CHAPTER 9. CONSTRUCTION PLAN AND COST ESTIMATE

9.1 Construction Plan

9.1.1 Mode of construction

It is assumed that the construction works of the Project will be carried out by contractors and suppliers, who will be selected through international competitive tenders. The works will be divided into the following contract packages:

(1) Preparatory works: Temporary buildings for the Project's authority and engineers' use with water and power supply system, relocation road and so forth.

(2) Civil works:

- temporary buildings for contractors' and suppliers' use with water and power supply systems, water and power supply systems for construction, temporary plants and equipment.

- access tunnels, a diversion tunnel, coffer dams, a main dam, a spillway tunnel, grouting tunnels, curtain grouting works, a power intake, a headrace tunnel, a headrace surge tank with a ventilation tunnel, pressure shafts, a power house with a ventilation tunnel, a tailrace tunnel, a tailrace surge tank with a ventilation tunnel, a tailrace outlet, an outdoor switchyard.

- Erik intake weir, a desilting basin, Erik diversion tunnel, a headtank, a penstock, an excess water spillway, Erik power house, a tailrace chamber, an

inlet shaft with air trap chamber, a connecting tunnel.

(3) Supply and installation of hydromechanical equipment and facilities

(4) Supply and installation of electromechanical equipment

(5) Supply and installation of transmission lines and substations

9.1.2 Preparatory works

The preparatory works will include construction of temporary buildings, a relocation road, access roads, power and water supply systems, and a communications system.

The following relocation and access roads and temporary buildings will be constructed by local contractors preceding the main civil works.

(1) Relocation road and access road

- Relocation road	6m wide X 13.5km long
- Existing road to be improved	6m wide X 42.0km long
- Access road to be constructed	6m wide X 10.0km long
- Bridges to be constructed	2 bridge

(2) Temporary buildings

(a) Buildings for authority and engineers: The total floor area is estimated to be about 3,400 m^2, which consist of 420 m^2 for offices, 150 m^2 for motor pool, 600 m^2 for warehouse, 1,900 m^2 for residential buildings, and 300 m^2 for others.

(b) Buildings for contractors: Although these are of contractor's option, the total floor area is

estimated for the purpose of cost estimate to be 8,450 m^2, which consist of 770 m^2 for offices, 450 m^2 for workshop in the construction site, 810 m^2 for warehouses, 780 m^2 for repair shop and motor pool, 5,420 m^2 for residential buildings, and 220 m^2 for others.

(3) Water supply system

Water supply systems for construction and camp use will be constructed separately for each working area by pumping up water from the Ermenek river. The water will be purified if necessary.

The total required capacity of the water supply system is estimated to be 13.5 m^3/min, which consist of 8.7 m^3/min for construction plants, 0.2 m^3/min for temporary buildings, 5.0 m^3/min for construction of dam, 4.3 m^3/min for the waterway, power house and other construction works.

(4) Other facilities

The facilities of a first-aid clinic and a fire fighting system will be constructed.

9.1.3 Construction plants, equipment and materials

(1) Construction plants

The Project will require concrete aggregates of about 711,000 m^3. Quarried rock will be obtained from the quarry site located on the left bank of the dam site.

A crashing and screening plant for concrete aggregates will have a production capacity of 280 ton/hr. Three concrete batcher plants will be provided. One, having

a capacity of 45 m^3/hr, will be located on a banker line at an elevation of 675.0 m on the left bank of dam site, and will be used for the main dam construction works. The second plant of 100 m^3/hr in capacity will be located at the intermediate point of the headrace tunnel, and will be used for concreting works of waterway tunnels and power house. The third concrete batcher plant of about 45 m^3/hr will be located at a point downstream of the dam site for preparatory works and grouting.

A concrete cooling plant with the capacity of 370 RT and 1.0 m^3/min will be provided for precooling of aggregates and cooling of the dam concrete.

(2) Cable crane for dam

A cable crane with movable supports will be installed across the valley for placing the dam concrete. Another cable crane of fixed type will also be provided for carrying supplementary materials.

(3) Other major equipment

The other major equipment required for the construction works are estimated as listed below:

Equipment	Capacity	Quantity
Crawler drill	65	10
Wheel loader	3.2 m^3 class	4
Wheel loader	2.1 m^3 side dump	6
Crawler jumbo	2 booms	12
Bulldozer	43 ton class	12
Bulldozer	32 ton class	4
Bulldozer	24 ton class	4
Back hoe	0.6 m^3	6

Equipment	Capacity	Quantity
Loading shovel	3.8 m^3	1
Rocker shovel	0.4 m^3	12
Battery locomotive	6-4 ton	12
Concrete spraying machine		2
Scaffold		2
Raise climber		1
Concrete pump car	65 m^3/h	4
Truck mixer	4.5 m^3	20
Boring machine		40
Grout pump		60

(4) Main materials

The main materials required for the construction are estimated as follows:

1. Cement	267,000	ton
2. Reinforcement bar	15,000	ton
3. Steel support	400	ton
4. Rock bolt	206,000	m
5. PC anchor	31,000	m
6. Dynamite and ANFO	1,700	ton

9.1.4 Construction power supply and communications systems

(1) Construction power supply system

The peak power requirement is estimated at 14,250 kVA, which consist of 14,000 kVA for construction plants and equipment and 250 kVA for residential building.

A TEK's 34.5 kV distribution line from the Yerköprü power station to Kazançi via Ermenek is running over the proposed dam site across the valley. This line will need some rerouting before commencement of the dam

construction works. A branch line of this line runs along the Mut-Ermenek road, which will be connected to the Gezende power station in the future. After the completion of the Gezende project, the power supply to these lines will be reinforced with the supply from the Gezende side.

Meanwhile, two 34.5 kV permanent lines will be required for the operation and maintenance purposes as well as to send out the generated power at the Erik power station: Line-1 between the Ermenek power station and the Ermenek dam via the Erik power station; Line-2 between the Erik intake and the Erik power station. These 2 lines will be constructed as permanent structures of the Project preceding the commencement of main construction works. The electric power for construction works will be taken from these 2 lines, by providing metering outfits at appropriate points. Diesel generators will also be provided in order to secure the minimum lighting, ventilation and drainage in the underground work sites in case of power failure.

(2) Communications system for construction use

Two communications systems will be provided for the communication during and after the construction period: (A) a system connected to the existing public telephone system including facsimile and telex; (B) a radio telephone system.

(A) Public telephone system

The PTT's Ermenek telephone exchange is connected with the national telephone system through a 2 GHz band microwave radio link via Silifke. Both of ordinary telephone lines and multi-channel carrier telephone lines are available at this telephone

exchange in enough quantity. The latter is appropriate for the communications of the Project.

An automatic private digital telephone exchange will be provided in the authority's construction site office for the connection with the public telephone system, and for the communication among the internal extensions and contractors. This telephone exchange will first be placed at the dam site for the communication during the construction period. It will be shifted to the Ermenek power station upon completion of the construction works and will be used for the operation and maintenance of the Project.

(B) Radio communications system

As the backup communications between the site and the authority's head office in Ankara, a short wave radio communications system will be provided. The system will be of single channel press-to-talk pattern.

9.1.5 River diversion works

After construction of an access tunnel DA-1, a temporary bridge will be constructed across the gorge at an elevation of 515 m (see Plate P10). From the right bank end of the bridge, another access tunnel of 4.0 m in diameter and 80 m in length will be excavated downwards at a slope of 7 per cent to reach the mid point of the diversion tunnel. The diversion tunnel will be excavated from this point concurrently towards upstream and downstream ends. The tunnel will be excavated by full face method, using 2-boom crawler drill jumbo, 2.1 m^3 wheel loaders (side damp), and 11-ton dump trucks. Immediately after the excavation, shotcrete and concrete lining works will be performed.

The river diversion works will be performed in four steps: (A) the Ermenek river will be temporarily dammed up with earth materials available a little upstream of the Görmel bridge; (B) a preliminary upstream coffer dam will be constructed immediately after the temporary damming up of the river flow; (C) after the preliminary coffer dam is filled up to a height of 10 m above the riverbed, the river flow will gradually be released by removing the temporary embankment near the Görmel bridge, and the flow will be diverted to the diversion tunnel; (D) after the diversion, the preliminary downstream coffer dam will be constructed.

Both the upstream and downstream preliminary coffer dams will be of earth embankment type. A 37.5 m high upstream coffer dam of concrete arch type will be constructed after excavation and cleaning of the base rock using back hoes and bulldozers. The dam concrete of about 1,300 m^3 will be transported through the access tunnel DA-1. A 18.5 m high downstream coffer dam will be of concrete gravity type having a dam volume of about 2,600 m^3.

The machinery and materials for construction of the coffer dams will be transported through the access tunnel DA-1, which have an outlet to the dam site at an elevation of 505 m, being about 7 m above the riverbed. The concrete placing works will be carried out using truck cranes of 40-ton class with a bucket of 2 m^3. The concrete will be transported from the concrete bather plant No. 3.

9.1.6 Construction plan of principal structures

(1) Dam and tunnel spillway

After completion of the rock excavation above the banker line and cable crane, the dam excavation works of 570,000 m^3 will be performed by bench cut method with a bench height of 5 m using 1-boom crawler drills,

partially on steep cliff using leg drills with a reduced bench height of 2.5 m.

The excavated rock above banker line will be transported by dump trucks to a spoil bank on both the left and right banks. For the transportation of excavated rock, a temporary road will be constructed at EL. 735 m on the left bank and at EL. 720 m on the right bank. An access tunnel to the dam crest will be used for transportation of the excavated rocks below the temporary roads.

The excavated rocks below the dam crest will be gathered on the riverbed and will be transported to a spoil bank located on the left bank through an access tunnel DA-1 of 7.0 m in diameter and 690 m in length. After completion of the excavation, the consolidation grouting of riverbed will be carried out before placing concrete.

The dam concrete will be placed with a block width of 15 m and a lift height of 2 m, using a 9.5-ton cable crane with a 3 m^3 bucket. The pipe cooling will be carried out using river water. The secondary cooling and precooling will be made using cold water produced by a cooling plant.

The total length of the curtain grout hole will be 386,000 m. The drilling works will be carried out mainly from inside the grouting tunnel, using rotary boring machines for the areas around the dam, and using percussion machines for the other areas. The grouting will be made by packer grouting method.

The grouting tunnels will be 3.5 m in diameter, 6 lines and 3,730 m in total length in the left bank, 1 line of 130 m in length below the riverbed, 7 lines and 10,300

m in total length in the right bank. The total length of the grouting tunnel will amount to 13,580 m. The tunnels will be concrete lined except for that at HWL. On both left and right banks, access roads and tunnels with a slope of 3 per cent (B=2.6 m, H=2.5 m) will be constructed by rail and rocker shovel method for the access to each grouting tunnel.

Each grouting tunnel will be excavated by rail method using rocker shovel of 0.4 m^3 class. Curtain grouting works will be proceeded after lining and placement of the invert concrete. The curtain grouting works will be carried out from the lower tunnels in both banks in accordance with the progress of dam concreting works.

The spillway tunnel of 9.0 m in diameter and 263 m in length will be constructed in the right bank. The tunnel excavation works will be carried out by full face driving method using 2 boom crawler jumbos, 2.1 m^3 class wheel loaders (side dump), and 11-ton class dump trucks. The excavated rocks will be hauled out through an access tunnel SAT (see Plate P14). Immediately after completion of the excavation works, rock bolting, shotcreting and concrete lining will be carried out.

The excavation of gate shaft will be carried out in 2 steps; first, a 2 m square pilot shaft will be excavated from the bottom using leg drills and a raise climber; the pilot shaft will be enlarged to the full section using 1 boom drills and 0.6 m^3 class back hoes. The excavated rocks will be gathered in the spillway tunnel, and will be hauled out through an access tunnel SAT. After completion of the excavation, rock bolting and concrete lining will be proceeded.

(2) Headrace tunnel and surge tank

The headrace tunnel will be 6.1 m in diameter and 9,042 m in length. Four work adits of 7.0 m wide will be constructed for the tunnel works. The tunnel excavation works will be simultaneously carried out at three excavation faces. The excavation will be made in the similar way to that for the tunnel spillway. The concrete lining will be performed using a teleform centle of 15 m long, followed by the consolidation grouting.

The excavation of headrace surge tank will be carried out in the similar way to that for the spillway gate shaft; a 2 m square pilot shaft will be excavated from the bottom using 2 leg drills and a raise climber and thereafter the pilot shaft will be enlarged to the full section using a 1 boom crawler drill and a 0.6 m^3 class back hoe. The excavated rocks will be gathered into the headrace tunnel through the pilot shaft, and will be hauled out through work adit No. 5 using 11-ton class dump trucks. After completion of the excavation works, shotcreting, concrete lining and grouting will be proceeded.

(3) Pressure shaft

The pressure shaft will consist of an upper horizontal tunnel, inclined shaft portion of double lanes, and lower horizontal tunnel portion of double lanes. The horizontal portions will be excavated in the similar way to that for the headrace tunnel. The excavation of an inclined shaft will comprise 2 construction stages: a 2 m square pilot shaft will be excavated from the bottom using 2 leg drills and a raise climber followed by the enlargement to the full section. The excavated rocks will be gathered into the pilot hole and will be

hauled out to the spoil bank through the access tunnel of the power house, using 11-ton class dump trucks.

After completion of excavation, steel liners will be transported into the inclined shaft from the upper side, and will be installed from the bottom upward. Concrete will be filled after fixing each pipe unit.

(4) Tailrace tunnel and surge tank

The tailrace tunnel will be 6.1 m in diameter and 1,764 m in length. The construction of tailrace tunnel will be carried out concurrently from both the upstream and downstream ends, in the similar way to that for the headrace tunnel. The construction of the tailrace surge tank will be carried out in the similar way to that for the headrace surge tank.

(5) Underground power house

For the construction of the underground power house, access tunnels of 1,350 m in total length will be constructed; the ventilation tunnels of 600 m long will also be used for the construction works. These tunnels will be branched to approach the arch crown, generator floor, and bottom of the power house.

The excavation of the arch portion will be performed from adits at the crown and both springings. Enlargement will be conducted, immediately followed by rock bolting and shotcreting. 2 boom crawler jumbos, 2.1 m^3 class wheel loaders (side dump), 11-ton class dump trucks and 3.8 m^3 class loading shovels will be used for the excavation.

Horizontal tunnels will be constructed at the levels of generator floor and the bottom of power house, followed

by a vertical shaft connecting these. The main cavern will be enlarged by bench cut method with a height of 2 m. The construction machinery will be 1-boom crawler drills, 3.8 m^3 class loading shovels and 3.2 m^3 class wheel loaders. The excavated rocks will be gathered into the horizontal tunnel through the vertical shafts, and will be hauled out using 11-ton class dump trucks.

PC anchor, rock bolting and shotcreting works will be carried out as soon as the local excavation is completed.

9.1.7 Erik Diversion Scheme

The diversion tunnel will have a semi-horseshoe type section of 2.2 m in width, 2.3 m in height, and 3,580 m in length. The tunnel excavation will be performed concurrently from both the upstream and downstream ends. Because of the topography, no work adit will be provided in the middle of the tunnel. It will be excavated in full face by rail method, using 0.2 m^3 class rocker shovels, 4-ton class battery locomotives, and three 2.0 m^3 class muck-cars of side dump type. After completion of the excavation works, concrete lining will be proceeded. 30 months will be required for the excavation at a progress rate of 70 m a month. 25 months will be required for concrete lining: 15 months for the arch and side wall portion at a rate of 150 m a month; 10 months for the invert at a rate of 200 m a month.

9.2 Construction time schedule

The construction schedule of the Project was prepared with the base year at the commencement of the detailed design, assuming a local tender for the preparatory works, and international tenders for the main construction works.

As shown in Plate P8, the detailed investigation and design works including the preparation of tender documents will be continued for 3.5 years. Local contractors will construct access roads and tunnels to the proposed dam site in the 2nd and 3rd years counting from the base year, while contractors for the main works will be selected within the 3rd year. Construction works of the main civil works will be started from the 4th year and the river diversion will be performed at the beginning of the 5th year. Supply and erection works of the hydromechanical facilities, electromechanical equipment and a 380 kV power transmission line will be started in the 8th year. All the construction works will be completed at the middle of the 10th year upon completion of the critical path works of the curtain grouting in the limestone block, and the commissioning tests will follow.

When the dam is constructed up to the elevation of 615 m (LWL) in the late 8th year, the river diversion tunnel will be closed to start initial filling of the reservoir. Construction works of the dam body will be completed in the late 9th year. In the late 10th year, the reservoir would be filled to half of the effective storage capacity, and the generating facilities will be commissioned.

The main work schedule will be as follows:

Work Items	Number of months from commencement of detailed design
Relocation & access roads	1 year from 13th to 24th month
Access road and tunnel to dam site	1 year from 25th to 36th month
Access road and tunnel to diversion tunnel	1 year from 25th to 36th month
Diversion tunnel	1 year from 37th to 48 month
River diversion	at 49th month

Work Items	Number of months from commencement of detailed design
Dam excavation above crest	5 months from 47th to 51st
Dam excavation below crest	16 months from 53rd to 68th
Dam concrete	3 years from 69th to 104th
Grouting tunnel	56 months from 49th to 104th
Curtain grout	54 months from 61st to 114th

9.3 Construction Costs

9.3.1 Basic conditions and assumptions

Construction costs of the Project were estimated based on the price levels as of November 1989. The then exchange rate was US$1.00 = TL2,300 = ¥143.

The contractor's overhead and profit were assumed at 25 per cent of the direct construction cost. Customs were not included assuming that the Project would be encouraged with the Government's incentive measures. Value added tax of 10 per cent was added.

It was assumed that most of the construction machinery would be imported from the West Europe and/or Japan. The purchase prices were estimated based on the market prices, or were assumed at 80 to 85 per cent of the prices published. The prices included ocean freight and insurance costs, which were assumed at 0.05 times the purchase prices.

The concept and conditions on depreciation costs of construction machinery are different from country to country. Foreign contractors would have their own depreciation system depending on their country. After reviewing the

practice in Turkey, the depreciation costs were estimated with some adjustments for the depreciation period of equipment and costs for non-working time with reference to the standard in Japan.

No indirect cost was accounted for exploiting the riverbed deposits and quarrying rocks, and no right-of-way cost was considered.

To estimate interest during construction (IDC), an implementation mode by a public organization with an international soft loan combined with a commercial loan was assumed.

The following repayment conditions were assumed for the 2 loans:

(1) Loan-1

An international soft loan of the following conditions would be provided in hard currency including IDC for Loan-1:

- amount	:	75 per cent of the eligible cost, which excludes ordinary administration costs, taxes, and so forth.
- interest rate	:	2.9 per cent per annum
- loan period	:	30 years including a grace period
- grace period	:	the construction period, = 10 years

(B) Loan-2

The rest of the cost was assumed to be financed by a commercial loan including IDC for Loan-2 under the following conditions:

- interest rate : 8.0 per cent per annum
- loan period : 20 years including the grace period
- grace period : 10 years

9.3.2 Construction Costs

Basic prices of labors, materials and equipment used in the cost estimate are shown in Tables 9.1 to 9.3. The estimated financial costs of the Project are given in Table 9.4, with a bill of quantities in Table 9.5.

IDC was calculated for the above loan conditions as shown in Table 10.4. The IDC for Loan-1 was estimated to be US$51.6 million, and US$54.5 million for Loan-2.

The financial costs of the Project were estimated at about US$552 million including the VAT of US$41 million and an IDC of US$106 million. These consisted of about TL773 billion (equivalent to US$336 million) of local currency portion and about US$216 million of foreign currency portion, as broken down below:

(US$ million at Nov. 1989 price levels)

Work Items	Foreign Portion	Local Portion	Total
1. Land acquisition	0.21	11.52	11.73
2. Direct construction cost	139.73	176.51	316.24
3. Administration & engineering	15.45	21.41	36.86
4. Physical contingency	14.59	26.00	40.59
5. Total construction cost	169.98	235.44	405.42
6. VAT (10 %)	17.00	23.54	40.54
7. IDC	28.90	77.20	106.10
8. Total investment costs	215.88	336.18	552.06

CHAPTER 10. PROJECT FEASIBILITY

10.1 Impacts on the Gezende Power Station

As described in Section 4.2 and 7.1, the Project will have both a firming-up effect and an adverse effect on the downstream power stations. These effects were assessed only for the Gezende power station and were reflected to the plan formulation study. The effects on the Kayraktepe power station were not taken into consideration as it is not yet in the construction stage.

These effects on the Gezende power station were assessed as summarized below for the proposed HWL of 675 m:

No.	Items	Unit	without Ermenek	with Ermenek	Increase
	Firm-up effect				
(1)	Firm energy	GWh	118	526	408
(2)	2ndary energy	GWh	448	115	-333
(3)	Annual energy	GWh	566	641	75
(4)	90% dependable power	MW	41	150	109
(5)	Annual benefit	Mil.$	18.6	34.9	16.3
	Adverse effect during first stage filling				
(1)	Firm energy	GWh	118	118	-
(2)	2ndary energy	GWh	448	71	-377
(3)	Annual energy	GWh	566	189	-377
(4)	90% dependable power	MW	41	41	-
(5)	Annual benefit	Mil.$	18.6	9.8	-8.8

As shown in the table above, the Project would decrease the economic benefit of the Gezende power station by about US$8.8 million a year during the initial filling period. After completion of the filling however, the Project will increase the Gezende benefit by US$16.3 million per annum.

10.2 Economic Evaluation

(1) Economic costs

The financial construction costs of the Project were estimated as described in Section 9.3. The economic costs were estimated by adjusting the financial costs in the following way:

(A) Price contingencies were not included in the economic costs as they were not included in the assessment of power benefits.

(B) Compensation costs were excluded being transfer payments within the national economy of Turkey. There are few valuable non-movable assets in the proposed reservoir area except for the farmland. The agricultural production forgone was assumed to take place after the start of initial filling of the reservoir, and was capitalized to the starting year of initial filling with a discount rate of 9.5 per cent per annum.

(C) In addition to the above 2 adjustments, all non-tradable goods were adjusted to economic costs; all tradable goods were adjusted to border prices. This was accomplished by applying a standard conversion factor (SCF) of 0.8 to the local currency cost. This SCF was adopted in accordance with that estimated by the World Bank for the nation's economy.

The economic costs were thus evaluated as summarized below:

(A)	Construction cost	:	US$346.4 million
(B)	Production forgone	:	US$6.6 million
(C)	Operation and maintenance cost	:	US$0.71 million per yr

(2) Economic power benefit

The economic power benefit of the Project was assessed at US$79.93 million per annum using the power values described in Section 3.6. Of the benefit US$16.29 million or 20 per cent are attributable to the firming-up effect to the Gezende power station.

However, due to the adverse effects of initial filling of the large Ermenek reservoir on the Gezende power station, the power benefits after commencement of the initial filling will be as follows:

Year	Power Benefit (US$ million)
1	-2.20
2	-8.79
3	10.77
4	79.93
.	.
.	.
50	79.93

(3) Economic internal rate of return (EIRR)

The power values were evaluated in Section 3.6 with a discount rate of 9.5 per cent. This rate is the opportunity cost of capital in the energy sector of Turkey (OCC). The disbursement schedule was estimated in

accordance with the construction time schedule shown in Plate P8 (see Sub-section 7.3.5 for the disbursement schedule). The assessment period was taken as 60 years including the 10 years for the detailed design and construction works.

The power benefit and cost streams are shown in Table 10.1. The capitalized benefit will amount to US$350.8 million at the level of the starting year of the detailed design; the cost US$198.6 million; and the net benefit US$152.2 million. The B/C ratio will amount to 1.76.

The EIRR of the Project was assessed at 14.9 per cent. This EIRR much exceeds the OCC of 9.5 per cent.

(4) Economic sensitivity

The economic sensitivity of the Project was examined for the following 5 cases of different costs and benefits:

Case-1: Investment costs increase by 10 per cent

Case-2: Investment costs increase by 20 per cent

Case-3: Relative increase of the fuel prices to other commodities at 20 per cent (in the base case it was assumed at 30 per cent)

Coal	US$52/ton	----------> US$48/ton
Natural gas	US$130/1,000 m^3	---> US$120

Case-4: Case-1 + Case-3

Case-5: Case-2 + Case-3

In Cases-3, 4 and 5, the power values become US¢6.267 per kWh of the firm energy and US¢2.154 per kWh of the secondary energy.

The EIRR was obtained for the above 5 cases as summarized below:

Case	Economic Construction Costs (Mil.US$)	Fuel Price in 2004 (US$)	EIRR (%)
Base	346.4	Coal 52, NG 130	14.9
Case-1	381.0	Coal 52, NG 130	13.9
Case-2	415.7	Coal 52, NG 130	13.0
Case-3	346.4	Coal 48, NG 120	14.5
Case-4	381.0	Coal 48, NG 120	13.6
Case-5	415.7	Coal 48, NG 120	12.7

The Project will have EIRR much higher than OCC of 9.5 per cent for all the cases, that is, the economic feasibility will be sound against the possible changes in the future economic conditions.

10.3 Financial Analysis

The financial construction costs of the Project were estimated in Section 9.3 except for the price contingency and customs.

(1) Price contingency

The recent decade of 1980s had been highly inflationary for the Turkish economy. During this period the Government of Turkey has set long-term goals in which the market forces would be the determining factor of the nation's economy. One of the first programs of the newly elected government in 1983 was to gradually relax the exchange rates and to cut back most of the subsidies.

The wholesale price index (WPI), estimated by the State Institute of Statistics (SIS), was used to project the future inflation. The estimation of the WPIs has been

based on long-term policy objectives as set by the Government of Turkey, in which the inflation rates are to be gradually decreased. These long-term plans were assumed herein as decreasing the rate of inflation stepwise over the next 10 years: by 20 per cent for 1990-1994; by 10 per cent for 1995-1999; to eventually attain an inflation rate of 10 per cent by 2000.

A breakdown of these projections is presented in Table 10.2. As seen from the figures, the price escalation will be tremendous for the construction period of 10 years of the Project, or would become 820 per cent in the 10 years. It is therefore considered wise not to include price contingencies in the financial cost estimate at this feasibility study stage, but to express all the costs and power tariff at the November 1989 fixed price levels.

(2) Government's incentive measures

The Government of Turkey publishes/revises investment incentive measures on an annual basis: Foreign Investment Regulation and Application Forms, Foreign Investment Directorate, the State Planning Organization (SPO). The institutional responsibility for determining and implementing the incentive programs are with SPO.

The most recently published version of these measures was in May 1989. Although the basic elements of each of the incentives do not change significantly, there are frequent refinements.

Based on the latest incentive measures, investment projects which may be eligible for an Incentive Certificate by SPO are those with a total fixed investment value over 150 million TL (approximately US$65,000 in

mid-1989) in Priority Regions and 750 million TL (approximately US$326,000 in mid-1989) in all other regions.

Since energy-related investments are not included in the investment list as ineligible for an Incentive Certificate, investment in the Project would be encouraged by the Government by benefits from the incentives.

The main form of incentives that are granted to energy related investments are:

(A) 100 per cent customs exemption for all machinery and equipment needed for the investment.

(B) Exemption from the value added tax (VAT) during the investment period. However, the cumulative amount of the VAT will be collected after completion of the investment period.

Accordingly, customs were not included in the financial costs. VAT of 10 per cent was added to the financial cost as the conditions for VAT exemption are not very clear.

(3) Power tariff and operating revenue

The power tariff has been often revised to adjust for the inflation. The latest tariff was effective from September 1, 1989. The average tariff per unit energy sold was TL131.23/kWh, equivalent to US¢5.7/kWh (US$1.00=TL2,300). This average tariff seems to be rather low. It is of the same order as the generation cost of thermal power plants. If the costs for power transmission, distribution and the overhead expenses are included, the overall cost per sold energy would exceed this average tariff.

The operating revenue was, however, estimated with the latest average tariff of US¢5.7/kWh. The revenue was obtained by multiplying this tariff to the salable energy, which was obtained by deducting station use and transmission and distribution losses of 12 per cent in total. This loss rate was assumed based on the average rate of the overall national power system at 14.5 per cent, with an adjustment for the close location of the Project to the demand center.

No financial effect was taken into account as to the increase of firm energy output of the Gezende power station.

The operating revenue was then estimated at US$52.9 million per annum.

(4) Financial internal rate of return (FIRR)

A financial cash flow table was prepared as shown in Table 10.3. The disbursement schedule was prepared based on the construction time schedule with consideration to the advance payment of 20 per cent and retention money of 10 per cent. FIRR was obtained at 8.7 per cent being slightly lower than the economic OCC. In spite of the high economic viability of the Project, it will need some financial arrangements like provision of soft loans.

The Government of Turkey has an implementing policy of energy related projects by Build-Operate-Transfer system (BOT) in conjunction with its privatization policy. However, as shown above, the Project would need some financial arrangements. Accordingly, an implementation mode by a public organization was assumed as described in Sub-section 9.3.2. In this implementation mode, the Government budget will not be input except for incentive measures.

The Project cash flow table was prepared as shown in Tables 10.4. The total loan amount including IDC was obtained to be about US$386 million for Loan-1; US$166 million for Loan-2; or US$552 million in total. Both the two loans can be paid back out of the operating net income. Upon completion of the repayment to Loan-1, the accumulated operating surplus will amount to US$270 million.

It is judged that the Project has a financial viability even for the present tariff of US¢5.7/kWh if it is implemented by an public organization with a soft loan.

CHAPTER 11. FURTHER STUDIES

11.1 Decision of Mode of Implementation

As examined in Section 10.3, the unit generation cost of electricity would be acceptable to TEK when the Project is implemented as a public project being financed with a soft loan. It is recommended that the Government of Turkey scrutinize and determine the mode of implementation of the Project at an early stage, so that the financial arrangement can be started.

11.2 Geological Investigations

Further geological investigation is necessary to ensure safe and economical design under such the condition that limestone is prevailing. At the proposed dam site it is necessary to clarify the conditions at the contact zone of the limestone block and the Görmel Formation near the proposed right end of the grout curtain in the right bank and also the underground conditions of the joint systems including faults. The extent, solution condition and mechanical properties of the limestone block for the proposed power house cavern should be examined by means of core boring, test adit and in-site rock test.

Drilling works will also be required at those structure sites as portal of work adits on the waterway routes, outlet of the tailrace tunnel, outdoor switchyard, the Erik headtank, penstock, power house, and inlet shaft sites.

Although EİE is carrying out some geological investigations in order to clarify the problems emerged during the course of study, it is assumed that a lot of time will be required to obtain all the information necessary for the

detailed design. It is recommended that a detailed schedule of geological investigation be prepared and the EIE's investigation be continued accordingly.

11.3 Hydrological Measurements

An automatic water level recorder was installed by EIE in July 1990 near the Ermenek dam site. It will be important to continue water stage observation using this recorder to clarify actual conditions of the daily water level changes due to snow-melt, as well as to collect and analyze information on the shape of the flood hydrograph. It is recommended that automatic raingauges be installed in the Ermenek river basin for clarification of the rainfall characteristics of shorter durations than 24 hour and the basin lag.

Suspended load measurements should be started at the proposed Erik intake weir site, to collect data necessary for the decisions on the necessity and design of a desilting basin.

11.4 Design Works

The Erik Diversion Scheme was designed at only a prefeasibility level, because this scheme was emerged during the progress of the Study. A thorough review of the design is necessary. The detailed design of the Project facilities including detailed construction planning should be started, so that the construction works of the access roads and temporary facilities can be commenced in a good timing.

11.5 Environmental Impact Study

The main environmental issues were identified and countermeasures to them were proposed based on investigations to date. As in any reservoir project, it is important

to have detailed social and environmental studies made so that future problems can be avoided by timely mitigation or avoidance. These studies should include a biological inventory study, fishery and tourism potential studies, and consultations, including questionnaire studies, with local people.

11.6 Effect on the Upper Ermenek Plans

The proposed Ermenek reservoir will extend beyond the Nadire dam site, or up to a point about 3 km downstream of the confluence of the Ermenek river and the Günder river. Accordingly, for the development of hydropower potential of the upper Ermenek river above the HWL of 675 m, a new planning study will be required.

Since no hydrological and geological surveys have been made yet, only a provisional idea conceivable for the upper Ermenek river is shown in Plate A38 for reference.

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TABLES

Table 1.1 NAME LIST OF EİE COUNTERPART PERSONNEL (1/2)

Project Department

Mr. Nezih SAYAN	: Head of Project Department
Mr. Engin ERBERİK	: Chief of Reconnaissance and Planning Div.
Mr. Şükrü KARABİBER	: Chief of Dam and HPP Div.
Mr. Necati KUŞKONMAZ	: Chief of Run-of-River HPP Div.
Mr. Yildirim BARIK	: Chief of Basin Planning Div.
Mr. Mehmet GÜNGÖR	: Chief of Electrical and Mechanical Div.
Mr. Erdem ÖZYURT	: Chief of Mapping Div.
Mr. Volkan DİPÇIN	: Civil Engineer
Mr. Muharrem AYBAKIR	: Electrical Engineer
Ms. Muâllâ DEMİRDELEN	: Mechanical Engineer
Ms. Sule AKÇAY	: Civil Engineer
Ms. Gülgün GÜRÇAN	: Civil Engineer
Ms. Hatice TURAN	: Civil Engineer

Geology and Drilling Department

Mr. Aydin KIRMACIOĞLU	: Head of Geology and Drilling Department
Mr. Vedat ÇAĞLAYIK	: Geological Engineer
Mr. Orhan YAĞCI	: Chief of Geotechnical Service Div.
Mr. Yüksel TAN	: Chief of Rock, Foundation and Laboratory Div.
Mr. Mahmut KIRIŞ	: Chief of Drilling Div.
Mr. Osman DEMİRAĞ	: Chief of Geophysic Div.
Mr. Seyhan ÖNÇ	: Geological Engineer (MSc) Responsible Geologist

Table 1.1 NAME LIST OF EİE COUNTERPART PERSONNEL (2/2)

Hydrological Survey Department

Mr. Mete TÜRKSOY	: Head of Hydrological Survey Department
Mr. Sabahattin YALKIN	: Meteorological Engineer, Hydrologist
Mr. Hüseyin GÜRİPEK	: Chief of Hydrometric Evaluation Division
Mr. Halil MERMER	: Chief of Hydrometric Observation Division
Mr. Adil ALIŞIK	: Chief of Sediment Survey Div.
Mr. Mehmet TANRIKULU	: Chief of Project Hydrology Div.
Mr. Hayati HANÇER	: Meteorological Engineer, Hydrologist

Table 3.1 INSTALLED CAPACITIES OF GENERATING PLANTS BASED ON ENERGY SOURCES (1988)

(Unit: MW)

	TEK	Power Companies	Self Generation	Turkey Total	Proportion in Turkey		
					%	%	%
(1) Solid Fuel							
Hard Coal	129.0	-	52.6	181.6	3.9	2.2	1.3
Lignite	4,328.0	-	128.4	4,456.4	96.1	53.7	30.7
Subtotal	4,457.0	-	181.0	4,638.0	100.0	55.9	31.9
(2) Liquid Fuel							
Fuel Oil	680.0	106.0	761.6	1,547.6	74.0	18.6	10.7
Motorin, Gas Turbine	333.6	-	-	333.6	16.0	4.0	2.3
Diesel	5.6	-	204.8	210.4	10.0	2.5	1.4
Subtotal	1,019.2	106.0	966.4	2,091.6	100.0	25.2	14.4
(3) Others							
Geo Thermal	15.0	-	-	15.0	1.0	0.2	0.1
Natural Gas	1,555.2	-	-	1,555.2	99.0	18.7	10.7
Subtotal	1,570.2	-	-	1,570.2	100.0	18.9	10.8
(4) Thermal Total	7,046.4	106.0	1,147.4	8,299.8	-	100.0	57.2
(5) Hydro Total	5,935.1	272.4	10.8	6,218.3	-	-	42.8
(6) Grand Total	12,981.5	378.4	1,158.2	14,518.1	-	-	100.0

Source: TEK

Table 3.2 DEVELOPMENT OF INSTALLED CAPACITY

(Unit : MW)

Year	Turkey				T E K			Power Companies			Self Generation, etc.		
	Thermal	Hydro.	Total	Increase (%)	Thermal	Hydro.	Total	Thermal	Hydro.	Total	Thermal	Hydro.	Total
1975	2,407.0	1,779.6	4,186.6	-	1,708.5	1,520.7	3,229.2	106.0	219.8	325.8	592.5	39.1	631.6
76	2,491.6	1,872.6	4,364.2	4.2	1,771.1	1,613.8	3,384.9	106.0	219.8	325.8	614.5	39.0	653.5
77	2,854.6	1,872.6	4,727.2	8.3	2,071.1	1,613.8	3,684.9	106.0	219.8	325.8	678.0	39.0	717.0
78	2,987.9	1,880.8	4,868.7	3.0	2,178.8	1,622.0	3,800.8	106.0	219.8	325.8	703.1	39.0	742.1
79	2,987.9	2,130.8	5,118.7	5.1	2,178.8	1,872.0	4,050.8	106.0	219.8	325.8	703.1	39.0	742.1
80	2,987.9	2,130.8	5,118.7	0.0	2,178.8	1,872.0	4,050.8	106.0	219.8	325.8	703.1	39.0	742.1
81	3,181.3	2,356.3	5,537.6	8.2	2,344.7	2,097.5	4,442.2	106.0	219.8	325.8	730.6	39.0	769.6
82	3,556.3	3,082.3	6,638.6	19.9	2,719.7	2,823.5	5,543.2	106.0	219.8	325.8	730.6	39.0	769.6
83	3,695.8	3,239.3	6,935.1	4.5	2,937.6	2,998.5	5,936.1	106.0	218.4	324.4	652.2	22.4	674.6
84	4,584.3	3,874.8	8,459.1	22.0	3,542.9	3,644.2	7,187.1	106.0	218.4	324.4	935.4	12.2	947.6
85	5,244.3	3,874.8	9,119.1	7.8	4,417.9	3,644.2	7,792.1	106.0	218.4	324.4	990.4	12.2	1,002.6
86	6,235.2	3,877.5	10,112.7	10.9	5,141.8	3,644.2	8,786.0	106.0	222.4	328.4	987.4	10.9	998.3
87	7,489.3	5,003.3	12,492.6	23.5	6,290.8	4,720.1	11,011.0	106.0	272.4	378.4	1,092.4	10.8	1,103.2
88	8,299.8	6,218.3	14,518.1	16.2	7,046.4	5,935.1	12,981.5	106.0	272.4	378.4	1,147.4	10.8	1,158.2

Source: TEK

Table 3.3 DISTRIBUTION OF ELECTRICAL ENERGY GENERATION BY PRIMARY ENERGY SOURCES

Year	Hard Coal (%)	Lignite (%)	Oil Products (%)	Other /1 Fuels (%)	Hydraulic (%)	Total Generation (GWh)
1975	9.1	17.2	34.5	1.4	37.8	15,623
76	7.4	16.3	29.6	0.9	45.8	18,283
77	6.2	17.6	33.4	1.1	41.7	20,565
78	5.6	20.1	30.7	0.6	43.0	21,726
79	4.7	23.8	25.1	0.6	45.8	22,522
80	3.9	21.7	25.0	0.6	48.8	23,275
81	3.6	21.3	23.6	0.4	51.1	24,673
82	3.4	20.8	22.4	-	53.4	26,552
83	2.9	28.5	27.1	-	41.5	27,347
84	2.3	30.7	23.0	0.1	43.9	30,613
85	2.1	41.8	20.7	0.2	35.2	34,219
86	2.0	47.0	17.6	3.5	29.9	39,695
87	1.4	38.4	12.4	5.8	42.0	44,353
88	0.7	25.3	6.9	6.8	60.3	48,049

/1: Fire wood generation upto 1981 and natural gas and geothermal after 1984. However, the share of geothermal is nearly zero in the period.

Source: TEK

Table 3.4 TURKEY'S DEVELOPMENT OF ENERGY GENERATION

(Unit: GWh)

Year	Thermal	Hydro.	Total	Increase (%)	Import	Gross Supply	Increase (%)	Distribution of Generation		
								TEK	Power Companies	Self Generation etc.
1975	9,719	5,904	15,623	-	96	15,719	-	12,845	1,730	1,048
76	9,908	8,375	18,283	17.0	332	18,615	18.4	15,454	1,639	1,190
77	11,973	8,592	20,565	12.5	492	21,057	13.1	17,230	1,716	1,617
78	12,361	9,365	21,726	5.6	621	22,347	6.1	17,968	1,875	1,883
79	12,218	10,304	22,522	3.7	1,044	23,566	5.5	18,934	1,554	2,034
80	11,927	11,348	23,275	3.3	1,341	24,616	4.5	19,414	1,610	2,251
81	12,057	12,616	24,673	6.0	1,616	26,289	6.8	20,588	1,937	2,148
82	13,385	14,167	26,552	7.6	1,773	28,325	7.7	23,243	1,590	1,719
83	16,004	11,343	27,347	3.0	2,221	29,568	4.4	23,689	1,618	2,040
84	17,187	13,426	30,613	11.9	2,653	33,266	12.5	26,686	1,691	2,237
85	22,174	12,045	34,219	11.8	2,142	36,361	9.3	30,249	1,592	2,378
86	27,822	11,873	39,695	16.0	777	40,472	11.3	35,470	1,454	2,771
87	25,735	18,618	44,353	11.7	572	44,925	11.0	36,679	1,592	3,082
88	19,099	28,950	48,049	8.3	381	48,430	7.8	43,014	1,858	3,177

Source: TEK

Table 3.5 DEVELOPMENT OF POWER LINE LENGTH IN TURKEY

	Transmission Lines					Distribution Lines	
	380kV	220kV 1/	154kV	66kV 2/	Total	3/, 4/	Grand total
1979	2,870	93	11,393	2,436	16,792	161,678	178,470
80	2,870	93	12,937	2,447	18,347	188,781	207,128
81	2,918	93	12,818	2,418	18,247	198,869	217,116
82	3,679	93	13,388	2,279	19,439	213,473	232,912
83	4,068	93	14,247	2,301	20,709	228,039	248,748
84	4,485	15.7	15,184	2,302	21,987	250,743	272,730
85	4,995	15.7	16,472	2,179	23,662	279,014	302,676
86	5,767	95.7	17,468	2,006	25,257	309,815	335,072
87	6,606	87.5	17,985	1,919	26,598	344,839	371,437
88	7,202	87.5	18,832	1,772	27,894	381,850	409,744

1/: For interconnection with foreign power systems only.
2/: 66kV lines were converted to 33kV where demand is small.
3/: 34.5kV and lower tension lines.
4/: Village electrification lines are included. For 1979-85 period, the total is obtained assuming 5km line length for every village. After 1986, actual length is used.

Source: TEK

Table 3.6 DEVELOPMENT OF QUANTITY AND CAPACITY OF TRANSFORMER IN TURKEY

	380kV, 3/		154kV		66kV		Sub Total		Distribution Tr.4/		Total	
Capacity		Capacity		Capacity		Capacity		Capacity		Capacity		
Year	Q'ty	(MVA)	Q'ty	(MVA)	Q'ty	(MVA)	Q'ty	(MVA)	Q'ty	(MVA)	Q'ty	(MVA)
1979	17	2,610	248	6,490	293	1,526	558	10,626	34,070	9,241	34,628	19,867
80	20	3,060	279	8,067	295	1,544	594	12,671	37,205	11,066	37,799	23,738
81	22	3,360	294	2,224	294	1,571	610	13,155	38,821	11,402	39,431	24,557
82	25	3,810	307	8,585	297	1,585	629	13,981	41,589	13,060	42,218	27,041
83	29	4,410	323	9,219	299	1,691	651	15,320	45,212	13,411	45,863	28,731
84	30	4,530	354	10,945	298	1,731	682	17,206	47,298	13,566	47,980	30,772
85	36	5,730	392	11,843	265	1,753	693	19,385	51,385	13,823	52,078	33,149
86	49	7,680	427	13,702	167	1,358	643	22,740	62,639	14,612	63,282	37,352
87	55	8,610	450	15,093	159	1,320	664	25,023	65,317	15,499	65,981	40,522
88	56	8,660	478	16,237	150	1,295	684	26,192	80,632	17,997	81,316	44,189

Note: 1/: Figures do not include transformers for voltage regulation, raising and lowering.
2/: Quantity and capacity of station service transformers are not included in the total.
3/: Quantity and capacity of 220kV transformers are included in the figures for 380kV transformers.
4/: 34.5kV and lower tension transformers include village electrification transformers.
For 1979-85 period, the totals are obtained assuming 50kVA for every village electrification transformer.
After 1986, actual values are used.

Source: TEK

Table 3.7 DEVELOPMENT OF NUMBER OF VILLAGE WITH ELECTRICITY BY YEARS

Year	Total village number	Number of electrified village in the year	Number of village with electricity at the end of the year	Percentage of village with electricity
1979	-	2,466	15,460	42.8
1980	36,155	2,885	18,345	50.7
1981	-	1,466	19,811	54.8
1982	-	2,221	22,032	60.9
1983	-	2,404	24,436	67.6
1984	-	2,079	26,515	73.3
1985	36,155	4,076	30,591	84.6
1986	-	3,294	33,885	93.7
1987	35,187	672	34,557	98.2
1988	35,167	227	34,834	99.0

Note: Also covers Sub-District.

Source: TEK

Table 3.8 VILLAGE ELECTRIFICATION WORK OF POWER DISTRIBUTION ENTERPRISES AND NUMBER OF ELECTRIFIED VILLAGES (1988)

Enterprise	Total No. of Village	Villages with Electricity (%)	Villages Without Electricity			
			Install. Work Underway	Install. Work not Initiated	Defective Villages	Total
Bosphorus	938	938 (100)	-	-	-	-
Southern-Marmara	2,284	2,272 (99.5)	5	1	6	12
Aegean	2,932	2,914 (99.4)	2	1	15	18
Toroslar	1,688	1,688 (100)	-	-	-	-
Erciyes	1,455	1,451 (99.7)	1	-	3	4
Kah.-Gazi	2,170	2,143 (98.8)	14	3	10	27
Eastern-Anatoria	2,374	2,318 (97.6)	52	3	1	56
Kizikirmak	1,956	1,946 (99.5)	-	-	10	10
Ondokuzmayis	2,141	2,135 (99.7)	2	1	3	6
Porsuk	1,665	1,664 (99.9)	-	-	1	1
Mediterranean	945	945 (100)	-	-	-	-
Meram	1,114	1,113 (99.9)	-	-	1	1
Central-Anatolia	3,120	3,113 (99.8)	-	1	6	7
Dicle (Tigris)	1,924	1,832 (95.2)	26	22	44	92
Firat (Euphrates)	1,305	1,254 (96.1)	27	5	19	51
Van Golu (Lake Van)	1,366	1,341 (98.2)	4	8	13	25
Eastern Black Sea	2,167	2,159 (99.6)	6	-	2	8
Ilgaz	1,839	1,839 (100)	-	-	-	-
Sakarya	709	705 (99.4)	-	-	4	4
Malatya	512	504 (98.4)	4	-	4	8
Erzinkan	563	560 (99.5)	-	-	3	3
Turkey	35,167	34,834 (99.1)	143	45	145	333

Source: 1988 Annual Report of TEK

Table 3.9 SUMMARY OF POWER SYSTEM OPERATION

Year	Gross Generation (GWh)	Installed Capacity (MW)	Peak Demand (MW)	Equivalent Peak Hour (hr, 2/4)	Utilization Factor (%, 4/3)	Annual Load Factor (%, 5/8,760 hr)
1	2	3	4	5	6	7
1975	15,623	4,186.6	2,872.4	5,439	68.6	62.1
76	18,283	4,364.2	3,137.9	5,826	71.9	66.3
77	20,565	4,727.2	3,278.8	6,272	69.4	71.6
78	21,726	4,868.7	3,602.4	6,031	74.0	68.8
79	22,521	5,118.7	3,543.6	6,356	69.2	72.5
80	23,275	5,118.7	3,772.1	6,170	73.7	70.4
81	24,673	5,537.6	3,872.6	6,371	69.9	72.7
82	26,552	6,638.6	4,308.2	6,163	64.9	70.1
83	27,347	6,935.1	4,419.0	6,188	63.7	70.6
84	30,613	8,459.1	5,108.3	5,993	60.4	68.2
85	34,219	9,119.1	5,409.9	6,325	59.3	72.2
86	39,695	10,112.7	6,340.5	6,261	62.7	71.5
87	44,353	12,492.6	7,312.0	6,066	58.5	69.2
88	48,049	14,518.1	7,613.0	6,311	52.4	72.0

Note: Gross generation in 1989 was 51,503 GWh.

Source: TEK

Table 3.10 CONSUMPTION OF ELECTRIC POWER BY ECONOMIC ACTIVITIES

(Unit: GWh)

Economic Activity	1979	1980	1981	1982	1983	1984	1985	1986
Total	**19,663.1**	**20,398.2**	**22,030.0**	**23,586.8**	**24,464.2**	**27,671.1**	**30,250.0**	**33,540.0**
Agriculture, forestry hunting and fishing	149.0	160.3	168.9	187.7	197.2	223.1	243.9	280.4
Coal and lignite mining	548.5	557.3	567.0	620.4	651.8	737.2	806.0	905.7
Mining industries other than coal and lignite mining	202.2	182.2	196.7	184.4	193.7	219.0	239.5	273.5
Food, beverage and tobacco industries	1,487.2	1,539.4	1,587.9	1,751.0	1,809.5	2,046.2	2,236.8	2,490.1
Manufacture of textiles, leather and clothing	1,843.4	1,740.4	1,955.3	2,097.1	2,163.1	2,496.9	2,674.7	2,985.6
Manufacture of wood, paper and allied industries	982.0	1,021.6	1,112.0	1,157.4	1,215.9	1,395.4	1,503.5	1,670.0
Manufacture of rubber products	330.8	336.8	368.7	473.8	497.8	563.1	615.5	682.4
Manufacture of chemicals	1,522.4	1,522.2	1,716.9	1,779.7	1,839.7	2,080.9	2,305.1	2,565.8
Manufacture of earthenware and cement	1,977.2	2,001.7	2,286.4	2,358.1	2,407.3	2,722.8	2,976.7	3,308.4
Iron and steel basic industries	1,647.1	1,824.3	1,809.7	2,020.5	2,072.7	2,344.4	2,613.4	2,904.6
Non-ferrous metal basic industries	1,358.6	1,518.5	1,743.6	1,711.2	1,787.7	2,022.0	2,210.7	2,451.1
Manufacture of electrical machinery and transport equipment	396.3	390.2	459.5	518.6	544.8	656.4	718.7	799.9
Manufacturing industries not elsewhere classified	217.0	186.7	249.0	290.0	304.7	344.6	376.9	417.9
Building and public works	29.8	186.7	189.2	235.4	247.4	279.8	305.9	339.2
Public administration and public utilities	1,940.9	1,879.9	1,957.4	2,124.1	2,171.5	2,456.2	2,685.1	3,171.5
Commerce, services and handicrafts	1,345.3	1,371.2	1,494.7	1,686.0	1,751.2	1,980.8	2,165.3	2,271.0
Transportation and communication	193.6	190.0	203.6	236.4	248.7	291.3	307.4	339.9
Public illumination	290.5	289.5	298.4	309.0	333.1	356.7	386.9	462.3
Households	3,201.3	3,499.3	3,665.1	3,846.0	4,026.4	4,454.3	4,878.0	5,220.7

Source: Statistical Yearbook, 1987

Table 3.11 RECEIVED ENERGY IN KONYA AND KARAMAN (1988)

Item	Received Energy (MWh)	Sent out Energy (MWh)	Loss (%)
A. Substations			
Konya I	216,740	216,740	-
Konya II	100,093	96,194	3.9
Karaman	64,779	64,137	1.0
Ereğli	59,307	56,923	4.1
Seydişehir	48,540	46,321	4.6
Akşehir	46,328	43,859	5.4
Ladik	43,936	41,572	5.4
Cihanbeyli	32,902	30,437	7.5
Çurma	28,394	28,796	-1.4
Alibeyhöyügü	11,238	10,096	9.8
Göksu	9,065	7,399	18.4
Karasinir	8,809	7,785	11.7
Subtotal	670,124	650,259	3.0
B. Other Provinces			
Received	2,275	-	-
Sent out	5,315	-	-
C. Small Hydro	4,517	-	-
D. Total	671,601	-	-

Source: TEK, Meram Power Distribution Company

Table 3.12 CONSUMED ENERGY IN KONYA AND KARAMAN (1988)

Category	Consumed Energy (MWh)	Composition (%)
1. Official Department	29,893	5.0
2. Household	204,229	33.9
3. commerce	29,637	4.9
4. Small Industry	129,376	21.5
5. Big Industry	92,888	15.4
6. State enterprise	48,028	8.0
7. Construction	3,293	0.6
8. Agriculture Irrigation	24,299	4.0
9. Municipality Waterworks	3,629	0.6
10. Village Water-works	1,684	0.3
11. Company Employees	1,738	0.3
12. Charitable Institution	1,732	0.3
13. Various Selling	5,316	0.9
14. Interior Illumi-nation	198	0.0
15. General Illumni-nation	25,633	4.3
16. TEK	1,305	0.2
Total	602,878	100.0

Source: TEK, Meram Power Distribution Company

Table 3.13 (1/3) POWER TARIFF STRUCTURE

(Valid from 1/09/1989)

FOR GENERATION - TRANSMISSION ENTERPRISE

	ACTIVE ENERGY	PEAK-LOAD TARIFF (TL/kWh)			POWER	EXCESS POWER	REACTIVE ENERGY
	(TL/kWh)	17-22	22-06	06-17	(TL/kW)	(TL/kW)	(TL/kVARh)
A) TWO-PART TARIFF							
The provinces having priority in development	108.00	106.00	73.00	108.00	4,900.00	7,200.00	47.00
Other provinces	127.00	190.00	85.00	127.00	5,850.00	8,600.00	56.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	133.00	197.00	90.00	133.00	6,100.00	9,100.00	58.00
Arc ovens	94.00	135.00	66.00	94.00	3,960.00	7,700.00	41.00
B) ONE-PART TARIFF							
The provinces having priority in development	120.00						47.00
Other provinces	141.00						56.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	148.00						58.00
Special sale (ÇEAS and KEPEZ)	91.70						

Table 3.13 (2/3) POWER TARIFF STRUCTURE

FOR DISTRIBUTION ENTERPRISES

A) TWO-PART TARIFF Industry							
The provinces having priority in development	115.00	168.00	80.00	115.00	5,200.00	8,600.00	66.00
Other provinces	136.00	200.00	93.00	136.00	6,200.00	10,200.00	77.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	143.00	210.00	97.00	143.00	6,500.00	10,750.00	80.00
Arc ovens	94.00	135.00	66.00	94.00	3,960.00	7,700.00	41.00
Organized industrial and small industrial districts							
The provinces having priority in development	109.00	160.00	74.00	109.00	5,000.00	8,300.00	61.00
Other provinces	128.00	190.00	87.00	128.00	5,900.00	9,700.00	72.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	135.00	198.00	93.00	135.00	6,200.00	10,200.00	77.00
B) ONE-PART TARIFF Industry							
The provinces having priority in development	128.00						66.00
Other provinces	151.00						77.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	159.00						80.00
Organized industrial and small industrial districts							
The provinces having priority in development	120.00						61.00
Other provinces	142.00						72.00
Istanbul, Kocaeli, Izmir, Ankara, Bursa, Adana	150.00						77.00
HOUSEHOLDS							
-up to and including 150 kWh in a month	85.00						
-over 150 kWh in a month	185.00						
Commerce - state organization - office	164.00						77.00
State and public establishments - sport installations	115.00						
Construction sites and temporary subscribers	155.00						77.00
Common parts of buildings	135.00						
Households groups to which whole sale selling is made	135.00						
Agricultural irrigation	48.00						
Domestic water for provinces and counties	151.00						77.00
Domestic water for villages	48.00						
Villages and subscribers of village	85.00						
Illumination of mosque and street							

Table 3.13 (3/3) POWER TARIFF STRUCTURE

NOTES:

1) For electricity consumption of subscribers with arc oven in rolling-mills and elsewhere, industrial tariff shall be applied.

2) When measurement is made at the 0.4 kV side, to all items in tariffs 3% price increment shall be applied.

3) To the households, offices of the state establishment and organizations, public sport installations, prayer rooms, charities, embassies, public associations, common parts of households, household groups to which whole sale selling is made, villages, villages' subscribers, public part of villages and domestic water installations of villages having total installed capacity of 500 kVA or less than 500 kVA, reactive energy tariff shall not be applied.

4) Arc ovens tariff shall be applied at the whole voltage levels identically.

5) To the prayer rooms, charities and public associations, the tariff used for state and public organizations and sport installations shall be applied.

6) To the subscribers, inhabiting within the villages and having total installed capacity of 100 kVA or less than 100 kVA, the tariff used for villages and village subscribers shall be applied.

Source: TEK

Table 3.14 (1/2) LONG-TERM POWER DEMAND FORECAST
(High Scenario)

Year	Peak Demand (MW)	Growth Rate (%)	Required Energy (GWh)	Growth Rate (%)
1989	9,250	-	57,925	-
1990	10,370	12	64,910	12
1991	11,480	11	71,885	10
1992	12,650	10	79,200	10
1993	13,940	10	87,260	10
1994	15,485	11	96,140	10
1995	17,060	10	105,930	10
1996	18,695	9.6	115,710	9
1997	20,485	9.5	126,790	9.6
1998	22,450	9.6	138,940	9.6
1999	24,600	9.6	152,250	9.6
2000	26,955	9.5	166,830	9.6
2001	28,825	7	177,020	6
2002	30,825	7	189,310	7
2003	32,965	7	202,450	7
2004	35,255	7	216,500	7
2005	37,700	7	231,530	7
2006	40,320	7	247,600	7
2007	43,115	7	264,790	7
2008	46,110	7	283,170	7
2009	49,310	7	302,830	7
2010	52,730	7	323,850	7

Average Growth Rate: 8.5% per annum

Source: 1988 Long-Term Generation-Consumption Study (1994-2010), TEK

Table 3.14 (2/2) LONG-TERM POWER DEMAND FORECAST
(Low Scenario)

Year	Peak Demand (MW)	Growth Rate (%)	Required Energy (GWh)	Growth Rate (%)
1989	8,870	-	55,545	-
1990	9,860	11	61,760	11
1991	10,890	10	68,180	11
1992	12,020	10	75,260	10
1993	13,270	10	83,080	10
1994	14,815	10	91,785	10
1995	16,335	10	101,210	10
1996	17,820	9	110,610	9
1997	19,435	9	120,640	9
1998	21,195	9	131,575	9
1998	23,115	9	143,505	9
2000	25,210	9	156,515	9
2001	27,160	8	165,290	6
2002	29,265	8	178,085	8
2003	31,530	8	191,865	8
2004	33,970	8	206,715	8
2005	36,600	8	222,710	8
2006	39,430	8	239,945	8
2007	42,480	8	258,515	8
2008	45,770	8	278,520	8
2009	49,310	8	300,075	8
2010	53,125	8	323,295	8

Average growth rate: 8.7% per annum

Source: 1988 Long-Term Generation-Consumption Study (1994-2010), TEK

Table 3.15 (1/2) GROWTH RATE OF GDP AND ENERGY CONSUMPTION (Middle Income Countries, per Capita GDP: US$500-6,000)

Country	GDP Growth (%) 1965-80	GDP Growth (%) 1980-87	Energy Consumption Growth (%) 1965-80	Energy Consumption Growth (%) 1980-87
Lower Middle Income Countries (Per Capita GDP: 500-2,000)				
1. Philippine	5.9	-0.5	5.8	-1.4
2. Morocco	5.4	3.2	7.9	2.5
3. Egypt	6.8	6.3	6.2	6.6
4. Thailand	7.2	5.6	10.1	7.3
5. Turkey	6.3	5.2	8.5	7.3 (9.7)
6. Colombia	5.6	2.9	6.0	2.1
7. Chile	1.9	1.0	3.0	1.5
8. Peru	3.9	1.2	5.0	0.2
9. Jordan	-	4.3	9.7	7.9
10. Syria	8.7	0.3	12.4	4.4
11. Malaysia	7.4	4.5	6.7	6.2
12. Mexico	6.5	0.5	7.9	0.6
13. South Africa	4.1	1.0	4.3	3.7
14. Roland	-	-	4.8	0.9
Average	5.7	2.1	5.9	2.4
Higher Middle Income Countries (Per Capita GDP: 2,000-6,000)				
1. Brazil	9.0	3.3	9.9	4.0
2. Hungary	5.6	1.7	3.8	1.1
3. Argentine	3.5	-0.3	4.3	1.5
4. Yugoslavia	6.0	1.5	6.0	3.2
5. Algeria	7.5	3.8	11.9	5.3
6. Korea	9.5	8.6	12.1	5.9
7. Portugal	-	1.4	6.5	2.7 (4.0)
8. Venezuela	3.7	0.2	4.6	2.3
9. Greece	5.6	1.4	8.5	2.7 (4.2)
Average	6.7	3.4	7.3	3.0

Note:
1: The average includes other countries not shown in the above table.
2: ( ) shows growth rate of electric energy consumption for the period of 1980-87, 1989 OECD statistics.

Source: World Development Repot 1989, World Bank

Table 3.15 (2/2) GROWTH RATE OF GDP AND ENERGY CONSUMPTION
(High Income Countries, per Capita GDP: US$6,000)

Country	GDP Growth (%)		Energy Consumption Growth (%)	
	1965-80	1980-87	1965-80	1980-87
1. Spain	4.6	2.1	6.5	1.9 (2.7)
2. Italy	3.8	2.1	3.7	0.0 (1.2)
3. England	2.4	2.6	0.9	1.1 (0.8)
4. Australia	4.2	3.2	5.0	0.6 (4.7)
5. Belgium	3.9	1.3	2.9	0.1 (2.4)
6. Netherlands	4.1	1.5	5.0	1.3 (0.8)
7. Austria	4.3	1.6	4.0	0.9 (2.7)
8. France	4.3	1.6	3.7	0.6 (5.6)
9. W. Germany	3.3	1.6	3.0	0.2 (1.8)
10. Finland	4.0	2.8	5.1	3.1 (4.0)
11. Denmark	2.9	2.5	2.4	1.0 (1.4)
12. Canada	5.0	2.9	4.5	0.9 (4.1)
13. Sweden	2.9	1.3	2.5	2.3 (6.2)
14. Japan	6.3	3.8	6.1	1.7 (3.2)
15. Norway	4.4	3.7	4.1	2.7 (3.1)
16. USA	2.7	3.1	2.3	0.1 (1.7)
17. Switzerland	2.0	1.7	3.1	2.0 (2.8)
OECD Average	3.6	2.7	3.0	0.5

Note:

1. The average includes other countries not shown in the above table.

2. ( ) shows growth rate of electric energy consumption for the period of 1980-87, 1989 OECD statistics.

Source: World Development Report 1989, World Bank

Table 3.16 COMPARISON OF VARIOUS DEMAND FORECASTS

	TEK's 1988 Forecast				Adjusted F'cast/1		Team's Forecast			
	High Scenario		Low Scenario		High S. Energy	Low S. Energy	High Scenario		Low Scenario	
	Energy (GWh)	Growth (%)	Energy (GWh)	Growth (%)	(%)	(%)	Energy (GWh)	Growth (%)	Energy (GWh)	Growth (%)
1989	57,925	-	55,545	-	52,062	52,062	52,062	-	52,062	-
90	64,910	12	61,760	11	58,310	57,790	56,485	8.5	55,706	7.0
91	71,885	10	68,180	11	64,140	64,145	61,289	8.5	59,606	7.0
92	79,200	10	75,260	10	70,555	70,560	66,498	8.5	63,778	7.0
93	87,260	10	83,080	10	77,610	77,615	72,151	8.5	68,243	7.0
94	96,140	10	91,785	10	85,370	85,380	78,283	8.5	70,020	7.0
95	105,930	10	101,210	10	93,910	93,915	84,437	8.5	78,131	7.0
96	115,710	9	110,610	9	102,360	102,370	92,157	8.5	83,600	7.0
97	126,790	9.6	120,640	9	112,185	111,580	99,991	8.5	89,452	7.0
98	138,940	9.6	131,575	9	122,955	121,620	108,490	8.5	95,714	7.0
99	152,250	9.6	143,505	9	134,760	132,570	117,711	8.5	102,414	7.0
2000	166,830	9.6	156,515	9	147,700	144,500	127,717	8.5	109,583	7.0
01	177,020	6	165,290	6	156,560	153,170	138,573	8.5	117,254	7.0
02	189,310	7	178,085	8	167,520	165,425	150,351	8.5	125,461	7.0
03	202,450	7	191,865	8	179,245	178,660	163,131	8.5	134,244	7.0
04	216,500	7	206,715	8	191,790	192,950	176,997	8.5	143,641	7.0
05	231,530	7	222,710	8	205,215	208,390	192,042	8.5	153,696	7.0
06	247,600	7	239,945	8	219,580	225,060	208,366	8.5	164,454	7.0
07	264,790	7	258,515	8	234,950	243,060	226,077	8.5	175,966	7.0
08	283,170	7	278,520	8	251,400	262,510	245,293	8.5	188,284	7.0
09	302,830	7	300,075	8	269,000	283,510	266,143	8.5	201,463	7.0
10	323,850	7	323,295	8	287,830	306,190	288,766	8.5	215,566	7.0

/1: Actual result is used for 1989 demand and growth rate is same as the 1988 forecast.

Table 3.17 MAJOR FEATURES OF DAILY LOAD CURVES (2000)

Item	April	July	December
1. Maximum demand time in a day (o'clock)	21	22	18
2. Minimum demand time in a day (o'clock)	4	7	7
3. Maximum demand day	Thursday	Thursday	Wednesday
4. Ratio of minimum/maximum demand in a day			
Weekday	0.647	0.680	0.625
Saturday	0.668	0.702	0.627
Sunday	0.655	0.694	0.663
5. Ratio against maximum demand in a week			
Sunday peak/weekly peak	0.850	0.855	0.806
Saturday peak/weekly peak	0.952	0.960	0.986
Min. of weekday peak/ weekly peak	0.969	0.979	0.976
6. Daily load factor			
Weekday	0.800	0.826	0.813
Sunday	0.790	0.800	0.803
Saturday	0.820	0.829	0.814

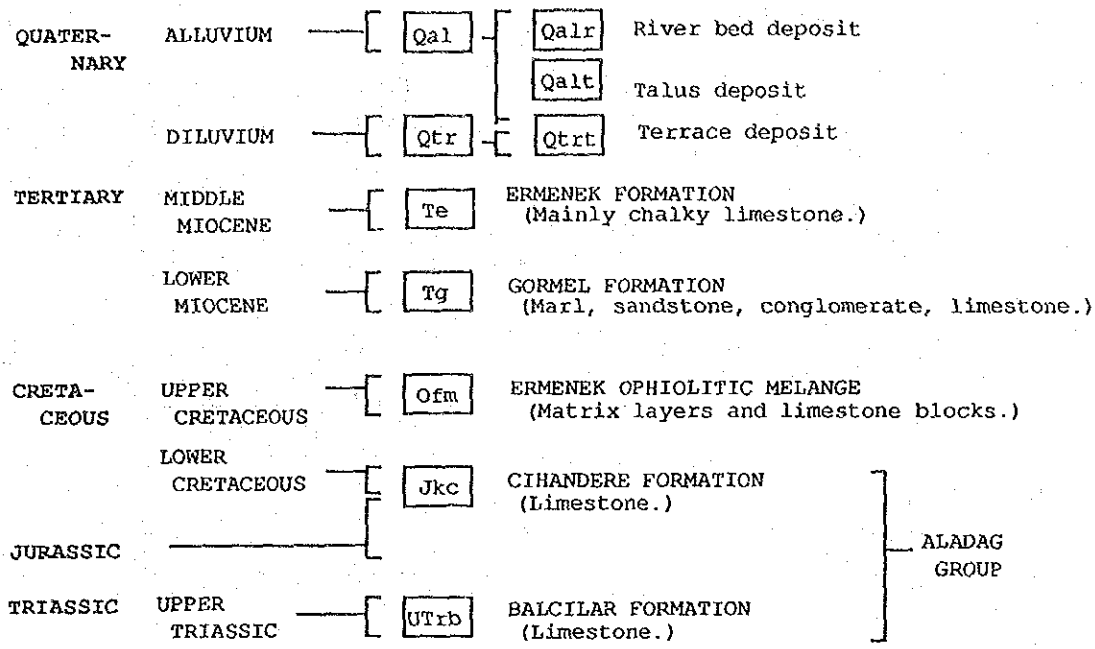
Source: TEK

Table 3.18 FORECASTED DEMAND OF KONYA AND KARAMAN

Year	General Demand 1/		Heavy Industry 2/		Total	
	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)
1988	140	671	-	-	-	-
89	150	721	146	1,114	296	1,835
90	167	801	152	1,147	319	1,948
91	184	889	159	1,182	343	2,071
92	202	978	166	1,217	368	2,195
93	222	1,075	173	1,254	395	2,329
94	245	1,183	180	1,291	425	2,474
95	269	1,301	187	1,330	456	2,631
96	293	1,418	195	1,370	488	2,788
97	320	1,546	203	1,411	523	2,957
98	348	1,685	211	1,454	559	3,139
99	380	1,837	219	1,497	599	3,334
2000	414	2,002	227	1,542	641	3,544
01	447	2,122	236	1,588	683	3,710
02	483	2,292	245	1,636	728	3,928
03	521	2,475	255	1,685	776	4,160
04	563	2,673	264	1,736	827	4,409
05	608	2,887	274	1,788	882	4,675
06	657	3,118	284	1,841	941	4,959
07	709	3,368	295	1,897	1,004	5,265
08	766	3,637	306	1,953	1,072	5,590
09	828	3,928	317	2,012	1,145	5,940
10	894	4,242	328	2,072	1,222	6,314

1/: Same growth rates as the low scenario forecast are applied.
2/: 3% growth per annum is assumed for the energy demand and 60% load factor is assumed for the increased portion.

Table 5.1 GEOLOGY OF THE PROJECT AREA



ERMENEK OPHIOLITIC MELANGE

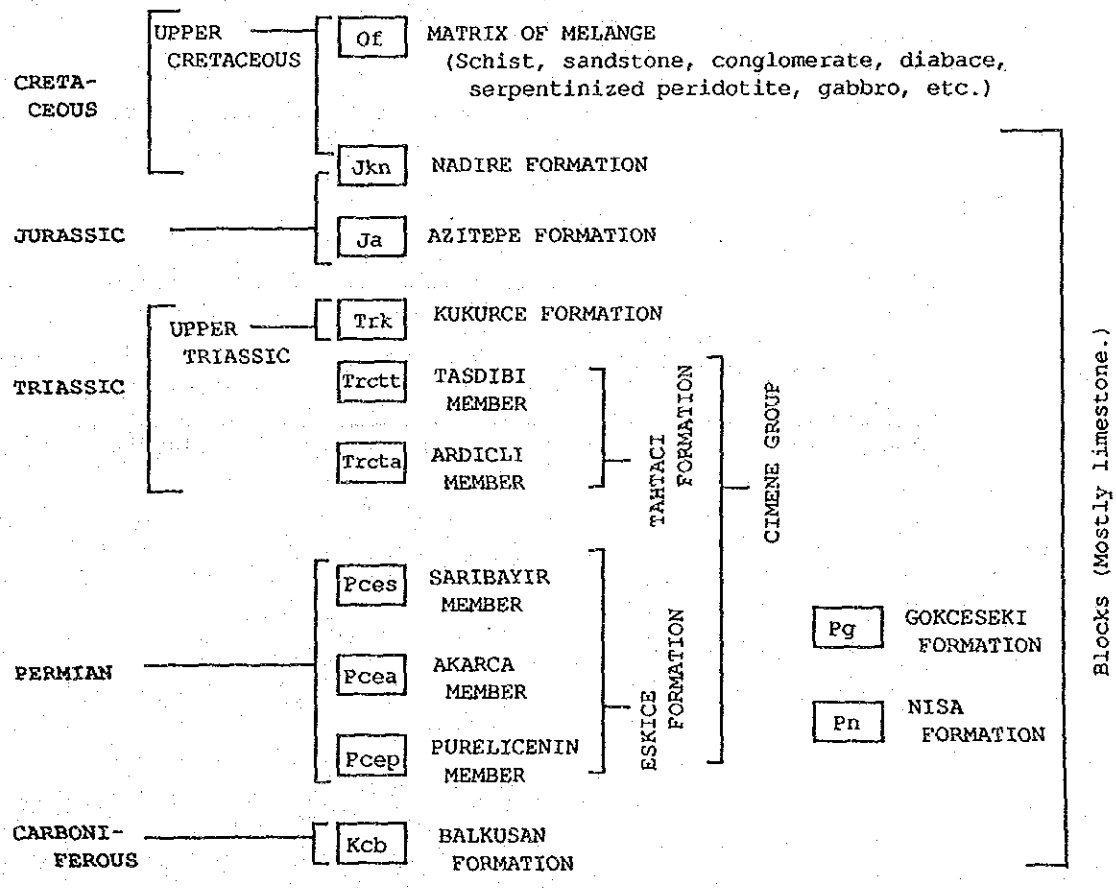


Table 5.2 WORK QUANTITY OF CORE BORING INVESTIGATION (1/4)

1. SUMMARY OF WORK QUANTITY

LOCATION		HOLE (nos)	LENGTH (m)	LU.TEST (times)
DAMSITE I-B AND LANDSLIDE AREA				
	PRE F/S STAGE	17	2005.85	223
	F/S STAGE	2	228.00	30
	TOTAL	19	2233.85	253
DAMSITE I-C				
	PRE F/S STAGE	8	2340.65	697
	F/S STAGE	4	1235.90	171
	TOTAL	12	3576.55	868
POWER HOUSE AREA				
	PRE F/S STAGE	0	0.00	0
	F/S STAGE	5	754.80	22
	TOTAL	5	754.80	22
QUARRY SITE				
	PRE F/S STAGE	0	0.00	0
	F/S STAGE	2	109.00	0
	TOTAL	2	109.00	0
LIMESTONE AREA NEAR NADIRE				
	PRE F/S STAGE	2	546.05	48
	F/S STAGE	0	0.00	0
	TOTAL	2	546.05	48
HEADRACE TUNNEL AREA				
	PRE F/S STAGE	1	218.50	0
	F/S STAGE	0	0.00	0
	TOTAL	1	218.50	0
TOTAL	PRE F/S STAGE	28	5111.05	968
	F/S STAGE	13	2327.70	223
	GRAND TOTAL	41	7438.75	1191

Table 5.2 WORK QUANTITY OF CORE BORING INVESTIGATION (2/4)

2. WORK QUANTITY FOR EACH SITE

(1) DAMSITE I-B AND LANDSLIDE AREA

PRE F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LONG.	LU.TEST (times)
SK-201	200.00	544.30	4,048,094.87	495,429.37	12
SK-202	150.00	613.50	4,048,392.96	495,401.29	30
SK-203	35.00	516.76	4,047,818.36	495,383.80	6
SK-204	33.00	514.21	4,047,761.60	495,379.33	6
SK-205	150.00	524.89	4,047,958.88	495,399.81	23
SK-206	100.00	538.55	4,048,322.36	494,517.04	33
SK-207	200.00	534.14	4,047,633.45	495,464.86	38
SK-208	127.00	547.35	4,047,443.94	495,457.06	18
SK-209	101.00	619.57	4,048,310.69	495,526.30	9
SK-210	101.00	608.36	4,048,276.01	495,636.52	10
SK-211	50.00	553.43	4,048,136.51	495,337.52	4
SK-212	125.00	602.31	4,047,331.59	495,730.59	16
SK-213	100.00	602.56	4,047,330.54	495,731.04	13
SK-214	160.00	715.51	4,048,587.69	495,564.30	5
SK-217	201.20	713.74	4,048,893.91	495,645.81	0
SK-218	85.00	762.49	4,049,271.13	495,534.45	0
SK-219	87.65	709.72	4,048,914.23	495,933.67	0
SUB TOTAL	2005.85				223

F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LONG.	LU.TEST (times)
SK-220	150.00	748.78	4,049,165.13	495,701.12	7
SK-221	78.00	628.26	4,048,465.50	496,032.73	23
SUB TOTAL	228.00				30
TOTAL	2233.85				253

Table 5.2 WORK QUANTITY OF CORE BORING INVESTIGATION (3/4)

(2) DAMSITE I-C

PRE F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LONG.	LU.TEST (times)
SK-301	178.00	668.85	4,048,239.23	496,925.74	70
SK-302	200.65	614.76	4,048,523.65	496,492.08	53
SK-303	143.75	651.83	4,048,805.27	496,324.60	2
SK-304	499.35	676.73	4,048,126.64	497,011.07	170
SK-305	426.50	750.07	4,047,939.09	497,744.97	93
SK-306	425.00	708.54	4,047,369.51	497,635.14	124
SK-307	220.20	663.85	4,048,430.70	496,826.69	87
SK-308	247.20	578.42	4,048,180.55	496,628.42	98
SUB TOTAL	2340.65				697

F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LONG.	LU.TEST (times)
SK-309	190.80	674.07	4,047,374.28	496,882.20	16
SK-310	169.75	520.00			23
SK-313	425.00	729.65	4,048,720.74	497,216.38	87
SK-314	450.35	726.73	4,047,124.12	497,414.95	45
SUB TOTAL	1235.90				171
TOTAL	3576.55				868

(3) POWER HOUSE AREA

PRE F/S STAGE: No boring works.

F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LONG.	LU.TEST (times)
SK-102	341.60	615.25	4,048,303.56	505,971.89	1
SK-106	90.00	369.55	4,048,499.46	506,424.62	6
SK-107	50.00	368.89	4,049,255.17	507,504.22	15
SK-108a	72.00	484.19	4,048,401.81	506,140.73	0
SK-108b	201.20	484.19	4,048,401.81	506,140.73	0
SUB TOTAL	754.80				22
TOTAL	754.80				22

(SK-103, 104 & 105: Canceled.)

Table 5.2 WORK QUANTITY OF CORE BORING INVESTIGATION (4/4)

(4) QUARRY SITE

PRE F/S STAGE: No boring works.

F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LOCATION LONG.	LU.TEST (times)
SK-311	59.00	789.27	4,049,783.04	496,566.96	0
SK-312	50.00	864.52	4,049,521.46	496,600.14	0
SUB TOTAL	109.00				0
TOTAL	109.00				0

(5) LIMESTONE AREA NEAR NADIRE

F/S STAGE: No boring works.

PRE F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LOCATION LONG.	LU.TEST (times)
SK-215	201.05	739.88	4,049,449.32	481,050.10	1
SK-216	345.00	838.28	4,049,100.35	482,217.01	47
SUB TOTAL	546.05				48
TOTAL	546.05				48

(6) HEADRACE TUNNEL AREA

F/S STAGE: No boring works.

PRE F/S STAGE

HOLE NO.	DEPTH (m)	EL. (m)	LOCATION LAT.	LOCATION LONG.	LU.TEST (times)
SK-101	218.50	980.61	4,048,252.26	501,596.09	0
SUB TOTAL	218.50				0
TOTAL	218.50				0

Table 5.3 SUMMARY OF LABORATORY TEST RESULTS: FOUNDATION ROCKS OF I-C DAM SITE (SK-302, 307 AND 313)

			Physical Test				Super Sonic Test				
Hole No.	Depth	(m)	Compressive strength (kg/cm2)	Water absorption (x10-3 %)	Bulk specific gravity (g/cm3)	Density (g/cm3)	Longt. velocity Vp(m/sn)	Transv. velocity Vs(m/sn)	Poisson's ratio	Dynum. shear modulus G(kg/cm2)	Dynum. elast. modulus E(kg/cm2)
SK-302	21.60 -	21.85	499	1.75	2.04	2.78	5,890	2,896	0.34	245,614	658,534
	21.85 -	22.25	1,036	1.04	1.67	2.85	6,273	2,924	0.36	248,641	676,906
	22.25 -	22.50	726	1.01	2.23	2.77	5,847	2,875	0.34	233,630	626,394
	22.70 -	23.00	647	1.67	1.67	2.79	5,938	2,836	0.35	228,976	619,264
	Average		727	1.37	1.90	2.80	5,987	2,883	0.35	239,215	645,275
SK-307	40.50 -	40.80	601	0.79	2.24	2.83	6,131	2,877	0.36	239,023	649,574
	40.80 -	41.07	338	1.90	2.23	2.85	6,268	2,883	0.37	241,717	660,293
	45.60 -	45.85	561	0.59	2.25	2.89	6,444	2,862	0.38	241,552	665,301
	46.15 -	46.55	632	0.59	2.24	2.80	6,007	2,808	0.36	225,282	612,854
	Average		533	0.97	2.24	2.84	6,213	2,858	0.37	236,894	647,006
SK-313	22.50 -	23.00	712	1.00	2.34	2.83	6,143	3,052	0.34	268,986	718,802
	23.15 -	23.35	288	1.90	2.33	2.85	6,267	3,091	0.34	277,854	744,242
	26.65 -	27.00	1,301	1.20	2.33	2.89	6,458	3,185	0.34	299,151	801,303
	28.00 -	28.25	683	1.30	2.31	2.90	6,489	3,210	0.34	304,917	815,959
	29.20 -	29.40	1,060	1.50	2.32	2.90	6,500	3,204	0.34	303,778	813,835
	51.30 -	51.60	1,366	0.79	2.30	2.88	6,402	3,178	0.34	296,807	793,365
	57.50 -	57.70	521	1.70	2.31	2.85	6,258	3,108	0.34	280,919	750,780
	74.70 -	75.00	518	1.80	2.31	2.84	6,224	3,091	0.34	276,879	739,992
	79.00 -	79.30	1,150	1.40	2.29	2.90	6,475	3,261	0.33	314,683	837,107
	79.30 -	79.50	518	0.57	2.30	2.85	6,232	3,116	0.33	282,367	752,978
	Average		812	1.32	2.31	2.87	6,345	3,150	0.34	290,634	776,836
	Average of all		731	1.25	2.21	2.85	6,236	3,025	0.35	267,265	718,749

Table 5.4 ROCK CLASSIFICATION FOR THE ERMENEK PROJECT

(1) HARDNESS

Class.	Explanation
A	Hard rocks. Very strong.
B	Medium hard rocks. Strong.
C	Soft rocks and moderately friable rocks. Moderately strong.
D	Very soft rocks and highly friable rocks. Weak.
E	Decomposed rocks. Rocks are almost decomposed by weathering, alteration and/or fault fracturing. Very weak.

(2) WEATHERING CONDITION

Class.	Explanation
a	Fresh rocks. No visible sign of weathering and discoloration on joint surface.
b	Slightly weathered rocks. Discoloration is generally seen on joint surface.
c	Moderately weathered rocks. Weathering is seen along some joints. Discoloration and thin weathered materials are generally seen on joint surface.
d	Highly weathered rocks. Weathering is seen along most of joints. Discoloration and rather thick weathered materials are observed on joint surface.
e	Decomposed rocks. Rocks are almost decomposed by weathering.

(3) JOINT SPACING

Class.		Spacing(cm)	Nos of joints(/m)
I	Extremely wide	More than 200	0
II	Very wide	60 - 200	0 - 2
III	Wide	20 - 60	2 - 5
IV	Moderately wide	6 - 20	5 - 20
V	Narrow	2 - 6	More than 20
VI	Very narrow	Less than 2	-

Table 5.5 ROCK PROPERTIES IN THE PROJECT AREA

Rock Classification for Ermenek Project

Hard Rock: Limestone, etc.			Medium Hard Rock: Sandstone, Conglomerate, etc.			Soft Rock: Marl, Siltstone, Schist, etc.		
Hard.	Weath.	Joint.	Hard.	Weath.	Joint.	Hard.	Weath.	Joint.
A	a	I						
A-B	b	I-III	B	a	I-III			
B	b-c	III-IV	B-C	a-c	III-IV			
C	c	IV-V	C	b-c	IV-V	C-D	a-b	I-IV
D	d	V	D	d	V	D	c-d	IV-V
E	e	VI	E	e	VI	E	e	VI

Rock Classification and Estimated Rock Properties (K.Kikuchi Et.al.)

	Static Modulus of Elasticity (kg/cm2)	Modulus of Deformation (kg/cm2)	Cohesion (kg/cm2)	Internal Friction Angle (degree)	Elastic Wave Velocity (km/sec)
A					
B	80,000 or more	50,000 or more	40 or more	55 to 65	3.7 or more
CH	80,000 to 40,000	50,000 to 20,000	40 to 20	40 to 55	3.7 to 3.0
CM	40,000 to 15,000	20,000 to 5,000	20 to 10	30 to 45	3.0 to 1.5
CL	15,000 or less	5,000 or less	10 or less	15 to 38	1.5 or less
D					

Notes.
Hard.: Hardness.
Weath.: Weathering condition.
Joint.: Joint frecuency.

Compressive Strength in Fresh Rock Condition (kg/cm2)	
Hard rock	More than "800 - 1,000"
Medium Hard Rock	"200 - 300" to "800 - 1,000"
Soft Rock	Less than "200 - 300"

Table 5.6 SUMMARY OF GROUND ACCELERATION AT PROJECT SITE ON MAXIMUM CREDIBLE EARTHQUAKES

Reference	Maximum Magnitude M	Epicneral Distance d (km)	Deth of Hypocenter R (km)	Ground Acceleration
1.Project Earthquake	6.0	0	25	0.0361-0.2932
2.Linear No.1	5.4	97	100	0.0006-0.0141
3.Linear No.2	5.5	154	156	0.0007-0.0080
4.E.A.F No.3	6.8	252	253	0.0018-0.0093
5.Earth-quake A	5.2	106	109	0.0009-0.0109
6.Earth-quake B	5.0	112	115	0.0005-0.0089
7.Earth-quake C	5.6	118	121	0.0017-0.0123

Table 5.7 WORK QUANTITY OF TEST PIT INVESTIGATION AND SAMPLING

BORROW AREA	PRE F/S STAGE PIT NO.	DEPTH (m)	SAMPLE (nos)	F/S STAGE PIT NO.	DEPTH (m)	SAMPLE (nos)
Aa	A-1	5.0	1			
	A-3	5.0	1			
Ab	A-2	4.0	1			
	A-4	3.0	1			
B	B-1	2.5	1			
C	C-1	5.0	1			
	C-2	3.0	1			
	C-3	5.0	1			
	C-4	2.0	1			
D	D-1	5.0	1			
	D-2	5.0	1			
	D-3	5.0	1			
	D-4	5.0	1			
E	E-1	3.5	1			
Ec				E-2	4.5	2
				E-3	3.2	2
Ea				E-4	3.5	2
				E-5	4.0	2
Eb				E-6	1.6	2
Fb	F-1	5.0	1			
	F-2	5.0	1			
	F-3	5.0	1			
Fa				F-4	3.5	2
				F-5	5.0	2
Ga	G-1	2.0	1			
	G-2	2.1	1			
	G-6	0.8	1			
Gb	G-5	0.8	1			
Gc	G-7	2.0	1	G-12	2.9	2
Gd	G-3	0.8	1	G-10	2.4	2
	G-4	1.7	1	G-11	1.8	2
Ge	G-8	3.6	1	G-13	2.0	2
	G-9	4.5	0			
H	H-1	3.0	1			
				H-2	1.0	0
				H-3	1.0	0
				H-4	1.0	0
				H-5	1.0	0
				H-6	1.0	0
I	I-1	3.0	1			
TOTAL	28	97.3	27	16	39.4	22

Notes:
(1) Borrow areas A, B, C, D, E, F, H & I ; for impervious materials.
(2) Borrow area Ga to Ge; for filter and concrete aggregate materials.
(3) Test pit H-1; downstream of I-B damsite.

Table 5.8 WORK QUANTITY OF LABORATORY TESTS

(1) Core Materials

Test item	Test quantity Pre-F/S stage	F/S stage	
Grain size analysis	19	14	samples
Natural moisture content	19	14	samples
Liquid & plastic limits	19	14	samples
Specific gravity	19	14	samples
Compaction test	19	14	cases
Permeability test	19	14	cases
Triaxial UU test	0	14	cases
Triaxial CU test	0	14	cases
Shear test	10	0	cases

(2) Filter Materials for Fill Dam and Concrete Aggregates

Test item	Test quantity Pre-F/S stage	F/S stage	
Grain size analysis	8	8	samples
Specific gravity & water absorption	8	12	samples
Soft rock ratio	0	4	samples
Soundness	8	12	samples
Abrasion	8	12	samples
Alkali aggregate reaction	0	12	samples

(3) Rock Materials for Fill Dam

Test item	Test quantity Pre-F/S stage	F/S stage	
Specific gravity & water absorption	0	17	samples
Unconfined compression test	0	17	samples
Super sonic wave test	0	17	samples

(4) Foundation Rock for Damsite I-C

Test item	Test quantity Pre-F/S stage	F/S stage	
Specific gravity & water absorption	0	18	samples
Unconfined compression test	0	18	samples
Super sonic wave test	0	18	samples

Table 5.9 SUMMARY OF LABORATORY TEST RESULTS: IMPERVIOUS CORE MATERIALS (1/4)

Borrow Area Aa

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
A-1	9.52	3	31	66	33.7	25.0	8.7	19.9	OL-ML	17.9	17.5	1.72											0.1700
A-3	9.52	1	17	82	30.4	22.8	7.6	20.0	OL-ML	21.4	18.0	1.68											0.2200
Average	9.52	2	24	74	32.1	23.9	8.2	20.0		19.7	17.8	1.70											0.1950
Max.	9.52	3	31	82	33.7	25.0	8.7	20.0		21.4	18.0	1.72											0.2200
Min.	9.52	1	17	66	30.4	22.8	7.6	19.9		17.9	17.5	1.68											0.1700

Borrow Area Ab

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
A-2	0.59	0	51	49					SP	13.7	13.0	1.84											1.2000
A-4	0.59	0	63	37					SP	9.7	13.2	1.81											1.4500
Average	0.59	0	57	43						11.7	13.1	1.83											1.3250
Max.	0.59	0	63	49						13.7	13.2	1.84											1.4500
Min.	0.59	0	51	37						9.7	13.0	1.81											1.2000

Borrow Area Fa

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
F-4A	38.10	2	26	72	36.2	25.7	10.5		CL	17.0	15.0	1.87	1.14	39	1.12	39	0.82	9					0.0170
F-4B	38.10	8	35	57	37.2	23.7	13.5		CL	17.0	16.0	1.83	1.19	25	1.10	26	1.84	11					0.0210
F-5A	19.10	1	9	90	36.8	24.3	12.5		CL	17.0	12.0	1.88	0.62	39	0.66	38	1.73	21					0.0120
F-5B	19.10	2	8	90	37.0	21.4	15.6		CL	17.0	14.0	1.91	0.53	33	0.38	34	1.46	24					0.0130
Average	28.60	3	20	77	36.8	23.8	13.0			17.0	14.3	1.87	0.87	34	0.82	34	1.46	16					0.0158
Max.	38.10	8	35	90	37.2	25.7	15.6			17.0	16.0	1.91	1.19	39	1.12	26	1.84	24					0.0210
Min.	19.10	1	8	57	36.2	21.4	10.5			17.0	12.0	1.83	0.53	25	0.38	39	0.82	9					0.0120

Table 5.9 SUMMARY OF LABORATORY TEST RESULTS: IMPERVIOUS CORE MATERIALS (2/4)

Borrow Area Fb

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
F-1	4.76	0	23	77	34.0	22.0	12.0	11.5	CL		18.5	1.70							0.81	21.7	0.89	25.5	0.0320
F-2	9.52	1	9	90	39.4	24.8	14.6	10.5	CL		20.3	1.64							0.45	20.0	0.56	22.0	0.0014
F-3	4.76	0	6	94	36.0	20.0	16.0	12.2	CL		16.5	1.67							0.58	22.0	0.67	25.6	0.0260
Average	6.35	0	13	87	36.5	22.3	14.2	11.4			18.4	1.67							0.61	21.2	0.70	24.4	0.0198
Max.	9.52	1	23	94	39.4	24.8	16.0	12.2			20.3	1.70							0.81	22.0	0.89	25.6	0.0320
Min.	4.76	0	6	77	34.0	20.0	12.0	10.5			16.5	1.64							0.45	20.0	0.56	22.0	0.0014

Borrow Area C

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
C-1	9.52	2	17	81	60.5	26.6	33.9	20.7	CH	20.5	23.3	1.55											0.0320
C-2	9.52	2	21	77	31.7	19.3	12.4	12.8	CL	15.0	19.0	1.66											0.0280
C-3	19.10	7	21	72	56.1	33.4	22.7	24.3	OH-MH	20.3	21.1	1.56											0.3100
C-4	19.10	5	23	72	32.3	21.8	10.5	19.4	CL	17.7	19.5	1.65											0.0550
Average	14.31	4	21	76	45.2	25.3	19.9	19.3		18.4	20.7	1.61											0.1063
Max.	19.10	7	23	81	60.5	33.4	33.9	24.3		20.5	23.3	1.66											0.3100
Min.	9.52	2	17	72	31.7	19.3	10.5	12.8		15.0	19.0	1.55											0.0200

Borrow Area D

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
D-1	19.10	2	9	89	34.5	22.5	12.0	9.0	CL-ML		18.5	1.72							0.17	24.9	0.20	28.7	0.0610
D-2	19.10	2	10	88	40.4	24.0	16.4	10.9	CL		19.2	1.67							0.51	25.8	0.57	29.8	0.0025
D-3	9.52	1	18	81	36.1	23.6	12.5	10.6	CL-ML		17.5	1.70							0.52	25.2	0.55	29.7	0.0410
D-4	4.76	0	6	94	38.7	23.4	15.3	9.5	CL		19.3	1.66							0.19	18.7	0.21	21.8	0.0180
Average	13.12	1	11	88	37.4	23.4	14.1	10.0			18.6	1.69							0.35	23.7	0.38	27.5	0.0306
Max.	19.10	2	18	94	40.4	24.0	16.4	10.9			19.3	1.72							0.52	25.8	0.57	29.8	0.0610
Min.	4.76	0	6	81	34.5	22.5	12.0	9.0			17.5	1.66							0.17	18.7	0.21	21.8	0.0025

Table 5.9 SUMMARY OF LABORATORY TEST RESULTS: IMPERVIOUS CORE MATERIALS (3/4)

Borrow Area B and I

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
B-1	4.76	0	17	83	29.5	21.4	8.1	17.5	CL	16.1	18.4	1.70											0.0410
I-1	19.10	3	21	76	49.3	30.4	18.9	17.3	ML		22.0	1.61							0.50	27.1	0.60	29.2	0.0220

Borrow Area Ea

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-4A	4.76	0	24	76	35.3	21.6	13.7		CL	20.0	18.5	1.69	0.23	28	0.11	31	0.61	14					0.0210
E-4B	4.76	0	21	79	35.6	21.5	14.1		CL	20.0	18.8	1.70	0.17	28	0.23	28	0.89	10					0.0220
E-5A	4.76	0	10	90	31.3	20.5	10.8		CL	23.0	17.6	1.76	0.30	27	0.11	32	0.70	4					0.0140
E-5B	4.76	0	10	90	30.4	20.3	10.1		CL	21.0	17.5	1.75	0.29	28	0.26	29	1.53	13					0.0120
Average	4.76	0	16	84	33.2	21.0	12.2			21.0	18.1	1.73	0.25	28	0.18	30	0.93	10					0.0173
Max.	4.76	0	24	90	35.6	21.6	14.1			23.0	18.8	1.76	0.30	28	0.26	32	1.84	14					0.0220
Min.	4.76	0	10	76	30.4	20.3	10.1			20.0	17.5	1.69	0.17	27	0.11	28	0.61	4					0.0120

Borrow Area Eb

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-6A	4.76	0	36	64	32.0	20.5	11.5		CL	17.0	20.8	1.67	0.19	28	0.23	29	0.98	1					0.0350
E-6B	4.76	0	25	75	36.3	25.5	10.8		CL	16.0	19.5	1.62	0.16	27	0.03	32	1.84	18					0.0290
Average	4.76	0	31	70	34.2	23.0	11.2			16.5	20.2	1.65	0.18	28	0.13	31	1.41	10					0.0320
Max.	4.76	0	36	75	36.3	25.5	11.5			17.0	20.8	1.67	0.19	28	0.23	32	1.84	18					0.0350
Min.	4.76	0	25	64	32.0	20.5	10.8			16.0	19.5	1.62	0.16	27	0.03	29	0.98	1					0.0290

Table 5.9 SUMMARY OF LABORATORY TEST RESULTS: IMPERVIOUS CORE MATERIALS (4/4)

Borrow Area Ec

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-2A	38.10	15	36	49	36.4	25.1	11.3		SC-CL	21.0	16.0	1.86	0.92	30	0.90	30	0.92	19					0.2800
E-2B	90.00	45	26	29	38.0	25.0	13.0		GC-CL	19.0	16.0	1.88	0.77	31	0.68	32	1.85	20					0.1300
E-3A	38.10	19	30	51	33.7	23.0	10.7		CL	16.0	14.0	1.92	1.88	24	1.92	23	1.68	24					0.0200
E-3B	38.10	17	42	41	32.3	21.7	10.6		SC	16.0	14.0	1.94	0.46	36	0.32	37	1.38	15					0.0190
Average	51.08	24	34	43	35.1	23.7	11.4			18.0	15.0	1.90	1.01	30	0.96	31	1.46	20					0.1123
Max.	90.00	45	42	51	38.0	25.1	13.0			21.0	16.0	1.94	1.88	36	1.92	37	1.85	24					0.2800
Min.	38.10	15	26	29	32.3	21.7	10.6			16.0	14.0	1.86	0.46	24	0.32	23	0.92	15					0.0190

Other Test Results

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-1	19.10	13	54	33					SP		14.3	1.85							0.21	35.3	0.19	40.3	1.4000
H-1	38.10	20	27	53	33.0	21.0	12.0	13.0	CL		13.1	1.74							0.25	31.9	0.24	36.7	0.0021

Table 5.10 SUMMARY OF LABORATORY TEST RESULTS: SAND AND GRAVEL MATERIALS (1/2)

BORROW AREA Ga

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-1	1.46	1.76	50.80	33	40	27	40.00	3.90	57.20	2.56	2.52	2.69	3.9	0.8	11.5	8.3	22.6
G-2	1.74	1.62	50.80	61	36	3	8.00	0.10	3.73	0.20	2.60	2.67	3.3	1.0	10.8	6.6	23.9
G-6	1.71	1.79	76.20	58	39	3	8.20	0.20	1.61	0.33	2.63	2.66	3.7	1.2	11.0	11.0	23.9
Average	1.64	1.72		51	38	11	18.73	1.40	20.85	1.03	2.58	2.67	3.6	1.0	11.1	8.6	23.5
Max.	1.74	1.79	76.20	61	40	27	40.00	3.90	57.20	2.56	2.63	2.69	3.9	1.2	11.5	11.0	23.9
Min.	1.46	1.62	50.80	33	36	3	8.00	0.10	1.61	0.20	2.52	2.66	3.3	0.8	10.8	6.6	22.6

BORROW AREA Gb

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-5	1.67		76.20	18	78	4	4.90	0.60	8.37	1.40	2.58	2.58	3.9	3.1	8.8	6.2	

BORROW AREA Gc

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-7	1.59	1.69	76.20	56	33	11	24.00	0.60	16.00	0.94	2.60	2.66	3.3	1.1	12.3	6.0	24.4
G-12A			76.20	60	33	7					2.68	2.65	1.8	1.2	13.7	9.9	25.6
G-12B			76.20	66	29	5					2.61	2.65	2.9	1.2	13.3	8.2	26.6
Average			76.20	61	32	8					2.63	2.65	2.7	1.2	13.1	8.0	25.5
Max.				66	33	11					2.68	2.66	3.3	1.2	13.7	9.9	26.6
Min.				56	29	5					2.60	2.65	1.8	1.1	12.3	6.0	24.4

Notes: SC (silt - clay) of samples G-10A to G-13B; % of No.100 sieve passing.
G-1 to G-8; tested in 1987, G-10 to -13; tested in 1990.
MSC: Maximum gravel size. G: Gravel S: Sand

Table 5.10 SUMMARY OF LABORATORY TEST RESULTS: SAND AND GRAVEL MATERIALS (2/2)

BORROW AREA Gd

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-3	1.79	1.69	76.20	43	53	4	7.30	0.50	1.62	0.13	2.63	2.65	2.5	1.1	7.8	8.8	25.0
G-4	1.82	1.69	76.20	46	48	6	10.50	0.20	2.21	0.48	2.65	2.67	2.5	0.9	8.3	10.6	25.0
G-10A			102.00	76	23	1					2.71	2.65	0.8	1.1	12.1	7.1	23.9
G-10B			102.00	70	29	1					2.70	2.70	1.2	0.5	10.1	13.5	28.6
G-11A			102.00	68	31	1					2.68	2.69	1.8	0.9	11.7	5.7	24.7
G-11B			102.00	59	40	1					2.70	2.66	1.6	1.0	12.7	6.2	24.6
Average	1.81	1.69		60	37	2	8.90	0.35	1.92	0.31	2.68	2.67	1.7	0.9	10.5	8.7	25.3
Max.			102.00	76	53	6					2.71	2.70	2.5	1.1	12.7	13.5	28.6
Min.			76.20	43	23	1					2.63	2.65	0.8	0.5	7.8	5.7	23.9

BORROW AREA Ge

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-8	1.55		50.80	14	75	11	12.30	1.50	36.40	2.36	2.66	2.65	2.0	1.2	11.9	7.6	
G-13A			76.20	70	25	5					2.66	2.67	2.0	1.0	15.3	9.4	23.1
G-13B			76.20	56	34	10					2.65	2.66	2.5	1.1	14.7	6.5	24.7
Average				47	45	9					2.66	2.66	2.2	1.1	14.0	7.8	23.9
Max.			76.2	70	75	11					2.66	2.67	2.5	1.2	15.3	9.4	
Min.			50.8	14	25	5					2.65	2.65	2.0	1.0	11.9	6.5	

Notes: SC (silt - clay) of samples G-10A to G-13B; % of No.100 sieve passing.
G-1 to G-8; tested in 1987, G-10 to -13; tested in 1990.
MSC: Maximum gravel size. G: Gravel S: Sand

Table 5.11 SUMMARY OF LABORATORY TEST RESULTS: QUARRY SITE (SK-311 AND SK-312)

			Physical Test			Super Sonic Test						
Hole No.	Depth	(m)	Compressive strength (kg/cm2)	Water absorption (x10-3 %)	Bulk specific gravity (g/cm3)	Density (g/cm3)	Longt. velocity Vp(m/sn)	Transv. velocity Vs(m/sn)	Poisson's ratio	Dynum. shear modulus G(kg/cm2)	Dynum. elast. modulus E(kg/cm2)	Bulk modulus k(kg/cm2)
SK-311	12.20 -	12.50		2.50	1.68							
	12.80 -	19.15		1.24	2.28							
	18.80 -	19.15	1,322			2.89	6,468	3,147	0.34	297,508	797,324	830,546
	22.95 -	23.20	1,244	1.29	2.12	2.89	6,429	3,103	0.35	289,248	780,968	867,744
	32.65 -	32.87	170	1.65	2.23	2.72	5,586	2,793	0.33	220,551	586,664	575,162
	35.05 -	35.35	409	0.98	1.92	2.83	6,164	3,030	0.34	270,068	723,783	753,946
	44.70 -	44.90	617	1.36	2.16	2.89	6,436	3,066	0.35	282,386	762,440	847,157
	51.25 -	51.55		1.30	2.25							
	54.45 -	54.60	366	0.62	2.23	2.86	6,292	3,094	0.34	304,982	762,695	794,479
	55.05 -	55.30	1,509	3.37	1.82	2.88	6,409	3,147	0.34	296,478	794,560	827,670
	58.75 -	59.00	972	1.48	2.23	2.87	6,325	3,136	0.34	293,388	786,280	819,043
	Average		826	1.58	2.09	2.85	6,264	3,065	0.34	281,826	749,339	574,159
SK-312	15.70 -	16.10		0.35	2.28							
	21.60 -	21.90	1,313	1.50	2.19	2.88	6,389	3,194	0.33	305,400	812,364	796,437
	27.20 -	27.45	508	0.66	2.24	2.89	6,441	3,192	0.34	306,073	820,277	854,458
	31.25 -	31.55	441	0.61	2.33	2.89	6,468	3,264	0.33	320,043	851,317	834,624
	35.50 -	35.65	1,253	0.89	2.17	2.89	6,470	3,113	0.35	291,114	786,005	873,342
	37.00 -	37.30	685	2.10	2.29	2.89	6,435	3,159	0.34	299,782	803,411	836,888
	40.70 -	41.10	941	0.55	2.05	2.92	6,589	3,205	0.35	311,773	841,793	935,330
	43.90 -	44.10	1,301	1.50	2.16	2.87	6,351	3,147	0.34	295,448	791,797	824,784
	44.85 -	45.00	798	0.73	2.25	2.88	6,376	3,048	0.35	278,113	750,907	834,339
	45.00 -	45.35	1,244	0.79	2.29	2.88	6,389	3,194	0.33	305,400	812,364	796,437
	45.00 -	45.35		0.62	2.33							
	Average		943	0.94	2.23	2.89	6,434	3,168	0.34	301,461	807,804	842,960
	Average of all		888	1.24	2.17	2.87	6,354	3,120	0.34	292,221	780,291	817,787

AGGREGATE TEST RESULTS

Sample No.	Water absorption (%)	Bulk specific gravity (g/cm3)	Soundness (%)	Los Angeles Abrasion (500cycles, %)
SK-311A	0.10	2.68	0.2	23.2
SK-311B	0.10	2.69	2.8	21.1
SK-312A	0.20	2.68	3.9	25.5
SK-312B	0.10	2.70	1.1	23.6
Average	0.13	2.69	2.0	23.4

Table 5.12 RESULTS OF ALKALI AGGREGATE REACTIVITY TEST

(1) Sand and Gravel Materials

Sample No.	Decrease in Alkali (m mol/l)	Dissolved Silica (m mol/l)
G-10A	190	67
G-10B	150	64
G-11A	170	40
G-11B	130	19
G-12A	160	32
G-12B	190	56
G-13A	190	71
G-13B	180	71
Average	170	53

(2) Core Samples (Boreholes SK-311 and SK-312)

Sample No.	Decrease in Alkali (m mol/l)	Dissolved Silica (m mol/l)	Content Ratio of CaCO3 (%)
SK-311A	50	2	94.3
SK-311B	50	3	94.8
SK-312A	50	1	95.3
SK-312B	50	2	94.3
Average	50	2	94.7

Table 5.13 RESULTS OF SOFT ROCK RATIO TEST

Sample No.	Soft Rock Ratio (%)
G-10	2.3
G-11	0.9
G-12	1.9
G-13	9.0
Average	3.5

Table 5.14 MEAN RUNOFF COEFFICIENTS CALCULATED FROM RUNOFF RECORDS (1965-1987)

Sub-basin	River	Drainage Area (km^2)	Mean Annual Runoff (m^3/s)	Annual Runoff (MCM)	Runoff (mm)	Mean Annual Rainfall (mm)	Runoff Coefficient	Loss (mm)
>17-14 1/	Ermenek	2000.0	44.6	1406	703	960	0.73	257
17-14 - 1719 2/	Ermenek	1499.6	17.8	561	374	635	0.59	261
>1712	Göksu	2639.2	32.0	1008	375	620	0.62	245
1712 - 1720	Göksu	1614.8	19.1	604	374	675	0.55	301
1720 - 1714 1719	Göksu downstream	2261.6	15.5	488	216	647	0.33	431

1/: the sub-basin upstream from the station 17-14

2/: the sub-basin between the stations 17-14 and 1719

Table 5.15 MEAN RUNOFF COEFFICIENTS CALCULATED FOR ESTIMATED RUNOFF OF STATION 17-14 (1965-1987)

Sub-basin	Drainage Area (km^2)	Mean Annual Runoff (m^3/s)	Annual Runoff (MCM)	Runoff (mm)	Mean Annual Rainfall (mm)	Runoff Coefficient	Loss (mm)
>Nadire	1318.8	33.4	1053	799	1090	0.73	291
Nadire - 17-14	681.2	11.2/44.6	353	519	721	0.72	202
17-14 - Görmel B. (Zeyve Creek)	156.0	2.9	91.4	586	825	0.71	239
17-14 - II-B	428.4	4.0	126	294	520	0.57	226
II-B - II-A (Erik R.)	238.8	3.8	120	502	830	0.61	328
II-A - Gezende	326.8	3.3/58.6	104	318	600	0.53	282
Gezende - 1719	341.1	3.8/62.4	120	351	650	0.54	299

Table 5.16 ESTIMATED RUNOFF BY SUB-BASIN (1946-1987)

Sub-basin	Drainage Area (km^2)	Mean Annual Runoff (m^3/s)	Annual Runoff (MCM)	Runoff (mm)	Mean Annual Rainfall (mm)	Runoff Coeffi-cient	Loss (mm)
>Nadire	1318.8	30.3	956	725	-	-	-
Nadire - 17-14	681.2	10.1/40.4	319	468	-	-	-
17-14 - Görmel B.	156.0	2.6/43.0	82	526	-	-	-
Görmel B.- II-B	428.4	3.7	117	272	-	-	-
II-B - II-A (Erik)	238.8	3.5	110	462	-	-	-
II-A - Gezende	326.8	3.0/53.2	95	289	-	-	-
Gezende - 1719	341.1	3.5/56.7	110	324	-	-	-

Table 5.17 ANNUAL FLOOD PEAK FLOW OBSERVED AT STATION 17-14

Year	Date day, month	Peak Discharge m^3/s
1965	21 JAN	480
1966	25 JAN	730 *
1967	12 JAN	540
1968	13 MAR	680
1969	-	-
1970	-	-
1971	-	-
1972	10 APR	240
1973	26 FEB	160
1974	15 MAR	870
1975	20 DEC	560
1976	12 APR	880
1977	3 DEC	820
1978	20 JAN	700 *
1979	3 JAN	880
1980	14 DEC	1,200
1981	6 JAN	630
1982	16 NOV	855 *
1983	27 DEC	410
1984	1 DEC	750
1985	1 APR	280

Note: * indicates that the value was revised after rechecking daily water level and discharge data and rating curves at 17-14 (DSI)

Table 5.18 PROBABLE FLOOD AT STATION 17-14

(Unit : m^3/s)

Return Period (yr)	Third Type of Log-Pearson	Probable Flood Gumbel
1.01	173	143
1.5	465	497
2	582	610
5	904	889
10	1137	1074
25	1452	1308
50	1701	1481
100	1960	1653
200	2233	1824

Table 5.19 PROBABLE FLOOD VOLUME AT STATION 17-14

(Unit : 10^6 m)

Return Period (yr)	Duration (day)					
	1	2	3	5	7	10
1.01	6	19	30	55	75	92
1.50	33	54	72	102	129	164
2	42	65	85	117	146	187
5	63	92	118	153	189	243
10	77	110	140	178	217	281
25	95	133	167	208	253	328
50	108	150	187	231	279	363
100	121	167	207	253	306	398
200	134	184	228	276	332	433

Table 5.20 BRIDGES ON SILIFKE-GÜLNAR-ERMENEK ROAD

Distance (km)	Bridge			Remarks
	Gross Length (m)	Net Width (m)	Nos. of Span	
0	-	-	-	Silifke junction Asphalt paved road
6	-	-	-	Branch from Route 35
65	-	-	-	Gülnar town, El. 1,000 m
111		6	1	RC
111	50	6	2	Olukpinar Bridge, RC, El. 1,100 m Gravel stabilized road from hear to Görmel Bridge
	-	-	-	Hairpins and steep slope to climb up to the plateau
	-	-	-	Highest point at El. 1,550 m
136	55	4.5	2	Görmel Bridge, Stone, El. 1,550 m, Asphalt paved road
146	-	-	-	Junction with the Mut- Ermenek road
150	-	-	-	Ermenek town

Table 5.21 BRIDGES ON SILIFKE-MUT-ERMENEK ROAD (1/2)

Distance (km)	Bridge			Remarks
	Gross Length (m)	Net Width (m)	Nos. of Span	
0	-	-	-	Silifke junction Asphalt paved Route 35
15	90	5.5	3	Göksu Bridge on the main stream of Göksu, RC, Upstream from Kayraktepe dam site
36	34	5.5	1	Kargicak Bridge, RC
52	85	6	4	RC, on a branch stream with river water
67	27	7	1	
80			1	Mut town
83	-	-	-	Branch from Route 35 towards Ermenek
86	8	6	1	RC + Stone arch
88	60	3.5		Kadi Bridge, stone bridge on Branch Göksu
90	11	3.5	1	RC
92	16	3.5	1	RC, stone abutment
104	-	-	-	Branch to Gezende P.S.
107	30	3.5	1	After Evren Village
115	-	-	-	Hairpin curve
120	-	-	-	Partly narrow section
122	-	-	-	Partly narrow section
125	-	-	-	Narrow section for about 2 km, with rock cliff on the right side

Table 5.21 BRIDGES ON SILIFKE-MUT-ERMENEK ROAD (2/2)

Distance (km)	Bridge			Remarks
	Gross Length (m)	Net Width (m)	Nos. of Span	
136	-	-	-	Branch to Gezende dam site
151	30	5.5	1	Yerköprü Bridge, steel truss, load capacity 36 t
171	-	-	-	Ermenek town

Table 6.1 LAND USE IN ERMENEK DISTRICT, 1988

Land use	Area (ha)	Share (%)
Cultivated land	32,075	13.8
Cereals	12,360	5.4
Follow	10,556	4.5
Pulses	1,150	0.5
Industrial crops	654	0.3
Fodder crops	73	0.0
Vegetables	677	0.3
Vineyards	4,925	2.1
Fruits	1,680	0.7
Pasture / meadow	31,300	13.5
Forests	161,000	69.4
Settlements	700	0.3
Ponds and marshland	500	0.2
Land unsuited to production activities	6,350	2.8
TOTAL	231,925	100.0

Source : Ermenek District Agricultural Office

Table 6.2 PATIENTS HOSPITALIZED IN ERMENEK HOSPITAL

Disease	Nos. of Patients
Infectious hepatitis	23
Rabies	37
Tuberculosis	2
Diarrhoea	277
Death of new borne by diarrhoea	2

Remarks; January to October 1989

Table 6.3 WATER QUALITY OF THE ERMENEK RIVER

Sampling point and date	Water Temperature °C	pH	Na	K	Ca/Mg	CO_3	HCO_3	Cl	SO_4	Total Salt ppm	BOD mg/1
Görmel											
18.2.1987	10	8.0	0.11	0.03	3.20	0.10	2.90	0.18	0.16	195	1.60
25.8.1987	16	8.2	0.10	0.03	3.30	0.40	2.20	0.20	0.63	187	0.00
Çavusköyü											
10.8.1988	18	8.2	0.08	0.00	3.10	0.40	1.90	0.22	0.68	183	0.70
7.2.1989	8	8.1	0.15	0.00	3.70	0.30	2.90	0.20	0.48	227	0.90

Note : No or trace ammonia/nitrate/nitrite has been detected.

Source : DSİ

Table 6.4 BIRD SPECIES CONFIRMED

Accipitridae	Vulture (Akbaba in Turkish), Sparrow-hawk (Atmaca) Eagle (Kartal)
Falconidae	Peregrine (Sahin)
Ciconidae	Stork (Leylek)
Fringillidae	Goldfinch (Saka)

Source: Combination by the JICA Study Team in consultation with scholars.

Table 6.5 TREE SPECIES IN THE ERMENEK RIVER BASIN

Botanical name	Common name
Shrubs	
Quercus coccifera/illex	Holly oak
Arbutus andrachne	Strawberry tree
Laurus nobilis	Laurel
Olea europea var.	Wild olive
Pistacea trebinthus/lentiscus	Terebinth
Cistus villosus/salviifolius	Rockroses
Forest trees	
Acacia cyanophylla	Cypress acacia
Pinus brutia	Turkish red pine
Cedrus Libani	Cedar
Juniperus feoditissima/excelsa/ axyeedrus/phoenicea	Junipers
Pinus nigra	Black pine
Others	
Staphyles pinnata	Bead tree
Crataegrus manegya	Fig
Euphorbis tinctoris	Euphorbia
Creminea	
Durphacca	Elecampane
Verbaseum olympicum	
Mentha	Pepper
Astragalus	Gum-tragacanth
Thymus serpylum	Thyme
Acer	
Platanus orientalis	Plane tree
Salix alba	Willow
Ostrya Carpinifolia	
Corylus	Hazelnut
Polypodium yulgave	
Rosa canina	
Selvia	
Rubus ideus	Blackberry
Phas coriaia	Sumac

Remarks: Existence confirmed by the Ermenek Regional Office of General Directorate of Forestry.

Table 6.6 FISH SPECIES IN THE GÖKSU RIVER SYSTEM

Scientific name	English name	Turkish name
* Anguilla anguilla	Eel fish	Yılan balığı
* Salmotrutta macrostigma	Trout	Dere alası
* Cyprinus carpio	Carp	Sazan balığı
* Vimba vimba tenella		Tahta balığı, Karagöz
Acanthorutilus anatolicus		Yag balığı
Pararhodeus kervilleri		
* Chondrostoma nasus		Kababurun
* Leuciscus cephalus	Chub	Tatlısu kefali
L.borysthenicus		Tatlısu kefali
L.lepidus		Akbalık
* Barbus capito pectoralis	Barbel fish	Bıyıklı balık
* B.plebejus escherichi	Barbel fish	Bıyıklı balık
Capoeta capoeta angorae		Karabalık
Cobitis taenia	Spined loach	Tasyiyen balığı
Nemacheilus angorae	Ankara stone loach	Cöpcü balığı
* Silurus glanis	Wels	Yayın balığı
Aphanius chantrei fontinalis		Dislisazapcık balıkları
A. sophiae mentoides		"
* Mugil cephalus	Mullet	Deniz kefali
* M. ramade	Mullet	Deniz kefali
* Stizastedion lucioperca	Pike perch	Aklevrek (Sudak)
Blennius fluviatilis		Horos bina balığı

Source: Combination by the JICA Study Team in consultation with scholars.

Table 6.7 REGIONAL & NATIONAL URBAN CENTERS
(Populations 20,000+)

Urban Settlement	Province	Population 1975	Population 1980	Population 1985	Annual Growth (%) 1975 1980	Annual Growth (%) 1980 1985	Annual Growth (%) 1975 1985
Regional Centers							
Manavgat	ANTALYA	10804	14255	21520	5.70	8.59	7.13
Ilgin	KONYA	11830	16762	22539	7.22	6.10	6.66
Cumra	KONYA	19225	20919	24175	1.70	2.94	2.32
Erdemli	IÇEL	19936	21234	26074	1.27	4.19	2.72
Silifke	IÇEL	19257	22041	28111	2.74	4.99	3.86
Anamur	IÇEL	21475	23025	28726	1.40	4.52	2.95
Alanya	ANTALYA	18520	22190	28733	3.68	5.30	4.49
Seydisehir	KONYA	25651	30065	37226	3.23	4.37	3.79
Aksehir	KONYA	35544	40312	45320	2.55	2.37	2.46
Karaman	KARAMAN	43759	51208	64735	3.19	4.80	3.99
Eregli	KONYA	50354	56931	68749	2.49	3.84	3.16
Tarsus	IÇEL	102186	121074	146502	3.45	3.89	3.67
Antalya	ANTALYA	130774	173501	261114	5.82	8.52	7.16
Mersin	IÇEL	152236	216308	314350	7.28	7.76	7.52
Konya	KONYA	300882	374290	478635	4.46	5.04	4.75
National Centers							
Bursa		346103	445113	612510	5.16	6.59	5.87
Adana		475384	574515	777554	3.86	6.24	5.04
Izmir		1701004	1877755	2235035	2.00	3.54	2.77
Ankara		2547364	2772708	5475982	1.71	14.58	7.95
Istanbul		5706689	6427945	10590853	2.41	10.50	6.38
Total Population of Turkey		40347719	44736957	50664458	2.09	2.52	2.30

Source: Statistical Yearbook of Turkey, 1987, SIS.

Table 6.8 RISK RESULTANT MATRIX FOR PEIA OF THE PROJECT

Aspect of Environment	Possible Impact: Precon-struction	Possible Impact: Con-struction	Possible Impact: Opera-tion	Note
1. Socio-economy				
(1) Demography	0	±	+	- Relocation of people + Employment opportunities
(2) Agriculture	0	0	-	- Inundation of agri-cultural land
(3) Fishery	0	0	+	+ Aquaculture in the long run
(4) Industry	0	0	±	+ Konya and Karaman Provinces - Negative effect on coal mines
(5) Trade	0	0	+	+ Use of reservoir
(6) Tourism	0	0	+	+ Better access, increased opportunities
(7) Land tenure	-	0	0	- Problem associated with resettlement
(8) Health	0	0	x	
2. Natural/Physical Aspects				
(1) Topography	0	-	±	- Submergence of canyon, minor disruption + Better landscape by reservoir
(2) Geology	0	0	x	
(3) Vegetation	-	-	0	- Tree cutting, Erosion
(4) Meteoro-hydrology	0	0	x	
(5) Water quality	0	-	-	- Discharge of sediment, wastes etc.
3. Fauna and Flora				
(1) Terrestrial fauna	0	0	x	
(2) Terrestrial flora	0	0	x	
(3) Aquatic fauna	0	-	±	- Effect by lower water quality + Increased productivity
(4) Aquatic flora	0	-	±	- Effect by lower water quality + Diversification

Table 9.1 LABOR WAGE RATES

	Description	Unit	L.C(TL)	F.C(US$)
1.	Foreman			
	a) Chief of Common labor	m.d	46,340	20.1
	b) Chief of skilled labor	m.d	29,580	12.9
2.	Operator			
	a) Heavy equipment	m.d	53,020	23.1
	b) Light equipment	m.d	36,280	15.8
3.	Driver			
	a) Driver	m.d	29,580	12.9
	b) Trailer driver	m.d	32,920	14.3
4.	Mechanic	m.d	29,580	12.9
5.	Welder	m.d	29,580	12.9
6.	Concrete worker	m.d	27,910	12.1
7.	Carpenter	m.d	39,630	17.2
8.	Steel worker	m.d	39,630	17.2
9.	Common laber	m.d	21,200	9.2
10.	Skilled labor	m.d	22,960	10.0
11.	Driller	m.d	23,550	10.2

Source: Surveyed by the JICA Study Team

Table 9.2 MARKET PRICES OF CONSTRUCTION MATERIALS

	Description	Unit	L.C(TL)	F.C(US$)
1.	Cement			
	a) Cement (in bag)	ton	138,470	60.2
	b) Cement (in bulk)	bag	147,000	63.9
2.	Aggregate			
	a) gravel	m3	25,000	10.9
	b) sand	m3	25,000	10.9
3.	Fuel & lubricant			
	a) Gasoline	l	1,040	0.5
	b) Diesel	l	963	0.4
	c) Heavy oil	l	591	0.3
4.	Gas			
	a) Propan gas	l	985	0.4
5.	Steel materials			
	a) Reinforcement bar	ton	1,045,000	454.3
6.	Wooden Materials			
	a) plywood	m3	420,000	182.6
	b) Pine,plank	M3	910,000	395.7
7.	Dynamite	kg	5,500	2.4

Source: Surveyed by the JICA Study Team

Table 9.3 PRICES OF CONSTRUCTION EQUIPMENT

	Description	Capacity	L.C(1000TL)	F.C(US$)
1.	Bulldozer	D9N 43t	780,045	339,150
2.	- do -	D8N 32t	610,995	265,650
3.	- do -	D8L 32t	678,615	295,050
4.	- do -	D7H 24t	490,245	213,150
5.	- do -	D7G 24t	425,040	184,800
6.	Wheel loader	980C 3.2m3	584,430	254,100
7.	- do -	966E 2.8m3	364,665	158,550
8.	- do - (side dump)	950E 2.1m3	312,869	136,030
9.	Back hoe	235C 1.5m3	615,825	267,750
10.	- do -	0.6m3	185,587	80,690
11.	- do -	0.4m3	120,865	52,550
12.	Dump truck	D35C 32t	647,220	281,400
13.	- do -	D30C 27t	594,090	258,300
14.	- do -	D25C 23t	497,490	216,300
15.	Crawler jumbo	2 booms	1,030,055	447,850
16.	Crawler drill	1 boom	106,168	46,160
17.	Rocker shovel	0.4 m3	191,107	83,090
18.	Battery Locomotive	12 t	467,176	203,120
19.	Raise Climber	STH 5E	416,300	181,000
20.	Truck crane	20 t	329,820	143,400
21.	Truck mixer	4.5 m3	122,038	53,060
22.	Concrete pump	65 m3	363,837	158,190
23.	Batcher plant	45 m3	717,002	311,740
24.	- do -	85 m3	1,005,169	437,030

Source: Surveyed by the JICA Study Team

Table 9.4 SUMMARY OF INVESTMENT COSTS

	Foreign (Mİ.$)	Local (Mİ.$)	Total (Mİ.$)
1.Land Acquisition	0.23	13.65	13.88
2.Preparatory Works	2.52	9.63	12.14
3.Civil Works			
2.1 River Diversion Works	1.07	2.43	3.50
2.2 Dam and Spillway	39.73	86.90	126.63
2.3 Power WaterWay	22.22	43.93	66.15
2.4 Power House	6.03	15.90	21.93
2.5 Tailrace tunnel	3.15	6.47	9.62
2.6 Outdoor Switchyard	0.15	0.16	0.31
2.7 Erik Diversion Scheme	2.31	4.68	6.99
(Sub-Total)	74.66	160.46	235.12
4.Hydraulic Works	11.09	4.80	15.89
5.Mechanical and Electric Equipment	44.46	11.12	55.58
6.Engineering and Administration Free	15.45	21.39	36.84
7.Transmission Line	21.58	14.38	35.96
8.Tax (VAT 10%)	17.00	23.54	40.54
9.Interest During Construction	28.90	77.20	106.10
Grand Total	215.88	336.18	552.06

Note: Local currency is expressed in US$ equivalents at an exchange rate of US$1.00 = TL2,300.

Table 9.5 BILL OF QUANTITIES (1/10)

No.	Work Item	Unit	Q'ty	Foreign Currency Unit Price US$	Foreign Currency Amount US$1,000	Local Currency Unit Price US$	Local Currency Unit Price 1,000TL	Local Currency Amount TL million	Total in US$ Unit Price US$	Total in US$ Amount US$1,000
1.	Land Acquisition									
1.1	Land acquisition & compensation	L.S.				9,730		22,379.00		9,730.00
1.2	Relocation road	m	13,800	15.00	207.00	130	299.00	4,126.20	145.00	2,001.00
	Sub-total				207.00			26,505.20		11,731.00
	Physical contingency (20% of 1.1 & 10% of 1.2)				20.70			4,888.42		2,146.10
	Total of land acquisition				227.70			31,393.62		13,877.10
2.	Preparatory Works									
2.1	Access road									
	- Access roads	m	42,000	15.00	630.00	130	299.00	12,558.00	145.00	6,090.00
	- Bridges near switchyard	nos.	1	10,000.00	10.00	90,000	207,000.00	207.00	100,000.00	100.00
2.2	Improvement of existing road	m	10,000	15.00	150.00	130	299.00	2,990.00	145.00	1,450.00
2.3	Camp facilities for owner & engineers incl. power, water etc.	L.S.			1,500.00			4,370.00		3,400.00
	Sub-total				2,290.00			20,125.00		11,040.00
	Physical contingency (10 %)				229.00			2,012.50		1,104.00
	Total of Preparatory Works				2,519.00			22,137.50		12,144.00
3.	River Diversion Works									
3.1	Access tunnel to diversion tunnel (D7)									
	- excavation, tunnel	c.m.	1,400	14.49	20.29	22	49.47	69.26	36.00	50.40
	- slab concrete, tunnel	c.m.	64	41.10	2.63	69	158.47	10.14	110.00	7.04
	- reinforcing bar (20 kg/m3)	ton	1	22.60	0.03	697	1,604.02	2.05	720.00	0.92
	- access road (W=6 m)	m	700	15.00	10.50	130	299.00	209.30	145.00	101.50

Table 9.5 BILL OF QUANTITIES (2/10)

No.	Work Item	Unit	Q'ty	Foreign Currency		Local Currency			Total in US$	
				Unit Price US$	Amount US$1,000	Unit Price US$	Unit Price 1,000TL	Amount TL million	Unit Price US$	Amount US$1,000
3.2	Diversion tunnel (D7.0)									
	- excavation, w. rock	c.m.	1,000	1.00	1.00	1	2.30	2.30	2.00	2.00
	- excavation, rock	c.m.	1,000	2.00	2.00	2	4.60	4.60	4.00	4.00
	- excavation, tunnel	c.m.	21,600	14.00	302.40	22	50.60	1,092.96	36.00	777.60
	- shotcrete	c.m.	72	92.00	6.62	273	627.90	45.21	365.00	26.28
	- concrete, open	c.m.	500	28.00	14.00	47	108.10	54.05	75.00	37.50
	- lining concrete, tunnel	c.m.	6,771	41.00	277.61	69	158.70	1,074.56	110.00	744.81
	- reinforcing bar (40 kg/m3)	ton	291	23.00	6.69	697	1,603.10	466.25	720.00	209.40
	- consolidation grout	m	1,825	2.00	3.65	28	64.40	117.53	30.00	54.75
	- plugging works	lot	1	113,000.00	113.00	387,000	890,100.00	890.10	500,000.00	500.00
3.3	Coffer dam									
	- excavation, w. rock	c.m.	2,000	1.00	2.00	1	2.30	4.60	2.00	4.00
	- embankment	c.m.	7,700	2.00	15.40	2	4.60	35.42	4.00	30.80
	- concrete, open	c.m.	3,860	28.00	108.08	47	108.10	417.27	75.00	289.50
	- reinforcing bar (20 kg/m3)	ton	77	23.00	1.78	697	1,603.10	123.76	720.00	55.58
	Sub-total				887.68			4,619.35		2,896.09
	Others (5%)				44.38			230.97		144.80
	Sub-total of item3.				932.06			4,850.32		3,040.89

Table 9.5 BILL OF QUANTITIES (3/10)

No.	Work Item	Unit	Q'ty	Foreign Currency Unit Price US$	Foreign Currency Amount US$1,000	Local Currency Unit Price US$	Local Currency Unit Price 1,000TL	Local Currency Amount TL million	Total in US$ Unit Price US$	Total in US$ Amount US$1,000
4.	Dam and Spillway									
4.1	Access tunnel to dam site (D7 at crest and riverbed)									
	- excavation, tunnel	c.m.	76,900	14.00	1,076.60	22	50.60	3,891.14	36.00	2,768.40
	- shotcrete	c.m.	512	92.00	47.10	273	627.90	321.48	365.00	186.88
	- slab concrete, tunnel	c.m.	2,730	41.00	111.93	69	158.70	433.25	110.00	300.30
	- reinforcing bar (20 kg/m3)	ton	109	23.00	2.51	697	1,603.10	174.74	720.00	78.48
	- access road at crest (W=6 m)	m	2,000	15.00	30.00	130	299.00	598.00	145.00	290.00
	- access road at riverbed (W=6 m	m	2,000	15.00	30.00	130	299.00	598.00	145.00	290.00
4.2	Main dam									
	- excavation, w. rock	c.m.	399,060	4.00	1,596.24	6	13.80	5,507.03	10.00	3,990.60
	- excavation, rock	c.m.	405,860	4.00	1,623.44	6	13.80	5,600.87	10.00	4,058.60
	- concrete, open (10 %)	c.m.	27,000	28.00	756.00	47	108.10	2,918.70	75.00	2,025.00
	- dam concrete	c.m.	270,000	50.00	13,500.00	80	184.00	49,680.00	130.00	35,100.00
	- reinforcing bar (5 kg/m3)	ton	1,485	23.00	34.16	697	1,603.10	2,380.60	720.00	1,069.20
	- consolidation grout	m	7,038	8.00	56.30	22	50.60	356.12	30.00	211.14
4.3	Access tunnel to grout gallery (B2.6 x H2.5)									
	- excavation, tunnel	c.m.	56,600	14.00	792.40	43	98.90	5,597.74	57.00	3,226.20
	- shotcrete	c.m.	549	92.00	50.51	273	627.90	344.72	365.00	200.39
	- access road (W=6 m)	m	4,000	15.00	60.00	130	299.00	1,196.00	145.00	580.00
	- temporary bridge	nos.	1	4,000.00	4.00	31,000	71,300.00	71.30	35,000.00	35.00
4.4	Vertical shafts to grout gallery									
	- excavation, shaft	c.m.	23,400	62.00	1,450.80	38	87.40	2,045.16	100.00	2,340.00
	- shotcrete	c.m.	1,360	92.00	125.12	273	627.90	853.94	365.00	496.40
	- rockbolts	m	18,900	6.00	113.40	14	32.20	608.58	20.00	378.00
	- lining concrete, shaft	c.m.	8,670	52.00	450.84	123	282.90	2,452.74	175.00	1,517.25
	- reinforcing bar (40 kg/m3)	ton	347	23.00	7.98	697	1,603.10	555.96	720.00	249.70

Table 9.5 BILL OF QUANTITIES (4/10)

No.	Work Item	Unit	Q'ty	Foreign Currency Unit Price US$	Foreign Currency Amount US$1,000	Local Currency Unit Price US$	Local Currency Unit Price 1,000TL	Local Currency Amount TL million	Total in US$ Unit Price US$	Total in US$ Amount US$1,000
4.5	Grout tunnels and curtain grout									
	- excavation, tunnel (D3.5)	c.m.	200,700	14.00	2,809.80	43	98.90	19,849.23	57.00	11,439.90
	- lining concrete, tunnel	c.m.	76,100	41.00	3,120.10	69	158.70	12,077.07	110.00	8,371.00
	- reinforcing bar (40 kg/m3)	ton	3,044	23.00	70.01	697	1,603.10	4,879.84	720.00	2,191.68
	- grout hole drilling	m	385,891	1.80	694.60	12.1	27.83	10,739.35	13.90	5,363.88
	- grouting (100 kg/m)	ton	38,589	69.00	2,662.65	318	731.40	28,224.07	387.00	14,933.98
	- replacement concrete	c.m.	22,000	45.00	990.00	60	138.00	3,036.00	105.00	2,310.00
4.6	Spillway tunnel (D9.0)									
	- excavation, w. rock	c.m.	300	1.00	0.30	1	2.30	0.69	2.00	0.60
	- excavation, rock	c.m.	2,700	2.00	5.40	2	4.60	12.42	4.00	10.80
	- excavation, tunnel	c.m.	29,300	16.00	468.80	24	55.20	1,617.36	40.00	1,172.00
	- excavation, shaft	c.m.	11,100	62.00	688.20	38	87.40	970.14	100.00	1,110.00
	- shotcrete	c.m.	480	92.00	44.16	273	627.90	301.39	365.00	175.20
	- rockbolts	m	3,480	6.00	20.88	14	32.20	112.06	20.00	69.60
	- concrete, open	c.m.	2,000	28.00	56.00	47	108.10	216.20	75.00	150.00
	- lining concrete, tunnel	c.m.	10,190	41.00	417.79	69	158.70	1,617.15	110.00	1,120.90
	- lining concrete, shaft	c.m.	3,430	52.00	178.36	123	282.90	970.35	175.00	600.25
	- reinforcing bar (40 kg/m3)	ton	625	23.00	14.37	697	1,603.10	1,001.62	720.00	449.86
	- consolidation grout	m	5,390	8.00	43.12	22	50.60	272.73	30.00	161.70
	Sub-total				34,203.87			172,083.73		109,022.88
	Others (1%)				342.04			1,720.84		1,090.23
	Sub-total of item 4.				34,545.91			173,804.57		110,113.11

Table 9.5 BILL OF QUANTITIES (5/10)

No.	Work Item	Unit	Q'ty	Foreign Currency		Local Currency			Total in US$	
				Unit Price US$	Amount US$1,000	Unit Price US$	Unit Price 1,000TL	Amount TL million	Unit Price US$	Amount US$1,000
5.	Power Waterway									
5.1	Work adit (D7.0)									
	- excavation, w. rock	c.m.	400	1.00	0.40	1	2.30	0.92	2.00	0.80
	- excavation, rock	c.m.	2,000	2.00	4.00	2	4.60	9.20	4.00	8.00
	- excavation, tunnel	c.m.	102,900	14.00	1,440.60	21	48.30	4,970.07	35.00	3,601.50
	- steel support	ton	330	287.70	94.94	482	1,109.29	366.07	770.00	254.10
	- shotcrete	c.m.	1,510	92.00	138.92	273	627.90	948.13	365.00	551.15
	- rockbolts	m	14,600	6.00	87.60	14	32.20	470.12	20.00	292.00
	- concrete, open	c.m.	800	28.00	22.40	47	108.10	86.48	75.00	60.00
	- lining concrete, tunnel	c.m.	8,980	41.00	368.18	69	158.70	1,425.13	110.00	987.80
	- slab concrete, tunnel	c.m.	2,550	41.00	104.55	69	158.70	404.69	110.00	280.50
	- reinforcing bar (20 kg/m3)	ton	67	23.00	1.54	697	1,603.10	107.41	720.00	48.24
	- plugging works	nos.	5	45,000.00	225.00	155,000	356,500.00	1,782.50	200,000.00	1,000.00
5.2	Intake									
	- excavation, w. rock	c.m.	1,000	1.00	1.00	1	2.30	2.30	2.00	2.00
	- excavation, rock	c.m.	2,000	2.00	4.00	2	4.60	9.20	4.00	8.00
	- excavation, shaft	c.m.	9,700	27.00	261.90	16	36.80	356.96	43.00	417.10
	- shotcrete	c.m.	339	92.00	31.19	273	627.90	212.86	365.00	123.74
	- rockbolts	m	3,700	6.00	22.20	14	32.20	119.14	20.00	74.00
	- concrete, open	c.m.	500	28.00	14.00	47	108.10	54.05	75.00	37.50
	- lining concrete, shaft	c.m.	3,580	52.00	186.16	123	282.90	1,012.78	175.00	626.50
	- reinforcing bar (40 kg/m3)	ton	163	23.00	3.75	697	1,603.10	261.63	720.00	117.50
	- consolidation grout	m	3,600	2.00	7.20	28	64.40	231.84	30.00	108.00
5.3	Headrace tunnel (D6.1)									
	- excavation, tunnel	c.m.	397,700	16.00	6,363.20	24	55.20	21,953.04	40.00	15,908.00
	- shotcrete	c.m.	12,660	92.00	1,164.72	273	627.90	7,949.21	365.00	4,620.90
	- rockbolts	m	79,100	6.00	474.60	14	32.20	2,547.02	20.00	1,582.00

Table 9.5 BILL OF QUANTITIES (6/10)

No.	Work Item	Unit	Q'ty	Foreign Currency		Local Currency			Total in US$	
				Unit Price US$	Amount US$1,000	Unit Price US$	Unit Price 1,000TL	Amount TL million	Unit Price US$	Amount US$1,000
	- concrete, lining	c.m.	133,500	41.00	5,473.50	69	158.70	21,186.45	110.00	14,685.00
	- reinforcing bar (40 kg/m3)	ton	5,340	23.00	122.82	697	1,603.10	8,560.55	720.00	3,844.80
	- consolidation grout	m	36,230	2.00	72.46	28	64.40	2,333.21	30.00	1,086.90
	- replacement concrete	c.m.	2,400	45.00	108.00	60	138.00	331.20	105.00	252.00
5.4	Surge tank & ventilation tunnel									
	- excavation, shaft	c.m.	15,100	18.00	271.80	25	57.50	868.25	43.00	649.30
	- excavation, tunnel	c.m.	18,400	16.00	294.40	24	55.20	1,015.68	40.00	736.00
	- shotcrete	ton	451	92.00	41.49	273	627.90	283.18	365.00	164.62
	- rockbolts	m	6,300	6.00	37.80	14	32.20	202.86	20.00	126.00
	- lining concrete, shaft	c.m.	3,840	52.00	199.68	123	282.90	1,086.34	175.00	672.00
	- lining concrete, tunnel	c.m.	2,500	41.00	102.50	69	158.70	396.75	110.00	275.00
	- slab concrete, tunnel	c.m.	100	41.00	4.10	69	158.70	15.87	110.00	11.00
	- reinforcing bar (40 kg/m3)	ton	258	23.00	5.92	697	1,603.10	412.96	720.00	185.47
	- consolidation grout	m	2,650	2.00	5.30	28	64.40	170.66	30.00	79.50
5.5	Pressure shaft & access tunnel									
	- excavation, shaft	c.m.	17,160	62.00	1,063.92	38	87.40	1,499.78	100.00	1,716.00
	- excavation, tunnel	c.m.	8,300	16.00	132.80	24	55.20	458.16	40.00	332.00
	- shotcrete	c.m.	675	92.00	62.10	273	627.90	423.83	365.00	246.38
	- rockbolts	m	5,530	6.00	33.18	14	32.20	178.07	20.00	110.60
	- concrete, open	c.m.	200	28.00	5.60	47	108.10	21.62	75.00	15.00
	- backfill concrete	c.m.	7,630	6.00	45.78	89	204.70	1,561.86	95.00	724.85
	- slab concrete, tunnel	c.m.	300	41.00	12.30	69	158.70	47.61	110.00	33.00
	- reinforcing bar (40 kg/m3)	ton	325	23.00	7.48	697	1,603.10	521.33	720.00	234.14
	- consolidation grout	m	2,000	2.00	4.00	28	64.40	128.80	30.00	60.00
	Sub-total				19,128.99			86,985.76		56,948.89
	Others (1%)				191.29			869.86		569.49
	Sub-total of item 5.				19,320.28			87,855.62		57,518.37

Table 9.5 BILL OF QUANTITIES (7/10)

No.	Work Item	Unit	Q'ty	Foreign Currency Unit Price US$	Foreign Currency Amount US$1,000	Local Currency Unit Price US$	Local Currency Unit Price 1,000TL	Local Currency Amount TL million	Total in US$ Unit Price US$	Total in US$ Amount US$1,000
6.	Power House									
6.1	Access and ventilation tunnel									
	- excavation, common	c.m.	2,000	0.50	1.00	0.5	1.15	2.30	1.00	2.00
	- excavation, w.rock	c.m.	1,000	1.00	1.00	1	2.30	2.30	2.00	2.00
	- excavation, rock	c.m.	500	2.00	1.00	2	4.60	2.30	4.00	2.00
	- excavation, tunnel	c.m.	67,300	14.00	942.20	22	50.60	3,405.38	36.00	2,422.80
	- steel support	ton	33	288.00	9.50	482	1,108.60	36.58	770.00	25.41
	- shotcrete	c.m.	820	92.00	75.44	273	627.90	514.88	365.00	299.30
	- rockbolts	m	7,700	6.00	46.20	14	32.20	247.94	20.00	154.00
	- concrete, open	c.m.	400	28.00	11.20	47	108.10	43.24	75.00	30.00
	- lining concrete, tunnel	ton	900	41.00	36.90	69	158.70	142.83	110.00	99.00
	- slab concrete, tunnel	c.m.	2,300	41.00	94.30	69	158.70	365.01	110.00	253.00
	- reinforcing bar (20 kg/m3)	ton	72	23.00	1.66	697	1,603.10	115.42	720.00	51.84
6.2.	Underground power house including tailrace surge tank									
	- excavation, underground	c.m.	132,500	12.00	1,590.00	18	41.40	5,485.50	30.00	3,975.00
	- shotcrete	c.m.	3,920	92.00	360.64	273	627.90	2,461.37	365.00	1,430.80
	- rockbolts	m	44,000	6.00	264.00	14	32.20	1,416.80	20.00	880.00
	- concrete, underground	c.m.	17,800	38.00	676.40	87	200.10	3,561.78	125.00	2,225.00
	- reinforcing bar (60 kg/m3)	ton	1,068	23.00	24.56	697	1,603.10	1,712.11	720.00	768.96
	- PC anchor	m	33,000	6.00	198.00	79	181.70	5,996.10	85.00	2,805.00
	- minor items (12 %)				373.63			2,476.04		1,450.17
	- architectural works (14 %)				488.21			3,235.36		1,894.89
	- aboveground control room	m2	500		0.00	220	506.00	253.00	220.00	110.00
	Sub-total				5,195.85			31,476.24		18,881.17
	Others(1%)				51.96			314.76		188.81
	Sub-total of item 6.				5,247.81			31,791.00		19,069.98

Table 9.5 BILL OF QUANTITIES (8/10)

No.	Work Item	Unit	Q'ty	Foreign Currency Unit Price US$	Foreign Currency Amount US$1,000	Local Currency Unit Price US$	Local Currency Unit Price 1,000TL	Local Currency Amount TL million	Total in US$ Unit Price US$	Total in US$ Amount US$1,000
7.	Tailrace tunnel (D6.1)									
	- excavation, common	c.m.	1,000	0.50	0.50	0.5	1.15	1.15	1.00	1.00
	- excavation, w. rock	ton	2,000	1.00	2.00	1	2.30	4.60	2.00	4.00
	- excavation, rock	c.m.	500	2.00	1.00	2	4.60	2.30	4.00	2.00
	- excavation, tunnel	c.m.	77,600	16.00	1,241.60	24	55.20	4,283.52	40.00	3,104.00
	- steel support	ton	50	288.00	14.40	482	1,108.60	55.43	770.00	38.50
	- shotcrete	c.m.	2,470	92.00	227.24	273	627.90	1,550.91	365.00	901.55
	- rockbolts	m	15,400	6.00	92.40	14	32.20	495.88	20.00	308.00
	- concrete, open	c.m.	1,000	28.00	28.00	47	108.10	108.10	75.00	75.00
	- lining concrete, tunnel	c.m.	26,000	41.00	1,066.00	69	158.70	4,126.20	110.00	2,860.00
	- reinforcing bar (40 kg/m3)	ton	1,080	23.00	24.84	697	1,603.10	1,731.35	720.00	777.60
	- consolidation grout	m	7,070	2.00	14.14	28	64.40	455.31	30.00	212.10
	Sub-total				2,712.12			12,814.75		8,283.75
	Others (1%)				27.12			128.15		82.84
	Sub-total of item 7.				2,739.24			12,942.90		8,366.59
8.	Outdoor Switchyard (100 x 60 m)									
	- excavation, common	c.m.	1,000	0.50	0.50	0.5	1.15	1.15	1.00	1.00
	- excavation, w.rock	c.m.	500	1.00	0.50	1	2.30	1.15	2.00	1.00
	- excavation, rock	c.m.	100	2.00	0.20	2	4.60	0.46	4.00	0.40
	- embankment	c.m.	30,000	3.00	90.00	1	2.30	69.00	4.00	120.00
	- concrete, open	c.m.	1,000	28.00	28.00	47	108.10	108.10	75.00	75.00
	- reinforcing bar (80 kg/m3)	ton	80	23.00	1.84	697	1,603.10	128.25	720.00	57.60
	Sub-total				121.04			308.11		255.00
	Others (5%)				6.05			15.41		12.75
	Sub-total of item 8.				127.09			323.51		267.75

Table 9.5 BILL OF QUANTITIES (9/10)

No.	Work Item	Unit	Q'ty	Foreign Currency		Local Currency			Total in US$	
				Unit Price US$	Amount US$1,000	Unit Price US$	Unit Price 1,000TL	Amount TL million	Unit Price US$	Amount US$1,000
9.	Erik Diversion Scheme									
	- excavation, common	c.m.	1,500	0.50	0.75	0.5	1.15	1.73	1.00	1.50
	- excavation, w. rock	c.m.	9,200	1.00	9.20	1	2.30	21.16	2.00	18.40
	- excavation, rock	c.m.	40,700	2.00	81.40	2	4.60	187.22	4.00	162.80
	- excavation, tunnel	c.m.	31,000	22.94	711.22	34	78.33	2,428.30	57.00	1,767.00
	- excavation, shaft	c.m.	5,200	10.00	52.00	33	75.90	394.68	43.00	223.60
	- concrete, open	c.m.	9,850	28.00	275.80	47	108.10	1,064.79	75.00	738.75
	- lining concrete, tunnel	c.m.	11,260	41.00	461.66	69	158.70	1,786.96	110.00	1,238.60
	- lining concrete, shaft	m	2,300	52.00	119.60	123	282.90	650.67	175.00	402.50
	- reinforcing bar (40 kg/m3)	ton	936	23.00	21.54	697	1,603.10	1,501.14	720.00	674.21
	- consolidation grout	m	750	2.00	1.50	28	64.40	48.30	30.00	22.50
	- minor items (5 %)				86.73			404.25		262.49
	- architectural works (5 %)				91.07			424.46		275.62
	Sub-total				1,912.47			8,913.65		5,787.97
	Others (5%)				95.62			445.68		289.40
	Sub-total of item 9.				2,008.09			9,359.33		6,077.37
	Total of main civil works (items 3. to 9.)				64,920.48			320,927.26		204,454.07
	Physical contingency (15 %)				9,738.07			48,139.09		30,668.11
	Grand total of civil works				74,658.55			369,066.35		235,122.18
10.	Metal Works									
10.1	Penstock pipe	ton	2,280	2,275.00	5,187.00	1,225	2,817.50	6,423.90	3,500.00	7,980.00
10.2	Steel liner	ton	146	2,275.00	332.15	1,225	2,817.50	411.36	3,500.00	511.00
10.3	Low head gate and trashracks	ton	549	2,800.00	1,537.20	1,200	2,760.00	1,515.24	4,000.00	2,196.00
10.4	High head gate and trashracks	ton	510	6,400.00	3,264.00	1,600	3,680.00	1,876.80	8,000.00	4,080.00

Table 9.5 BILL OF QUANTITIES (10/10)

No.	Work Item	Unit	Q'ty	Foreign Currency		Local Currency			Total in US$	
				Unit Price US$	Amount US$1,000	Unit Price US$	Unit Price 1,000TL	Amount TL million	Unit Price US$	Amount US$1,000
10.5	Metal for Erik scheme	ton	105	2,275.00	238.88	1,225	2,817.50	295.84	3,500.00	367.50
	Sub-total				10,559.23			10,523.13		15,134.50
	Physical contingency (5 %)				527.96			526.16		756.73
	Total of Metal Works				11,087.19			11,049.29		15,891.23
11.	Generating Equipment									
11.1	Ermenek plant	kW	320,000	126.40	40,448.00	32	72.68	23,257.60	158.00	50,560.00
11.2	Erik plant	kW	6,700	283.20	1,897.44	71	162.84	1,091.03	354.00	2,371.80
	Sub-total				42,345.44			24,348.63		52,931.80
	Physical contingency (5 %)				2,117.27			1,217.43		2,646.59
	Total of Generating Equipment				44,462.71			25,566.06		55,578.39
12.	Transmission Line									
12.1	380 kV line, 1-cct, 3x954 MCM	km	160	114,000.00	18,240.00	76,000	174,800.00	27,968.00	190,000.00	30,400.00
12.2	380 kV, 1-cct				420.00	280		644.00		700.00
12.3	SR,SC				810.00	540		1,242.00		1,350.00
12.4	34.5 kV line	km	16	9,000.00	144.00	6,000	13,800.00	220.80	15,000.00	240.00
	Sub-total				19,614.00			30,074.80		32,690.00
	Physical contingency (10%)				1,961.40			3,007.48		3,269.00
	Total of Transmission Line				21,575.40			33,082.28		35,959.00
	Total of direct cost				139,936.14			432,504.02		327,981.37
	Total of physical contingency				14,594.41			59,791.08		40,590.53
	Total				154,530.55			492,295.09		368,571.89
13.	Administration and engineering (10%)				15,453.05			49,229.51		36,857.19
	Grand total				169,983.60			541,524.60		405,429.08

Table 10.1 ECONOMIC COST AND BENEFIT STREAMS

Year	Construction Cost	Disbursement (%)	OMR and PFG	Total Cost	Power Benefit	Present Worth Factor	Present Worth of Cost	Present Worth of Benefit	Present Worth of B-C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1.73	0.5		1.73		0.9556	1.66	0.00	-1.66
2	6.58	1.9		6.58		0.8727	5.74	0.00	-5.74
3	20.09	5.8		20.09		0.7970	16.01	0.00	-16.01
4	10.74	3.1		10.74		0.7279	7.82	0.00	-7.82
5	27.02	7.8		27.02		0.6647	17.96	0.00	-17.96
6	38.10	11.0		38.10		0.6070	23.13	0.00	-23.13
7	41.57	12.0		41.57		0.5544	23.04	0.00	-23.04
8	71.70	20.7		71.70	-2.20	0.5063	36.30	-1.11	-37.42
9	89.37	25.8		89.37	-8.79	0.4624	41.32	-4.06	-45.39
10	39.49	11.4	0.18	39.67	10.77	0.4222	16.75	4.55	-12.20
11			1.34	1.34	79.93	0.3856	0.52	30.82	30.31
12			1.34	1.34	79.93	0.3522	0.47	28.15	27.68
13			1.34	1.34	79.93	0.3216	0.43	25.71	25.27
14			1.34	1.34	79.93	0.2937	0.39	23.48	23.08
15			1.34	1.34	79.93	0.2682	0.36	21.44	21.08
16			1.34	1.34	79.93	0.2450	0.33	19.58	19.25
17			1.34	1.34	79.93	0.2237	0.30	17.88	17.58
18			1.34	1.34	79.93	0.2043	0.27	16.33	16.06
19			1.34	1.34	79.93	0.1866	0.25	14.91	14.66
20			1.34	1.34	79.93	0.1704	0.23	13.62	13.39
21			1.34	1.34	79.93	0.1556	0.21	12.44	12.23
22			1.34	1.34	79.93	0.1421	0.19	11.36	11.17
23			1.34	1.34	79.93	0.1298	0.17	10.37	10.20
24			1.34	1.34	79.93	0.1185	0.16	9.47	9.31
25			1.34	1.34	79.93	0.1082	0.15	8.65	8.51
26			1.34	1.34	79.93	0.0988	0.13	7.90	7.77
27			1.34	1.34	79.93	0.0903	0.12	7.21	7.09
28			1.34	1.34	79.93	0.0824	0.11	6.59	6.48
29			1.34	1.34	79.93	0.0753	0.10	6.02	5.92
30			1.34	1.34	79.93	0.0688	0.09	5.50	5.40
31			1.34	1.34	79.93	0.0628	0.08	5.02	4.93
32			1.34	1.34	79.93	0.0573	0.08	4.58	4.51
33			1.34	1.34	79.93	0.0524	0.07	4.19	4.12
34			1.34	1.34	79.93	0.0478	0.06	3.82	3.76
35			1.34	1.34	79.93	0.0437	0.06	3.49	3.43
36			1.34	1.34	79.93	0.0399	0.05	3.19	3.13
37			1.34	1.34	79.93	0.0364	0.05	2.91	2.86
38			1.34	1.34	79.93	0.0333	0.04	2.66	2.61
39			1.34	1.34	79.93	0.0304	0.04	2.43	2.39
40			108.74	108.74	79.93	0.0277	3.02	2.22	-0.80
41			1.34	1.34	79.93	0.0253	0.03	2.03	1.99
59			1.34	1.34	79.93	0.0049	0.01	0.40	0.39
60			1.34	1.34	79.93	0.0045	0.01	0.36	0.35
Total	346.40	100.00	174.58	520.98	3996.28	10.97	198.61	350.83	152.22

(1) Discount rate: 9.5 %

(2) OMR means operation, maintenance & replacement; PFG mean production foregone

Table 10.2 PRICE MOVEMENTS

(1) Actual records

	YEAR	WPI	TL/US$	INFLATION %/YEAR
	1980		89	
	1981	100	132	
	1982	127	185	27.00
	1983	166	280	30.47
	1984	249	442	50.33
	1985	357	574	43.24
	1986	462	756	29.57
	1987	610	1018	32.04
	1988	1027	1682	68.30
	1989	1787	2300	73.97

Note: Source of figures for 1980-1989: SIS and SPO.

(2) PHASE 1: 1990-1994
(DECREASING INFLATION BY 20%/YEAR)

	1990	2845	3661	59.18
1	1991	4192	5394	47.34
2	1992	5779	7437	37.87
3	1993	7530	9691	30.30
4	1994	9355	12039	24.24

(3) PHASE 2: 1995-1999
(DECREASING INFLATION BY 10%/YEAR)

5	1995	11396	14666	21.81
6	1996	13633	17545	19.63
7	1997	16042	20645	17.67
8	1998	18594	23929	15.90
9	1999	21255	27354	14.31

(4) PHASE 3: 2000 +
(STEADY INFLATION OF 10%/YEAR)

10	2000	23380	30089	10.00
11	2001	25718	33098	10.00
12	2002	28290	36408	10.00
13	2003	31119	40048	10.00
14	2004	34231	44053	10.00
15	2005	37654	48458	10.00
16	2006	41420	53304	10.00
17	2007	45562	58635	10.00
18	2008	50118	64498	10.00
19	2009	55130	70948	10.00
20	2010	60643	78043	10.00

Table 10.3 FINANCIAL CASH FLOW

(1) interest rate: 8.7 %
(2) Power tariff: US$0.0570/kWh
(3) Annual energy generation : 1,054 GWh
(4) Energy loss rate : 12 %

Year	Expenditure: Construction Cost (Mil.$)	Expenditure: Construction Cost (%)	Expenditure: OMR Cost (Mil.$)	Expenditure: Total (Mil.$)	Operating Revenue: Energy Sold (GWh)	Operating Revenue: Gross Revenue (Mil.$)	Operating Revenue: Net Income (Mil.$)	Present Worth Factor	Present Worth of net Income	Accumulated Net Income (Mil.$)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	4.5	1.0		4.5			-4.5	0.9591	-4.3	-4.3
2	8.0	1.8		8.0			-8.0	0.8823	-7.1	-11.4
3	25.9	5.8		25.9			-25.9	0.8117	-21.0	-32.4
4	59.8	13.4		59.8			-59.8	0.7467	-44.6	-77.0
5	26.3	5.9		26.3			-26.3	0.6869	-18.1	-95.1
6	48.6	10.9		48.6			-48.6	0.6319	-30.7	-125.8
7	51.7	11.6		51.7			-51.7	0.5813	-30.1	-155.9
8	69.1	15.5		69.1			-69.1	0.5348	-37.0	-192.8
9	78.1	17.5		78.1			-78.1	0.4920	-38.4	-231.2
10	37.0	8.3	0.8	37.9	348	19.8	-18.0	0.4526	-8.2	-239.4
11	37.0	8.3	2.3	39.3	928	52.9	13.6	0.4163	5.7	-233.7
12			2.3	2.3	928	52.9	50.6	0.3830	19.4	-214.3
13			2.3	2.3	928	52.9	50.6	0.3523	17.8	-196.5
14			2.3	2.3	928	52.9	50.6	0.3241	16.4	-180.1
15			2.3	2.3	928	52.9	50.6	0.2982	15.1	-165.0
16			2.3	2.3	928	52.9	50.6	0.2743	13.9	-151.1
17			2.3	2.3	928	52.9	50.6	0.2523	12.8	-138.3
18			2.3	2.3	928	52.9	50.6	0.2321	11.8	-126.6
39			2.3	2.3	928	52.9	50.6	0.0402	2.0	-15.0
40			120.3	120.3	928	52.9	-67.4	0.0370	-2.5	-17.5
41			2.3	2.3	928	52.9	50.6	0.0341	1.7	-15.7
59			2.3	2.3	928	52.9	50.6	0.0076	0.4	-0.4
60			2.3	2.3	928	52.9	50.6	0.0070	0.4	0.0
Total	446.0	100.0	231.3	677.3	46724	2663.3	1985.9	11.9	0.0	

Table 10.4 LOAN REPAYMENT SCHEDULE

Year	Loan-1 Loan Disburse - Capital (Mil.$)	Loan-1 Loan Disburse - IDC (Mil.$)	Loan-1 Accumu. Loan (Mil.$)	Loan-1 Repayment - Interest (Mil.$)	Loan-1 Repayment - Capital (Mil.$)	Loan-1 Repayment - Total (Mil.$)	Loan-2 Loan Disburse - Capital (Mil.$)	Loan-2 Loan Disburse - IDC (Mil.$)	Loan-2 Accumu. Loan (Mil.$)	Loan-2 Repayment - Interest (Mil.$)	Loan-2 Repayment - Capital (Mil.$)	Loan-2 Repayment - Total (Mil.$)	O&M Costs (Mil.$)	Annual Expenditu (Mil.$)	Annual Revenue (Mil.$)	Annual Surplus (Mil.$)	Accumu. (Mil.$)
(1)	(2)	(3)	(4)				(2)	(3)	(4)								
1	3.3	0.1	3.4				1.1	0.1	1.2					0.0		0.0	0.0
2	6.0	0.3	9.7				2.0	0.3	3.5					0.0		0.0	0.0
3	19.4	0.8	30.0				6.5	0.8	10.7					0.0		0.0	0.0
4	44.8	2.2	77.0				14.9	2.1	27.7					0.0		0.0	0.0
5	19.7	2.8	99.5				6.6	2.7	37.0					0.0		0.0	0.0
6	36.5	3.9	139.9				12.2	3.9	53.1					0.0		0.0	0.0
7	38.8	5.2	183.9				12.9	5.3	71.4					0.0		0.0	0.0
8	51.8	6.8	242.6				17.3	7.1	95.7					0.0		0.0	0.0
9	58.5	8.7	309.9				19.5	9.2	124.5					0.0		0.0	0.0
10	27.8	9.8	347.4				9.3	10.7	144.4				0.8	0.8	19.8	19.0	19.0
11	27.8	10.9	371.5	11.2	14.5	25.7	9.3	12.3	154.5	13.3	11.5	24.7	2.3	52.7	52.9	0.2	19.2
12			356.6	10.8	14.9	25.7			142.1	12.4	12.4	24.7	2.3	52.7	52.9	0.2	19.3
13			341.2	10.3	15.4	25.7			128.8	11.4	13.4	24.7	2.3	52.7	52.9	0.2	19.5
14			325.4	9.9	15.8	25.7			114.3	10.3	14.4	24.7	2.3	52.7	52.9	0.2	19.7
15			309.2	9.4	16.3	25.7			98.8	9.1	15.6	24.7	2.3	52.7	52.9	0.2	19.9
16			292.4	9.0	16.7	25.7			81.9	7.9	16.8	24.7	2.3	52.7	52.9	0.2	20.0
17			275.2	8.5	17.2	25.7			63.7	6.6	18.2	24.7	2.3	52.7	52.9	0.2	20.2
18			257.4	8.0	17.7	25.7			44.1	5.1	19.6	24.7	2.3	52.7	52.9	0.2	20.4
19			239.2	7.5	18.2	25.7			22.9	3.5	21.2	24.7	2.3	52.7	52.9	0.2	20.6
20			220.4	6.9	18.8	25.7			0.0	1.8	22.9	24.7	2.3	52.7	52.9	0.2	20.7
27			72.9	2.8	22.9	25.7							2.3	28.0	52.9	24.9	195.1
28			49.3	2.1	23.6	25.7							2.3	28.0	52.9	24.9	220.0
29			25.0	1.4	24.3	25.7							2.3	28.0	52.9	24.9	244.9
30			0.0	0.7	25.0	25.7							2.3	28.0	52.9	24.9	269.8
Total	334.5	51.6	5475.9	128.1	386.1	514.2	111.5	54.5	1420.4	81.4	166.0	247.3	45.8	807.4	1077.2	269.8	

Loan-1: Interest rate 2.9 % Loan-2: Interest rate 8.0 % Power tariff: US¢5.7/kWh
Repayment period, net 20.0 yr Repayment period, net 10.0 yr

FIGURES

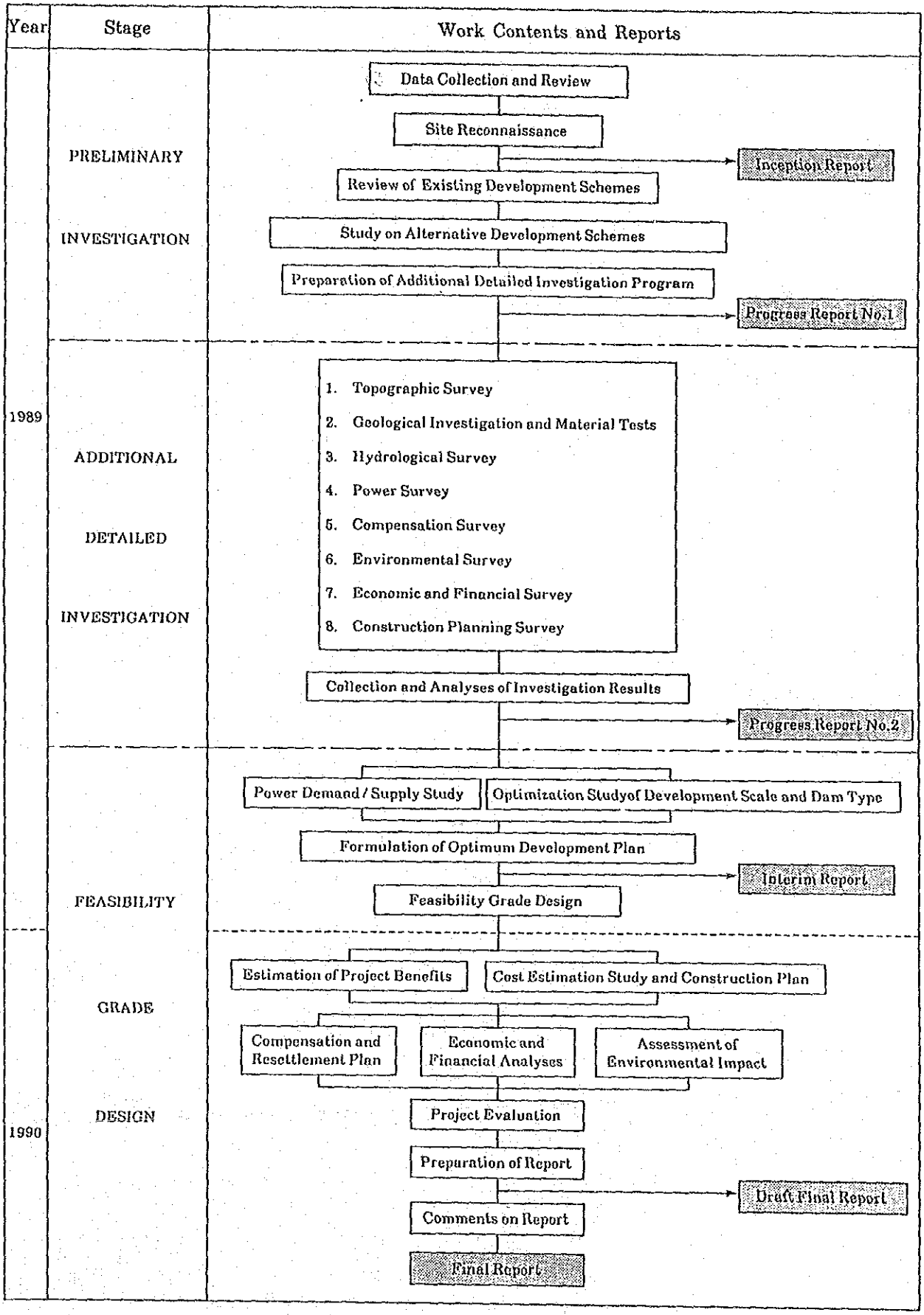


Fig. 1.1 Flow Chart of the Study

FEASIBILITY STUDY ON ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT

GENERAL WORK SCHEDULE

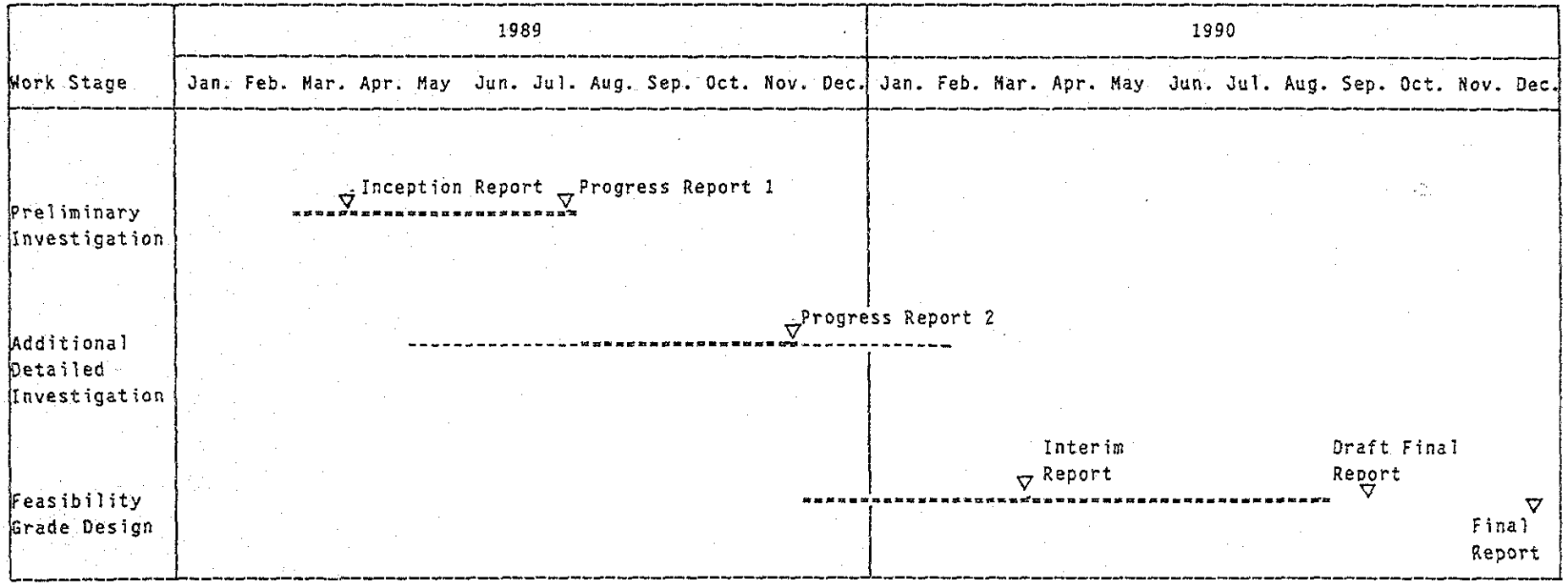


Fig. 1.2 General Work Schedule of the Study

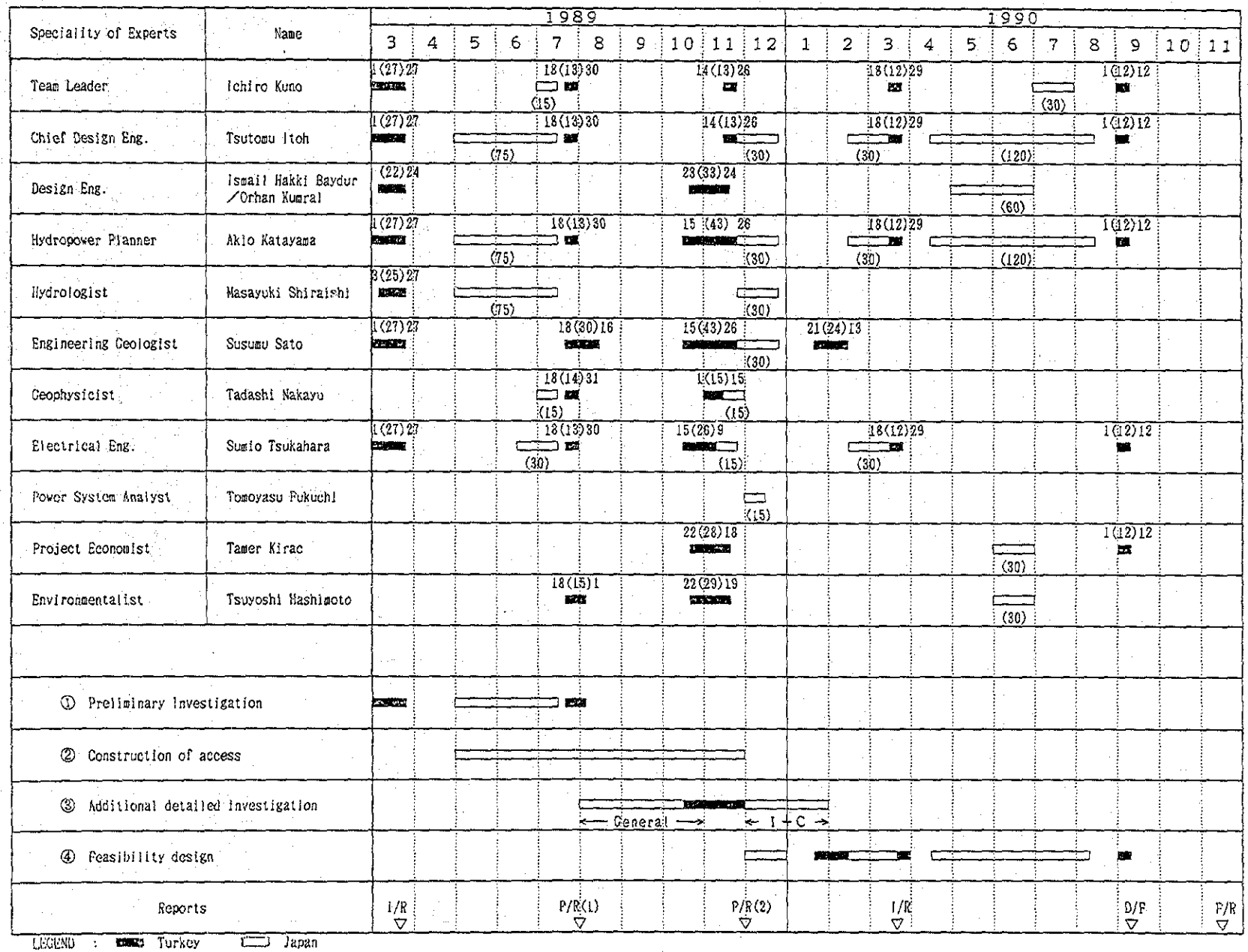


Fig. 1.3 Assignment Schedule of the JICA Study Team