall be June 1992. The foreign currency exchange rate is US$1.00 = M$2,512 as announced by Malayan Banking Bhd. on June 10, 1992.

- The construction cost has been divided in to two parts: the local currency part and the foreign currency part. The local currency part shall be used primarily for the costs of labor, procurement of domestically available materials, transportation by land and installation of the equipment. The foreign currency part shall be appropriated to the purchase of the imported equipment.

- The interests (IDC) during construction shall not be included in the construction cost proper.

- The engineering fees and the administration cost shall be 10% of the direct cost of construction.

- The contingency has been estimated as follows:

  10% with respect to the civil engineering work cost
  5% with respect to the electro-mechanical equipment cost
  5% with respect to the power transmission line
  10% with respect to the purchase/compensation for the land
  10% with respect to the engineering/administration costs

13.1.3 Estimate of Construction Cost

(1) Civil Engineering Works

- The cost for the intake facilities comprises the costs required for the intake dams, desalting basins, connecting pipe (Mesilau), headponds and spillways. Also, the cost for the gate and stop valves shall be included in the cost for the civil engineering works. The costs for screens, fences and other appurtenances were listed in a lump sum under miscellaneous costs.

- The cost for pipelines shall comprise the costs for steel pipes, bridges for pipes, anchor blocks and saddles and the like. The costs for appurtenant facilities including drainage

valves and air valves were listed in a lump sum under miscellaneous costs. The cost for the roads along the pipelines were estimated separately as the cost for access roads to the intake facilities.

- The construction cost for the penstock comprises the costs for steel penstocks, foundation excavation and backfilling works, and anchor blocks. The appurtenances including protection works for surfaces of penstocks were listed in a lump sum under miscellaneous costs.

- The cost for access roads includes the road to the power station, and the roads to the Liwagu and Mesilau intake facilities (along the pipelines). The estimate includes the cost for repairing part of the existing roads.

(2) Electro-mechanical Equipment

- The electro-mechanical equipment and facilities include hydraulic turbines, power generators, main transformer, switching equipment, control and protection facility, 11-kV HV lines to connect to the existing power transmission system and the communication system to both Ranau and Kundassang Diesel power station.

- While the estimate has been calculated on the assumption that all units of electro-mechanical equipment excluding the 11-kV HV lines should be imported from overseas, the unit prices of these pieces of equipment have been on the basis of the prices of the similar small-scale hydroelectric power plant equipment imported from overseas by SEB up to the present time, as well as the unit prices of electro-mechanical equipment used in similar projects in countries other than Malaysia.

- Ten percent (10%) of the price of the electro-mechanical equipment excluding the 11-kV HV lines have been listed in the estimate as the cost for transportation by sea and land to the

project site including the miscellaneous costs such as custom clearance.

- Twenty percent (20%) of the price of the electric equipment excluding the 11-kV HV lines have been listed in the estimate as the cost for the local installation work at the site. This amount shall include the cost for other miscellaneous materials involved with the installation works that are locally available.

- The communication facility shall utilize the existing public telecommunication network. A telephone line shall be installed from Naradaw small scale hydro electric power plant to Ranau and Kundassang diesel power plants. Also, a radio communication facility shall be installed at all three stations mentioned above for emergency.

- An estimate shall be made for the cost of 11-kV HV lines to be used for the project on the basis of the records of unit prices in the costs of constructions executed by SEB in the past.

13.1.4 Totals of Construction Costs

The total construction costs of the Naradaw project is shown in **Table 13-1.**

On the other hand, the breakdown of the construction costs classified by individual facilities is shown in **Appendix 7.**

13.2 Scheduling of Yearly Disbursement

The scheduling of yearly disbursement for the construction of the project has been formulated on the basis of the construction schedule proposed under **Section 12.3** as reference. The result is shown in **Table 13-2**.

Table 13-1 Summary of Construction Cost

	Description	Local Currency (M$)	Foreign Currency (M$)	Amount (M$)
1.	Civil Engineering Works	6,099,000	O	6,099,000
	1.1 Preliminaries	200,000	O	200,000
	1.2 Liwagu Intake Facilities	509,000	O	509,000
	1.3 Mesilau Intake Facilities	647,000	O	647,000
	1.4 Liwagu Pipeline	2,284,000	O	2,284,000
	1.5 Mesilau Pipeline	543,000	O	543,000
	1.6 Penstock	813,000	O	813,000
	1.7 Powerhouse	175,000	O	175,000
	1.8 Access Road	928,000	O	928,000
2.	Electrical and Mechanical Works	400,000	2,750,000	3,150,000
3.	Transmission Line	140,000	O	140,000
4.	Project Land Cost and Compensations	250,000	O	250,000
5.	Engineering and Management (10% of above total)	690,000	275,000	965,000
6.	Contingencies	731,000	165,000	896,000
	10% of Civil Engineerings Works	610,000	O	610,000
	5% of Electrical and Mechanical Works	20,000	138,000	158,000
	5% of Transmission Lines	7,000	O	7,000
	10% of Project Land Cost and compensations	25,000	O	25,000
	10% of Engineering, Management and Commissioning	69,000	27,000	96,000
	Grand Total	8,310,000	3,190,000	11,500,000

Table 13-2 Scheduling of Yearly Disbursement

unit: 1,000M$

Item		Total Cost	1st yr	2nd yr	3rd yr
1. Civil Engineering Works	L.C.	6,099	1,867	3,932	300
	F.C.	--	--	--	--
	Total	6,099	1,867	3,932	300
2. Electrical and Mechanical Works	L.C.	400	--	--	400
	F.C.	2,750	--	470	2,280
	Total	3,150	--	470	2,680
3. Transmission Line	L.C.	140	140	--	--
	F.C.	--	--	--	--
	Total	140	140	--	--
4. Project land Cost and Compensations	L.C.	250	250	--	-
	F.C.	--	--	--	--
	Total	250	250	--	--
5. Engineering and Management	L.C.	690	226	393	71
	F.C.	275	--	47	228
	Total	965	226	440	299
6. Contingencies	L.C.	731	242	432	57
	F.C.	165	--	29	136
	Total	896	242	461	193
Grand Total	L.C.	8,310	2,725	4,757	828
	F.C.	3,190	--	546	2,644
	Total	11,500	2,725	5,303	3,472

Chapter 14 ENVIRONMENTAL IMPACT STUDY

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14. ENVIRONMENTAL IMPACT STUDY

14.1 Outline

Following the Technical Specifications provided by JICA Team, Environmental Impact Study was conducted by University Kebangsaan Malaysia, and an EIA report was submitted to JICA Team. Potential impacts of the project on environment are not expected to be significant if the recommendations in the EIA report are followed and the appropriate mitigation and abatement measures are taken.

According to the EIA report, no unique floral species of special conservation or scientific interests has been found in the project area. No rare or endangered faunal species were recorded there. The proposed project will acquire about 10 ha. of land for laying the pipe, powerhouse and the pond. Most of these lands are private lands. About five houses have to be relocated and compensated as they are located very close to the pipeline and the powerhouse. A resettlement scheme is not necessary. There is no established intake structure between the intake points and the powerhouse except for occasional/limited use for washing and small scale fishing.

The survey reveals that about 76 percent of respondents in the project area agreed the project to be built in the proposed site, anticipating that they will benefit from the project, and 16 percent disagreed. Those who disagreed feel that the area is not suitable for the hydroelectric project as they have experienced that there is always a shortage of water.

The potential impacts of the site surveying, engineering and geophysical investigations in the investigation stage are expected to be of low magnitude. Nevertheless, the entry of the investigation team should be made known to the village head.

Earth work and excessive use of the existing Kauluan gravel road in the construction and development stage can cause among others, (1) damage to the road, (2) soil erosion and slope failure, (3) increase in suspended sediment in steam waters, (4) increase of airborne particu-

lates during dry periods, (5) noise from the machineries deployed, and (6) inherent risks to human safety both of on-site workers and the surrounding neighborhood. The construction of intake weirs can result in immediate siltation of downstream water if the flow is not properly diverted. Indiscriminate disposal of wastes into the surrounding water bodies can seriously affect the aquatic ecosystem and downstream water use. Appropriate mitigation measures must therefore be taken during the civil works.

Major environmental issues that can be associated with the operation and maintenance of the proposed small scale upper Liwagu hydroelectric project are (1) the power generation activities, particularly with regard to water extraction, and (2) waste disposal.

Water quantity for the Liwagu and Mesilau rivers upstream of the intake points, and also the Liwagu river downstream of the powerhouse will not be affected, as what comes into the hydroelectric power plant system will go out.

However, for the stretch between the intake points and the powerhouse, there will be some reduction in water flow. The reduction in river water quantity between the intake points and the powerhouse may lead to a number of adverse implications, the most critical being possible loss of habitat for aquatic life. Another potential negative impact will be creation of sites for mosquito breeding as low flows will lead to formation of small water pools in the rocky bed.

The ponding of water is not expected to affect the downstream water quality as the retention time in the pond is only about 2 hours.

Solid wastes, particularly the silt/sludge from the headpond and used lubrication oil from the power plant maintenance must be properly managed to avoid pollution of downstream water.

In view of the pressing demand for water resource by the various users within the upper Liwagu catchment area, an accurate water auditing must be worked out to verify the feasibility of the proposed hydroelectric

power project and avoid adverse environmental implications associated with water quantity.

During low flows, priority must be given to allocating sufficient quantity of flow for river maintenance purpose (for the intake - powerhouse stretch); the recommended minimum flow is 0.05 m^3/sec for Sg. Mesilau and 0.10 m^3/sec for Sg. Liwagu. The minimum flow of 0.05 m^3/sec for Sg. Liwagu in the original design of the project was increased to 0.10 m^3/sec to meet this recommendation.

Affected villagers must be appropriately compensated for losses due to displacement or acquisition of land, prior to commencement of construction work. It seems that villagers most often refer matters of importance to the village head. Thus, with regard to village problem such as payment for compensation, the village head should be consulted, and for any information to be more effective at the village level, it should be channelled through the village head.

As the area is still tectonically active, structures must be firmly anchored to the bedrocks; all installations must incorporate adequate safety features to minimize impact in case of foundation failure.

All engineering works must in corporate strict erosion control measures to minimize siltation problem of surface waters during the construction stage.

14.2 Environmental Impact Study

Potential impacts and mitigation measures on the project are summarized in **Table 14-1**. Executive Summary of the Environmental Impact Study Report prepared by Universiti Kebangsaan Malaysia is shown in **Appendix 8**.

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (1/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
A.	**INVESTIGATION STAGE**				
	Site surveying and engineering/geotechnical investigation.	Minimal in terms of traffic related impacts (airborne dust, road safety, noise).	S		
		May cause anxiety among population.	S	First inform the village head.	
		Minimal impacts on biological components.		Ensure minimal cutting of rentices/riparian vegetation.	
	Note: No new access road required.				
B.	**CONSTRUCTION AND DEVELOPMENT**				
1.	**Access Road**	Reduction in surface water quality.	S	Make use of existing roads rather than cutting new roads.	
	Note: Existing roads are unsurfaced and on hillslopes.		S	Road surface to be improved (gravelled and compacted to appropriate specification).	
		Reduction in air quality.	S	Water to be lightly sprayed on access roads when dust is excessive.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (2/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		Increase in noise.	S	Working hours limited to daytime only.	
		Degradation of roads due to overloading.	S	Close supervision by Site Engineer.	
				Roads to be immediately resurfaced if damaged during usage.	
		Some loss in agriculture land.	P	Affected land owners to be compensated for new roads stretch that cut across vegetable farms.	
2. Site Clearing		Increased suspended solids in surface water due to surface erosion.	S	Attempt should be made at synchronizing site clearing with dry periods.	
	Note: ○ The area is generally devoid of primary vegetation (replaced with vegetable farms). ○ There are no endangered and rare plant and wildlife species in the area.			Minimal cutting of riparian vegetation; replanting cleared strips.	
				Provision of temporary drain and silt trap around headpond and powerhouse areas.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (3/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
				Exposed steep slopes to be protected with plastic sheeting.	
				Use excess earth for road grading and bunds.	
		Increase in noise level.	S	Working hours near settlement areas to be limited to daytime.	
		Increase in suspended particulates in the air.	S	Water to be sprinkled during dry periods.	
				Plant debris must not be burnt on-site but properly stacked along the riparian or hill slopes to act as silt screen.	
		Displacement of houses (Note: Land acquisition not extensive).	P	Affected population should be adequately compensated.	Displacement of about five households.
				Resettlement of affected household to be completed first prior to site clearing.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (4/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
3.	Earthworks	Increase in suspended particulates in air prior to stabilization.	S	Spray water when dust is excessive.	
		Increase in suspended solids due to erosion by runoff.	S	Construct temporary drains which lead to a silt trap or settling pond.	
				Earthwork is best confined to periods of expected low precipitation.	
				Excess earth to be stockpiled on levelled ground and compacted, or used for road grading or bunding.	
				Earthwork should be phased so as not to allow too much area being exposed to erosion at any one time. Exposed areas to be revegetated/turfed immediately upon completion of earthwork.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (5/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		Siltation of streams during construction of intake weirs.	S	Proper diversion of stream flow.	
		Slope failure.	S	Minimal cutting of slope. Slope to be cut or cleared of vegetation only when the site is ready to be worked on. Work first from higher ground.	
		Increase in noise due to earthwork machinery.	S	Working time near settlement areas to be limited to daytime only.	
		Reduction of aesthetics.		Good landscaping work, particularly around headpond and powerhouse.	
4. Transportation		Increase in suspended particulates in air.	S	Lorry loads must be covered to avoid spillage. Sprinkling of roads and tracks when dust is excessive.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (6/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		Decrease in tranquility.	S	Transportation movement to be restricted to daytime.	
		Safety hazards.	S	Safety regulation and normal construction supervision to be enforced.	
				Minimize number of trips by proper planning.	
5.	Material and Equipment	Increase in noise.	S	Working hours in Kg. Naradaw is limited to daytime only.	
		Safety hazard in storage area.	S	Machines, pipes etc. to be stored away from the public right of way and guarded.	
		Risk of accident at construction site.	S	Safety regulation and normal construction supervision to be enforced.	
6.	Waste Disposal	Deterioration of water quality.	S	Proper management of wastes (e.g. use of covered containers/pit).	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (7/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
				Excess earth to be reused or properly stocked. Other construction wastes to be disposed off at approved waste dump site.	
				No open burning on-site.	
				No full scale maintenance work on machineries/vehicles be allowed in the project area.	
		Water contamination by sewage.	S	Provision of temporary septic tank to worker quarters.	
7. Base Camp		Indiscriminate dumping of wastes leading to ground and water pollutions - potential health hazard.	S	Proper management of wastes (see Waste Disposal).	
8. Labour Force		Employment opportunities (a positive impact)	S	(Job priority given to locals).	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (8/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
9.	Scenic Modification	Loss of natural scenery particularly at headpond - powerhouse area.	P	Replace with good landscape, and revegetate.	Man-made structure.
		Obstruction to human and animal passage.	P	Minimize by bunding the blocking segment. Good landscaping.	
10.	Abandonment	Safety: abandoned structures and machineries could be hazardous.	S	Dangerous machineries to be stored/parked in a guarded premise.	
C.	OPERATION AND MAINTENANCE STAGE				
11.	Power Generation	Reduced flow between intake and powerhouse during low flows:	P		
		a. impacting aquatic life (loss of habitat)		Ensure a minimum of 0.05 and 0.10 m^3/sec of flow for Mesilau and Liwagu, respectively, for river maintenance (minimum 6" depth).	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (9/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		b. affecting direct water use		Possibly compensated by distributing a fraction of ponded water to nearby population.	
		c. possible mosquito breeding		Alternate day flushing during dry periods.	
		d. temporal reduction in water quantity for downstream users due to flow regulation.		Headpond storage must not exceed 2,000 m^3.	
		Noise.	P	Proper installation of pipeline and genset to minimize vibration.	
		Risk of headpond and pipeline collapse/rupture.		Installation of fail-safe system (including control valves and bundwalls at strategic points; consider alarm system. Structures (including pipeline support) must be anchored firmly on bedrocks.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (10/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		Deterioration of water quality on impact.		Installation of impact buffering structure (impact of this slight turbulence is counterbalanced by the SS removal in the headpond).	
12.	**Infrastructure and Utility**				
	a) Road	Anticipated improved road pavement upon completion of project (a positive impact).	L		
	b) Water Supply			See Item 11(b).	
	c) Power Supply	Improved power supply along the Kundasang - Ranau grid (a positive impact).	L		
13.	**Waste Disposal**	Headpond sludge - potential contamination of river water by nutrients and pesticides.		Silt/sludge to be stockpiled on the level ground adjacent to the headpond. Encourage reuse for agricultural soil conditioning.	

Table 14.1 Summary of Potential Impacts and Mitigation Measures of the Project (11/11)

Item	Project Activities and Sources of Pollutants	Potential Impacts	Nature S (short-term) L (long-term) P (permanent)	Proposed Mitigation Measures	Residual Impacts
		Oil wastes from genset maintenance - water contamination.		Collected (oil sump, drums), carefully stored and returned to supplier.	

Chapter 15 ECONOMIC AND FINANCIAL ANALYSES

Chapter 15

ECONOMIC AND FINANCIAL ANALYSES

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15. ECONOMIC AND FINANCIAL ANALYSES

15.1 Economic Evaluation

15.1.1 Outline

Economic evaluation was made on the Naradaw Scheme (hereinafter called the "Project") which was selected as the optimal one described in **Chapter 9 "Selection of Optimum Plan"**.

Necessary studies were made on the total costs (comprising investment cost and OM cost) of the Project over its depreciation period of twenty-five (25) years and the total costs (comprising investment cost, OM cost and fuel cost) of an alternative high-speed diesel engine driven power plant which has the same installed capacity comparable to the firm peak capacity of the Project and fuel costs of the alternative diesel power plant as well as existing diesel power plants which can be saved by realization of the Project.

Then the respective total costs were converted into their present values at the beginning of the first year of investment in the Project. As a result, the surplus benefit (B-C) is M$625 x 10^3, the Benefit/Cost (B/C) ratio is 1.06, and the economic equalizing discount rate obtained is 10.71%. Therefore, the economic feasibility of this Project has been confirmed.

15.1.2 Method of Economic Analysis and Basic Assumptions

The Project envisages to supply electricity to the Ranau area including Ranau, Kundasang and Bundu Tuhan as an isolated system for the meantime. In the economic evaluation, it is assumed that a diesel power plant having the same installed capacity comparable to the firm peak capacity of the Project with its planned installed capacity of 1,600 kW and firm peak capacity of 460 kW is to be installed at load centers of the Ranau area.

Based on the above-mentioned assumptions, the following Cost and Benefit were converted to present values at the beginning of the first year of investment in the Project. Thus, the surplus Benefit (B-C) and Benefit/Cost (B/C) ratio were obtained. At the same time, an economic equalizing discount rate (EEDR) which gives an equalized present value of "benefit" and "cost" has been calculated to evaluate the economic viability of the Project.

Cost : (a) Total Investment Cost for the Project

(b) Operation and Maintenance Cost to be incurred after completion of the Project

Benefit : (a) It is assumed that diesel power plants having the same installed capacity comparable to the firm peak capacity of the Project are to be installed at load centers of the Ranau area. The total investment cost for these diesel power plants is estimated.

(b) Operation and maintenance cost of diesel power plants

(c) Fuel cost for generating energy corresponding to the firm peak capacity of the Project

(d) Fuel cost for generating non-firm energy at diesel power plants other than those mentioned in (c) above equal to the non-firm energy generation of the Project. (The amount of such fuel cost to be incurred at the said diesel power plants which will be saved upon completion of the Project.)

(1) Basic Conditions for Economic Analysis

(a) Price Level and Escalation

All prices are as of June 1992. No escalation has been considered according to general practice of economic evaluation.

(b) Composite Service Life

It is said that a composite service life of a small scale hydroelectric power project is generally 25 to 30 years. The composite service life of the Project is to be 25 years in accordance with the internal regulation of SEB. Likewise, the service life of the high speed diesel-engine power plant is to be 15 years.

(c) Discount Rate

A social discount rate of 10% is applied to this Project.

(d) Conditions for Calculations for Economic Analysis

Table 15-1-1 gives technical parameters of the mini hydro project (Project) and the alternative diesel power plant.

Table 15-1-1 Technical Parameters for Calculations for Economic Evaluation

No.	Description	Mini Hydro	Diesel
(1)	Installed Capacity (kW)	1,600	514
(2)	Firm Peak Capacity (kW)	460	
	Actual Capacity of Diesel (kW)		550
(3)	Station Service Rate;		
	kW Service Rate	1.0%	4.0%
	kWh Service Rate	1.0%	4.0%
(4)	Transmission Loss Rate (%)	3.0%	0
(5)	Scheduled Outage Rage (%)	1.0%	10.0%
(6)	Forced Outage Rate	5.0%	5.0%
(7)	Annual Output Declining Rate	0.4%	2.0%
(8)	kW Adjustment Factor	1	1.12 1/
(9)	Per kW Investment Cost of Diesel (10^3 M$)		1.56
(10)	Service Life (Year)	25	15
(11)	Kind of Fuel	-	Diesel Oil
(12)	Thermal Efficiency (%)	-	28.0%
(13)	Calorific Value (Kcal/kg)	-	10,000
(14)	Specific Gravity (kg/liter)	-	0.81
(15)	Fuel Consumption (Liter/kWh)	-	0.379
(16)	Fuel Unit Price (M$/liter)	-	0.50
(17)	Fuel Cost per kWh (M$ kWh)	-	0.190
(18)	OM Cost Rate to Total Construction Cost	1.1% 2/	5.0%

Note)

1/ kW Adjustment Factor:

$$\textit{Mini Hydro Disel}\ \frac{(1-0.01)\times(1-0.01)\times(1-0.05)\times(1-0.004)\times(1-0.03)}{(1-0.04)\times(1-0.10)\times(1-0.05)\times(1-0.02)\times(1-0)}$$

$$= \frac{0.899549501}{0.804384}$$

$$= 1.1183$$

460 kW x 1.12 = 514 kW

However, 550 kW has been selected as the installed capacity of the alternative diesel power plant in consideration of standard sizes of diesel-engine sets available widely on the market.

2/ Annual OM Cost Rate (Composite) of Mini Hydro:

	Total Construction Cost of Mini Hydro (10^3 M$)		OM Rate	OM Cost
(a)	Civil Works	7682	0.5%	38
(b)	Electro/Mechanical	3655	2.5%	91
(c)	Transmission	163	1.5%	2
	Total	11,500		132
Annual OM Rate			1.1498% (Average)	

Table 15-1-2 shows annual energy generation, annual saleable energy, etc. of the Project as well as the quantity of energy to be generated at the diesel power plants that correspond to the quantity of saleable energy of the Project.

Table 15-1-2 Required Quantity of Energy to Be Generated At Diesel Power Plant

Year	Annual Energy Generation (MWh)	Firm Usable Energy (MWh)	Non-firm Usable Energy (MWh)	Firm Saleable Energy (MWh) (a)	Non-firm Saleable Energy (MWh) (b)	Energy Generated at D/G for (a) (MWh)	Energy Generated at D/G for (b) (MWh)
1997	4500	2314	2186	2245	2120	2338	2209
1998	5365	2314	3051	2245	2959	2338	3083
1999	6233	2314	3919	2245	3801	2338	3960
2000	7177	2314	4863	2245	4717	2338	4914
2001	7813	2314	5499	2245	5334	2338	5556
2002	8276	2314	5962	2245	5783	2338	6024
2003	8595	2314	6281	2245	6093	2338	6346
2004	8839	2314	6525	2245	6329	2338	6593
2005	9047	2314	6733	2245	6531	2338	6803
2006	9195	2314	6881	2245	6675	2338	6953
2007	9317	2314	7003	2245	6793	2338	7076
2008	9472	2314	7158	2245	6943	2338	7233
2009	9472	2314	7158	2245	6943	2338	7233
2010	9472	2314	7158	2245	6943	2338	7233
2011	9472	2314	7158	2245	6943	2338	7233
2012	9472	2314	7158	2245	6943	2338	7233
2013	9472	2314	7158	2245	6943	2338	7233
2014	9472	2314	7158	2245	6943	2338	7233
2015	9472	2314	7158	2245	6943	2338	7233
2016	9472	2314	7158	2245	6943	2338	7233
2017	9472	2314	7158	2245	6943	2338	7233
2018	9472	2314	7158	2245	6943	2338	7233
2019	9472	2314	7158	2245	6943	2338	7233
2020	9472	2314	7158	2245	6943	2338	7233
2021	9472	2314	7158	2245	6943	2338	7233
Total	216965	57850	159115	56114	154342	58453	160772

15.1.3 Cost (Total Costs of the Project)

(1) Investment Cost for the Project

The investment cost will amount to M$2,725 x 10^3 in the first year, M$5,303 x 10^3 in the second year and M$5,472 x 10^3 in the third year, totalling M$11,500 x 10^3.

(2) Operation and Maintenance Cost

The annual operation and maintenance cost of completed facilities and equipment as a result of implementing the Project will include mainly personnel expenses of staff to be engaged in operation and maintenance of the hydropower plant and related transmission line facilities and their repair costs. Generally, the annual operation and maintenance cost ratio of a small scale hydroelectric development project ranges from 1 to 1.5%of its total investment cost. The Project is to be composed of the following major components; civil structures, power plant equipment and transmission line facilities. The OM cost rates to their respective total amount of investments are as follows in general.

Civil structures	:	0.5%
Power plant equipment	:	2.5%
Transmission line facilities	:	1.5%

The total construction cost of the Project amounting to M$11,500 x 10^3 consists of M$7,682 x 10^3 for civil structures, M$3,655 x 10^3 for power plant equipment and M$163 x 10^3 for transmission line facilities. Consequently, the weighted average of the total OM cost of the respective items is 1.1% applying the OM cost ratios of the above-mentioned three items and the construction cost of each project component.

The OM cost equivalent to 1.1% of the total construction cost will be incurred annually. The annual OM cost is calculated to be M$11,500 x 10^3 x 0.11498 = M$132 x 10^3.

15.1.4 Benefit (Total Cost of Alternative Diesel Power Plant and Others)

(1) Amount of Investment in Alternative Diesel Power Plant

The Project envisages construction of a hydroelectric power plant with an installed capacity of 1,600 kW and a firm peak capacity of 460 kW. It is a general practice in an economic evaluation to compare a diesel power plant which has an installed capacity comparable to the firm peak capacity throughout a year of the hydro plant.

The installed capacity of the alternative diesel power plant which is comparable to the firm peak capacity of the Project is to be 550 kW, already described in **Table 15-1-1**.

The experience of SEB in recent years in the installation of diesel power plants equipped with high speed engines shows that the cost per kW of such plants is M$1,350. However, the construction per kW is assumed to be 1,560 M$/kW, taking into account construction costs of powerhouse and associated equipment and facilities. The total investment cost for the alternative diesel power plant will be 1.56×10^3 M$/kW x 550 kW = M$858 x 10^3.

(2) Operation and Maintenance Cost

The operation and maintenance cost of the alternative diesel power plant includes personnel expenses of those who are to be engaged in operation and maintenance of the power plant and its repair costs. The annual operation and maintenance cost of a diesel power plant is 3% to 5% in general. The alternative diesel power plant is assumed to be equipped with a high speed engine. Accordingly, the operation and maintenance the will become rather costly. Therefore, 5% is used as the annual OM cost ratio to the total investment cost. Consequently, the

operation and maintenance cost will be M$858 x 10^3 x 0.05 = M$43 x 10^3 annually.

(3) Fuel Cost

(a) Fuel Cost per kWh

- The unit fuel cost for the diesel power with an installed capacity of 550 kW is 0.19 M$/kWh as shown in **Table 15-1-1**.

- The fuel cost per kWh of existing diesel power plants in the Ranau/Kundasang area is assumed to be M$0.18, based on records available in the said area during the last five (5) years.

Oil Consumption
(Kiloliter)

	Ranau	Kundasang	Bundu Tuhan	Total
1987	1825	395	36	2256
1988	1858	419	36	2313
1989	1471	419	38	1928
1990	1590	450	46	2086
1991	859	489	50	1398
Total	7603	2172	206	9981

Oil Purchase Cost
(10^3 M$)

	Ranau	Kundasang	Bundu Tuhan	Total
1987	837	181	16	1034
1988	837	185	16	1038
1989	611	173	16	800
1990	786	220	22	1028
1991	493	281	28	802
Total	3564	1040	98	4702

Generation
(MWh)

	Ranau	Kundasang	Bundu Tuhan	Total
1987	3862	1078	81	5021
1988	4289	1687	81	6057
1989	4462	1163	89	5714
1990	4842	1233	114	6189
1191	5387	1388	120	6895
Total	22842	6549	485	29876

Source: SEB Department of Finance/Accounts

Average Fuel Cost
(M$)/kWh

	Ranau	Kundasang	Bundu Tuhan	Average
1987	0.22	0.17	0.20	0.19
1988	0.20	0.11	0.20	0.17
1989	0.14	0.15	0.18	0.16
1990	0.16	0.18	0.19	0.18
1991	0.09	0.20	0.23	0.18

(b) **Energy Generation**

Energy to be generated by the proposed the hydroelectric project can be divided into two categories of "firm" energy and "non-firm" energy. Annual saleable energy for each year has been calculated by subtracting station service loss, losses due to outages, transmission line losses, etc. from the firm energy and non-firm energy, respectively.

The annual saleable firm energy which should be generated at the alternative diesel power plant having an installed capacity of 550 kW should correspond to the firm-peak capacity of the hydroelectric power plant.

The "non-firm" energy of the hydroelectric power plant is equivalent to that of energy generated at existing diesel power plants (which could be saved if the Project is realized).

In this study, the diesel power plants are assumed to generate the same quantity of energy as that of the saleable energy. For this purpose, the energy which will be generated at the diesel power plants has been obtained by multiplying the saleable energy by 1/(1-0.04).

(c) **Fuel Cost**

The fuel costs were calculated according to Items (a) and (b). The fuel costs of the alternative diesel power plant and other existing diesel power plant(s) which could be saved by realization of the Project have been obtained.

15.1.5 Economic Evaluation

The streams of "Benefit" and "Cost" are given in **Table 15-1-3**. The surplus benefit (B-C) and Benefit/Cost (B/C) ratio at a social discount rate of 10% and economic equalizing discount rate are as shown below.

B-C : M$625 x 10^3

B/C : 1.06

EEDR : 10.71%

It is verified that construction and operation of the hydroelectric power plant and associated facilities through the implementation of the Project are more economical than those of alternative diesel power plants. The economic equalizing discount rate of the Project slightly exceeds 10%. In view of the fact that the economic equalizing discount rate of the Project is slightly larger than 10% which is generally used for project evaluation in the power sector in Sabah State, the Project is economically feasible.

Table 15-1-3 Economic Evaluation

SDR= 10.0%

		Project (as Cost)					Diesel(as Benefit)									(In thousand Malaysian dollars)
Year	Serial No.	Invest.	OM Cost	Sub-Total	Gene.Ene. at D/G (MWh)	Energy of Other D/G (MWh)	Invest.	OM Cost	Fuel Cost(a)	Fuel Cost(b)	Sub-Total	B-C	PV Factor	NPV Cost	NPV Benefit	NPV B-C
1994	1	2725		2725							0	-2725	0.909	2477	0	-2477
1995	2	5303		5303			343				343	-4960	0.826	4383	284	-4099
1996	3	3472		3472			515				515	-2957	0.751	2609	387	-2222
1	4		132	132	2338	2209		43	443	398	884	752	0.683	90	604	513
2	5		132	132	2338	3083		43	443	555	1041	909	0.621	82	646	564
3	6		132	132	2338	3960		43	443	713	1199	1067	0.564	75	677	602
4	7		132	132	2338	4914		43	443	884	1371	1238	0.513	68	703	636
5	8		132	132	2338	5556		43	443	1000	1486	1354	0.467	62	693	632
6	9		132	132	2338	6024		43	443	1084	1571	1438	0.424	56	666	610
7	10		132	132	2338	6346		43	443	1142	1629	1496	0.386	51	628	577
8	11		132	132	2338	6593		43	443	1187	1673	1541	0.350	46	586	540
9	12		132	132	2338	6803		43	443	1225	1711	1579	0.319	42	545	503
10	13		132	132	2338	6953		43	443	1251	1738	1605	0.290	38	503	465
11	14		132	132	2338	7076		43	443	1274	1760	1628	0.263	35	463	429
12	15		132	132	2338	7233		43	443	1302	1788	1656	0.239	32	428	396
13	16		132	132	2338	7233		43	443	1302	1788	1656	0.218	29	389	360
14	17		132	132	2338	7233	343	43	443	1302	2131	1999	0.198	26	422	395
15	18		132	132	2338	7233	515	43	443	1302	2303	2171	0.180	24	414	390
16	19		132	132	2338	7233		43	443	1302	1788	1656	0.164	22	292	271
17	20		132	132	2338	7233		43	443	1302	1788	1656	0.149	20	266	246
18	21		132	132	2338	7233		43	443	1302	1788	1656	0.135	18	242	224
19	22		132	132	2338	7233		43	443	1302	1788	1656	0.123	16	220	203
20	23		132	132	2338	7233		43	443	1302	1788	1656	0.112	15	200	185
21	24		132	132	2338	7233		43	443	1302	1788	1656	0.102	13	182	168
22	25		132	132	2338	7233		43	443	1302	1788	1656	0.092	12	165	153
23	26		132	132	2338	7233		43	443	1302	1788	1656	0.084	11	150	139
24	27		132	132	2338	7233		43	443	1302	1788	1656	0.076	10	136	126
25	28		132	132	2338	7233	-286	43	443	1302	1502	1370	0.069	9	104	95
Total		11500	3306	14806	58453	160772	1430	1073	11082	28939	42524	27718		10370	10995	625

B-C= 625
B/C= 1.060

EEDR= 10.71%

15.1.6 Sensitivity Analysis

The following is the results of sensitivity analysis of fluctuations in construction cost of the Project and in the fuel cost of alternative diesel power plant.

(1) Fluctuation in Construction Cost of the Project (discount rate 10%)

Construction Cost	up 3%	up 4%	up 5%	up 6%	up 7%	up 10%
B-C (10^3 M$)	+314	+210	+107	+3	-101	-412
B/C	1.029	1.020	1.018	1.000	0.991	0.964
EEDR (%)	10.35	10.29	10.12	10.00	9.89	9.56

(2) Fluctuation in Fuel Cost of Diesel Power Plant (discount rate 10%)

Fuel Cost	up 3%	up 5%	up 7%	up 9%	up 10%
B-C (10^3 M$)	+922	+1,120	+1,318	+1,515	+1,614
B/C	1.089	1.108	1.127	1.146	1.156
EEDR (%)	11.04	11.26	11.47	11.69	11.79

15.2 Financial Analysis

15.2.1 Outline

In the financial analysis of total investment in the Project, the present values of a stream of operating revenues (energy sales revenue) and a stream of costs (comprising investments and OM cost) of the Project were calculated. As a result, surplus benefit (B-C) is M$811 x 10^3, benefit/cost (B/C) ratio 1.078 and financial equalizing discount rate (FEDR) 10.86%. The financial equalizing discount rate obtained exceeds the social discount rate of 10% which is used by SEB for project evaluation. Hence, it is concluded that investment in this Project is financially sound.

Regarding financial analysis made from the point of view of power utility, necessary studies were made for 2 cases bearing in mind the Government's policy in recent years of giving subsidies to the respective states of Malaysia in implementing their small scale hydroelectric power development projects. Case I - construction costs of the Project are to be financed by a loan from the Federal Government and Case II in which the total construction costs of the Project are to be funded by grants from the Federal Government.

Profit and loss statement and cash flow sheet have been prepared for Case I. As a result, net profit, which is the difference between revenue and cost (including interest), shows a deficit from the 3rd to 5th operating years but immediately thereafter the net profit turns into the black and this favorable situation continues until the last operating year, resulting in generating an aggregate net profit amounting to M$18,760 x 10^3 over 25 operating years. With regard to the cash flow, as borrowed funds are repaid from the net profit plus depreciation reserve, the yearly balance becomes red during the period from the 3rd to the 7th operating years. Nonetheless, the yearly balance turns into the black in the 8th operating year and subsequent years, however the cumulative balance shows a plus balance for the respective years.

The debt-service ratio is 1.76 in the 1st repayment year. The cumulative average debt-service ratio is 1.07 over 10 years from the commencement of repayment. The cumulative average debt-service ratio over the entire 15 year repayment period is 1.08. Consequently, stable operation of the power utility could be anticipated as far as this Project is concerned, even at the present unit sale rate. If Case II is taken into account, the operating expense will be only OM cost besides depreciation cost which is a non-cash item and is an internal reserve. The total net profit will amount to M$30,501 x 10^3 over the 25 operating years.

On the other hand, average generating costs are calculated at 0.122 M$/kWh in Case I and 0.068 M$/kWh in Case II respectively, over the depreciation period of twenty-five (25) years after completion of the Project.

15.2.2 Methods of Financial Analysis

Financial analysis of this Project was made by the two methods stated hereunder:

(1) Financial Analysis of Total Invested Capital Cost

A financial equalizing discount rate (FEDR) which equalizes the present value of a stream of operating revenue (energy sales revenue) to be generated by the materialization of the Project and that of a stream of costs (investments and operation and maintenance cost) was calculated.

A comparison is made between the FEDR thus obtained and the social discount rate of 10% to check if the former exceeds the latter. Then, judgement is to be made as to whether the Project is financially feasible or not.

(2) Financial Analysis from the Standpoint of Power Utility

SEB is the implementing agency of this Project and will operate and maintain the completed equipment and facilities upon completion of the Project. Therefore, it is believed that there will be the necessity of preparing guidelines for the management. In this context, amortization schedule, profit and loss statement and cash flow sheet are prepared in order to calculate debt-service ratios.

In recent years, the policy of the Federal Government of Malaysia through its Economic Planning Unit (EPU) has been to bear all costs of constructing small scale hydroelectric power development projects undertaken by its States in light of the important role to be played by such projects in rural electrification and regional electricity supply.

Therefore, studies in the "Financial Analysis from the Standpoint of Power Utility" were made on Case I where conventional government loan is provided for all construction costs and Case II in which all required construction costs are to be funded by grants provided by the Federal Government.

15.2.3 Basic Conditions of Financial Analysis

(1) Conditions of Financial Analysis of Total Invested Capital Cost

(a) Construction Cost

	(10^3 MS)
Project Year 1st	2,725
Project Year 2nd	5,303
Project Year 3rd	3,472
Total	11,500

(b) Operation and Maintenance Cost

As already described in **15.1 "Economic Evaluation"**, the composite ratio of annual OM cost is equivalent to 1.1% of the total construction cost. Accordingly, the OM cost is calculated to be M$132 x 10^3.

(c) Energy Sales Revenue

The energy sales revenue was studied as follows on the basis of data furnished by the Department of Finance/Accounts of SEB.

1) Average Sale Rate

The unit average sale rate obtained through the energy sold and energy sales revenue for 7 years from 1985 to 1991 in the Ranau, Kundasang and Bundu Tuhan districts are different from one district to another in the respective years. The said sale rate roughly ranges form M$0.23 to M$0.29 per kWh. The overall average of the sale rates in each district in the respective years is calculated to be 0.26 M$/kWh. This sale rate has been used as the average sale rate per kWh in the financial analysis.

Table 15-2-1 Average Sale Rate at Ranau/Kundasang System

Energy Sold (MWh)	Ranau	Kundasang	Bundu Tuhan	Total
1985	2,150	622	64	2,836
1986	2,348	677	78	3,103
1987	2,914	878	72	3,863
1988	3,777	1,025	73	4,875
1989	3,821	1,076	74	4,971
1990	4,272	1,110	102	5,484
1991	4,497	1,360	108	5,965
Total	23,779	6,748	570	31,097

Gross Energy Sales (10^3M$)	Ranau	Kundasang	Bundu Tuhan	Total
1985	587	127	15	729
1986	766	221	15	1,002
1987	851	265	19	1,135
1988	960	273	19	1,252
1989	969	283	20	1,272
1990	1,078	273	26	1,377
1991	1,142	254	27	1,423
Total	6,353	1,696	141	8,190

Average Sale Rate (M$ per kWh)	Ranau	Kundasang	Bundu Tuhan	Average
1985	0.27	0.20	0.23	0.24
1986	0.33	0.33	0.19	0.28
1987	0.29	0.30	0.27	0.29
1988	0.25	0.27	0.26	0.26
1989	0.25	0.26	0.27	0.26
1990	0.25	0.25	0.25	0.25
1991	0.25	0.19	0.25	0.23
Average	0.27	0.26	0.25	0.26

2) Average Sale Rate to be allocated to the Project

Based on the data provided by SEB's Department of Finance/Accounts on the "total supply cost" of energy in the components of generation and transmission/distribution as shown in **Table 15-2-2**, the following composition ratios have been obtained.

Composition Ratios of Generation and Transmission/Distribution.

Year	1987	1988	1989	1990	1991
Generation (%)	80.2	78.7	80.1	76.8	77.0
Transmission/Distribution (%)	19.8	21.3	19.9	23.2	23.0

However, the Department of Finance/Accounts has treated the supply costs of "transmission" and "distribution" components in the same accounting category, which makes it quite difficult to separate both items.

According to SEB, the transmission component occupies roughly 60% and the distribution accounts for approximately 40% of the supply cost of both components.

If their estimation is correct, the composition ratios of Generation, Transmission and Distribution occupied in the total supply cost can be estimated as follows:

Year	1987		1988		1989		1990		1991	
Generation (%)	80	92	79	92	80	92	77	91	77	91
Transmission (%)	12		13		12		14		14	
Distribution (%)	8		8		8		9		9	

As can be easily seen from the above, the composition ratio of "distribution" component in the total supply cost is 8 to 9%. Applying 8% of the total supply cost for distribution purposes, and taking into account the situation of the Ranau area, 92% which is the estimated composition ratio of "Generatio" and "Transmission" is allocated to this Project.

Consequently, since the average sale rate per kWh is M$0.26, the average unit sale rate of this Project at the receiving end is M$0.26 x 0.92 = M$0.239.

Table 15-2-2 Share of Generation, Transmission and Distribution Occupied in Supply Costs of SEB during the Recent Five (5) Years

(In thousand Malaysian dollars)

Items	Amount				
	1987	1988	1989	1990	1991
(1) Operating revenue (10^3 M$)	193,805	208,507	226,998	256,273	267,193
(2) Energy gold (MWh)	660,420	705,235	770,041	877,464	928,181
(3) Supply (Prime) costs (10^3 M$)					
(a) Operation and maintenance cost					
Generation	80,188	79,153	91,358	115,298	138,323
Transmission & Distribution	9,566	10,441	20,680	11,296	16,255
Sub-total	89,754	89,594	102,038	126,594	154,578
(b) Depreciation cost					
Generation	15,885	16,123	16,130	15,883	17,191
Transmission & Distribution	17,591	18,962	19,939	34,717	36,006
Sub-total	33,476	35,085	36,069	50,600	53,197
(c) Administration cost					
Generation	26,886	26,149	29,102	30,953	32,783
Transmission & Distribution	3,207	3,449	3,402	3,032	3,853
Sub-total	30,093	29,598	32,504	33,985	36,636
(d) Total supply costs					
Generation	122,959	121,425	136,590	162,134	188,297
Transmission & Distribution	30,364	32,852	34,021	49,045	56,114
Total	153,323	154,277	170,611	211,179	244,411

3) Energy Sales to Ultimate Consumers

Energy to be sold to ultimate consumers has been obtained by subtracting distribution losses equivalent to 10% from Saleable Energy (the energy obtained by subtracting 3% as transmission losses from Usable Energy) shown in **Table 15-1-2**.

4) Energy Sales Revenue

Energy sales revenue from the 1st to 25th operating years has been summed up, based on Items 1) through 3) above.

(2) Financial Analysis from the Standpoint of Power Utility

(a) Fund Raising Conditions

Funding conditions were worked out in consultation with SEB by making reference to previous funding conditions of SEB-owned projects. As stated before, Case I is the case in which all construction costs will be financed by Federal Government loan and Case II in which all construction costs will be funded by grants from the said Government.

1) Case I

All construction costs are to be financed by loan from the Federal Government.

Annual Interest Rate	:	8%
Grace Period	:	5 years (counted from L/A date)
Repayment Period	:	15 years (counted from the maturity of the grace period)
Repayment Mode	:	Equal annual installments with interest. No payment

during the grace period and accrued interest due during the said period will be capitalized.

2) **Case II**

All construction costs are to be funded by grants from the Federal Government.

(b) Depreciation

The depreciation period is to be 25 years with a salvage value of zero according to the internal regulation of SEB. The amount to be depreciated is the total sum of the principal and capitalized interest at the end of the last Project year, namely: borrowing year.

(c) Energy Sales Revenue

Refer to **15.2.3(1)(C)**.

15.2.4 Results of Financial Analysis

(1) Financial Analysis of Total Invested Capital Cost

As shown in **Table 15-2-3**, FEDR of the Project is 10.86%. This value exceeds the social discount rate of 10% which is used by SEB in project evaluation. Therefore, this Project is found to be financially sound and feasible.

(a) **Change in FEDR due to Fluctuations in Construction Cost and Unit Sale Rate**

- Fluctuation in Construction Cost

Construction Cost	up 3%	up 5%	up 7%	up 8%	up 10%
FEDR (%)	10.52	10.30	10.09	9.98	9.78

- Fluctuation in Unit Sale Rate

Sale Rate (kWh)	0.20	0.25	0.30	0.35
FEDR (%)	7.97	10.41	12.58	14.55

(2) **Financial Analysis from the Standpoint of Power Utility**

Case I

(a) **Amortization Schedule**

As shown in **Table 15-2-4**, M$11,500 x 10^3 is to be borrowed at the outset, but the total sum of the principal plus capitalized interest amounts to M$12,378 x 10^3 at the end of the last borrowing year. No payment of accrued interest is made during the grace period from the 1st to 5th borrowing years.

Equal installments of principal and interest amounting to M$1,687 x 10^3 will be made each year for fifteen (15) years from the 6th year counted from the first borrowing year until the end of the 20th borrowing year.

(b) **Profit and Loss Statement**

As shown in **Table 15-2-5**, the profit is red consecutively for three (3) years from the maturity of the grace period but turns into black in the 4th year. The total sum of net profit is calculated to be M$18,760 x 10^3.

(c) **Cash Flow Sheet**

The Cash Flow Sheet is given in **Table 15-2-6** in which the yearly balance shows a deficit consecutively for five (5) years counted form the commencement of repayment. However, the cumulative balance is black every year, which shows no shortage of funds at SEB in the respective years and its financial situation is in a favorable situation.

(d) **Debt-Service Ratio**

As shown in **Table 15-2-7**, ratios were calculated between the cumulative total of net profit and depreciation reserve and that of the accrued interest plus principal to be repaid for 15 years from the commencement year of repayment until the last repayment year. The debt-service ratio is 1.76 at the commencement year of repayment. The average debt-service ratio between the cumulative internal fund generated and the cumulative debt is 1.08. The average cumulative debt-service ratios during the entire period of repayment exceeds 1 which is the standard in assessing repayment capability.

As a result, it is judged that there will be no problem of repayment by SEB of the loan mentioned in **15.2.3** above as far as this Project is concerned.

Case II

(a) Profit and Loss Statement

As given in **Table 15-2-8**, M$30,501 x 10^3 is the aggregate net profit for 25 service (operating) years.

(b) Cash Flow Sheet

The cash flow sheet covering 25 operating years is as shown in **Table 15-2-9**.

Table 15-2-3 Financial Analysis of Benefit and Cost

Sale Rate : M$0.26/kWh
Discount Rate : 10%

(In Thousand Malaysian dollars)

Year	Serial No.	Invest-ment	OM Cost	Sub-Total	Energy (MWh)	Sales Revenue	B-C	PV Factor	NPV Cost	NPV Benefit	NPV B-C
1994	1	2725		2725			-2725	0.909	2477	0	-2477
1995	2	5303		5303			-5303	0.826	4383	0	-4383
1996	3	3472		3472			-3472	0.751	2609	0	-2609
1	4		132	132	4365	940	807	0.683	90	642	552
2	5		132	132	5204	1120	988	0.621	82	696	614
3	6		132	132	6046	1302	1169	0.564	75	735	660
4	7		132	132	6962	1499	1366	0.513	68	769	701
5	8		132	132	7579	1632	1499	0.467	62	761	699
6	9		132	132	8028	1728	1596	0.424	56	733	677
7	10		132	132	8337	1795	1663	0.386	51	692	641
8	11		132	132	8574	1846	1714	0.350	46	647	601
9	12		132	132	8776	1889	1757	0.319	42	602	560
10	13		132	132	8919	1920	1788	0.290	38	556	518
11	14		132	132	9037	1946	1813	0.263	35	512	478
12	15		132	132	9188	1978	1846	0.239	32	474	442
13	16		132	132	9188	1978	1846	0.218	29	430	402
14	17		132	132	9188	1978	1846	0.198	26	391	365
15	18		132	132	9188	1978	1846	0.180	24	356	332
16	19		132	132	9188	1978	1846	0.164	22	323	302
17	20		132	132	9188	1978	1846	0.149	20	294	274
18	21		132	132	9188	1978	1846	0.135	18	267	249
19	22		132	132	9188	1978	1846	0.123	16	243	227
20	23		132	132	9188	1978	1846	0.112	15	221	206
21	24		132	132	9188	1978	1846	0.102	13	201	187
22	25		132	132	9188	1978	1846	0.092	12	183	170
23	26		132	132	9188	1978	1846	0.084	11	166	155
24	27		132	132	9188	1978	1846	0.076	10	151	141
25	28		132	132	9188	1978	1846	0.069	9	137	128
Total		11500	3306	14806	210456	45307	30501		10370	11182	811

B-C = 811
B/C = 1.078
(FEDR = 10.86%)

Table 15-2-4 Amortization Schedule

Case I
Interest Rate: 8.0% per annum

(In Thousand Malaysian dollars)

Serial No.	Amount of Loan	Principal & Interest at 3rd Year	IDC	Accrued Interest	Repayment of Principal	Total Interest & Principal	Outstanding Balance
1	2725	3178					2725
2	5303	5727					8246
3	3472	3472					12378
Total	11500	12378					
4							13368
5							14437
6				1155	532	1687	13906
7				1112	574	1687	13331
8				1067	620	1687	12711
9				1017	670	1687	12041
10				963	723	1687	11318
11				905	781	1687	10537
12				843	844	1687	9693
13				775	911	1687	8782
14				703	984	1687	7797
15				624	1063	1687	6735
16				539	1148	1687	5587
17				447	1240	1687	4347
18				348	1339	1687	3008
19				241	1446	1687	1562
20				125	1562	1687	0
Total				10863	14437	25301	

Case I

Table 15-2-5 Profit and Loss Statement

(In Thousand Malaysian dollars)

Serial No. of Year	Depreciation Year	Operating Revenue	Depreciation	OM	Total	Profit	Financial IDC	Expense Accrued Interest	Net Profit
1									0
2									0
3									0
4	1	940	495	132	627	312		0	312
5	2	1120	495	132	627	493		0	493
6	3	1302	495	132	627	674		1155	-481
7	4	1499	495	132	627	871		1112	-241
8	5	1632	495	132	627	1004		1067	-62
9	6	1728	495	132	627	1101		1017	84
10	7	1795	495	132	627	1167		963	204
11	8	1846	495	132	627	1218		905	313
12	9	1889	495	132	627	1262		843	419
13	10	1920	495	132	627	1293		775	517
14	11	1946	495	132	627	1318		703	616
15	12	1978	495	132	627	1351		624	727
16	13	1978	495	132	627	1351		539	812
17	14	1978	495	132	627	1351		447	904
18	15	1978	495	132	627	1351		348	1003
19	16	1978	495	132	627	1351		241	1110
20	17	1978	495	132	627	1351		125	1226
21	18	1978	495	132	627	1351			1351
22	19	1978	495	132	627	1351			1351
23	20	1978	495	132	627	1351			1351
24	21	1978	495	132	627	1351			1351
25	22	1978	495	132	627	1351			1351
26	23	1978	495	132	627	1351			1351
27	24	1978	495	132	627	1351			1351
28	25	1978	495	132	627	1351			1351
Total		45307	12378	3306	15683	29624	0	10863	18760

Case I

Table 15-2-6 Cash Flow Sheet

(In Thousand Malaysian dollars)

Serial No. of Year	Depreciation Year	Cash Inflow			Total	Cash Outflow		Total	Balance	
		Investment	Net Profit	Depreciation		Construction Cost	Repayment of Prinicpal		Yearly	Cumulative
1		2725	0		2725	2725		2725	0	0
2		5303	0		5303	5303		5303	0	0
3		3472	0		3472	3472		3472	0	0
4	1		312	495	807			0	807	807
5	2		493	495	988			0	988	1796
6	3		-481	495	14		532	532	-517	1278
7	4		-241	495	254		574	574	-320	958
8	5		-62	495	433		620	620	-187	771
9	6		84	495	579		670	670	-91	680
10	7		204	495	699		723	723	-24	656
11	8		313	495	808		781	781	27	683
12	9		419	495	914		844	844	70	753
13	10		517	495	1012		911	911	101	854
14	11		616	495	1111		984	984	127	981
15	12		727	495	1222		1063	1063	159	1140
16	13		812	495	1307		1148	1148	159	1299
17	14		904	495	1399		1240	1240	159	1458
18	15		1003	495	1498		1339	1339	159	1617
19	16		1110	495	1605		1446	1446	159	1776
20	17		1226	495	1721		1562	1562	159	1935
21	18		1351	495	1846				1846	3781
22	19		1351	495	1846				1846	5626
23	20		1351	495	1846				1846	7472
24	21		1351	495	1846				1846	9318
25	22		1351	495	1846				1846	11163
26	23		1351	495	1846				1846	13009
27	24		1351	495	1846				1846	14855
28	25		1351	495	1846				1846	16701
Total		11500	18760	12378	42638	11500	14437	25937	16701	

Case I

Table 15-2-7 Debt-Service Ratio

(In Thousand Malaysian dollars)

Serial No. of Year	No. of Repayment Year	Operating Profit	Depreciation	Total	Cumulative (A)	Interest	Principal	Total	Cumulative (B)	Debt Service Ratio (A)/(B)
1										
2										
3										
4										
5										
6	1	1480	1485	2965	2965	1155	532	1687	1687	1.76
7	2	871	495	1366	4331	1112	574	1687	3373	1.28
8	3	1004	495	1499	5831	1067	620	1687	5060	1.15
9	4	1101	495	1596	7427	1017	670	1687	6747	1.10
10	5	1167	495	1663	9089	963	723	1687	8434	1.08
11	6	1218	495	1714	10803	905	781	1687	10120	1.07
12	7	1262	495	1757	12560	843	844	1687	11807	1.06
13	8	1293	495	1788	14348	775	911	1687	13494	1.06
14	9	1318	495	1813	16161	703	984	1687	15180	1.06
15	10	1351	495	1846	18007	624	1063	1687	16867	1.07
16	11	1351	495	1846	19852	539	1148	1687	18554	1.07
17	12	1351	495	1846	21698	447	1240	1687	20240	1.07
18	13	1351	495	1846	23544	348	1339	1687	21927	1.07
19	14	1351	495	1846	25390	241	1446	1687	23614	1.08
20	15	1351	495	1846	27235	125	1562	1687	25301	1.08
Total		18819	8417	27235	219241	10863	14437	25301		

Table 15-2-8 Profit and Loss Statement

Case II (Case where all funds are to be raised from Grants)

(In Thousand Malaysian dollars)

Serial No. of Year	Depreciation Year	Operating Revenue	Depreciation	Operating Expense		Profit (Net)
				OM	Total	
1						
2						
3						
4	1	940	460	132	592	347
5	2	1120	460	132	592	528
6	3	1302	460	132	592	709
7	4	1499	460	132	592	906
8	5	1632	460	132	592	1039
9	6	1728	460	132	592	1136
10	7	1795	460	132	592	1203
11	8	1846	460	132	592	1254
12	9	1889	460	132	592	1297
13	10	1920	460	132	592	1328
14	11	1946	460	132	592	1353
15	12	1978	460	132	592	1386
16	13	1978	460	132	592	1386
17	14	1978	460	132	592	1386
18	15	1978	460	132	592	1386
19	16	1978	460	132	592	1386
20	17	1978	460	132	592	1386
21	18	1978	460	132	592	1386
22	19	1978	460	132	592	1386
23	20	1978	460	132	592	1386
24	21	1978	460	132	592	1386
25	22	1978	460	132	592	1386
26	23	1978	460	132	592	1386
27	24	1978	460	132	592	1386
28	25	1978	460	132	592	1386
Total		45307	11500	3306	14806	30501

Table 15-2-9 Cash Flow Sheet

Case II (Case where All Funds are to be Raised from Grants)

(In Thousand Malaysian dollars)

Serial No. of Year	Depreciation Year	Cash Inflow			Total	Cash Outflow	Balance
		Investment	Net Profit	Depreciation		Construction Cost	Yearly
1		2725			2725	2725	0
2		5303			5303	5303	0
3		3472			3472	3472	0
4	1		347	460	807		807
5	2		528	460	988		988
6	3		709	460	1169		1169
7	4		906	460	1366		1366
8	5		1039	460	1499		1499
9	6		1136	460	1596		1596
10	7		1203	460	1663		1663
11	8		1254	460	1714		1714
12	9		1297	460	1757		1757
13	10		1328	460	1788		1788
14	11		1353	460	1813		1813
15	12		1386	460	1846		1846
16	13		1386	460	1846		1846
17	14		1386	460	1846		1846
18	15		1386	460	1846		1846
19	16		1386	460	1846		1846
20	17		1386	460	1846		1846
21	18		1386	460	1846		1846
22	19		1386	460	1846		1846
23	20		1386	460	1846		1846
24	21		1386	460	1846		1846
25	22		1386	460	1846		1846
26	23		1386	460	1846		1846
27	24		1386	460	1846		1846
28	25		1386	460	1846		1846
Total		11500	30501	11500	53501	11500	42001

15.2.5 Average Generating Cost over Whole Operating Years

(1) Case I where all Construction Costs are to be Financed by Loan

Unit generating cost depends upon funding conditions of construction costs. Based on the total of energy generated and total costs of depreciation, accrued interest and OM cost over 25 operating years, the average generating cost per kWh has been obtained to be M$0.122 as shown below. The amount of depreciation and accrued interest has been calculated according to the loan conditions stated in **15.2.3.**

		(10^3 M$)
Depreciation	:	12,378
Accrued Interest	:	10,863
OM Cost	:	3,306
Total		26,547

Total Energy Generated
Over 25 years : 216,965 MWh (See **Table 15-1-2**)

Average Unit Generating
Cost for 25 years : 0.122 M$/kWh

(2) Case II where all Construction Costs are to be Funded by Grants from the Federal Government

Different from Case I, payment of interest is not necessary, and the average unit generating cost will be M$0.068 as shown below.

		(10^3 M$)
Depreciation	:	11,500
OM Cost	:	3,306
Total		14,806

Total Energy Generated
Over 25 years : 216,965 MWh (See **Table 15-1-2**)

Average Unit Generating
Cost for 25 years : 0.068 M$/kWh

(3) Average Generating Cost by Change in Annual Interest Rate for Case I

The following are the average unit generating costs in case annual interest rate only of the loan conditions given in **15.2.3** above is changed.

Annual Interest Rate (%)	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
Generating Cost (M$/kWh)	0.098	0.102	0.106	0.110	0.114	0.118	0.122	0.127	0.132

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