ANNEX - K

PRELIMINARY DESIGN OF MORAGAHAKANDA DAM

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K.1 SUITABLE LAYOUT OF MAIN STRUCTURES

As described in the ANNEX-J, the optimum scale of dam and power station was formulated to have the reservoir H.W.L at EL. 195 m and an installed capacity of 26 MW. A comparative study was made to seek the most suitable layout of the dams and other main structures according to the following conditions and criteria:

- The selection of the most suitable layout was principally based on the construction cost minimization criteria,
- Alternative layouts were kept to have H.W.L at EL. 195 m and installed capacity of 26 MW,
- Alternative layouts were prepared in conformity with the design criteria as mentioned in Note III.1. The work quantities were calculated based on these layouts design, and
- The unit prices for cost estimate are referred to in ANNEX-L.

The project has three dams, consisting of the main dam, the first saddle dam and the second saddle dam. Prior to the overall comparative study of the dam, a comparative study for the second saddle dam was made to obtain the most suitable dam axis due to the following backgrounds: The UNDP FAO Master Plan has proposed to have the dam layout, consisting of concrete gravity type for the main dam providing the spillway in the middle part, rockfill type for the first saddle dam and earthfill type for the second saddle dam. In this plan, the saddle dam has the unfavourable alignment of dam axis protruding toward downstream. In addition, rock materials were found in a close distance for the damsite. In these new findings, the review for dam axis and type was required.

In order to select the most favourable dam axis and suitable type, three alternative lines including the UNDP/FAO proposal as shown in DWG.Pl.D-01 were compared as the first step. These alternatives tentatively took rockfill type dam. As the further step, a comparative study on dam type was between rockfill and earthfill types for the most favourable dam axis obtained in the first step.

Table K.1.1 shows the results of the comparative study as the first step. As seen in this table, the least cost alternative was given to Alternative B, in which the dam axis is laid on 200m downstream of the UNDP/FAO proposal. Further, the result of the comparative study on dam type revealed that the rockfill type would be more economical than earthfill type in the second saddle dam, as shown in Table K.1.1.

For formulation of the most suitable layout and other main structures, the following four alternative layouts were selected:

(1) Alternative I (Refer to Pl.D-02)

This alternative layout was proposed by the UNDP/FAO. The dams consist of the main dam of concrete gravity type providing the spillway, and the first and second saddle dams of rockfill type. The power station was laid out at the foot of the main dam. The construction was planned to commence on the right bank by coffering the Amban Ganga in the earlier stage and then on the left bank after provision for bypassing the river on the right bank would be ready.

(2) Alternative II (Refer to Pl.D-03)

This alternative comprises the main dam of rockfill type, the first saddle dam of concrete gravity type arranging spillway, the second saddle dam of rockfill type and power station located at the foot of the first saddle dam. The diversion canal is excavated along the valley of the first saddle dam for construction. By this diversion cannel, the construction will become far easier than that of Alternative I in view of the followings :

- The construction of dam foundation can be made in dry and spacious conditions.
- Uncertainty of water tightness in river deposit involved in coffering of the Amban Ganga in Alternative I will be dissolved or the countermeasure can be taken for easier.
- Adjustment against delay in the works and quality control will be made easier and much quicker than those for Alternative I.

Further, there is another merit that countermeasure against unexpected seepage through dam foundation would be taken easier in concrete dam than in rockfill dam, even if it would happen through limestone strata on the left bank of the first saddle dam.

(3) Alternative III (Refer to Pl.D-04)

All dams are of rockfill type, and the spilling way will be constructed on the ridge between the main and first saddle dams. Two tunnels with 12 m diameter were planned on the right bank for river diversion and one of them will be utilized as the waterway to the power station.

(4) Alternative IV (Refer to Pl.D-05)

This alternative has the same dam layout as Alternative III, consisting of three rockfill dams, but the axis of the main dam was moved up and the first saddle dam was moved down. The spillway will be provided on the hill slope between the main and first saddle dams. The diversion tunnels are driven into the ridge on the left bank of the main dam and the power station is located on the left bank downstream of the main dam utilizing one diversion tunnel. The layout entails shorter tunnels than Alternative and consequently smaller construction cost.

The result of comparison among the four Alternatives is tabulated in Table K.1.2, which indicates that Alternative II is the least cost alternative.

K.2 DESCRIPTION OF RESERVOIR, DAM AND POWER FACILITIES

As mentioned in the preceding section K.1, the reservoir high water and low water levels were set at EL.195.0 m and EL.170.0 m respectively. The reservoir surface area at H.W.L. will be 39.1 km^2. The reservoir will provide an effective storage capacity of 686 MCM with a 25 m drawdown between H.W.L. and L.W.L. The dead storage below L.W.L. will be 217 MCM, which will be enough to store sedimentation flow drown from the upstream reachers for 100 years period. The reservoir will allow a surcharge of 0.6 m above H.W.L. with 22 MCM for flood control. When the design flood with 4,650 m^3/s of peak discharge inflows into the reservoir, the outflow peak discharge from the spillway will be reduced to 3,400 m^3/s by the above surcharge according to the flood routine calculation.

The structures of the project consists of the civil structures such as the main, first saddle and second saddle dams, spillway, power intake, penstock line and powerhouse with outdoor switchyard, hydro-mechanical structures of gates and penstock, generating equipment and transmission line.

(1) Moragahakanda Dams

The main dam to be constructed on the Amban Ganga is of centre-cored rockfill type with 72 m in height and 490 m in crest length. The dam crest was set at EL. 199 m with 4 m freeboard above H.W.L. and the crest width was taken at 10 m. The slope of embankment was designed to be 1:1.8 for upstream surface and 1:1.6 for downstream surface. The total embankment volume was estimated at 2.43 MCM.

The first saddle was designed to be of concrete gravity type having 62 m in height and 396 m in crest length. The dam crest with 6 m in crest width is placed at EL. 197.5 m having 2.5 m freeboard above H.W.L. The dam has the surface slope being 1:0.05 in upstream side and 1:0.75 in downstream side. The total embankment volume is 376,000 m^3. The spillway, river outlet facilities and power facilities are provided in this dam.

The second saddle dam is of centre-cored rockfill type, having 42 m in height and 490 m in crest length. The dam crest is at EL. 199 m and 10 m in length. The slopes of upstream and downstream surfaces are 1:1.8 and 1:1.6 respectively.

The spillway is located in the middle portion of the first saddle dam in the direction of the diversion canal. The discharge capacity is 3,400 m^3/s at 0.6 m surcharge water level above H.W.L. against the peak flood inflow of 4,650 m^3 with 1.2 times of 200 years probable flood as mentioned in the above paragraph. Four sets of radial gate with 8 m in height and 17.5 m in clear span are installed on the overflow crest at EL. 187 m. Each gate is operated by a motor-driven hoist to be installed at the top of concrete pier. The chuteway is placed on the downstream face of the dam guided by concrete side walls. The stilling basin is provided downstream of the dam, in order to dissipate energy of jet flow.

Three sets of river outlet facilities are furnished in the spillway section of the first saddle dam. The total discharge capacity through the outlets is more than 56.6 m /s at L.W.L. These facilities was designed to be operated when operation of the power station is shut down or when water release to the downstream reach is required more than the maximum powerplant discharge. Each set has a fixed trashrack with 3.5 m square at the inlet, a ring follower valve and a jet flow valve with 1.5 m in diameter. The center line of the outlet was set at EL. 165 m. A steel pipe of 1.5 m inside diameter is embedded in the dam. The operation is made by a motor driven hydraulic system to be installed in a gallery in the dam body.

The geology in the dam site is classified principally into gnessic rock group and calcareous rock group. The gneissic rock group is composed of quartz-feldspar gneiss, charnockite,granulite etc., and the calcareous rock group is composed of crystalline limestone and calc gneiss. The boundary between them is sometimes not clearly distinguishable because of gradual and continuous variations. There is, however, no special geological problem in the dam site except possibility of cavity or opening in the calcareous rock, since geological conditions show fairly hard, solid and water tight in fresh rock under the overburden of 6 m to 12 m.

(2) Power Facilities

Two sets of power intake are provided on the upstream face of the non-overflow section of the dam located on the left side of the spillway. The maximum discharge for each intake was designed to be 56.6 m3/s. A fixed steel trashrack is installed at the bell-mouth inlet, having 6 m high and 6 m wide on each intake. The center line of the intake was set at EL. 164 m.

Two lanes of steel penstock are installed and the inside diameter of penstock pipe was determined at 3.9 m in the upper portion and to be reduced to 3.2 m at the powerhouse, according to the economic analysis. The total length of each penstock is 87 m.

The powerhouse is located about 84 m downstream from the first saddle dam. It is of reinforced concrete, having 32 m in height, 27.8 m in width and 41 m in length. The space of powerhouse is provided to accommodate two units of generating equipment.

A complete set of generating equipment consists of vertical sheft Francis turbine of 26 MW at rated head of 54.8 m and maximum discharge of 56.6 m^3/s, an alternating generator of 30 MVA, control gears and auxiliary equipment. One unit of main transformer of 30 MVA is installed behind the powerhouse and switchgears are equipped on the outdoor switchyard.

The tailrace channel is located adjacent to the stilling basin and protected by a guide wall against from violent flood flow protruding from the stilling basin. Two sets of roller gate with 3.5 m in height and 3.6 m in width are provided at the end of draft

tube and operated by a gantry crane to be installed on the platform in front of the powerhouse.

The layouts, plan and sections of the structures are exhibited in Plates No. 7 to 15.

A 132 kV single circuit transmission line is constructed between the Moragahakanda power station and the junction with the existing Bowatenne-Ukuwela line at the Bowatenna power station for distance of 16 km. The transmission line route is shown in Plate No. 6.

Note : Design Criteria of Dams for Alternative Study

(1) Freeboard:

The following formula are applied, and the bigger is taken as the freeboard:

$H1 = hw + he + ha + hi$, or
$H2 = hw + ha + hi + \Delta h$

where, H1, H2 : Freeboard above normal high water level
hw : Height of wind due to wind, including up-rushing on slope of dam
he : Height of wind due to earthquake
ha : Allowance against mis-operation of spillway gates (usually 0.5 m)
hi : Allowance for type of dam (1.0 m for fill type and nil for concrete dam)
Δh : Surcharge from high water level against design flood

In this project, the following are adopted in the calculation:

Wind velocity (10-min average) = 20 m/s
Fetch dam = 9 km
Seismic cofficient = 0.05

(2) Design Flood:

For spillway design : 1.2 times of 200-year probable flood both in peak discharge (4,654 m^3/sec) and total run-off of 348 MCM.

For river diversion during construction : 2,500 m^3/sec of 20-year probable flood during flood season and 570 m^3/sec (recorded max) in dry season from April to October.

(3) Excavation line for foundation of dams: to be drawn according to geological profile.

(4) Embankment materials: Borrow area and rock quarry as shown in the drawing. Engineering properties of the materials for stability analysis of dams are as follows:

Classification	Specific Gravity	Water Content	Density				Cohesion Consolidation & Undrained	Internal Friction Angle
			Dry	Wet	Satu-rated	Sub-merged		
Unit	-	%	t/m^3	t/m^3	t/m^3	t/m^3	t/m^2	deg.
Impervious material	2.66	21.3	1.61	1.95	2.00	1.00	2.0	17
Filter material	2.62	6.0	1.80	1.91	2.11	1.11	-	30
Rock material	2.70	2.0	1.80	1.84	2.13	1.13	-	40

(5) Stability analysis of dams: In the comparative study stage, section of dams is examined as follows:

i) Stability of upstream slope of fill dams shall be of the safety factor not less than 1.2 against rapid drawdown of reservoir surface and the normal water-level plus earthquake movement, and downstream slope of fill dams against the normal waterlevel plus earthquake,

ii) Section of concrete gravity dam shall be decided in a condition that no tensile stress take place against the normal high water plus earthquake and the flood water-level.

TABLES

Table K.1.1 COMPARATIVE STUDY OF SECOND SADDLE DAM

Item	Alternative A	Alternative B	Alternative C
Crest El. (m)	199	199	199
Crest Width (m)	10	10	10
Dam Height (m)	42	41	29
Crest Length (m)	320	490	630
Work Quantities			
Embankment excavation (m3)	181,500	177,100	243,000
Embankment (m3)	498,700	430,600	530,500
Core zone	141,800	139,300	144,800
Filter zone	50,400	50,700	72,100
Rock zone	306,500	240,600	313,600
Construction Cost (US$ 103) L1			
Foundation excavation	889	868	1,191
Embankment	3,641	3,143	3,873
Total	4,530	4,011	5,064

Remark:

L: Unit price is as follows:

US$4.9/m3 for foundation
US$7.3/m3 for embankment

Table K.1.2 COST COMPARISON FOR ALTERNATIVE LAYOUTS OF MORAGAHAKANDA DAMS

Work Items	Unit Price (US$)	Alternative I Qty.	Alternative I Amount	Alternative II Qty.	Alternative II Amount	Alternative III Qty.	Alternative III Amount	Alterative IV Qty.	Alterative IV Amount	Remarks
1. Main Dam										In this table, the following items are excluded because of small differences in alternatives. (1) Intake, penstock, powerhouse and generating equipment (2) Grouting for foundation treatment (3) General items such as access road, power supply system, etc.
Foundation excavation	4.9/m3	365,100	1,789	578,100	2,860	1,438,100	7,047	1,650,000	8,085	
Embankment	7.8/m3	-	-	2,429,100	18,893	2,429,100	18,893	2,793,000	21,785	
Dam concrete	103.8/m3	645,000	66,951	-	-	133,600	13,868	129,000	13,390	
Grouting		L.S.	4,350	L.S.	2,955	L.S.	2,955	L.S.	2,880	
Sub-total			73,090		24,708		42,763		46,140	
2. First Saddle Dam										
Foundation excavation	6.6/m3	328,300	2,167	306,800	1,631	328,300	2,167	336,500	2,221	
Embankment	7.3/m3	1,342,400	9,800	-	-	1,342,400	9,800	1,422,900	10,387	
Dam concrete	103.8/m3	-	-	427,100	44,333	-	-	-	-	
Grouting		L.S.	2,105	L.S.	2,421	L.S.	2,105	L.S.	2,230	
Sub-total			14,072		48,385		14,072		14,838	
3. Second saddle dam										
Foundation excavation	4.9/m3	177,100	874	177,100	874	177,100	874	177,100	874	
Embankment	7.3/m3	430,600	3,101	430,600	3,101	430,600	3,101	430,600	3,101	
Grouting		L.S.	3,126	L.S.	3,126	L.S.	3,126	L.S.	3,126	
Sub-total			7,101		7,101		7,101		7,101	
4. Coffering										
Foundation excavation	4.9/m3	-	-	303,200	1,486	303,200	1,486	270,000	1,323	
Embankment	4.0/m3	-	-	478,900	1,916	478,900	1,916	521,300	2,085	
Primary cofferdam	3.5/m3	-	-	85,500	299	85,500	299	85,500	299	
Steel sheet piling	800/ton	1,630	1,304	320	256	320	256	320	256	
Sub-total			1,304		3,957		3,957		3,963	
5. River diversion										
Open excavation	3.3/m3	359,000	1,185	635,900	2,098	-	-	-	-	
Tunnel works	15,000/ton	-	-	-	-	1,300	19,500	1,300	19,500	
Sub-total			1,185		2,098		19,500		19,500	
6. Surge tank										
Excavation	4.9/m3	-	-	-	-	20,400	100	20,400	100	
Concrete	166.6/m3	-	-	-	-	5,200	866	5,200	866	
Sub-total			-		-		966		966	
Total			96,752		86,249		88,359		92,508	

ANNEX - L

CONSTRUCTION PLAN AND COST ESTIMATE

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CONSTRUCTION PLAN AND COST ESTIMATE

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L.1 CONSTRUCTION PLAN AND TIME SCHEDULE

L.1.1 Implementation Schedule and Mode of Construction

The detailed survey and design as well as preparation of tender documents will be commenced in 1989 as soon as the financing arrangement is made. The time required for implementation of the whole project is estimated to be 7 years starting from 1989 through 1995 as shown below:

Stage	*Schedule*	*Period*
Pre-construction Activities		
(1) Financial arrangements	1988-1989	One (1) year
(2) Detailed survey and design	1989-1990	One (1) year
(3) Tendering and contract	1989-1990	Six (6) months
Construction		
(4) Dam & power station	1990-1994	Four (4) years
(5) Agricultural development		
- Rehabilitation of the irrigation	1990-1994	Four (4) years
- Main and branch canals of new irrigation system	1990-1994	Four (4) years
- Downstream development	1990-1995	Five (5) years
- Social infrastructure	1990-1995	Five (5) years
Operation & Maintenance		
(7) O&M for the completed facilities	1994 onward	-

The MASL will be the executing agency for implemenation of the Project. The construction works will be conducted by contracts through the international and local competitive tenders in compliance with the Government regulations or guidelines. Required fund for the implementation of the Project will be covered by the national budget and supporting loan from donate country/ies or agency/ies. The construction works will be conducted by the selected contractor/s divided into the following seven (7) lots.

International tender basis

Lot No.1. Dam (main dam, 1st and 2nd saddle dams), spillway, powerhouse and switchyard.

Lot No.2. Metal works. Supply, installation and testing for gates, penstock, valves and accessories.

Lot No.3. Generating equipment. Supply, installation and testing for turbine, generator and auxiliaries.

Lot No.4. Construction of newland. Irrigation and drainage canals with related structures and headworks for system A/D including on-farm works.

Local tender basis

Lot No.5. Construction of transmission line. Supply, erection and testing.

Lot No.6. Rehabilitation works for existing irrigation facilities including on-farm works.

Lot No.7. Social infastructure

L.1.2 Basic Considerations

In studying the construction plan and schedule, the following basic conditions and assumptions are considered:

- Construction will be carried out by contractor/s in modern mechanized construction method within the planned period stipulated in the implementation schedule.

- Conventional method and type of equipment will be applied principally, giving consideration to the local condition.

- Annual workable day is estimated at 200 days as follows excluding core embankment of main and 2nd saddle dams which is assumed to be 150 days.

Sunday and national holidays	:	75 days
Work suspend due to rainfall	:	90 days
Total	:	165 days

- Hourly production rate of equipment is estimated to meet with the site conditions according to the following swell and shrinkage factors of materials:

Material	Loose/Bank	Embank/Bank
Common	1.25	0.88
Sand and gravel	1.15	1.02
Rock	1.60	1.15

Production rate of major equipment is shown in Table L.1.1.

L.1.3 Preparatory Works

Prior to the commencement of main civil construction works, substantial preparatory works will be required to carried out. Major items for those works are considered as follows:

- Dam and power station site: Access and construction road including bridges, temporary buildings, power and water supply system and communication system.
- Irrigation development site: Access and construction road including bridges, temporary buildings and communication system.

Brief explanation is given hereunder.

(1) Access to the Site

The Katunayake International Airport situated at about 25 km in Northern part of Colombo is access to the project site by air.

The Colombo port will be utilized mainly for handling of the cargoes required for implementation of the project. The port has four (4) berths with the following dimensions:

Berth	Length (m)	Draught (m)	Crane Facility
QeQ4/1	150	11.0	30t x 1 set
QeQ5/1	275	12.0	35.5t x 2 sets
No. 1/2	300	12.0	35.5t x 2 sets
No. 2/2	332	13.0	35.5t x 2 sets

Note: /1 : Queen Elizabeth Quay
/2 : New Container Terminal

The port has also loading and unloading equipment. Major one is listed as follows.

Forklift	:	2.5t to 42t class, 43 units
Mobile crane	:	35t class, 14 units
Trailer	:	20t to 30t class, 103 units
Prime movers	:	36 units

Existing roads are available to the site. The following route is recommendable to access to the site.

Colombo - (Highway A1) - Ambepussa - (A6) - Kurunegala - (A6)
- Dambulla - (A6) - Habarana - Irrigation site
_ (A9) - Naula - (Rural) - Dam site

Distance is about 200 km between Colombo and dam site by the route mentioned above.

The route, A1, A6 and A9, are maintained fairly by the Ministry of Highways. No improvement or protection for those routes will be required for implementation of the project. The rural road branched-off from Naula (A9) to the dam site will be required to improve in about 2 to 3 km excluding relocation portion of that rural road.

(2) Construction Road

Haul road is required to be constructed newly at the dam site, especially for the rockfill dam construction. Total length of new haul road is estimated at about 10.0 km in total for the transportation of embankment materials and others as follows:

Quarry (QI)	- Dam site	:	2.0 km
Quarry (QII)	- Dam site	:	1.0 km
Borrow area	- Dam site	:	1.0 km
Sand and gravel borrow	- Dam site	:	1.0 km
Others		:	5.0 km
Total			10.0 km

Existing rural roads will be used upon improvement for the construction works of irrigation development site of 62,200 ha. Existing bridges will also be protected.

(3) Temporary Buildings and Yards

Temporary buildings and yards are required to provide at the project site. Those buildings will be provided at dam site and irrigation development site separately. The area required for buildings and yard are estimated at about 6,600 m^2 and 55,000 m^2 m in total as classified below.

Area for Temporary Buildings & Yard

Unit: m^2

Description	Dam Site/1		Irrigation Development Site/2	
	Building	Yard	Building	Yard
1. Office for contractor	200/3	500	200/4	500
2. Quarter for contractor	400/5	800	300/6	600
3. Material warehouse	500	1,000	500	1,000
4. Cement warehouse	500	1,000	200	400
5. Motorpool & repair shop	300	5,000	200	4,000
6. Batcher plant w/stockyard	-	10,000	-	-
7. Crushing plant w/stockyard	-	20,000	-	-
8. Laboratory	50	150	30	100
9. Others	150	750	150	750
Total	2,100 m^2	39,200 m^2	1,580 m^2	7,350 m^2

Note: /1 : Proposed area is left bank terrace between damsite and Elahera
/2 : Proposed area is in and around Migaswewa village in System D located near the project center
/3 : Office for Contractor Lot 1,2,3 & 5
/4 : Office for Contractor Lot 4,5,6 & 7
/5 : Quarter for Contractor Lot 1
/6 : Quarter for Contractor Lot 4 & 6

(4) Power Supply System

The electrical power required for the construction usage is estimated as follows:

Unit: kW

Description	Dam Site	Irrigation Development Site
(1) Office	50	50
(2) Quarter	100	100
(3) Repair shop, Motorpool	50	50
(4) Batcher plant	100	-
(5) Crushing plant	800	-
(6) Gravity dam concrete placing facility	400	-
(7) Job site lighting	50	100
(8) Cooling plant	200	-
(9) Others	250	100
Total	2,000	400

An existing 33 kV power line by the CEB (Ceylon Electricity Board) runs at the dam site along the road which branched-off from the Bowatenna hydro-power station. It is planned that the required electrical power for construction use at the dam site will be supplied branching from this line. A new distribution line to the dam site is estimated at about 0.5 km. However, due to frequent power cut, emergency diesel generators might be essential for the important places. Movable type diesel engine generators will be provided for the power supply of irrigation development construction site.

(5) Communication System

The Government's telecommunication department are serving the public telephone lines in the major town or village in the project area. Those lines will be utilized for the external communication upon extension of the line including telephone exchanger system. Wireless handy talky will also be provided for the internal communication in the project area.

(6) Water Supply System

Required water for construction usage will be supplied by pump-up system with head tank and distribution pipes from the close river to the respective work site. The source will be the Amban Ganga for the construction works of dams and power-station. Deepwell will provide at respective camp site for the supply living water of offices and quarters.

L.1.4 Construction Plan

(1) Dam

(a) General

Major civil work on this scheme is construction of 3 dams of which one main dam and two saddle dams as featured below.

Dam	Type	Height (m)	Embankment or Concrete Volume in Total (m^3)
- Main dam	Centre core rockfill	72.0	2,450,000
- 1st saddle dam	Concrete gravity	62.5	376,000
- 2nd saddle dam	Center-core rockfill	42.0	430,000

It will be basic conception that the construction of rockfill dams and gravity dam is conducted concurrently after diversion of the Amban Ganga.The critical path work will be the construction of the first saddle dam on this scheme.

(b) River Diversion

A diversion channel, diversion conduits and main coffer dam are planned to be constructed for the river diversion of 3,000 m^3/s peak capacity.

The diversion channel of about 1,000 m long is constructed in the 1st saddle dam section, and 5 sets of diversion conduits are also installed in the 1st saddle dam with the bottom El. of 137.5 to 143.5 m. Excavation of about 0.6 x 10^6 m^3 in the diversion channel will be carried out in the 1st dry season following to the foundation excavation of the 1st saddle dam, using 30 tons class bulldozer with ripper, 3.0 m^3 class dozer shovel and wheel loader and 30 tons class dump truck.

The diversion conduits are embedding in main body of massive concrete of 1st saddle dam. The main cofferdam is constructed within 2 months following to the primary cofferdam construction, using the excavated materials at main dam excluding the earthfill material which will be hauled from the borrow pit. Dump truck of 30 tons class will be used for the embankment of main cofferdams. The diversion channel and primary and main cofferdam will be constructed within one dry season of 1st year of construction. The Amban Ganga will divert to the channel following to completion of the primary cofferdam and the diversion channel in May 1991.

(c) Main dam

The main dam is a center-core type rockfill dam with the crest length of 490 m at El. 199.0, 72.0 m high and the following embankment volume approximately.

Impervious core	:	720,000 m^3
Filter	:	190,000 m^3
Rock	:	1,540,000 m^3
		2,450,000 m^3

Major works required for the main dam construction are the foundation excavation of about 0.6 x 10^6 m^3, foundation treatment of about 17,000 m for grouting works and the embankment work mentioned above.

Foundation of the main dam consists of the gneissic rock group with cohesive strength more than 25 kg/cm^2.

All embankment materials, core, filter and rock, are obtainable in a close distance from the dam.

The impervious core material is available on a flat land of the left bank terrain in about 1.3 km downstream of the dam. The materials for filter and rock are planned to obtain at the quarry site (Q-I & -II) with the distance of about 1.0 to 2.0 km from the dam site. Proposed borrow pit and quarry sites are shown in Fig. L.1-1.

The foundation excavation will be carried out mainly by 30 tons class bulldozer with ripper, and blasting method will be applied where the zone is unrippable. A fleet for the excavation work will be shifted following to the diversion channel excavation.

Monthly progress is estimated at about 150 x 10^3 m^3. Excavated materials will be used as the embankment material for main cofferdam, 2nd saddle dam and others as far as possible.

The exploitation of quarries will be conducted by the bench cut method in about 3.0 m high for each bench.

The embankment work for the impervious core will be controlled when the daily rainfall be more than 5 mm. Rock and filter embankments are planned to carried out throughout the year. Estimated yearly workable day is 150 and 200 days for core, filter and rock respectively. Hydraulic type crawler drill is planned for the drilling of blasting at the quarries. Loading at borrow pit and quarries will be 3.0 m^3 class dozer shovel and 5.0 m^3 class wheel loader respectively. Hauling work will be cerried out by 20 tons class dump truck for core materials and 30 tons class dump truck for filter and rock materials. Monthly standard progress is scheduled at 85 x 10^3 m^3 in bank measure for the main dam embankment work.

Grouting works of consolidation, blanket and curtain are planned to be carried out in the dam foundation. The blanket grout will be done at 5 m intervals with 5 m in depth under the core zone. Grout holes for curtain along the dam axis will 2 m in intervals and 30 m in depth. Grouting works will be conducted mostly advancing and in parallel with the dam embankment.

(d) 1st saddle dam

The 1st saddle dam is a concrete gravity dam of 376 x 10^3 m^3 in placement volume. This is the critical path work of the project. Spillway with four radial gates, power intake and river outlet facilities are equipped in this 1st saddle dam. Diversion conduits is embedded in the dam. The dam is 62.5 high and 396 m crest length at El. 197.5 m. A construction sequence for this dam construction is planned as shown in construction time schedule of Fig. L.1-2, and summarized as below.

Step	Works
(1)	Construction of temporary relocation for existing road at 2nd saddle dam site.
(2)	Foundation excavation of 1st saddle dam including the spillway portion.
(3)	Foundation treatment at the bottom portion of the dam.
(4)	Placement of the dam concrete until the bottom elevation of the river diversion conduits.
(5)	Installation of river diversion conduits
(6)	Re-start the placement of dam concrete, and continue to the crest of El. 197.5 m.

Foundation excavation of about 310 x 10^3 m^3 including the spillway portion is planned to carried out in advance of the excavation of diversion channel due to the critical path work by a fleet of equipment which will be 30 tons class bulldozer with ripper, 3.0 to 5.0 m^3 dozer shovel and wheel loader and 30 tons dump truck.

The dam concrete is planned to place using a movable jib crane with steel trestle girder due to the topographical condition and economical point of view. The placement period is scheduled at 41 months. Monthly average pour volume is estimated at 9,170 m^3, and maximum one will be approximately 13,700 m^3 including losses. The following plant will be selected as the major concreting facilities.

Jib Crane

Bucket capacity	:	3.0	m^3
Lifting capacity	:	9.0	t
Required unit	:	2	sets

Batcher Plant:

Production capacity	:	50-60	m^3/h
Mixer	:	0.8 m^3 x 3	units
Required unit	:	2	sets

A 30-ton truck crane will be applied for the concrete placement beyond the range of the jib crane.

A 250 t/h of crushing plant is planned for the production of concrete aggregates, as follows.

a)	Concrete volume, total	:	376,000	m^3
b)	Placement period	:	41	months
c)	Monthly pour volume in average	:	9,170	m^3/month

d)	Monthly pour volume in maximum (50% up of c))	:	13,700	m^3/month
e)	Daily average pour volume in the month for maximum pour (20 days per month is applied)	:	685	m^3/day
f)	Daily pour volume in maximum (30% up of e))	:	890	m^3/day
g)	Hourly pour volume in average (10 hours per day is applied)	:	89.0	m^3/h
h)	Aggregate, required per hour (2.1 t/m^3 is applied)	:	190	t/h

Considering the aggregates for other structures and plant loss, a 250 t/h capacity crushing plant will be selected.

Pipe cooling system will be applied for curing the poured concrete.

(e) 2nd Saddle Dam

The second saddle dam is a center-core type rockfill dam having 42.0 m high, 490 m of crest length at El. 199.0 with the following embankment volume:

Core	:	140,000 m^3
Filter	:	51,000 m^3
Rock	:	241,000 m^3
Total	:	432,000 m^3

Excavation, foundation treatment and embankment are major works required for this dam construction. Foundation of the second saddle dam consists of the gneissic rock and calcareous rock groups.

The sources of embankment materials for core, filter and rock are same to the main dam. While, the same method and equipment to the main dam works will be applied for the foundation excavation and treatment, embankment and other works required for the construction of the 2nd saddle dam.

It is scheduled that the construction of the 2nd saddle dam will conduct in later stage of construction period from the economical view point.

(2) Power Station

(a) Civil works

An above ground type powerhouse having about 1,150 m^2 of floor area is planned to be constructed in the left side toe of the 1st saddle dam closely to the spillway.

This power station is designed by 2 units of 26 MW of which one unit will be installed in the further stage (2nd stage). Major civil works is excavation and construction of substructure and superstructure.

Excavation in about 120 x 10^3 m^3 including outdoor switchyard will be carried out by 20 tons class bulldozer, 2 m^3 class dozer shovel and 15 tons class dump truck in a 4 month work period. Concrete placement in about 12,000 m^3 for substructure will be performed using 60 m^3/h class concrete pump car. Super-structure works will be done following to the completion of substructure works. Overhead travelling crane is scheduled to install in March 1993.

(b) Generating equipment

One unit of 26 MW vertical shaft francis turbine and 30.5 MVA generator are installed in the powerhouse. Other than the main generating equipment, auxiliaries such as overhead travelling crane of 120 tons capacity, storage batteries, power line carrier telephone are planned to be installed. One set of diesel engine generator of 150 kVA (120 kW) will also be installed for emergency power supply. Installation works of turbine and generator will be carried out using overhead crane mainly. Diesel generator, engine welder and truck crane will also be utilized for the installation works. It is planned to complete in the middle of 1994 for all the installation works of generating equipment.

(c) Transmission line

The proposed 16 km transmission line of 132 kV with single circuit is constructed between the Bowatenna and Moragahakanda power station. The line will be connected directly to the Bowatenna Ukuwela line near the Bowatenna power station. Required major works will be jungle clearing, tower foundation and erection and stringing.

Major equipment for the erection will be truck crane, winch and engine welder. Erection work is planned at 9 months.

(d) Hydromechanical works

The following hydromechanical works are required at for Moragahakanda dam and power station. Those are installed in the 1st saddle dam:

Items	Quantity	Total Weight
- Spillway gates & hoists	4 sets	560 t
- Gate, hoist & screen for diversion conduit	1 set	49 t
- Closing gate for diversion conduit	4 sets	5 t
- River outlet facilities (screen, ring follower valves, jet flow valves & steel pipes)	3 sets	268 t
- Intake gate, hoist & screen	2 sets	66 t
- Steel penstock	2 lanes	255 t
- Tailrace gates & hoists	2 sets	37 t
Total		1,290 t

The erection works will be conducted in about 12 months work period in later stage of construction period. Jib crane for dam concrete placement and truck cranes will be used for the installation of gates, valves, penstock and other facilities of metal works. Major plant and equipment required for the construction of dams and power station are tabulated in Table L.1.2.

(3) Irrigation Development

(a) General

The irrigation area of Moragahakanda agricultural development project has been worked out specified as below.

Scheme	Area (ha)	Scope of Works
- Existing area	40,000	Rehabilitation works including on-farm
- Moragahakanda Newland	13,900	Newland development including on-farm
- Associated scheme*1	8,300	(No work is requred)
Total	62,200	

Note : *1: The area which was proposed to be developed newly by other project finance, but the irrigation water will relase by the Moragahakanda reservoir.

The scope of works is briefed as follows:

Scope of Works	Work Items	Quantity	
- Rehabilitation including on-farm works for existing area	(1) Civil works		
	- Earthwork	1	lot
	- Canal lining	1	lot
	- Structures	56	nos.
	(2) On-farm works	38,100	ha
- Newland development	(1) Construction of new irrigation canals	145.2	km
	(2) Construction of new drainage canals	91.4	km
	(3) Headworks for System A/D	1	lot
	(4) Structures to new irrigation canal	400	nos.
	(5) On-farm works	13,900	ha

The construction works will be conducted concurrently both for rehabilitation works and newland development including the on-farm works.

It is noted that "land settlement" works are not treated in this ANNEX-L.

(b) Newland development

The proposed construction works for the Moragahakanda newland of 13,900 ha are tabulated as follows:

Summary of Work Quantity for Newland Development

Work Items	System D1	System D2	System A/D	Total
(1) New irrigation canal	58.2 km	52.8 km	34.2 km	145.2 km
(2) New drainage canal	44.1 km	32.5 km	14.8 km	91.4 km
(3) Related Structures				
1) Aqueduct	-	3 nos.	6 nos.	9 nos.
2) Cross drain	6 km	-	6 nos.	12 nos.
3) Drainage inlet	9 km	-	5 nos.	14 nos.
4) Bridge	56 km	45 nos.	40 nos.	141 nos.
5) Turnout	39 km	11 nos.	22 nos.	72 nos.
6) Division structure	4 km	4 nos.	4 nos.	12 nos.
7) Check gate	21 km	7 nos.	13 nos.	41 nos.
8) Water measuring device	6 km	5 nos.	3 nos.	14 nos.
9) Drop	24 km	2 nos.	6 nos.	32 nos.
10) Spillway and waterway	4 km	2 nos.	2 nos.	8 nos.
11) Washing and bathing place	18 km	16 nos.	11 nos.	45 nos.
(Sub-Total)	187 km	95 nos.	118 nos.	400 nos.
(4) Headworks*	-	-	1 lot	-
(5) On-farm works	9,100 ha	2,200 ha	2,600 ha	13,900 ha

Note * : Head works for Kalu Ganga Tank, Yodo Ela Anicut and Kalu Ganga Anicut.

Major work items with tonnage volume of work guantities for the newland development are excavation and embankment both for irrigation and drainage canals and construction of related structures to the irrigation canals with the following volume.

	Irrigation Canal	Draiange Canal	Total
Excavation*	1,340,000 m^3	2,920,000	4,260,000
Embankment	2,200,000 m^3	3,120,000	5,320,000
Related structures	400 nos.	-	-

Note * : including stripping of 400,000 m^3 and 340,000 m^3 for irrigation and drainage canal respectively.

It is planned that excavated materials are to be used as the embankment materials for the canals with minimization of hauling distance as far as possible. Shortage volume of embankment materials in about one (1) million m^3 in bank measure will be obtained from borrow in the project area.

The construction works for the canals, structures and on-farm (downstream development) works will be conducted concurrently throughout the year. However, those works will be accelerated in the dry season, especially for the on-farm works. Headworks will be carried out in dry season providing the temporary cofferdams during low water level.

Mechanized works will be applied for the new canals construction and related structures. The canals construction consists mainly of excavation and embankment will be conducted by using bulldozer, dozer shovel, backhoe, dump truck, motor scraper, tamping roller and vibration roller. Swamp type bulldozer will also be utilized for excavation of low contact pressure land. Backhoe and dump truck and portable type concrete mixer will be used mainly for the structure construction works. Diesel pile hammer will apply for driving the foundation piles. Headworks will be conducted in dry season providing cofferdams which will be constructed by sandbags with earth materials. On-farm works are planned to be conducted by combination of manual and equipment forces. Jungle clearing and rough levelling are performed by bulldozer, and construction of small ditch with structures are carried out by manual power.

(c) Rehabilitation works

The proposed rehabilitation area for existing irrigation facilities is 35,100 ha in Systems D1 and D2. Required works are categorized as rehabilitation of (i) canals (ii) structures (iii) anicut, and (iv) fields (facilities and on- farm) with the following scale:

(1)	Canals	
	1) Erahera-Minneriya Yoda Ela (9.7km - 31.4km)	21.7 km
	2) Kadula H.L.B main & branch (No.1) canals	16.4 km
	3) Parakrama samudra D1 main & branch canal	33.5 km
(2)	Structures	L.S.
	Bridges, measuring devices, gates & others	
(3)	Angameddilla Anicut (Amban Ganga)	L.S.
(4)	Fields (facilities & on-farm)	38,100 ha
	- Irrigation & drainage facilities, water measuring devices, farm roads and others	
	- On-farm works	

Major items for this rehabilitation works are concrete canal lining about 25,300 m^3 and on-farm works of 38,100 ha. Equipment power will be applied for those works concentratedly, with the following conception of construction execution:

Work Category	Method for Execution
- Earthwork	Manual power supported by light class equipment
- Canal lining	Equipments supported by manual power
- Structures	Manual power supported by light class equipment
- On-farm works	Equipment supported by manual

The equipment required for those works will be bulldozer, backhoe, dump truck, vibration roller and concrete mixer. Rehabilitation works will be conducted simultaneously upon diving the working crews in 4 years work period starting from 1990.

Major equipment required for the irrigation development works are tabulated in Table L.1.3.

L.1.5 Construction Time Schedule

The construction works of the project are scheduled to be implemented in 6.0 years (60 months) work period starting from 1990 upon execution of detailed survey and design including financial arrangement for the construction. Proposed schedule for each scheme are as follows.

Scheme	Schedule	Period
- Dam (main dam, 1st & 2nd saddle dam) saddle dam	1990-1994	4 year
- Irrigation development		
(1) Construction of newland including on-farm works	1990-1995	5 year
(2) Rehabilitation of existing facilities & on-farm	1990-1994	4 year
(3) Social infrastructure	1990-1995	5 year

The critical path work of this project will be 1st saddle dam construction as indicated in the construction time schedule in Fig. L.1-2. The important points of construction activities are;

i) issuance of engineer's order to commence in May 1990.
ii) divert of Amban Ganga to the diversion channel in May 1991.
iii) to start impounding the reservoir water in March 1994.
iv) to carried out dry and wet test for generating equipment in middle 1994.
v) to complete all the works for the dams, power station, newland construction and rehabilitation works in the end of September 1994 excluding the social infrastructure.

Construction time schedule is proposed as shown in Fig. L.1-2.

L.2 COST ESTIMATE

L.2.1 General

At the feasibility design stage in 1979, the financial cost of the Moragahakanda Agricultural Development Project was worked out as follows with the exchange rates of 1 US$ = 15 Rupees = 195 Yen.

Scheme	F.C. (10^6US$)	L.C (10^6Rs.)	Equiv. (10^6US$)
- Moragahakanda dam and powerstation 26 MW	144.4	551.8	181.2
- Irrigation development 62,200 ha	47.2	1,060.1	117.9
Total	191.6	1,611.9	299.1
(Billion J. Yen Equivalent)			(58.3)

The construction cost is reviewed and brought into up to date in this chapter on the basis of the current cost data.

L.2.2 Basis of Estimate

The following conditions and assumptions are applied for the review and updating the construction cost of the project.

1. Price level:February, 1988

2. Exchange rate : 1 US$ = Rs. 30.5 = ¥140.0

3. Currency for estimate:The construction cost is estimated divided into the foreign currency component and local currency component according to the origin of construction plant, equipment and materials which will be utilized the respective works. The foreign and local currencies are expressed in US Dollar and Sri Lankan Rupees respectively. The foreign and local currency components include the following cost itmes.

   Foreign currency component

   - Depreciation and spare parts costs for imported plant and equipment
   - Cost of imported materials and foreign portion of locally producted materials
   - Cost of foreign labours
   - Cost of engineering services for foreing consultant

   Local currency component

   - Cost of local labours

- Cost of local materials
- Maintenance, repairing and administration cost of construction plant and equipment
- Inalnd trasnsportation cost
- Cost of land acquisition and compensation cost
- Administration cost for executive body of the Government
- Local portion of engineering services

4. Rate of price escalation : Annual price escalation rate is assumed to be 8% for local currency portion. No escalation is considered for foreign currency portion.

5. Construction works will be performed by the contract system through the competitive tender.

6. Estimate of construction cost:

(1) Constitution of construction cost is as follows.

a) Direct construction cost (contract cost)
- Moragahakanda dam and powerstation
- Downstream irrigation development

b) Land acquisition and compensation cost

c) Government's Administration cost

d) Engineering services cost

e) Contingency
- Physical contingency
- Price contigency

(2) Direct construction cost for civil works

The direct construction cost for civil works is estimated by unit cost basis multiplied by work quantities. Table L.2.5 shows the priced bill of quantities of the construction works required for this Project. The unit cost of each work item consists of the price of construction materials, equipment, labour wages and contractor's overhead and profit as explained below.

1) Labour cost

The labour cost is assumed to be two currency components of foreign and local currency for specialized technicians from abroad and other labours respectively. The labour rates in each classes are shown in Table L.2.10. The labour wages include labour's fringe benefits.

The following employee's insurance area incorporated in the labour rates.

EPF (Employees provident fund)	:	15%
ETF (Employees trust fund)	:	13%
BTT (Business on tax turnover)	:	3%

2) Material cost

Prices of construction materials available in local market were canveassed in Colombo in February 1988. These prices are counted into the foreign and local currency component considering their usage of imported raw material, cost of production facilities and its imported amount as a secondary indirect foreign currency. The unit price of materials in site delivery basis with tits component of currency is tabulated in Table L.2.11.

3) Equipment cost

Equipment prices are based on the currency market price in Japan. Hourly equipment cost is estimated as shown in Table L.2.12.

4) Contractor's indirect cost

Contractor's expenses are taken account by including them propotionately in the unit prices. It is assumed to be 25% of direct cost. The unit cost for major work items are shown in Table L.2.9.

(3) Electro-mechanical works

Cost estimate of electro-mechanical works is based on past tendered record of similar project with considerations made on locality of this project.

(4) Indirect cost

1) Land acquisition and compensation cost

The cost of right of way and compensation is estimated on the basis of the prevailing government expropriation cost for the land, buildings and other private properties, as shown in Table L.2.6.

2) Administration cost

An allowance of 5 percent of the total estimated direct cost is provided for the government administration cost of the project.

3) Engineering services cost

The cost of the Engineering services for implementation of the project is estimated as 8 percent of the total estimated direct cost.

(5) Cost for social infrastructure

This cost is estimated by unit cost basis as tabulated in Table L.2.13.

L.2.3 Financial Cost

The financial cost on the Project was worked out at US$ equivalent 310 million including 66 percent of foreign currency portion as tabulated below.

Unit: million

	Cost Items	F.C Portion US$			L.C Portion Rs.			Total US$ Equivalent
		Dam & Power	Irriga-tion	Total	Dam & Power	Irriga-tion	Total	
(1)	Direct cost	96	67	163	732	854	1,586	215
(2)	Land acquisition	-	-	-	61	-	61	2
(3)	Government administration	-	-	-	183	153	336	11
(4)	E/services	9	6	15	31	61	92	18
	Sub-total	105	73	178	1,007	1,068	2,075	246
(5)	Physical contingency	16	11	27	150	160	310	37
	Total	121	84	205	1,157	1,228	2,385	283
(6)	Price contingency	-	-	-	367	473	840	27
	Grand Total	121	84	205	1,524	1,701	3,225	310

Tables L.2.1, L.2.2 and L.2.3 show the summary of financial cost for each scheme. Priced bill of quantities is shown in Table L.2.5.

L.2.4 Disbursement Schedule

The annual disbursement of investment cost was estimated on the basis of the implementation schedule as shown in Table L.2.4.

L.2.5 Operation and Maintenance Cost

Annual operation and maintenance costs are comprised of the staff's salaries for project administration and water control staffs, the material and labour costs for repair and maintenance of facilities and equipment, and the running cost of project facilities. The O&M cost for the Project are shown in Table L.2.7 and summarized as follows:

Scheme	Annual O&M Cost
Dam	400 x 10^3 US$
Power	340 x 10^3 US$
Irrigation	1,320 x 10^3 US$
Total	2,060 x 10^3 US$

Required O&M equipment is estimated as shown in Table L.2.8.

L.2.6 Replacement Cost

The Project facilities are required to replace according to the useful life at a certain interval of said facilities within the Project life. The replacement cost with its useful life are tabulated Table L.2.14.

TABLES

Table L.1.1 HOURLY PRODUCTION RATE OF MAJOR EQUIPMENT

(1) Bulldozer

(Excavating Work)

Q = (60 x q x F x E)/Cm

where:

Q = Hourly productin (m3/h)
q = Blade capacity (m3)
F = Swell factor of material
E = Operating efficiency
Cm = Cycle time (min.)
Cm = L/V1 + L/V2 = tg
L = Hauling distance (m)
V1 = Forward speed (m/min.)
V2 = Reverse speed (m/min.)
tg = Gear change and others

30 ton class Bulldozer

Work	q	F	E	L	V1	V2	tg	Cm	Q
Fine	6.94	0.80	0.70	20	42	58	0.33	1.15	203
Coarse	6.94	0.87	0.60	20	42	58	0.33	1.15	189
Rock	6.94	0.63	0.35	20	42	58	0.33	1.15	80

20 ton class Bulldozer

Work	q	F	E	L	V1	V2	tg	Cm	Q
Fine	3.19	0.80	0.70	20	42	58	0.33	1.15	94
Coarse	3.19	0.87	0.60	20	42	58	0.33	1.15	87
Rock	3.19	0.63	0.35	20	42	58	0.33	1.15	37

(Spreading Work)

Q = (W x V x D x F x E)/N

where:

Q = Hourly production (m3/h)
W = Effective spreading width (m)
V = Operating speed (m/hr)
D = Spreading depth (m)
F = Swell factor of material
E = Operating efficiency
N = Number of spreading

20 ton class Bulldozer

Work	W	V	D	F	E	N	Q
Fine	3.96	1,700	0.3	0.80	0.60	5	194
Coarse	3.96	1,700	0.3	0.87	0.55	5	193
Rock	3.96	1,700	0.3	0.63	0.50	5	127

13 ton class Swamp Bulldozer

Work	W	V	D	F	E	N	Q
Fine	3.5	1,200	0.2	0.80	0.40	3	90

(Compacting Work)

$Q = (W \times V \times D \times F \times E)/N$

where:

Q = Hourly production (m3/h)
W = Effective compacting width (m)
V = Compacting speed (m/h)
D = Compacted depth (m)
F = Swell factor of material
E = Operating efficiency

20 ton class Bulldozer

Work	W	V	D	F	E	N	Q
Fine	0.8	4,000	0.3	0.80	0.6	5	77
Coarse	0.8	4,000	0.3	0.87	0.6	6	84

(2) Loader

$Q = (3,600 \times q \times K \times F \times E)/Cms$

where:

Q = Hourly production (m3/h)
q = Bucket capacity (m3)
K = Bucket coefficiency
F = Swell factor of material
E = Operating efficiency
Cms = Cycle time (sec.)

0.6 m3 class Backhoe

Work	q	K	F	E	Cms	Q
Fine	0.6	0.85	0.80	0.7	21	48
Coarse	0.6	0.80	0.87	0.7	21	50
Rock	0.6	0.75	0.63	0.7	21	34

1.2 m3 class Backhoe

Work	q	K	F	E	Cms	Q
Fine	1.2	0.85	0.80	0.7	32	64
Coarse	1.2	0.80	0.87	0.7	32	66
Rock	1.2	0.75	0.63	0.7	32	45

2.0 m3 class Tractor Shovel

Work	q	K	F	E	Cms	Q
Fine	2.0	1.0	0.80	0.7	42	96
Coarse	2.0	0.7	0.87	0.7	42	73
Rock	2.0	0.5	0.63	0.7	42	38

3.0 m3 class Tractor Shovel

Work	q	K	F	E	Cms	Q
Fine	3.0	1.0	0.80	0.7	45	134
Coarse	3.0	0.7	0.87	0.7	45	102
Rock	3.0	0.5	0.63	0.7	45	53

5 m3 class Wheel Loader

Work	q	K	F	E	Cms	Q
Fine	5.0	1.0	0.80	0.7	36	280
Coarse	5.0	0.7	0.87	0.7	36	213
Rock	5.0	0.5	0.63	0.7	36	110

3 m3 class Wheel Loader

Work	q	K	F	E	Cms	Q
Fine	3.0	1.0	0.80	0.7	36	168
Coarse	3.0	0.7	0.87	0.7	36	128
Rock	3.0	0.5	0.63	0.7	36	66

(3) Dump Truck

Q = (60 x C x F x Et)/Cmt

where:

Q = Hourly production (m3/h)
C = Vessel capacity (m3)
F = Swell factor of material
Et = Operating efficiency of dump truck
Cmt = Cycle time of dump truck (min.)
Cmt = (Cms x n)/(60 x Es) + D/V1 + D/V2 + t1 + t2
Cms = Cycle time of loader (min.)
n = Number of loading
n = c/(q x k)
q = Bucket capacity of loader (m3)
K = Bucket coefficient
Es = Operating efficiency of loader
D = Hauling distance (m)
V1 = Travel speed with load (m/min.)
V2 = Travel sped without load (m/min.)
t1 = Unloading time (min.)
t2 = Waiting, setting and others (min.)

30 ton class Dump truck

Work	C	F	Et	Cmt	Cms	n	q	K	Es	D	V1	V2	t1	t2	Q
2,000 m (Quarry)															
Coarse	18.0	0.87	0.9	19.8	36	5	6.0	0.6	0.7	2,000	250	333	1.0	0.5	43
Rock	18.0	0.63	0.9	20.6	36	6	6.0	0.5	0.7	2,000	250	333	1.0	0.5	30

10 ton class Dump truck

Work	C	F	Et	Cmt	Cms	n	q	K	Es	D	V1	V2	t1	t2	Q
2,000 m															
Fine	5.6	0.80	0.9	17.9	36	2.8	2.1	0.9	0.7	2,000	250	333	1.0	0.5	14
Coarse	4.5	0.87	0.9	19.1	36	4.2	2.1	0.6	0.7	2,000	250	333	1.0	0.5	11
Rock	4.5	0.63	0.9	19.8	36	5.0	2.1	0.5	0.7	2,000	250	333	1.0	0.5	7
1,000 m															
Fine	5.6	0.80	0.9	10.9	36	2.8	2.1	0.9	0.7	1,000	250	333	1.0	0.5	22
Coarse	4.5	0.87	0.9	12.1	36	4.2	2.1	0.6	0.7	1,000	250	333	1.0	0.5	18
Rock	4.5	0.63	0.9	12.8	36	5.0	2.1	0.5	0.7	1,000	250	333	1.0	0.5	11
500 m															
Fine	5.6	0.80	0.9	7.4	36	2.8	2.1	0.9	0.7	500	250	333	1.0	0.5	33
Coarse	4.5	0.87	0.9	8.6	36	4.2	2.1	0.6	0.7	500	250	333	1.0	0.5	25
Rock	4.5	0.63	0.9	9.3	36	5.0	2.1	0.5	0.7	500	250	333	1.0	0.5	14
250 m															
Fine	5.6	0.80	0.9	5.7	36	2.8	2.1	0.9	0.7	250	250	333	1.0	0.5	42
Coarse	4.5	0.87	0.9	6.9	36	4.2	2.1	0.6	0.7	250	250	333	1.0	0.5	31
Rock	4.5	0.63	0.9	7.6	36	5.0	2.1	0.5	0.7	250	250	333	1.0	0.5	18
5,000 m															
Rock	4.0	0.63	0.9	35.0	36	5.6	2.1	0.5	0.7	5,000	300	400	1.0	0.5	4

(4) Motor grader

$Q = (60 \times W \times L \times D \times F \times E)/(N \times Cm)$

where:

Q = Hourly production (m3/h)
W = Width of blade
W = Length of blade x sin O - 0.3
= 3.7 x sin 60° - 0.3
L = Length of grading (m)
D = Depth of layer (m)
F = Swell factor of material
E = Operating efficiency
N = Number of grading
Cm = Cycle time (min.)
Cm = L/V1 + L/V2 + 2t
V1 = Forward speed (m/min.)
V2 = Reverse speed (m/min.)
t = Gear change and others (min.)

Work	W	L	D	F	E	N	Cm	V1	V2	t	Q
Fine	2.9	200	0.3	0.80	0.4	3	7.0	66.7	100	1.0	159
Coarse	2.9	200	0.3	0.87	0.4	3	7.0	66.7	100	1.0	173

(5) Compacting Equipment

$Q = (W \times V \times D \times F \times E)/N$

where:

Q = Hourly production (m3/h)
W = Width of compaction (m)
Road roller = width of roller - 0.3
Vibrating roller = width of roller - 0.2
V = Operating speed (m/h)
D = Depth of layer (m)
F = Swell factor of material
E = Operating efficiency
N = Number of compaction

20 ton class Tamping Roller

Work	W	V	D	F	E	N	Q
Fine	3.5	3000	0.3	0.8	0.5	6	210

10 ton class Road Roller

Work	W	V	D	F	E	N	Q
Fine	1.2	1,500	0.3	0.80	0.6	6	43
Coarse	1.2	1,500	0.3	0.87	0.6	6	47

3.0 ton class Vibratory Roller

Work	W	V	D	F	E	N	Q
Fine	0.8	1,500	0.3	0.80	0.6	6	29
Coarse	0.8	1,500	0.3	0.87	0.6	6	31

0.6 ton class Vibrating Roller

Work	W	V	D	F	E	N	Q
Fine	0.4	1,300	0.3	0.80	0.6	6	12
Coarse	0.4	1,300	0.3	0.87	0.6	6	14

80 kg class Tamper

Work	W	V	D	F	E	N	Q
Fine	0.24	900	0.3	0.80	0.6	6	5
Coarse	0.24	900	0.3	0.87	0.6	6	6

(6) Concrete Mixer

$Q = (60 \times q \times E)/Cm$

where:

Q = Hourly production (m3/h)
q = Mixing capacity (m3)
E = Working efficiency
Cm = Cycle time (min.)

0.3 m3 class Mixer

Work	q	E	Cm	Q
Concrete	0.3	0.4	4	1.8

(7) Truck Mixer

$Q = (60 \times q \times E)/Cm$

where:

Q = Hourly production (m3/h)
q = Capacity of truck mixer (m3)
E = Operating efficiency
Cm = Cycle time (min.)
Cm = t1 +t2 + t3 + L/V1 + L/V2
t1 = Charging time (min.)
t2 = Discharging time (min.)
t3 = Waiting and setting (min.)
L = Hauling distance
V1 = Transporting speed (m/min.)
V2 = Returning speed (m/min.)

3.0 m3 class Truck Mixer

Work	q	E	Cm	t1	t2	t3	L	V1	V2	Q
2,000 m	3.2	0.8	24	3	5	2	2,000	250	333	6.4
1,000 m	3.2	0.8	17	3	5	2	1,000	250	333	9.0
500 m	3.2	0.8	13.5	3	5	2	500	250	333	11.4
250 m	3.2	0.8	11.8	3	5	2	250	250	333	13.0

(8) Concrete bucket handled by 30 ton Crane

Q = (C x E x 60)/Cm

where:

Q = Hourly production
C = Concrete bucket capacity
E = Operating efficiency
Cm = Cycle time
Cm = t1 + t2 + t3
t1 = Bucket detaching and attaching
t2 = Lifting and setting
t3 = Discharging

C	E	t1	t2	t3	Cm	Q
1.0	0.7	2	3	1	6	7
1.5	0.7	2	3	1	6	11

Table L.1.2 MAJOR PLANT AND EQUIPMENT FOR DAM AND POWER STATION

No.	Description	Capacity (Class)	Q'ty
1.	Crushing plant	250 t/h	1
2.	Concrete mixing plant	0.8 m3 x 3 units	2
3.	Jib crane	9 t	2
4.	Bulldozer w/ripper	30 t	7
5.	Bulldozer w/ripper	20 t	5
6.	Wheel loader	5 m3	6
7.	Wheel loader	3 m3	4
8.	Tractor shovel	3 m3	3
9.	Tractor shovel	2 m3	3
10.	Heavy dump truck	30 t	15
11.	Heavy dump truck	15 t	10
12.	Concrete pump car	60 m3/h	1
13.	Motor grader	3.7 m	2
14.	Truck mixer	3 m3	3
15.	Crawler drill hydraulic	8 t	10
16.	Boring machine	200 m	5
17.	Grout mixer	500 lit./min.	3
18.	Grout pump	200 lit./min.	5
19.	Air compressor	17 m3/min.	2
20.	Truck crane	30 t	1
21.	Truck crane	15 t	2
22.	Crawler crane	30 t	1
23.	Tamping roller	20 t	2
24.	Vibration roller	8 t	4
25.	Fuel tanker	8 t	2
26.	Water tanker	8 t	2
27.	Road roller	10 t	2
28.	Saw mill	-	1
29.	Work shop car	8 t	2
30.	Ordinary truck	6 t	5
31.	Truck trailer	30 t	1
32.	Cooling plant	200 JRT	1

Table L.1.3 MAJOR PLANT AND EQUIPMENT FOR IRRIGATION DEVELOPMENT (1/2)

No.	Description	Capacity (Class)	Q'ty
1.	Motor scraper	11 m3	3
2.	Bulldozer w/winch & ripper	30 t	5
3.	Bulldozer	20 t	7
4.	Bulldozer	13 t	7
5.	Backhoe	1.2 m3	2
6.	Backhoe	0.6 m3	6
7.	Tractor shovel	2.0 m3	5
8.	Tractor shovel	1.0 m3	5
9.	Dump truck	10 t	10
10.	Tamping roller	20 t	3
11.	Vibration roller	0.5 t	7
12.	Crawler crane	30 t	1
13.	Truck crane	20 t	1
14.	Truck crane	10 t	2
15.	Motor grader	3.1 m	4
16.	Air Compressor, portable	7 m3/min.	3
17.	Diesel generator	200 kVA	1
18.	Diesel generator	100 kVA	3
19.	Vibration hammer	22 kW	3
20.	Submersible pump	4" ø	15
21.	Submersible pump	6" ø	2
22.	Fuel tanker	8 t	3
23.	Water tanker	8 t	3
24.	Work shop car	8 t	2
25.	Truck trailer	30 t	2
26.	Road roller	10 t	2
27.	Saw mill	-	2
28.	Portable crushing plant	50 t/h	1
29.	Concrete mixer	0.3 m3	11
30.	Ordinary truck	6 t	8

Table L.1.3 MAJOR PLANT AND EQUIPMENT FOR IRRIGATION DEVELOPMENT(2/2)

No.	Description	Capacity (Class)	Required quantity						Total
			Rehabilitation			Newland			
			Civil	On-farm	Sub-total	Civil	On-farm	Sub-total	
1.	Motor scraper	11 m3	-	-	0	3	0	3	3
2.	Bulldozer w/winch & ripper	30 t	-	-	0	2	3	5	5
3.	Bulldozer	20 t	2	1	3	3	1	4	7
4.	Bulldozer	13 t	1	2	3	2	2	4	7
5.	Backhoe	1.2 m3	1	-	1	1	0	1	2
6.	Backhoe	0.6 m3	2	-	2	3	1	4	6
7.	Tractor shovel	2.0 m3	0	0	0	4	1	5	5
8.	Tractor shovel	1.0 m3	1	1	2	2	1	3	5
9.	Dump truck	10 t	3	-	3	5	2	7	10
10.	Tamping roller	20 t	0	-	0	3	0	3	3
11.	Vibration roller	0.5 t	2	1	3	3	1	4	7
12.	Crawler crane w/dragline (0.6m3)	30 t	0	0	0	1	0	1	1
13.	Truck crane	20 t	0	0	0	1	0	1	1
14.	Truck crane	10 t	1	0	1	1	0	1	2
15.	Motor grader	3.1 m	1	1	2	1	1	2	4
16.	Air Compressor, portable	7 m3/min.	1	0	1	2	0	2	3
17.	Diesel generator	200 kVA	0	0	0	1	0	1	1
18.	Diesel generator	100 kVA	1	0	1	2	0	2	3
19.	Vibration hammer	22 kW	1	0	1	2	0	2	3
20.	Submersible pump	4" ø	5	0	5	10	0	10	15
21.	Submersible pump	6" ø	0	0	0	2	0	2	2
22.	Fuel tanker	8 t	1	0	1	1	1	2	3
23.	Water tanker	8 t	1	0	1	1	1	2	3
24.	Work shop car	8 t	1	0	1	1	0	1	2
25.	Truck trailer	30 t	1	0	1	1	0	1	2
26.	Road roller	10 t	1	0	1	1	0	1	2
27.	Saw mill	-	1	0	1	1	0	1	2
28.	Portable crushing plant	50 t/h	0	0	0	1	0	1	1
29.	Concrete mixer	0.3 m3	3	1	4	6	1	7	11
30.	Ordinary truck	6 t	2	1	3	3	2	5	8

Table L.2.1 SUMMARY OF FINANCIAL COST FOR THE PROJECT
(DAM, POWER & IRRIGATION)

1 US$ = RS.30.5 = Y140.0

Scheme & Cost Items	F.C /1 (US$ mil.)	L.C /1 (Rs.mil.)	Total Equivalent (US$ mil.)
1. Direct construction cost	163	1,586	215
2. Land Acquisition & building compensation cost	-	61	2
3. Government's Administration Cost for Implementation /2	-	336	11
4. Engineering services cost /3	15	92	18
Sub-total /1 + /2 + /3 + /4	178	2,075	246
5. Contingencies			
(1) Physical contingency /4	27	310	37
(2) Price contingency /5	-	840	27
Amount (1) + (2)	27	1,150	64
GRAND TOTAL	205	3,225	310

Notes: /1 F.C = Foreign currency, L.C = Local currency
/2 5% of direct construction cost.
/3 8% of direct construction cost.
/4 0% for F.C and 8% for L.C per annum.
/5 15% for F.C and L.C is assumed.

Table L.2.2 SUMMARY OF FINANCIAL COST FOR THE DAM AND POWER

1 US$ = RS.30.5 = Y140.0

Scheme & Cost Items	F.C /1 (US$ mil.)	L.C /1 (Rs.mil.)	Total Equivalent (US$ mil.)
1. Direct construction cost	96	732	120
2. Land Acquisition & building compensation cost	-	61	2
3. Government's Administration Cost for Implementation /2	-	183	6
4. Engineering services cost /3	9	31	10
Sub-total /1 + /2 + /3 + /4	105	1,007	138
5. Contingencies			
(1) Physical contingency /4	16	150	21
(2) Price contingency /5	0	367	12
Amount (1) + (2)	16	517	33
GRAND TOTAL	121	1,524	171

Notes: /1 F.C = Foreign currency, L.C = Local currency
/2 5% of direct construction cost.
/3 8% of direct construction cost.
/4 0% for F.C and 8% for L.C per annum.
/5 15% for F.C and L.C is assumed.

Table L.2.3 SUMMARY OF FINANCIAL COST FOR THE IRRIGATION DEVELOPMENT

1 US$ = RS.30.5 = Y140.0

Scheme & Cost Items	F.C /1 (US$ mil.)	L.C /1 (Rs.mil.)	Total Equivalent (US$ mil.)
1. Direct construction cost	67	854	95
2. Land Acquisition & building compensation cost	-	-	-
3. Government's Administration Cost for Implementation /2	-	153	5
4. Engineering services cost /3	6	61	8
Sub-total /1 + /2 + /3 + /4	73	1,068	108
5. Contingencies			
(1) Physical contingency /4	11	160	16
(2) Price contingency /5	0	473	15
Amount (1) + (2)	11	633	31
GRAND TOTAL	84	1,701	139

Notes: /1 F.C = Foreign currency, L.C = Local currency
/2 5% of direct construction cost.
/3 8% of direct construction cost.
/4 0% for F.C and 8% for L.C per annum.
/5 15% for F.C and L.C is assumed.

Table L.2.4 (1/4) ANNUAL DISBURSEMENT SCHEDULE (DAM)

Unit : FC;Million US$
LC; Million Rs.

Items	1 st year 1989		2 nd year 1990		3 rd year 1991		4 th year 1992		5 th year 1993		6 th year 1994		7 th year 1995		Total	
	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C
1.Direct Cost																
(1)Annual allocation F.C.	0.00		22.80		15.20		15.20		15.20		7.60				76.00	
Annual allocation L.C.		0.0		201.3		134.2		134.2		134.2		67.1				671.0
(2)Physical cont.,F.C.	0.00		3.42		2.28		2.28		2.28		1.14		0.00		11.40	
Physical cont.,L.C.		0.0		30.2		20.1		20.1		20.1		10.1		0.0		100.7
sub total (1)+(2)	0.00	0.0	26.22	231.5	17.48	154.3	17.48	154.3	17.48	154.3	8.74	77.2	0.00	0.0	87.40	771.7
(3)Price escalation F.C.	0.00		26.22		17.48		17.48		17.48		8.74		0.00		87.40	
Price escalation L.C.		0.0		270.0		194.4		210.0		226.8		122.5		0.0		1023.6
Total	0.00	0.0	26.22	270.0	17.48	194.4	17.48	210.0	17.48	226.8	8.74	122.5	0.00	0.0	87.40	1023.6
2.Land acquisition L.C.																
(1)Annual allocation		61.0		0.0		0.0		0.0		0.0		0.0		0.0		61.0
(2)Physical cont.		9.2		0.0		0.0		0.0		0.0		0.0		0.0		9.2
sub total (1)+(2)		70.2		0.0		0.0		0.0		0.0		0.0		0.0		70.2
(3)Price escalation		75.8		0.0		0.0		0.0		0.0		0.0		0.0		75.8
Total		75.8		0.0		0.0		0.0		0.0		0.0		0.0		75.8
3.Gov. admin.cost																
(1)Annual allocation		13.0		50.0		40.0		20.0		20.0		20.0		20.0		183.0
(2)Physical cont.		2.0		7.5		6.0		3.0		3.0		3.0		3.0		27.5
sub total (1)+(2)		15.0		57.5		46.0		23.0		23.0		23.0		23.0		210.5
(3)Price escalation		16.1		67.1		67.9		31.3		33.8		36.5		39.4		282.2
Total		16.1		67.1		67.9		31.3		33.8		36.5		39.4		282.2
4.E/services cost																
(1)Annual allocation F.C.	2.70		1.40		1.40		1.40		1.40		0.70				9.00	
Annual allocation L.C.		9.3		5.0		5.0		5.0		5.0		1.2				30.5
(2)Physical cont.,F.C.	0.41		0.21		0.21		0.21		0.21		0.11				1.35	
Physical cont.,L.C.		1.4		0.8		0.8		0.8		0.8		0.2				4.6
sub total (1)+(2)	3.11	10.7	1.61	5.8	1.61	5.8	1.61	5.8	1.61	5.8	0.81	1.4			10.35	35.1
(3)Price escalation F.C.	3.11		1.61		1.61		1.61		1.61		0.81		0.00		10.35	
Price escalation L.C.		11.6		6.7		7.2		7.8		8.4		2.2		0.0		44.0
Total	3.11	11.6	1.61	6.7	1.61	7.2	1.61	7.8	1.61	8.4	0.81	2.2	0.00	0.0	10.35	44.0
Annual total	3.11	103.5	27.83	343.6	19.09	259.6	19.09	249.1	19.09	269.0	9.55	161.1	0.00	39.4	97.75	1425.5
Total in US$ F.C.+L.C.	6.50		39.10		27.60		27.26		27.91		14.83		1.29		144.49	

Table L.2.4 (2/4) ANNUAL DISBURSEMENT SCHEDULE (POWER)

Unit : FC;Million US$
LC;Million Rs.

Items	1 st year 1989		2 nd year 1990		3 rd year 1991		4 th year 1992		5 th year 1993		6 th year 1994		7 th year 1995		Total	
	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C
1.Direct Cost																
(1)Annual allocation F.C.	0.00		0.00		2.50		2.50		10.00		5.00				20.00	
Annual allocation L.C.		0.0		0.0		15.3		15.3		15.3		15.3				61.0
(2)Physical cont.,F.C.	0.00		0.00		0.38		0.38		1.50		0.75		0.00		3.00	
Physical cont.,L.C.		0.0		0.0		2.3		2.3		2.3		2.3		0.0		9.2
sub total (1)+(2)	0.00	0.0	0.00	0.0	2.88	17.5	2.88	17.5	11.50	17.5	5.75	17.5	0.00	0.0	23.00	70.2
(3)Price escalation F.C.	0.00		0.00		2.88		2.88		11.50		5.75		0.00		23.00	
Price escalation L.C.		0.0		0.0		22.1		23.9		25.8		27.8		0.0		99.5
Total	0.00	0.0	0.00	0.0	2.88	22.1	2.88	23.9	11.50	25.8	5.75	27.8	0.00	0.0	23.00	99.5
2.Land acquisition L.C.																
(1)Annual allocation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(2)Physical cont.		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
sub total (1)+(2)		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(3)Price escalation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
3.Gov. admin.cost																
(1)Annual allocation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(2)Physical cont.		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
sub total (1)+(2)		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(3)Price escalation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
4.E/services cost																
(1)Annual allocation F.C.	0.00		0.00		0.00		0.00		0.00						0.00	
Annual allocation L.C.		0.0		0.0		0.0		0.0		0.0						0.0
(2)Physical cont.,F.C.	0.00		0.00		0.00		0.00		0.00						0.00	
Physical cont.,L.C.		0.0		0.0		0.0		0.0		0.0						0.0
sub total (1)+(2)	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0					0.00	0.0
(3)Price escalation F.C.	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Price escalation L.C.		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0					0.00	0.0
Annual total	0.00	0.0	0.00	0.0	2.88	22.1	2.88	23.9	11.50	25.8	5.75	27.8	0.00	0.0	23.00	99.5
Total in US$ F.C.+L.C.	0.00		0.00		3.60		3.66		12.34		6.66		0.00		26.26	

Table L.2.4 (3/4) ANNUAL DISBURSEMENT SCHEDULE (IRRIGATION DEVELOPMENT)

Unit : FC,Million US$
LC,Million Rs

Items	1 st year 1989		2 nd year 1990		3 rd year 1991		4 th year 1992		5 th year 1993		6 th year 1994		7 th year 1995		Total	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1.Direct Cost																
(1)Annual allocation F.C.	0.00		11.50		13.40		13.40		13.40		11.00		4.30		67.00	
Annual allocation L.C.		0.0		137.4		170.8		170.8		170.8		144.8		69.4		864.0
(2)Physical contl.,F.C.	0.00		1.73		2.01		2.01		2.01		1.65		0.65		10.05	
Physical contl.,L.C.		0.0		20.6		25.6		25.6		25.6		21.7		6.9		126.1
sub total (1)+(2)	0.00	0.0	13.23	158.0	15.41	198.4	15.41	196.4	15.41	196.4	12.65	166.6	4.95	68.3	77.05	982.1
(3)Price escalation F.C.	0.00		13.23		15.41		15.41		15.41		12.65		4.95		77.05	
Price escalation L.C.		0.0		184.3		247.4		267.2		288.6		264.2		117.1		1368.9
Total	0.00	0.0	13.23	184.3	15.41	247.4	15.41	267.2	15.41	288.6	12.65	264.2	4.95	117.1	77.05	1368.9
2.Land acquisition L.C.																
(1)Annual allocation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(2)Physical contl.		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
sub total (1)+(2)		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
(3)Price escalation		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Total		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
3.Gov. admini.cost																
(1)Annual allocation		11.0		40.0		30.0		18.0		18.0		18.0		18.0		153.0
(2)Physical contl.		1.7		6.0		4.5		2.7		2.7		2.7		2.7		23.0
sub total (1)+(2)		12.7		46.0		34.5		20.7		20.7		20.7		20.7		176.0
(3)Price escalation		13.7		53.7		43.5		28.2		30.4		32.8		35.6		237.7
Total		13.7		53.7		43.5		28.2		30.4		32.8		35.6		237.7
4.E/services cost																
(1)Annual allocation F.C.	1.80		0.80		0.80		0.80		0.80		0.60		0.40		6.00	
Annual allocation L.C.		12.4		8.5		8.5		8.5		8.5		8.5		6.1		61.0
(2)Physical contl.,F.C.	0.27		0.12		0.12		0.12		0.12		0.09		0.06		0.90	
Physical contl.,L.C.		1.9		1.3		1.3		1.3		1.3		1.3		0.9		9.2
sub total (1)+(2)	2.07	14.3	0.92	9.8	0.92	9.8	0.92	9.8	0.92	9.8	0.69	9.8	0.46	7.0	6.90	70.2
(3)Price escalation F.C.	2.07		0.92		0.92		0.92		0.92		0.69		0.46		6.90	
Price escalation L.C.		15.4		11.4		12.3		13.3		14.4		15.5		12.0		94.3
Total	2.07	15.4	0.92	11.4	0.92	12.3	0.92	13.3	0.92	14.4	0.69	15.5	0.46	12.0	6.90	94.3
Annual total	2.07	29.1	14.15	249.4	16.33	303.2	16.33	308.7	16.33	333.4	13.34	312.6	5.41	164.8	83.95	1709.9
Total in US$ F.C.+L.C.	3.02		22.32		26.27		25.45		27.26		23.59		10.80		139.72	

Table L.2.4 (4/4) ANNUAL DISBURSEMENT SCHEDULE (TOTAL)

Unit : FC,Million US$
LC,Million Rs

Items	1 st year 1989		2 nd year 1990		3 rd year 1991		4 th year 1992		5 th year 1993		6 th year 1994		7 th year 1995		Total	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1.Direct Cost																
(1)Annual allocation F.C.	0.00		34.30		31.10		31.10		38.60		23.60		4.30		163.00	
Annual allocation L.C.		0.0		261.3		320.3		320.3		320.3		227.2		69.4		1566.9
(2)Physical contl.,F.C.	0.00	0.0	5.15	0.0	4.67	0.0	4.67	0.0	5.79	0.0	3.54	0.0	0.65	0.0	24.45	0.0
Physical contl.,L.C.	0.00	0.0	0.00	50.8	0.00	48.0	0.00	48.0	0.00	48.0	0.00	34.1	0.00	8.9	0.00	237.9
sub total (1)+(2)	0.00	0.0	39.45	385.5	35.77	368.3	35.77	368.3	44.39	368.3	27.14	261.2	4.95	68.3	187.45	1623.9
(3)Price escalation F.C.	0.00	0.0	39.45	0.0	35.77	0.0	35.77	0.0	44.39	0.0	27.14	0.0	4.95	0.0	187.45	0.0
Price escalation L.C.	0.00	0.0	0.00	454.3	0.00	463.9	0.00	501.1	0.00	541.1	0.00	414.5	0.00	117.1	0.00	2492.0
Total	0.00	0.0	39.45	454.3	35.77	463.9	35.77	501.1	44.39	541.1	27.14	414.5	4.95	117.1	187.45	2492.0
2.Land acquisition L.C.																
(1)Annual allocation	0.00	61.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	61.0
(2)Physical contl.	0.00	9.2	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	9.2
sub total (1)+(2)	0.00	70.2	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	70.2
(3)Price escalation	0.00	75.8	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	75.8
Total	0.00	75.8	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	75.8
3.Gov. admini.cost																
(1)Annual allocation	0.00	24.0	0.00	90.0	0.00	70.0	0.00	38.0	0.00	38.0	0.00	38.0	0.00	38.0	0.00	336.0
(2)Physical contl.	0.00	3.6	0.00	13.5	0.00	10.5	0.00	5.7	0.00	5.7	0.00	5.7	0.00	5.7	0.00	50.4
sub total (1)+(2)	0.00	27.6	0.00	103.5	0.00	80.5	0.00	43.7	0.00	43.7	0.00	43.7	0.00	43.7	0.00	386.4
(3)Price escalation	0.00	29.8	0.00	120.7	0.00	101.4	0.00	59.5	0.00	84.2	0.00	69.3	0.00	74.9	0.00	519.8
Total	0.00	29.8	0.00	120.7	0.00	101.4	0.00	59.5	0.00	84.2	0.00	69.3	0.00	74.9	0.00	519.8
4.E/services cost																
(1)Annual allocation F.C.	4.50	0.0	2.20	0.0	2.20	0.0	2.20	0.0	2.20	0.0	1.30	0.0	0.40	0.0	15.00	0.0
Annual allocation L.C.	0.00	21.7	0.00	13.5	0.00	13.5	0.00	13.5	0.00	13.5	0.00	9.7	0.00	6.1	0.00	91.5
(2)Physical contl.,F.C.	0.68	0.0	0.33	0.0	0.33	0.0	0.33	0.0	0.33	0.0	0.20	0.0	0.06	0.0	2.25	0.0
Physical contl.,L.C.	0.00	3.3	0.00	2.0	0.00	2.0	0.00	2.0	0.00	2.0	0.00	1.6	0.00	0.9	0.00	13.7
sub total (1)+(2)	5.18	25.0	2.53	15.5	2.53	15.5	2.53	15.5	2.53	15.5	1.50	11.2	0.46	7.0	17.25	105.2
(3)Price escalation F.C.	5.18	0.0	2.53	0.0	2.53	0.0	2.53	0.0	2.53	0.0	1.50	0.0	0.46	0.0	17.25	0.0
Price escalation L.C.	0.00	27.0	0.00	18.1	0.00	19.6	0.00	21.1	0.00	22.8	0.00	17.7	0.00	12.0	0.00	138.3
Total	5.18	27.0	2.53	18.1	2.53	19.6	2.53	21.1	2.53	22.8	1.50	17.7	0.46	12.0	17.25	138.3
Annual total	5.18	132.5	41.98	593.1	38.30	584.9	38.30	581.6	46.92	628.2	28.64	501.6	5.41	264.0	204.70	3225.9
Total in US$ F.C.+L.C.	9.52	0.0	61.42	0.0	57.47	0.0	57.36	0.0	67.52	0.0	45.08	0.0	12.05	0.0	310.47	0.0

Table L.2.5 (1) PRICED BILL OF QUANTITIES FOR DAM & POWER GENERATION (1/3)

1US$ = Rs.30.5 = ¥140

Item No.	Work Items	Unit	Qty.	Foreign Currency Unit Cost (US$)	Foreign Currency Amount (1,000 US$)	Local Currency Unit Cost (Rs.)	Local Currency Amount (1,000 Rs.)	Total Equivalent Unit Cost (US$)	Total Equivalent Amount (1,000 US$)
I.	**General Items**								
1.	Permanent access road	km	3.0	90,000.0	270	1,830,000.0	5,490	150,000.0	450
2.	Construction roads	km	10.0	30,000.0	300	610,000.0	6,100	50,000.0	500
3.	Bridge crossing diversion channel	Nos.	1.0	-	300	-	8,575	-	581
4.	Relocation of Highway and public utilities	km	15.0	90,000.0	1,350	1,830,000.0	27,450	150,000.0	2,250
5.	Temporary buildings	-	L.S	-	112	-	9,124	-	411
6.	Power supply system	-	L.S	-	300	-	7,050	-	531
7.	Water supply system	-	L.S	-	140	-	5,830	-	331
8.	Communication system	-	L.S	-	140	-	5,830	-	331
9.	Miscellaneous work	-	L.S	-	180	-	7,660	-	431
	Sub-Total of I:				**3,092**		**83,109**		**5,816**
II.	**Diversion Canal**								
1.	Excavation, Common	cu.m	161,800.0	2.0	324	25.6	4,142	2.8	453
2.	Excavation, w/rock	cu.m	337,700.0	3.3	1,114	43.0	14,521	4.7	1,587
3.	Excavation, rock	cu.m	104,300.0	5.3	553	68.6	7,155	7.5	782
4.	Primary coffering w/dewatering	-	L.S	-	700	-	1,746	-	758
	Sub-Total of II:				**2,691**		**27,564**		**3,580**
III.	**Main Dam**								
1.	Excavation common	cu.m	103,100.0	2.3	237	30.2	3,114	3.3	340
2.	*	cu.m	201,100.0	3.9	784	51.2	10,296	5.6	1,126
3.	-do- rock	cu.m	98,700.0	5.6	553	73.2	7,225	8.0	790
4.	-do- riverbed	cu.m	175,300.0	2.3	403	30.2	5,291	3.3	578
5.	Embankment, core	cu.m	714,200.0	4.6	3,285	60.4	43,138	6.6	4,714
6.	-do- , filter	cu.m	181,700.0	9.8	1,781	128.1	23,276	14.0	2,544
7.	-do , rock	cu.m	1,533,200.0	5.3	8,126	68.6	105,178	7.5	11,499
8.	Grout, consolidation & blanket	lin.m	3,465.0	72.8	252	951.6	3,297	104.0	360
9.	Grout, curtain	lin.m	17,160.0	105.0	1,802	1,372.5	23,552	150.0	2,574
10.	Embeded instrument	-	L.S	-	393	-	1,269	-	434
	Sub-Total of III:				**17,616**		**225,635**		**24,960**

Table L.2.5(1) PRICED BILL OF QUANTITIES FOR DAM & POWER GENERATION (2/3)

1US$ = Rs.30.5 = ¥140

Item No.	Work Items	Unit	Qty.	Foreign Currency		Local Currency		Total Equivalent	
				Unit Cost (US$)	Amount (1,000 US$)	Unit Cost (Rs.)	Amount (1,000 Rs.)	Unit Cost (US$)	Amount (1,000 US$)
IV.	**First Saddle Dam**								
1.	Excavation, common	cu.m	37,100.0	2.3	85	30.2	1,120	3.3	122
2.	-do- , w/rock	cu.m	80,700.0	3.9	315	51.2	4,132	5.6	452
3.	-do- , rock	cu.m	130,500.0	5.6	731	73.2	9,553	8.0	1,044
4.	Concrete	cu.m	375,910.0	90.0	33,832	457.5	171,979	105.0	39,470
5.	Re-bar	t	176.0	595.0	105	7,777.5	1,369	850.0	150
6.	Grout, consolidation	lin.m	2,840.0	72.8	207	951.6	2,703	104.0	295
7.	Grout, curtain	lin.m	14,060.0	105.0	1,476	1,372.5	19,297	150.0	2,109
	Sub-Total of IV:				**36,751**		**210,152**		**43,642**
V.	**Spillway & Stilling Basin**								
1.	Excavation, common	cu.m	4,900.0	2.3	11	30.2	148	3.3	16
2.	-do- , w/rock	cu.m	17,300.0	3.9	68	51.2	886	5.6	97
3.	-do- , rock	cu.m	36,300.0	5.6	203	73.2	2,657	8.0	290
4.	Concrete, structure	cu.m	25,570.0	90.0	2,301	610.0	15,598	110.0	2,813
5.	Re-bar	t	384.0	595.0	229	7,777.5	2,987	850.0	326
6.	Spillway bridge	-	L.S	-	980	-	13,570	-	1,425
	Sub-Total of V:				**3,792**		**35,846**		**4,968**
VI.	**Power Intake**								
1.	Intake concrete	cu.m	2,560.0	70.0	179	915.0	2,342	100.0	256
2.	Re-bar	t	57.0	595.0	34	7,777.5	443	850.0	49
	Sub-Total of VI:				**213**		**2,786**		**305**
VII.	**Second Saddle Dam**								
1.	Excavation common	cu.m	43,600.0	2.0	87	25.6	1,116	2.8	122
2.	-do- w/rock	cu.m	92,600.0	3.3	36	43.0	3,982	4.7	435
3.	-do- rock	cu.m	40,900.0	5.3	217	68.6	2,806	7.5	307
4.	Embankment, core	cu.m	139,300.0	3.9	543	51.2	7,132	5.6	780
5.	-do- , filter	cu.m	50,700.0	9.8	497	128.1	6,495	14.0	710
6.	-do- , rock	cu.m	240,600.0	4.6	1,107	60.4	14,532	6.6	1,588
7.	Grout, consolidation & blanket	lin.m	3,665.0	72.8	267	951.6	3,488	104.0	381
8.	Grout, curtain	lin.m	18,150.0	105.0	1,906	1,372.5	24,911	150.0	2,723
	Sub-Total of VII:				**4,929**		**64,461**		**7,046**

Table L.2.5(1) PRICED BILL OF QUANTITIES FOR DAM & POWER GENERATION (3/3)

1US$ = Rs.30.5 = Y140

Item No.	Work Items	Unit	Qty.	Foreign Currency Unit Cost (US$)	Foreign Currency Amount (1,000 US$)	Local Currency Unit Cost (Rs.)	Local Currency Amount (1,000 Rs.)	Total Equivalent Unit Cost (US$)	Total Equivalent Amount (1,000 US$)
VII.	**Powerhouse & Outdoor S/Yard**								
1.	Excavation, common	cu.m	23,300.0	2.3	54	30.2	704	3.3	77
2.	-do- , w/rock	cu.m	52,100.0	3.9	203	51.2	2,668	5.6	292
3.	-do- , rock	cu.m	43,400.0	5.6	243	73.2	3,177	8.0	347
4.	Foundation treatment	L.S	-	-	150	-	2,077	-	218
5.	Concrete, structure	cu.m	11,710.0	70.0	820	915.0	10,715	100.0	1,171
6.	Re-bar	t	586.0	595.0	349	7,777.5	4,558	850.0	498
7.	Super structure	-	L.S	-	2,078	-	5,595	-	2,262
	Sub-Total of VIII:				**3,896**		**29,492**		**4,865**
IX.	**Hydromechanical Works**								
1.	Spillway gates & hoists	t	560.0	6,210.0	3,478	21,045.0	11,785	6,900.0	3,864
2.	Gate, hoist & screen for diversion conduit	t	49.0	4,950.0	243	16,775.0	822	5,500.0	270
3.	Closing gate of diversion conduit	t	55.0	4,950.0	272	16,775.0	923	5,500.0	303
4.	River outlet (screen, ring follower valves, jet flow valves & steel pipes)	t	268.0	4,050.0	1,085	13,725.0	3,678	4,500.0	1,206
5.	Intake gate, hoist & screen	t	66.0	5,400.0	356	18,300.0	1,208	6,000.0	396
6.	Steel penstock, 3.9m	t	255.0	3,150.0	803	10,675.0	2,722	3,500.0	893
7.	Tailrace gates & hoists	t	37.0	4,500.0	167	15,250.0	564	5,000.0	185
	Sub-Total of IX:				**6,404**		**21,702**		**7,116**
X.	**Generating Equipment & Transmission Line**								
1.	Hydro-turbine, generator and first auxiliary equipment (26MW x 1 unit, vertical Francis)	-	L.S		15,200		24,400		16,000
2.	Transmission line (132kV)	km	16.80%	56,000.0	896	427,000.0	6,832	70,000.0	1,120
	Sub-Total of X:				**16,096**		**31,232**		**17,120**
	TOTAL OF I TO X				**95,480**		**731,980**		**119,350**
					96,000		732,000		120,000

Table L. 2.5(2) PRICED BILL OF QUANTITIES FOR IRRIGATION DEVELOPMENT (1/3)

1US$ = Rs.30.5 = Y140

Item No.	Work Items	Unit	Qty.	Foreign Currency Unit Cost (US$)	Foreign Currency Amount (1,000 US$)	Local Currency Unit Cost (Rs.)	Local Currency Amount (1,000 Rs.)	Total Equivalent Unit Cost (US$)	Total Equivalent Amount (1,000 US$)
I.	**CIVIL WORKS**								
1.	**General Items**								
1)	Access & Construction roads w/bridges	-	L.S	-	450	-	11,285	-	820
2)	Temporary buildings	-	L.S	-	140	-	4,270	-	280
3)	Communication system	-	L.S	-	240	-	4,880	-	400
	Sub-Total of 1:				**830**		**20,435**		**1,500**
2.	**Rehabilitation**								
A.	Earthwork								
4)	Clearing	ha.	20.5	150.0	3	3,050.0	63	250.0	5
5)	Excavation, common	cu.m	456,800.0	1.4	640	18.3	8,359	2.0	914
6)	Embankment, canal	cu.m	140,200.0	1.4	196	18.3	2,566	2.0	280
7)	Turfing	sq.m	234,100.0	0.1	23	15.3	3,582	0.6	141
B.	Canal Lining								
8)	Concrete lining	cu.m	25,300.0	50.0	1,265	610.0	15,433	70.0	1,771
9)	Formwork	sq.m	92,000.0	5.0	460	152.5	14,030	10.0	920
C.	Structures (56 no.s)								
10)	Excavation, common	cu.m.	7,100.0	1.7	12	24.4	173	2.5	18
11)	" , rock	cu.m.	4,000.0	7.2	29	54.9	220	9.0	36
12)	Backfill	cu.m	4,000.0	0.9	4	18.3	73	1.5	6
13)	Concrete, 1:3:6	cu.m	3,640.0	53.0	193	671.0	2,442	75.0	273
14)	" , 1:2:4	cu.m	1,440.0	56.0	81	732.0	1,054	80.0	115
15)	Formwork	sq.m	11,440.0	5.0	57	152.5	1,745	10.0	114
16)	Support (scaffolding)	cu.m	13,500.0	2.0	27	30.5	412	3.0	41
17)	Re-bar	t	115.0	680.0	78	5,185.0	596	850.0	98
18)	Riprap, 300 mm	cu.m	1,420.0	5.0	7	152.5	217	10.0	14
19)	" , 450 mm	cu.m	470.0	5.0	2	152.5	71	10.0	5
20)	Concrete pipe, 300 mm in ida.	lin.m	2,740.0	7.0	19	152.5	418	12.0	33
21)	Handrail	lin.m	800.0	5.0	4	61.0	49	7.0	6
22)	Slide gate, 1,800 x 1,000 mm	Nos.	4.0	8,370.0	34	28,365.0	114	9,300.0	37
23)	" , 1,200 x 1,100 mm	Nos.	16.0	5,400.0	86	18,300.0	293	6,000.0	96
24)	Concrete pile, 300 mm in dia.	lin.m	1,560.0	24.0	37	488.0	761	40.0	62
25)	Care of water	-	L.S	-	18	-	366	-	30
	Sub-Total of 2:				**3,258**		**53,036**		**5,014**

Table L.2.5(2) PRICED BILL OF QUANTITIES FOR IRRIGATION DEVELOPMENT (2/3)

1US$ = Rs.30.5 = ¥140

Item No.	Work Items	Unit	Qty.	Foreign Currency Unit Cost (US$)	Foreign Currency Amount (1,000 US$)	Local Currency Unit Cost (Rs.)	Local Currency Amount (Rs.)	Total Equivalent Unit Cost (US$)	Total Equivalent Amount (1,000 US$)
3.	**New Irrigation Canal**								
A.	Earthwork								
26)	Clearing	ha.	231.0	198.0	46	4,026.0	930	330.0	76
27)	Stripping	cu.m	396,100.0	0.6	238	12.2	4,832	1.0	396
28)	Excavation, common	cu.m	855,600.0	1.4	1,027	9.2	7,829	1.5	1,283
29)	" , rock	cu.m	84,700.0	5.6	474	73.2	6,200	8.0	678
30)	Embankment, canal	cu.m	2,164,400.0	2.4	5,195	18.3	39,609	3.0	6,493
31)	Turfing	sq.m	933,700.0	0.1	93	15.3	14,286	0.6	560
32)	Pavement	cu.m	36,830.0	3.6	133	73.2	2,696	6.0	221
33)	Riprap	cu.m	32,600.0	5.0	163	152.5	4,972	10.0	326
B.	Canal Lining								
C.	Structures (350 nos.)								
34)	Excavation, common	cu.m	65,400.0	1.7	111	24.4	1,596	2.5	164
35)	" , rock	cu.m	4,400.0	7.2	32	54.9	242	9.0	40
36)	Backfill	cu.m	42,800.0	0.9	39	18.3	783	1.5	64
37)	Concrete, 1:3:6	cu.m	7,220.0	53.0	383	671.0	4,845	75.0	542
38)	" , 1:2:4	cu.m	12,620.0	56.0	707	732.0	9,238	80.0	1,010
39)	Formwork	sq.m	51,500.0	5.0	258	152.5	7,854	10.0	515
40)	Support (scaffolding)	cu.m	5,620.0	2.0	11	30.5	171	3.0	17
41)	Re-bar	t	938.0	68.0	638	5,185.0	4,864	850.0	797
42)	Riprap, 300 mm	cu.m	6,130.0	5.0	31	152.5	935	10.0	61
43)	" , 450 mm	cu.m	2,870.0	5.0	14	152.5	438	10.0	29
44)	Concrete pipe, 225 mm in dia.	lin.m	500.0	4.8	2	97.6	49	8.0	4
45)	" , 300 mm in dia.	lin.m	6,750.0	7.2	49	146.4	988	12.0	81
46)	" , 375 mm in dia.	lin.m	970.0	9.0	9	183.0	178	15.0	15
47)	" , 450 mm in dia.	lin.m	120.0	18.0	2	366.0	44	30.0	4
48)	" , 750 mm in dia.	lin.m	90.0	27.0	2	549.0	49	45.0	4
49)	" , 900 mm in dia.	lin.m	20.0	32.4	1	658.8	13	54.0	1
50)	" , 1,350 mm in dia.	lin.m	300.0	57.0	17	1,159.0	348	95.0	29
51)	Handrail	lin.m	2,460.0	5.0	12	61.0	150	7.0	17
52)	Slide gate, 1,800 x 1,000 mm	Nos.	12.0	8,370.0	100	28,365.0	340	9,300.0	112
53)	" , 1,800 x 600 mm	Nos.	3.0	7,110.0	21	24,095.0	72	7,900.0	24
54)	" , 1,200 x 1,100 mm	Nos.	48.0	5,400.0	259	18,300.0	878	6,000.0	288
55)	" , 900 x 1,100 mm	Nos.	46.0	4,500.0	207	15,250.0	702	5,000.0	230

Table L.2.5(2) PRICED BILL OF QUANTITIES FOR IRRIGATION DEVELOPMENT (3/3)

1US$ = Rs.30.5 = ¥140

Item No.	Work Items	Unit	Qty.	Foreign Currency Unit Cost (US$)	Foreign Currency Amount (1,000 US$)	Local Currency Unit Cost (Rs.)	Local Currency Amount (1,000 Rs.)	Total Equivalent Unit Cost (US$)	Total Equivalent Amount (1,000 US$)
56)	Slide gate, 300 mm in dia.	Nos.	29.0	1,440.0	42	4,880.0	142	1,600.0	46.4
57)	" , 375 mm in dia.	Nos.	12.0	1,710.0	21	5,795.0	70	1,900.0	22.8
58)	" , 450 mm in dia.	Nos.	20.0	2,430.0	49	8,235.0	165	2,700.0	54.0
59)	" , 750 mm in dia.	Nos.	10.0	3,420.0	34	11,590.0	116	3,800.0	38.0
60)	" , 900 mm in dia.	Nos.	1.0	4,050.0	4	13,725.0	14	4,500.0	4.5
61)	Radial gate, 4,000 x 2,100 mm	Nos.	1.0	54,000.0	54	183,000.0	183	60,000.0	60.0
62)	" , 4,600 x 1,800 mm	Nos.	4.0	54,900.0	220	186,050.0	744	61,000.0	244.0
63)	" , 4,600 x 2,500 mm	Nos.	5.0	63,000.0	315	213,500.0	1,068	70,000.0	350.0
64)	" , 4,600 x 3,000 mm	Nos.	1.0	65,700.0	66	222,650.0	223	73,000.0	73.0
65)	Concrete pile, 300 mm in dia.	lin.m	5,520.0	24.0	133	488.0	2,694	40.0	220.8
66)	Cofferdam	lin.m	L.S	-	480	-	3,660	-	600.0
67)	Dealing with water	-	L.S	-	42	-	855	-	70.0
	Sub-Total of 3				**11,749**		**126,059**		**15,862.2**
4.	**Drainage Canal**								
A.	Earth work								
68)	Clearing	ha.	540.0	198.0	107	4,026.0	2,174	330.0	178.2
69)	Stripping	cu.m	335,000.0	0.6	201	12.2	4,087	1.0	335.0
70)	Excavation, common	cu.m	2,557,000.0	1.2	3,068	9.2	23,397	1.5	3,835.5
71)	" , rock	cu.m	25,800.0	5.6	145	73.2	1,889	8.0	206.4
72)	Embankment	cu.m	3,117,000.0	1.4	4,489	4.9	15,225	1.6	4,863.0
73)	Turfing	sq.m	523,000.0	0.1	52	15.3	8,002	0.6	313.8
74)	Care of water	-	L.S	-	30	-	610	-	50.0
	Sub-Total of 4				**8,092**		**55,383**		**9,781.9**
	TOTAL OF I				**23,928**		**254,912**		**32,158.4**
II.	**ON-FARM WORKS**								
1)	Rehabilitation, existing on-farm	ha.	38,100.0	230.0	8,763	4,880.0	185,928	390.0	14,859.0
2)	On-farm works for newland	ha.	13,900.0	1,600.0	22,240	12,200.0	169,580	2,000.0	27,800.0
	TOTAL OF II				**31,003**		**355,508**		**42,659.0**
	TOTAL OF I + II				**54,931**		**610,420**		**74,817.4**
III.	**LAND SETTLEMENT COST**				**12,000**		**244,000**		**20,000.0**
	GRAND TOTAL OF I+II+III				**66,931**		**854,420**		**94,817.4**
					(67,000)		(854,000)		(95,000.0)

Table L2.6 BREAKDOWN OF LAND ACQUISITION AND BUILDING COMPENSATION COST

		Q'ty	Unit cost(Rs)	Amount(1,000 Rs)
A. Building				37,000
(1)	Residence/Shop	900 nos.	30,000	27,000
(2)	School	6 "	300,000	1,800
(3)	Hospital	1 "	600,000	600
(4)	Buddhist temple	9 "	600,000	5,400
(5)	Government facilities	3 "	300,000	900
(6)	Others	L.S	-	1,300
B. Land				24,000
(1)	Paddy field	425 ha	40,000	17,000
(2)	Upland cultivation	350 "	20,000	7,000
(3)	Forest/scrub	3,000 "	-	-
	Total			61,000

Notes: The above cost is the land acquisition and building compensation costs for the Moragahakanda reservoir area in about 45 km2.
No land acquisition cost is required at the irrigation development area.

Table L.2.7 OPERATION AND MAINTENANCE COST

Cost Items	Annual O&M Cost (1,000 US $)			
	Dam	Power	Irrigation	Total
1 Sararies and Wages	70	50	230	350
- Staff salary	20	30	100	150
- Labour eages	50	20	130	200
2 Office expenses	30	30	60	120
3 Operation Costs	80	90	500	670
- Fuel and lubricants for vehicle and equipment	70	10	300	380
- Running cost for project facilities	-	70	100	170
- Others	10	10	100	120
4 Maintenance cost	200	150	500	850
- Earthwork	30	10	100	140
- Concrete work	50	10	100	160
- Masonry work	30	10	100	140
- Metal works	40	20	100	160
- Repairing cost for other project facilities	50	100	100	250
5 Miscellaneous	20	20	30	70
Total	400	340	1320	2060

Table L.2.8 O&M EQUIPMENT

Item	Quantity				Unit Price	Amount
	Dam O&M Office	System D RPM Office	Existing ID Office	Total	(1,000 US$)	(1,000 US$)
1. Dragline, 0.6 m3	-	1	-	1	180.0	180
2. Backhoe, 0.6 m3	1	2	2	5	130.0	650
3. Backhoe, 0.3 m3	-	2	2	4	65.0	260
4. Bulldozer, 21 t	-	2	2	4	217.0	868
5. Bulldozer, 11 t	1	2	2	5	101.0	505
6. Dozer shoel, 1.4 m3	-	2	2	4	46.0	184
7. Wheel loader, 1.0 m3	1	2	2	5	57.0	285
8. Motor grader, 3.0 m	1	3	2	6	98.0	588
9. Fuel bowser, 5 kl	-	2	2	4	61.0	244
10. Water bowser, 5 kl	-	6	4	10	61.0	610
11. Vibration roller, 5 t	-	1	1	2	49.0	98
12. Vibration roller, 1 t	-	2	2	4	13.0	52
13. Tamper, 80 kg	-	5	5	10	1.8	18
14. Plate compactor, 90 kg	-	5	5	10	1.7	17
15. Portable concrete mixer, 0.2 m3	1	2	2	5	2.0	10
16. Concrete vibrator, O 45 mm	2	4	4	10	0.7	7
17. Submersible pump, O 150 mm	2	5	5	12	1.5	18
18. Generator, 2 kVA	-	5	5	10	2.5	25
19. Generator, 50 kVA	-	1	-	1	22.0	22
20. Trailer truck, 30 t	-	1	1	2	92.0	184
21. Dump truck, 11 t	1	-	-	1	60.0	60
22. Dump truck, 2 t	-	6	10	16	14.0	224
23. Cargo truck w/crane, 8 t	-	1	2	3	55.0	165
24. Ordinary truck, 8 t	1	2	2	5	30.0	150
25. Truck, 1 t D/cab, 4 x 4	-	15	10	25	9.0	225
26. Jeep, 4 x 4	8	15	10	33	15.0	495
27. Sedan car, 5 persons	1	3	2	6	12.0	72
28. Microbus, 20 persons	1	1	1	3	25.0	75
29. Motor cycle	1	30	30	61	2.0	122
30. Office equipment	L.S.	L.S.	L.S.	L.S.	20.0	20
31. Tractor equipment Tractor w/plough, tiler etc., 60-80 HP	-	20	-	20	18.0	360
32. Welder w/engine	-	4	-	4	3.0	12
33. Spare parts	L.S.	L.S.	L.S.	L.S.	L.S.	695
Total						7,500

Table L.2.9 UNIT COST FOR MAJOR WORKS

1US$ = Rs.30.5 = ¥140.0

Work Items	Unit	F.C (US$)	L.C (Rs.)	Total (US$)
(Dam & power)				
1. Excavation, common	m3	2.3	30.2	3.3
2. Excavation, w/rock	m3	3.9	51.2	5.6
3. Excavation, rock	m3	5.6	73.2	8.0
4. Embankment, core	m3	4.6	60.4	6.6
5. Embankment, filter	m3	9.8	128.1	14.0
6. Embankment, rock	m3	5.3	68.6	7.5
7. Consolidation grout	m	72.8	951.6	104.0
8. Blanket grout	m	72.8	951.6	104.0
9. Curtain grout	m	105.0	1,372.5	150.0
10. Concrete, massive w/form	m3	90.0	457.5	105.0
11. Concrete, structure w/form	m3	90.0	610.0	110.0
12. Re-bar	t	595.0	7,777.5	850.0
13. Metal works (Irrigation)	t	-	-	3,500-7,000
14. Clearing	ha	198.0	4,026.0	330.0
15. Excavation, common	m3	1.4	9.2	1.5
16. Excavation, rock	m3	5.6	73.2	8.0
17. Embankment, canal (Borrowed material)	m3	2.4	18.3	3.0
18. Embankment, canal (Excavated material)	m3	1.4	11.0	1.8
19. Turfing	m2	0.1	15.3	0.6
20. Concrete	m3	56.0	732.0	80.0
21. Metal works, slide gate	Nos.	-	-	1,600-9,300
22. Metal works, radial gate	Nos.	-	-	60,000-73,000
23. On-farm works (Rehabili.)	ha	-	-	390.0
24. On-farm works (Newland)	ha	-	-	2,000.0

Table L.2.10 LABOUR WAGES RATE

1US$ = Rs.30.5 = ¥140.0

Description		Wage/shift (Rs.)*1
1. Guidance engineer, A*2	m.d	US$ 500
2. Guidance engineer, B*3	m.d	US$ 150
3. foreman	m.d	283
4. Operator	m.d	283
5. Assist. operator	m.d	220
6. Driver	m.d	212
7. Mechanic	m.d	177
8. Welder	m.d	170
9. Electrician	m.d	177
10. Carpenter	m.d	167
11. Concrete worker	m.d	147
12. Mason	m.d	135
13. Tunnel worker	m.d	157
14. Steel worker	m.d	147
15. Semi-skilled labour	m.d	120
16. Common labour	m.d	102

Note *1: 8 hours/day. Site cost basis incuding overtime, holiday pay, EPF (Employee's provident fund), ETF (Employee's trust fund), BTT (Business on tax turnover), living allowance etc.

*2: Foreign technician with qualification of Class-A.

*3: - ditto -, Class-B

Table L.2.11 UNIT PRICE OF CONSTRUCTION MATERIALS

1US$ = Rs.30.5 = ¥140.0

No.	Description	Unit	Basic*1 Unit Price	Adjusted Unit Price			
				F.C		L.C	
			Rs.	%	US$	%	Rs.
1.	Fuel	lit.	10	60	0.20	40	4
2.	Cement, portland	t	2,500	70	57.40	30	750
3.	Reinforcement bar, round	t	13,000	75	320.00	25	3,250
4.	Reinforcement bar, deformed	t	14,000	75	344.30	25	350
5.	H-shaped steel	t	16,000	80	420.00	20	3,200
6.	Annealed steel wire	t	13,000	70	298.40	30	3,900
7.	Sand	m3	110	30	1.10	70	77
8.	Gravel, screened	m3	90	30	0.90	70	63
9.	Cobble & rubble stone	m3	120	30	1.20	70	84
10.	Timber, plank	m3	12,000	30	118.00	70	8,400
11.	Plywood, t = 20 mm	m3	19,000	50	311.50	50	9,500
12.	Gas pipe, 2" dia.	m	120	60	2.40	40	48
13.	Gas pipe, 4" dia.	m	300	60	5.90	40	120
14.	Gas pipe, 6" dia.	m	500	60	9.80	40	200
15.	Metal form, 300 x 1,500 mm	pc.	300	80	7.90	20	60
16.	Concrete pipe, 1,000 mm	m	2,500	60	49.20	40	1,000
17.	Concrete pipe, 500 mm	m	1,000	60	19.70	40	400
18.	P.V.C pipe, 2" dia.	m	100	70	2.30	30	30
19.	Gasoline	lit.	15	60	0.30	40	6
20.	Engine oil	lit.	30	80	0.80	20	6
21.	Grease	kg	50	80	1.30	20	10
22.	Dynamite	kg	200	70	4.60	30	60
23.	An-Fo powder	kg	25	100	0.80	0	-
24.	Detonator	pc.	80	100	2.60	0	-
25.	Taper rod, 22 mm	no.	3,000	100	98.40	0	-
26.	Cross bit, 36 mm	no.	3,600	100	118.00	0	-
27.	Electricity	kWh	2	80	0.05	20	0.4
28.	Brick	1,000 pcs.	700	20	4.60	80	560
29.	Asphalt	lit	10	50	0.20	50	5
30.	Water-reducing agent	kg	60	80	1.60	20	12

Note *1: Site delivery basis

Table L.2.12(1/2) HOURLY EQUIPMENT COST FOR DAM AND POWER STATION

(1US$ = Rs.30.5 = ¥140.0)

No.	Plant & Equipment	Capacity	Purchase Cost CIF, Site (US$)	Life (Hr.)	Depreciation Cost Rate (%)	Depreciation Cost F.C (100%) (US$)	Repairing Cost Rate (%)	Repairing Cost F.C (80%) (US$)	Repairing Cost L.C (20%) (Rs.)	Administration Cost Rate (%)	Administration Cost L.C (100%) (Rs.)	Hourly Cost F.C (US$)	Hourly Cost L.C (Rs.)	Hourly Cost Total (US$)
-	-	-	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1.	Crushing plant	250 t/h	4,500,000	12,000	90	338	50	150	1,143	30	3,431	488	4,574	638
2.	Concrete mixing plant	60 m3/h	500,000	10,000	90	45	90	36	275	40	610	81	885	110
3.	Jib crane	9 t	2,100,000	12,000	90	158	30	42	320	40	2,135	200	2,455	280
4.	Bulldozer with ripper	30 t	250,000	7,500	90	30	90	24	183	40	407	54	590	73
5.	Bulldozer	20 t	160,000	7,500	90	19	90	15	117	40	260	34	377	46
6.	Wheel loader	5 m3	260,000	7,000	90	46	80	33	251	40	627	79	878	108
7.	Wheel loader	3 m3	180,000	7,000	90	23	80	16	125	40	314	39	439	53
8.	Tractor shovel	3 m3	180,000	7,000	90	23	70	14	110	40	314	37	424	51
9.	Tractor shovel	2 m3	125,000	7,000	90	16	70	10	76	40	218	26	294	36
10.	Heavy dump truck	30 t	290,000	8,000	90	33	80	23	177	35	387	56	564	74
11.	Heavy dump truck	15 t	170,000	8,000	90	19	80	14	104	35	227	33	331	44
12.	Concrete pump car	60 m3/h	170,000	5,000	90	31	80	22	166	30	311	53	477	69
13.	Motor grader	3.7 m	90,000	6,000	90	14	50	6	46	40	183	20	229	28
14.	Truck mixer	3 m3	43,000	6,000	90	7	50	3	22	30	66	10	88	13
15.	Crawler drill, hydraulic	8 t	160,000	4,000	90	36	50	16	122	30	366	52	488	68
16.	Boring machine	200 m	21,000	5,000	90	4	50	2	13	40	51	6	64	8
17.	Grout mixer	500 lit. x 2	12,000	5,000	90	2	60	1	9	40	29	3	38	4
18.	Grout pump	200 lit./min.	10,000	5,000	90	2	60	1	7	40	24	3	31	4
19.	Air compressor	17 m3/min.	41,000	12,000	90	3	50	2	10	30	31	5	41	6
20.	Truck crane	30 t	250,000	7,000	90	32	40	11	87	40	436	43	523	60
21.	Truck crane	15 t	140,000	7,000	90	18	40	6	49	40	244	24	293	34
22.	Crawler crane	30 t	200,000	7,000	90	26	70	16	122	50	436	42	558	60
23.	Tamping roller	20 t	170,000	9,000	90	17	60	9	69	40	230	26	299	36
24.	Vibraton roller	8 t	85,000	5,000	90	15	50	7	52	40	207	32	259	40
25.	Fuel tanker	8 t	35,000	6,000	90	5	60	3	21	40	72	8	93	11
26.	Water tanker	8 t	34,000	6,000	90	5	60	3	21	40	69	8	90	11
27.	Road roller	10 t	35,000	7,000	90	5	50	2	15	30	46	7	61	9
28.	Saw mill	-	50,000	6,000	90	8	60	4	31	40	102	12	133	16
29.	Work shop car	8 t	85,000	6,000	90	13	60	7	52	40	173	20	225	27
30.	Ordinary truck	6 t	28,000	6,000	90	4	60	2	17	40	57	6	74	8
31.	Truck trailer	30 t	130,000	8,000	90	15	50	7	50	40	198	22	248	30
32.	Cooling plant	200 JRT	230,000	30,000	90	7	30	2	14	60	140	9	154	14
33.	Backhoe	1.2 m3	200,000	7,000	90	26	60	14	105	40	349	40	454	55

Note : (4)={(1)x(3)}/(2)
(6)={(1)x(5)x0.8}/(2)
(7)={(1)x(5)x0.2}/(2)
(9)={(1)x(8)}/(2)
(10)=(4)+(6)
(11)=(7)+(9)
(12)=(10)+(11)

Table L.2.12(2/2) HOURLY EQUIPMENT COST FOR IRRIGATION DEVELOPMENT

(1US$ = Rs.30.5 = ¥140.0)

No.	Plant & Equipment	Capacity	Purchase Cost CIF, Site (US$)	Life (Hr.)	Depreciation Cost Rate (%)	Depreciation Cost F.C (100%) (US$)	Repairing Cost Rate (%)	Repairing Cost F.C (80%) (US$)	Repairing Cost L.C (20%) (Rs.)	Administration Cost Rate (%)	Administration Cost L.C (100%) (Rs.)	Hourly Cost F.C (US$)	Hourly Cost L.C (Rs.)	Hourly Cost Total (US$)
-	-	-	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1.	Motor scraper	11 m3	320,000	7,000	90	41	70	26	195	40	549	67	744	92
2.	Bulldozer w/winch & ripp	30 t	250,000	7,500	90	30	90	24	183	40	397	54	580	73
3.	Bulldozer	20 t	160,000	7,500	90	19	90	16	117	40	275	35	392	48
4.	Bulldozer, swamp	13 t	96,000	6,500	90	13	90	11	81	40	183	24	264	33
5.	Backhoe	1.2 m3	200,000	7,000	90	26	60	14	105	40	366	40	471	56
6.	Backhoe	0.6 m3	110,000	7,000	90	14	60	8	58	40	183	22	241	30
7.	Tractor shovel	2.0 m3	125,000	7,000	90	16	70	10	76	40	214	26	290	36
8.	Tractor shovel	1.0 m3	70,000	7,000	90	9	70	6	43	40	122	15	165	21
9.	Dump truck	10 t	57,000	6,500	90	8	80	6	43	40	122	14	165	20
10.	Tamping roller	20 t	170,000	9,000	90	17	60	9	69	40	244	26	313	36
11.	Vibration roller	0.5 t	10,000	4,000	90	2	50	1	8	40	31	3	39	4
12.	Crawler crane w/dragline	30 t	210,000	7,000	90	27	70	17	128	50	458	44	586	63
13.	Truck crane	20 t	180,000	7,000	90	23	40	8	63	40	305	31	368	43
14.	Truck crane	10 t	100,000	7,000	90	13	40	5	35	40	183	18	218	25
15.	Motor grader	3.1 m	770,000	6,000	90	12	50	5	39	40	153	17	192	23
16.	Air compressor	7 m3/min.	23,000	12,000	90	2	50	1	6	30	31	3	37	4
17.	Diesel generator	200 kVA	47,000	10,000	90	4	40	2	12	30	61	6	73	9
18.	Diesel generator	100 kVA	23,000	10,000	90	2	40	1	6	30	31	3	37	4
19.	Vibration hammer	22 kW	29,000	4,000	90	7	60	4	27	30	61	11	88	14
20.	Submersible pump	4" dia.	3,000	3,000	90	1	110	1	7	30	31	2	38	4
21.	Submersible pump	6" dia.	4,000	3,000	90	2	110	1	9	30	31	3	40	4
22.	Fuel tanker	8 t	35,000	6,000	90	5	60	3	22	40	92	8	114	12
23.	Water tanker	8 t	34,000	6,000	90	5	60	3	21	40	61	8	82	11
24.	Work shop car	8 t	85,000	6,000	90	13	60	7	52	40	183	20	235	28
25.	Truck trailer	30 t	130,000	8,000	90	15	50	7	50	40	214	22	264	31
26.	Road roller	10 t	35,000	7,000	90	5	50	2	15	30	61	7	76	10
27.	Saw mill	-	50,000	6,000	90	8	60	4	31	40	122	12	153	17
28.	Portable crushing plant	50 t/h	250,000	8,000	90	28	80	20	153	30	305	48	458	63
29.	Concrete mixer	0.3 m3	1,500	3,000	90	1	60	1	2	30	31	2	33	3
30.	Ordinary truck	6 t	28,000	6,000	90	4	60	2	17	40	61	6	78	9

Note : (4)=[(1)x(3)]/(2) (10)=(4)+(6)
(6)=[(1)x(5)x0.8]/(2) (11)=(7)+(9)
(7)=[(1)x(5)x0.2]/(2) (12)=(10)+(11)
(9)=[(1)x(8)]/(2)

Table L.2.13 COST BREAKDOWN OF SOCIAL INFRASTRUCTURE

Item	Unit	Requirement D1	D2	A/D	Total	Unit Cost (1,000 Rs.)	Amount (1,000 Rs.)
1. System D O&M Office							
A. PROJECT CENTER							
Project Office	No.	1	-	-	1	2,660	2,660
Quarters - Gr.V	No.	2	-	-	2	530	1,060
Quarters - Gr.IV	No.	10	-	-	10	400	4,000
Quarters - Gr.III	No.	10	-	-	10	280	2,800
Quarters - Gr.II	No.	10	-	-	10	190	1,900
Dormitory	No.	2	-	-	2	530	1,060
World Food Stores	No.	1	-	-	1	260	260
Fertilizer Stores	No.	1	-	-	1	710	710
General Stores	No.	1	-	-	1	710	710
Workshop/Garage	No.	1	-	-	1	5,320	5,320
Development Center	No.	1	-	-	1	8,860	8,860
Circuit Bungalow	No.	1	-	-	1	930	930
Training Center	No.	1	-	-	1	1,870	1,870
Sub-Total PROJECT CENTER							32,140
B. BLOCK CENTERS							
Block Office	No.	3	1	1	5	530	2,650
Quarters - Gr.IV	No.	12	4	4	20	490	9,800
Quarters - Gr.III	No.	18	6	6	30	280	8,400
Quarters - Gr.II	No.	18	6	6	30	190	5,700
Dormitory	No.	6	2	2	10	530	5,300
Stores	No.	6	2	2	10	260	2,600
Sub-Total BLOCK CENTERS							34,450
C. UNIT CENTER							
Unit Service Center	No.	26	7	8	41	270	11,070
Quarters - Gr.III	No.	26	7	8	41	280	11,480
Quarters - Gr.II	No.	26	7	8	41	190	7,790
Stores	No.	26	7	8	41	260	10,660
Wells	No.	156	42	48	246	30	7,380
Sub-Total UNIT CENTER							48,380
D. PROJECT CENTER SCHOOLS							
Sr. Secondary School	No.	1	-	-	1	10,600	10,600
Jr. Secondary School	No.	1	-	-	1	3,190	3,190
Primary School	No.	1	-	-	1	2,130	2,130
Teacher House - Gr.IV	No.	2	-	-	2	490	980
Teacher House - Gr.III	No.	13	-	-	13	280	3,640
Teacher House - Gr.II	No.	1	-	-	1	190	190
Dormitory	No.	3	-	-	3	320	960
Sub-Total PROJECT CETNE SCHOOLS							21,690
E. BLOCK CENTERS SCHOOLS							
Sr. Secondary School	No.	1	-	1	2	10,600	21,200
Jr. Secondary School	No.	3	1	1	5	3,190	15,950
Primary School	No.	3	1	1	5	2,130	10,650
Teacher House - Gr.IV	No.	8	2	4	14	490	6,860
Teacher House - Gr.III	No.	20	5	9	34	280	9,520
Teacher House - Gr.II	No.	3	1	1	5	190	950
Dormitory	No.	11	3	5	19	320	6,080
Sub-Total BLOCK CENTER SCHOOLS							71,210

Table L.2.13 COST BREAKDOWN OF SOCIAL INFRASTRUCTURE (cont'd)

Item	Unit	Requirement D1	D2	A/D	Total	Unit Cost (1,000 Rs.)	Amount (1,000 Rs.)
F. UNIT CENTER SCHOOLS							
Project Office	No.	26	7	8	41	2,130	87,330
Teacher Houses - Gr.III	No.	26	7	8	41	280	11,480
Teacher Houses - Gr.II	No.	26	7	8	41	190	7,790
Dormitory	No.	26	7	8	41	320	13,120
Sub-Total UNIT CENTER SCHOOLS							119,720
G. UTILITIES & SERVICE FACILITIES							
Piped Water Supply	No.	1	-	-	1	21,300	21,300
Rural Electrification	No.				1	22,100	22,100
Sub-Total HEALTH FACILITIES							43,400
H. HEALTH FACILITIES							
Peripheral Health Unit	No.	1	-	-	1	7,620	7,620
Central Dispensary & Quarters	No.	2	-	1	3	1,030	3,090
Mid-wife Clinic & Quarters	No.	7	3	3	13	280	3,640
Rural Dispensary & Quarters	No.	7	3	3	13	280	3,640
Medical Off. Quarters	No.	1	-	-	1	530	530
Staff Quarters - Gr.IV	No.	1	-	-	1	490	490
Staff Quarters - Gr.III	No.	20	-	-	20	280	5,600
Sub-Total BLOCK CENTERS							24,610
I. PUBLIC SERVICE BLDG. & FACILITIES							
Police Station	No.	1	-	-	1	3,540	3,540
Quarters - Gr.IV	No.	1	-	-	1	490	490
Quarters - Gr.III	No.	1	-	-	1	280	280
Domitories	No.	4	-	-	4	320	1,280
Gramavasevaka Office/ Quarters	No.	4	2	2	8	180	1,440
Post Office-Telecom/ Quarters	No.	2	-	-	2	2,130	4,260
Sub-post Office/Quarters	No.	4	2	2	8	530	4,240
Townhall & Office	No.	1	-	-	1	1,330	1,330
Sub-Total PUBLIC SERVICE BLDG. & FACILITIES							16,860
J. SETTLEMENT PROGRAM							
1. Camps & Facilities						Ls	37,900
2. Orientation & Trans.	ha	9,100	2,200	2,600	13,900	14,800	14,800
3. Assistance Inputs							
Housing	ha	9,100	2,200	2,600	13,900	Ls	36,900
Agricultural Tools	ha	9,100	2,200	2,600	13,900	Ls	8,610
Paddy Seed	ha	9,100	2,200	2,600	13,900	Ls	12,300
Tree Plantings	ha	9,100	2,200	2,600	13,900	Ls	4,200
Sub-Total SETTLEMENT PROGRAM							114,710
TOTAL (1)							527,170

Table L.2.13 COST BREAKDOWN OF SOCIAL INFRASTRUCTURE (cont'd)

Item	Unit	Requirement D1	D2	A/D	Total	Unit Cost (1,000 Rs.)	Amount (1,000 Rs.)
2. Moragehakand a Dam O&M Office							
A. Project Office	No.	-	-	-	1	2,660	2,660
Quarter - Gr.V	No.	-	-	-	2	530	1,060
Quarter - Gr. IV	No.	-	-	-	10	400	4,000
Quarter - Gr.III	No.	-	-	-	15	280	4,200
Quarter - Gr. II	No.	-	-	-	20	190	3,800
Domitory	No.	-	-	-	3	320	960
Circuit Bungalou	No.	-	-	-	1	930	930
Store	No.	-	-	-	2	260	520
Workshop/Warehouse	No.	-	-	-	1	5,320	5,320
TOTAL (2)							23,450
3. Others						Ls	59,380
GRAND TOTAL							610,000

Table L.2.14 USEFUL LIFE AND REPLACEMENT COST

Items	Useful Life (Years)	Cost (1,000 US$)
A. Dam & power		
- Hydromechanical works	30	8,928
- Power generating equipment	30	20,976
- Transmission line	25	1,468
B. Irrigation facilities		
- Gate	25	2,019
C. O&M equipment	10	9,833