11.4 Electromechanical Equipment

11.4.1 Selection of Main Equipment

Based on the number of main equipment units, available discharge, and normal effective head determined previously in Chapter 9, vertical Francis type turbine will be the most suitable for this Project, and this type is to be adopted. Regarding the type of main transformer, single-phase transformer is to be adopted in consideration of transportation limit (capacity of floating crane at Mersin Port; 60 tons) and restorability when there is trouble.

The bus system of the 154 kV switchyard is to be that of a main bus plus transfer bus, and self-supporting aluminum pipe busses with which an outdoor steel structure can be omitted is to be adopted for the bus system.

For the tie transmission line connecting the powerhouse and the switchyard, economical double-circuit steel towers are to be adopted in view of topographical constraints.

The specifications of turbines, generators, main transformers, 154 kV switchyard, and tie transmission line are given below.

Turbine

Type	Vertical Francis
Number of units	2 units
Normal effective head	284.4 m
Available discharge	54 m^3/sec.
Output	137.5 MW
Speed	300 rpm

Generator

Type	3-phase, AC, synchronous
Number of units	2 units
Capacity	150 MVA
Power factor	0.9 lagging
Speed	300 rpm
Frequency	50 Hz
Voltage	14.4 kV

Main Transformer	
Type	Outdoor, single-phase
Number of units	7 units (incl. 1 reserve)
Capacity	50 MVA
Voltage	14.4 kV : 154 /$\sqrt{3}$ kV
Switchyard	
Bus system	Main bus + transfer bus
Bus	Self-supporting type aluminum pipe bus
Number of connections	5 bays
Voltage	154 kV
Tie Transmission Line	
Number of circuits	2 circuits
Number of towers	3 sets (double-circuit type steel tower)
Voltage	154 kV
Type of conductor	ACSR 795 MCM
Section	Powerhouse - switchyard

11.4.2 Main Circuit

For the main circuit, a unit system with synchronizing the generator at low-tension (14.4 kV) circuit is to be adopted in consideration of conditions such as reliability, maintainability, and securing of station service power supply.

The generators and main transformers are to be connected by 14.4 kV isolated phase bus, while the powerhouse and switchyard are to be connected by 154 kV overhead tie transmission lines.

Any circuit of 154 kV transmission lines is possible to make circuit breaker inspection without outage of power transmission due to provision for transfer bus.

The 34.5 kV distribution line is transferable by renewing the distribution line for power supply for construction as described in Chapter 12.

The single line diagram is given in Fig. 11-5.

11.4.3 Tie Transmission Line

The locations of the powerhouse and switchyard are shown in Fig. 11-6. As described in Chapter 10, the switchyard is planned to be provided at the opposite bank at EL. 495.0 m and approximately 800 m downstream of the powerhouse. In case 154 kV power cable is adopted for the tie transmission line to be interconnected between the powerhouse and switchyard, it will result in a cable route crossing the river and having large ups and downs in height due to topographical constraints. This will not only mean a comparatively high construction cost, but there will also be problems regarding the method of laying the power cable and in operation and maintenance such as security measures. Therefore, an overhead transmission line (length approximately 900 m) having 3 sets of double-circuit type steel towers which would be decidedly more advantageous compared with the power cable proposal and is of high reliability technology-wise is to be adopted.

11.4.4 Electro-mechanical Equipment of Powerhouse

The powerhouse is planned to be a semi-underground type with a erection bay situated at the center. The spacing between the main equipment units is to be 40 m, and two units of turbine and generators are to be installed. Other than these, there will be an overhead travelling crane for assembly work, main transformers, and auxiliary equipment provided.

Plans of the powerhouse are shown in Figs. 11-7 and 11-8.

11.4.5 Electrical Equipment of Switchyard

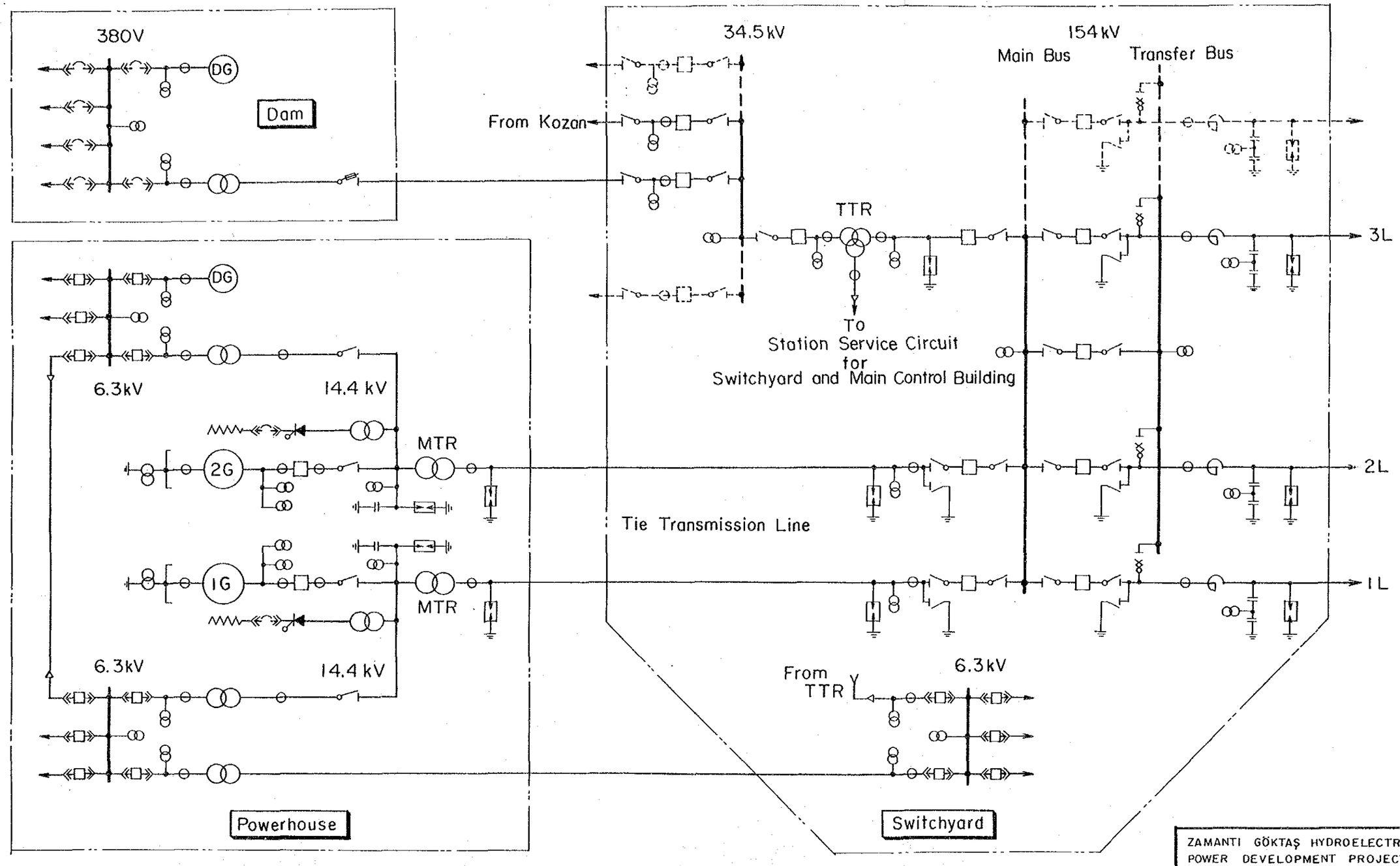
In consideration of the topography of the switchyard site, the 154 kV tie transmission line and the 34.5 kV distribution line are to be taken out to the upstream side and the 154 kV transmission lines are to be the downstream side.

The main control building is to be provided at the switchyard since the switchyard is more advantageous than the powerhouse regarding constructability, economics, and maintainability.

Plans of the switchyard are shown in Figs. 11-9 and 11-10.

11.4.6 Telecommunication Facility

In addition to conventional communication facilities, there will be a necessity for facilities for connection between the main control building in switchyard and the powerhouse. It is planned for one route of optical fiber cable to be provided in the overhead ground line of the 154 kV tie transmission line, and another route of optical fiber cable is to be provided together with 6.3 kV distribution line for switchyard station service.



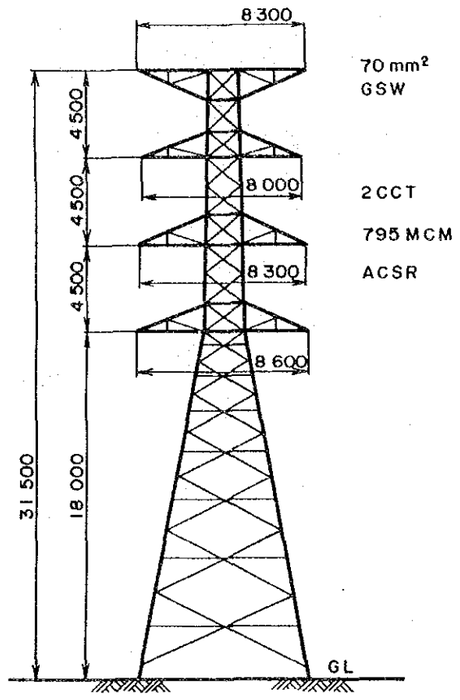
Francis Turbine	Generator	Main Transformer	Tie Transmission Line	Switchyard
137.5 MW	150 MVA	50 MVA x 3	2CCT	Main Bus + Transfer Bus
54 m^3/sec	300 rpm	14.4 : 154/$\sqrt{3}$ kV	795 MCM	Self-Supporting Type Alminum Pipe Bus
284.4 m	50 Hz	50 Hz	ACSR	154 kV

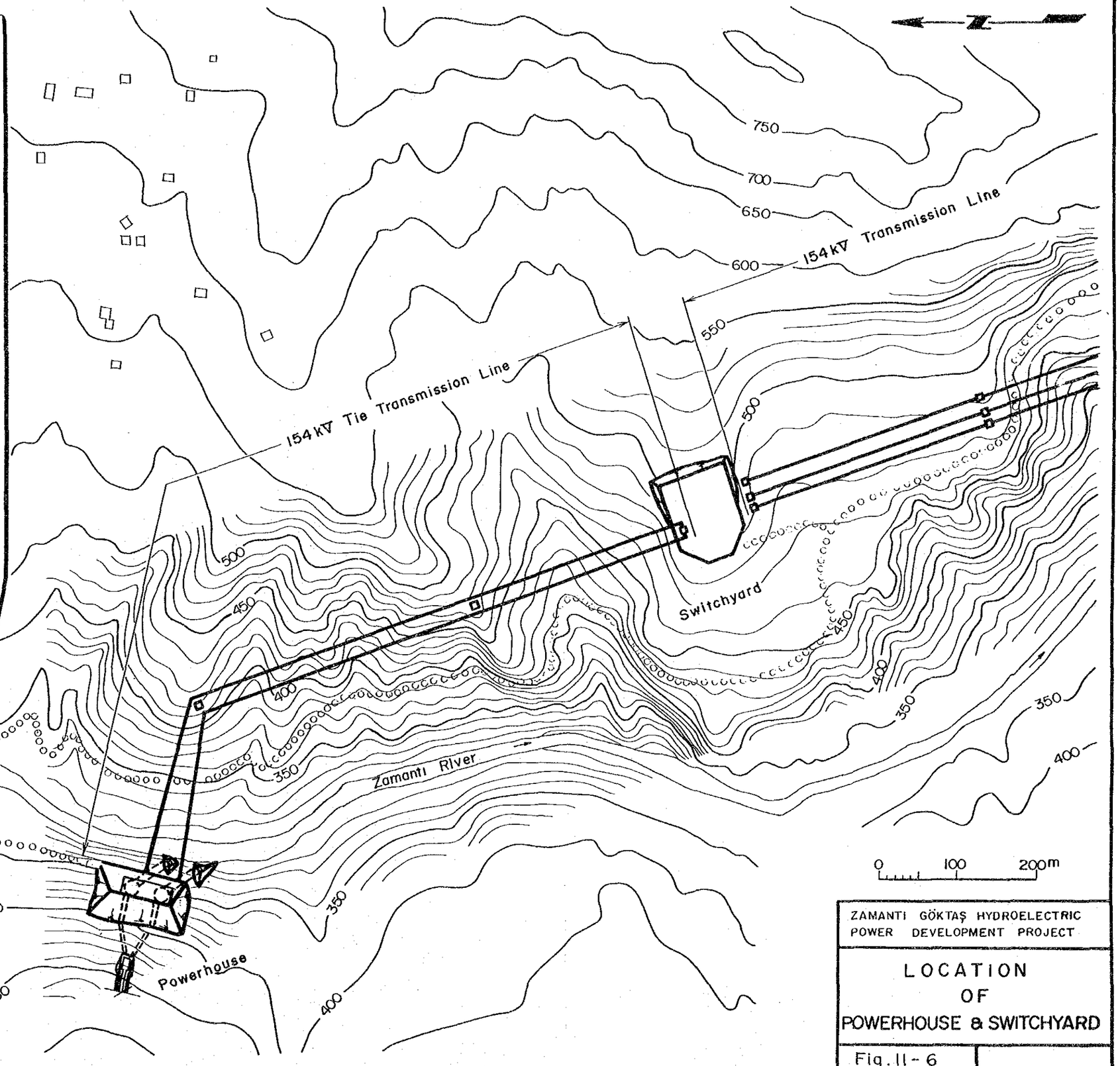
ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

SINGLE LINE DIAGRAM

Fig. 11 - 5

154 kV
TIE TRANSMISSION LINE
STANDARD SUSPENSION TOWER





ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

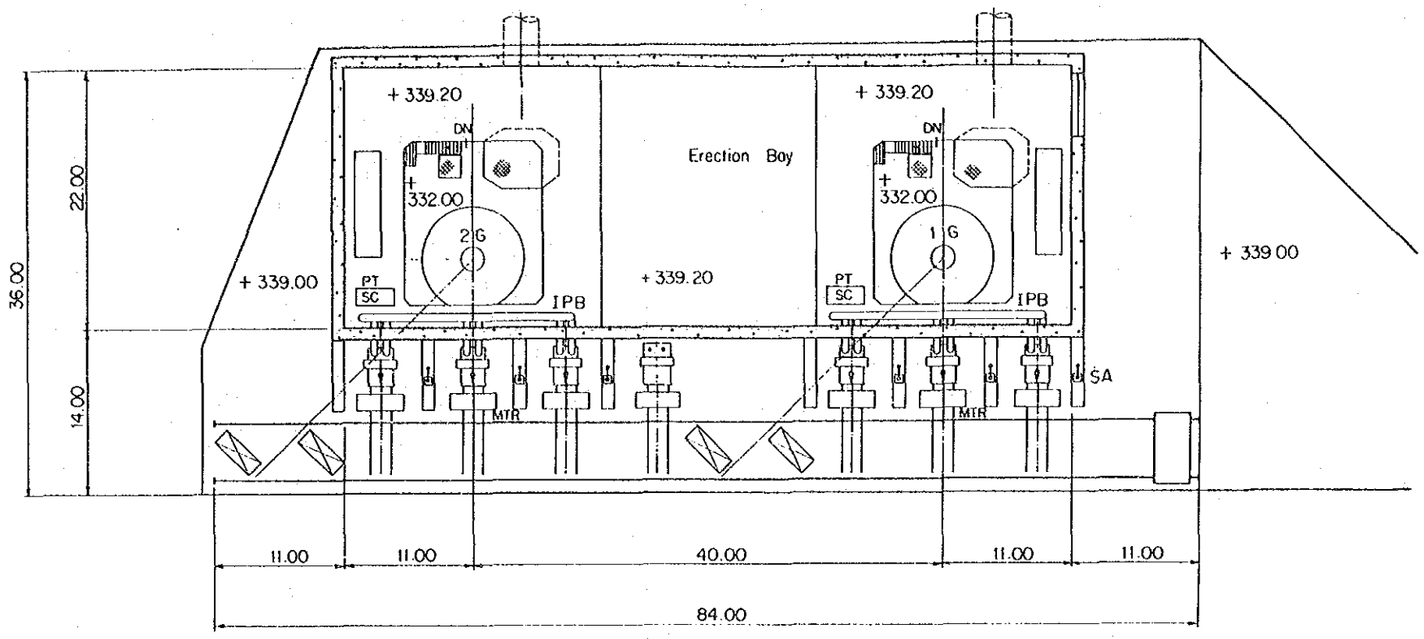
LOCATION OF POWERHOUSE & SWITCHYARD

Fig. II - 6

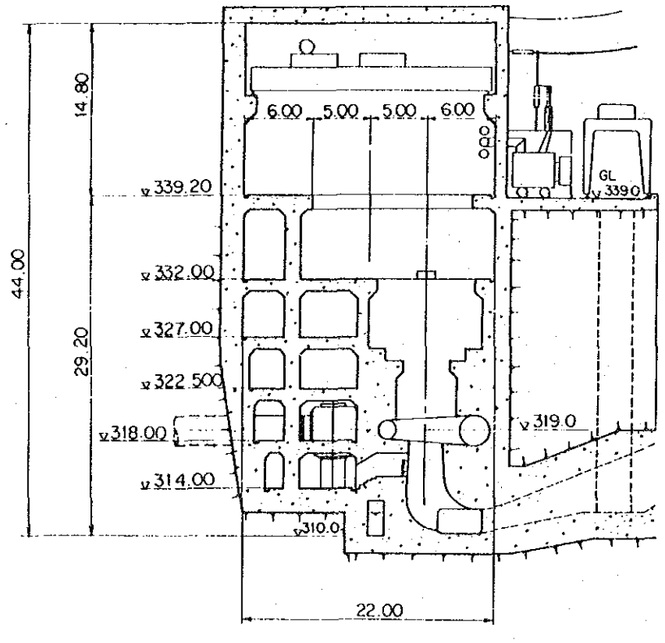
LEGEND

MTR	Main Transformer
IPB	Isolated Phase Bus
PT	Potential Transformer
SC	Static Condenser
SA	Surge Arrester

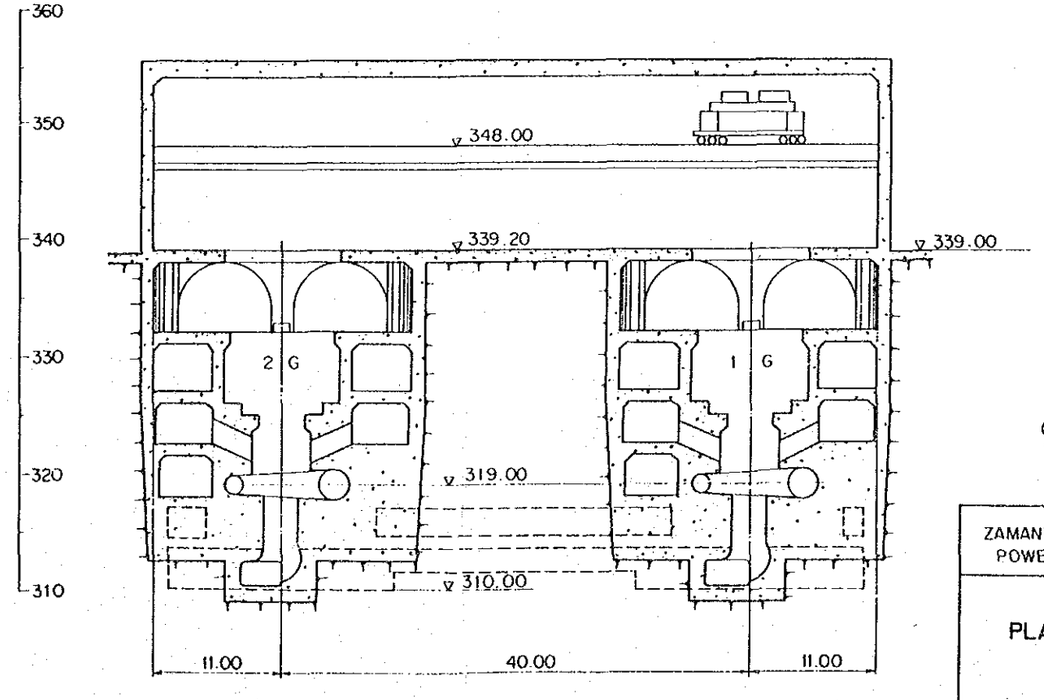
PLAN EL. 339.20



TRANSEVERSE SECTION



LONGITUDINAL SECTION



0 5 10 20M

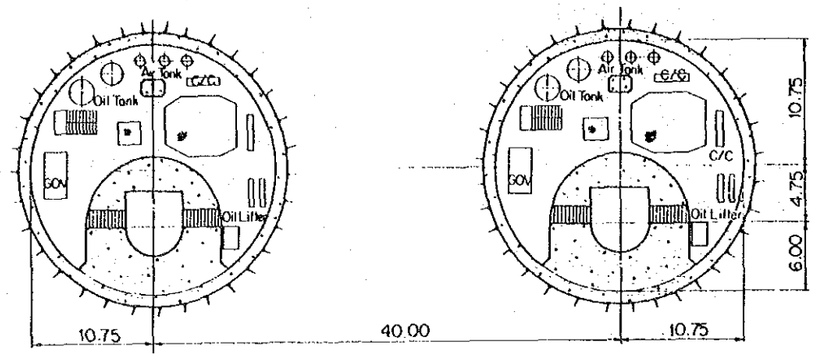
ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

PLAN OF POWERHOUSE

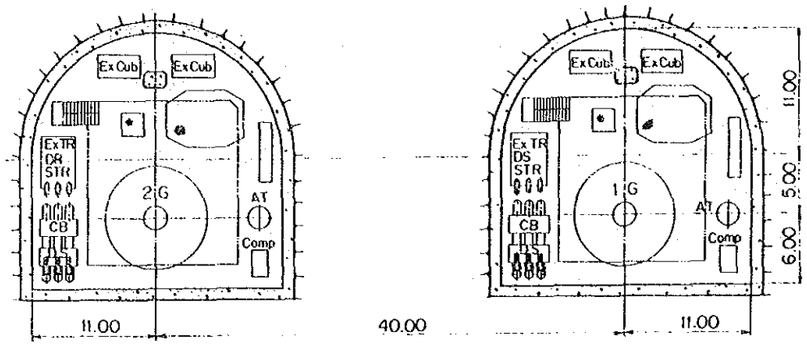
(1 - 2)

Fig. 11 - 7

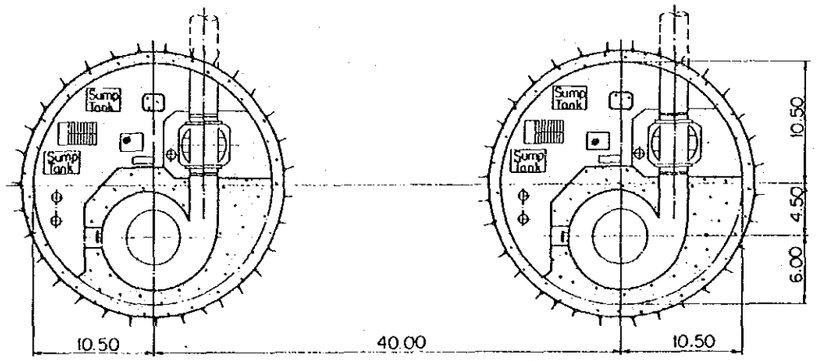
EL. 322.5



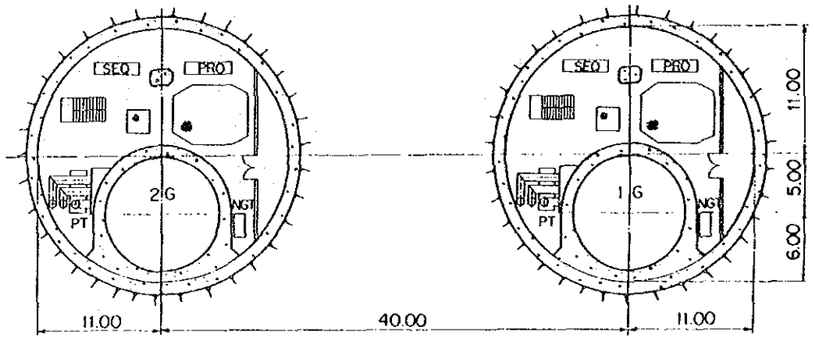
EL. 332.0



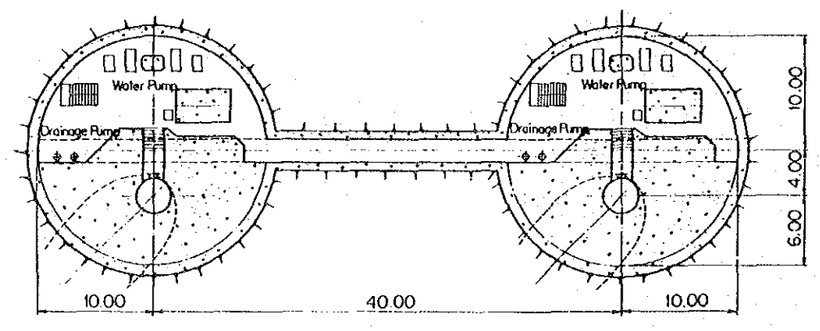
EL. 318.0



EL. 327.0



EL. 314.0



LEGEND

C B	Circuit Breaker
D S	Disconnecting Switch
P T	Potential Transformer
T R	Transformer
E X	Exciter
NGT	Neutral Grounding Transformer
STR	Station Service Transformer
SEQ	Sequence Control Equipment
PRO	Protection Relay
GOV	Governor
C/C	Control Center
A T	Air Tank

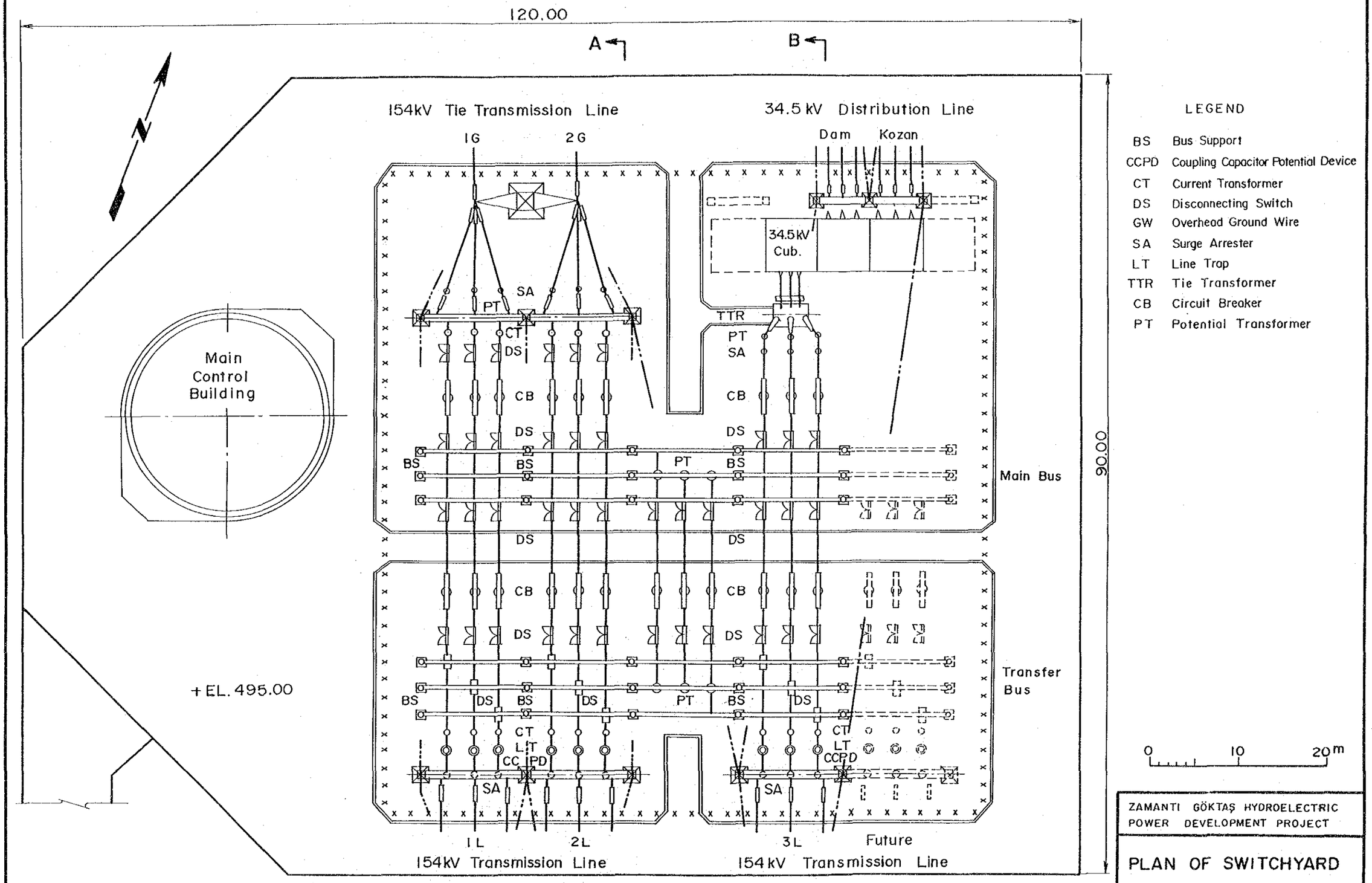
0 5 10 20 M

ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

PLAN OF POWERHOUSE

(2-2)

Fig. 11-8

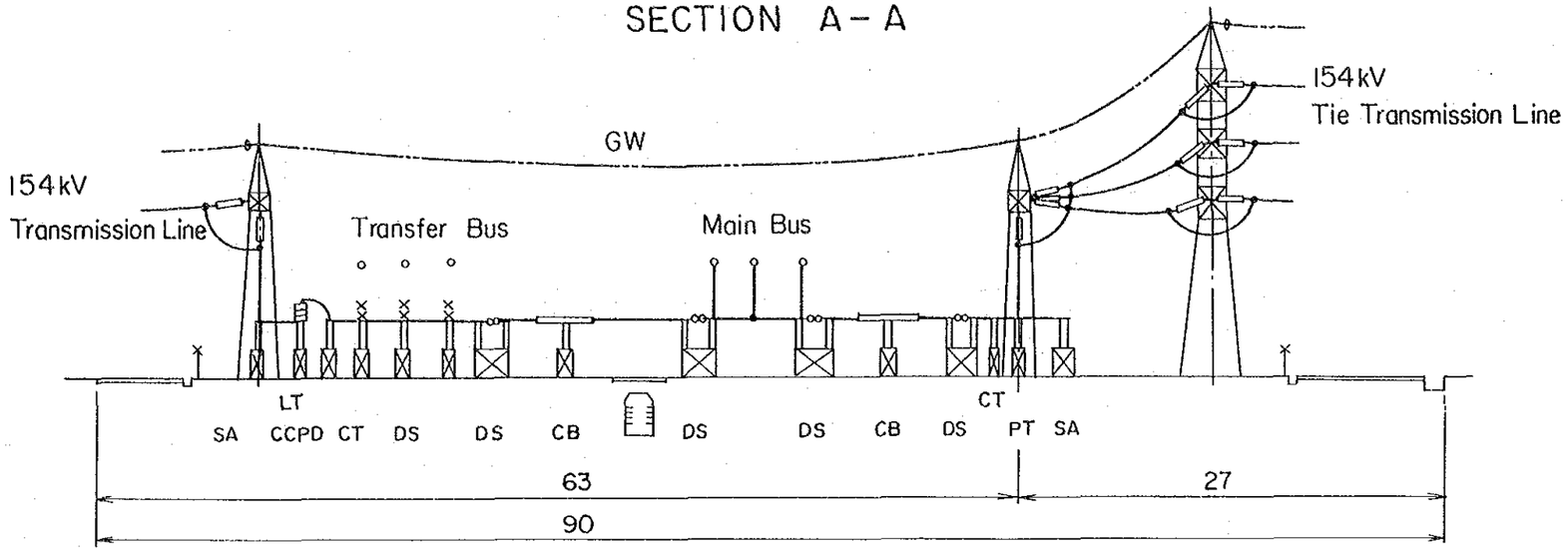


ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

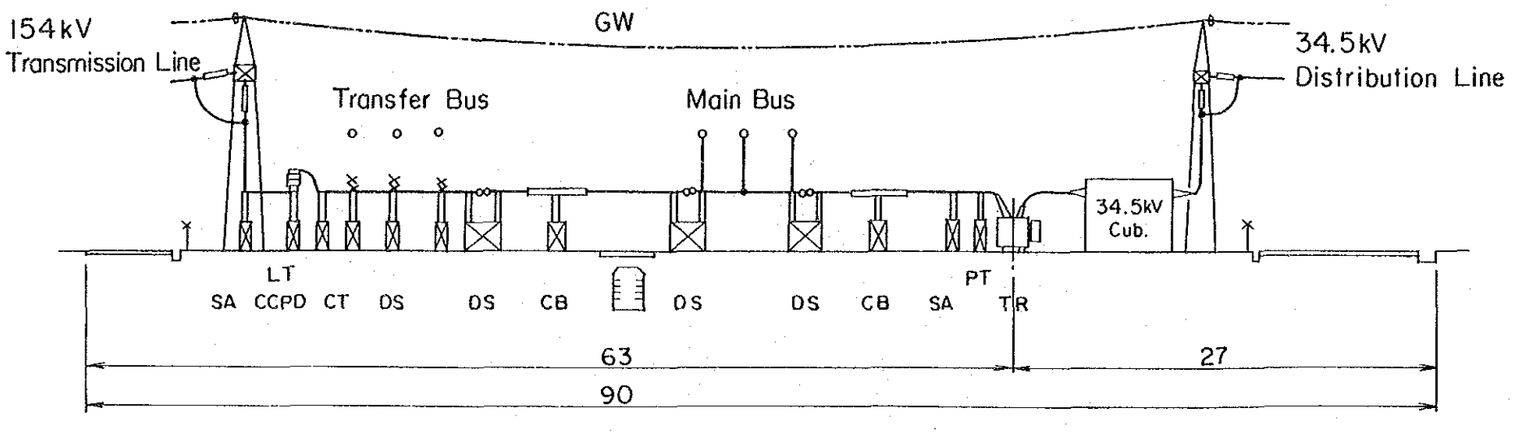
PLAN OF SWITCHYARD (1-2)

Fig. 11-9

SECTION A-A



SECTION B-B



LEGEND

BS	Bus Support
CCPD	Coupling Capacitor Potential Device
CT	Current Transformer
DS	Disconnecting Switch
GW	Overhead Ground Wire
SA	Surge Arrester
LT	Line Trap
TTR	Tie Transformer
CB	Circuit Breaker
PT	Potential Transformer

0 10 20m

ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

PLAN OF SWITCHYARD

(2 - 2)

Fig. 11-10

11.5 Transmission Line

11.5.1 Transmission Line Route

In construction of a transmission line, whether or not there are existing roads which can be utilized for transportation of equipment and materials will have a great effect on the construction cost. Therefore, the transmission line was planned parallel to existing roads as much as possible. From Goktas Switchyard to Akarca Substation to be newly constructed, it will be necessary to widen or newly construct a part of the road, but this will have been completed by the time the transmission line work is started, so it will be no problem. Further, it is assumed that a 380-kV transmission line, single circuit, will have been strung between Yedigoze and Adana by the time of commissioning of Yedigoze Power Station.

11.5.2 Specifications of Transmission Line Conductor and Steel Towers

(1) Transmission Voltage and Number of Circuits

It is necessary for 154 kV, 3 circuits, between Goktas Switchyard and Akarca Substation, and 380 kV, single circuit (double circuit at the final stage), between Akarca Substation and Yedigoze Switchyard to be constructed.

(2) Conductor

The conductor types are to be the following in consideration of current capacity corresponding with inflow from this Project and from related power systems, mechanical strength, and corona characteristics, while referring to performances in use in Turkey and the project plans of TEK.

(a) Goktas Switchyard - Akarca Substation, approximately 10 km, 154 kV, ACSR 1,272 MCM, single wire, 3 circuits

(b) Akarca Substation - Yedigoze Power Station, 25 km, 380 kV, ACSR 954 MCM, double wire, 1 circuit (2 circuits at final stage)

(c) Yedigoze Power Station - Adana Substation, 35 km, 380 kV, ACSR 954 MCM, triple wire, 1 circuit

(d) Catalan power Station - Dikili Substation, 25 km, 380 kV, ACSR 954 MCM, triple wire, 1 circuit, provided that operation to be at 154 kV initially at commissioning of Goktas Power Station

(e) Yedigoze Power Station - Catalan Power Station, 30 km, 1 circuit with same conductor type as (d) above, and to be interconnected with transmission line of (d) at final stage for operation at 380 kV between Yedigoze and Dikili.

(3) Lightning Protection Design

The 154 kV transmission line from Goktas Switchyard to Akarca Substation and the 380 kV transmission line from Akarca to Yedigoze Switchyard will be discussed here.

The observed value of IKL (isokeraunic level) at the central part of Anatolia is about 20, and the same level is conceivable for this project area also. Accordingly, overhead ground wires consisting of two lines of 70 mm^2 GSW are to be strung at 154 kV steel towers and two lines of 90 mm^2 GSW at 380 kV steel towers with shielding angles not more than 20 deg for 100 percent protection against lightning.

(4) Insulator Types and Numbers

Insulation design was considered with maximum voltages of 170 kV for 154 kV transmission lines and 420 kV for 380 kV transmission lines, and with elevations of transmission lines both under 1,000 m. The number of insulators would be decided by switching surge abnormal voltage, but a slight allowance is to be considered for the sake of coordination with existing facilities in Turkey, and the standard is to be strings of twelve 250 mmϕ suspension insulators (22 insulators in case of 380 kV).

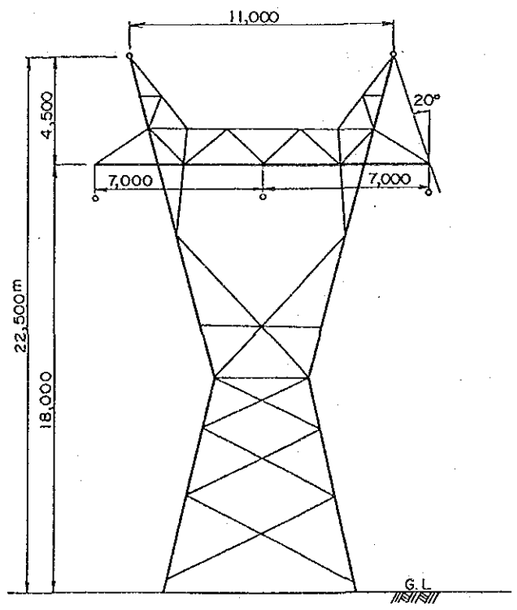
(5) Support Structures

In designing steel towers for transmission lines, the design standards of Turkey of wind pressure on aerial line 68 kg/m^2, wind pressure on steel tower 90 kg/m^2, and snowfall classification of the project area (Region 2, icing quantity in 954 MCM conductor about 1.1 kg/m) were referred to.

Drawings of standard suspension towers for 154 kV and 380 kV and shown in Fig. 11 - 11

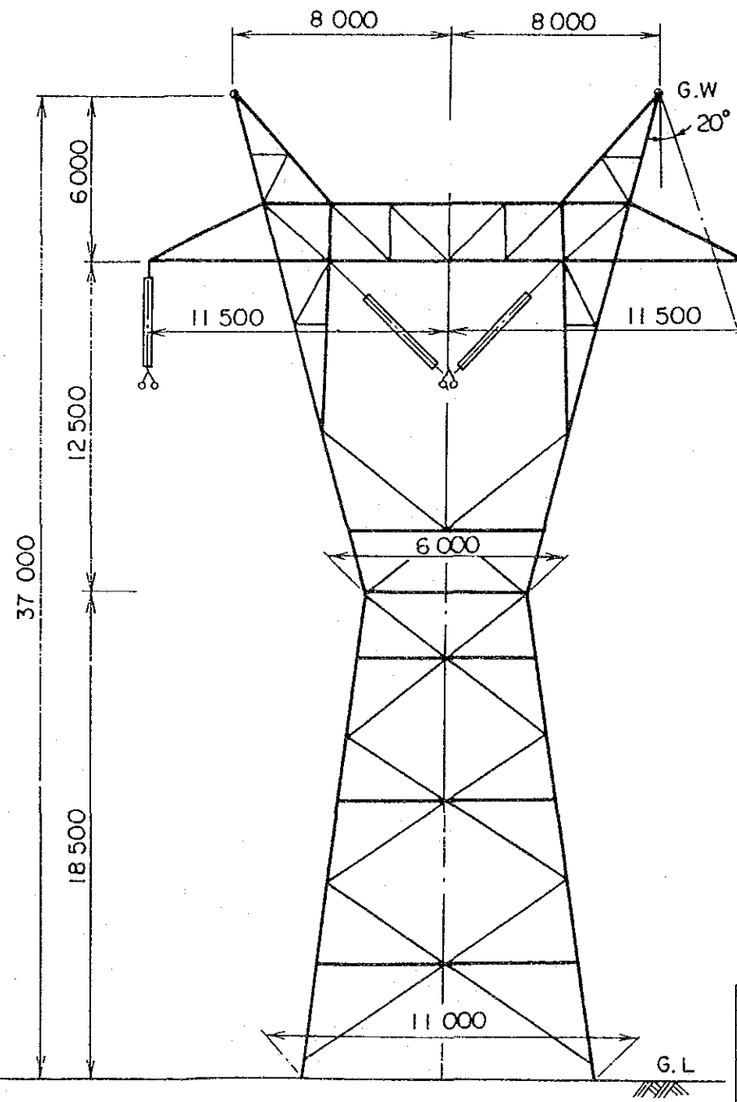
STANDARD SUSPENSION TOWER FOR GÖKTAŞ PROJECT

154kV, 1CCT, 1272MCMACSR + 70mm² GSW



TENSION TOWER "SD" TYPE

380kV 1cct Standard Suspension Tower



Span = 400m

Zamanti Goktas Hydroelectric Power Development Project

Structural Design for Steel Tower

Fig. 11-11 | December 1988

CHAPTER 12. CONSTRUCTION PLANNING AND COST ESTIMATION

CHAPTER 12. CONSTRUCTION PLANNING AND COST ESTIMATION

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12.1 Construction Planning and Construction Schedule

12.1.1 Fundamental Matters

It is expected that structures planned for the Project will consist of an arch-gravity dam of height approximately 150 m and a headrace tunnel of length approximately 16 km as main, along with an intake, penstock and power plant. The outline of matters that affect construction planning and the construction schedule of this Project are as follows:

(1) Meteorology

The meteorological conditions of this Project are as described in Chapter 6. The construction schedule was prepared on the assumption that work could be performed 10 months of the year.

(2) Transportation

Two routes are conceivable for transportation from Adana to the dam site.

One is a route starting from Adana and going through Imamoglu and the power plant site to reach the dam site by running along the Zamanti River.

Regarding the condition of the road, it is paved between Adana and Imamoglu. From Imamoglu to Akdam, the road is unpaved but since it is a hill area of comparatively gentle relief there is no obstacle to pose a special problem in transportation.

The section between Akdam and Comluk is a mountainland of elevation from 500 to 700 m and the road is to be widened in part. From Comluk to the Power Plant site, it will be necessary to build a new road along the Zamanti River and the Goksu River at the foot of a mountain of EL. 1,000 m. Bridges presently existing across the Goksu River must be rebuilt for hauling heavy articles such as electrical equipment. From the power plant site to the dam site, the existing road is to be widened, and new sections of road and tunnels provided as necessary.

The other route is one which starts from Adana, goes through Catalan and Karsanti, and crosses a mountain pass at elevation of 1,500 m to reach the dam site.

The section from Adana to Catalan is paved. From Catalan to Karsanti, the topography is comparatively flat, and there will be no special problem as a transportation route. From Karsanti to the dam site is a rugged mountainland having a pass on the way at an elevation of 1,500 m.

What will be a special problem in construction of the dam is the stable of materials such as cement and reinforcing bars. At the vicinity of the pass it will be difficult to secure transportation throughout the year because of rain and snow cover, and it will be necessary to provide a tunnel directly underneath the pass.

From the standpoint of economy, the construction program, and future operation and maintenance of the dam and power plant, it is thought the route from Adana via Imamoglu to the power plant site, and from there along the Zamanti River to reach the dam site will be more suitable.

The transportation routes are shown in Fig. 12-1.

(3) Ports and Harbors

The nearest port is Mersin (approximately 180 km from the Power plant site) situated southwest of Adana. The cargo unloading capacity of this port is a maximum of 60 t and there will be no obstacle to unloading of construction machinery and electrical equipment.

(4) Construction Materials

i) Cement

The cement plant at Tarsus (approximately 170 km from the dam site) located to the southwest of Adana will be the main source of supply.

ii) Aggregates for concrete

Aggregates are to be manufactured from muck produced in excavation work and from rock obtained at a quarry located at the left bank of the Zamanti River approximately 1 km downstream from the dam site. Aggregates for concrete of temporary facility are to be manufactured from river sand-gravel deposit at Doancay and river sand-gravel deposit near the power plant site.

iii) Steel

The steel mill at Iskenderun (approximately 220 km from the dam site) located southeast of Adana will be the source of supply for the principal steel materials such as structural steel.

(5) Electric Power Facilities for Construction

Electric power for construction in the Goktas Project will be required at the four areas below.

° Dam site
° Kup (headrace tunnel work; upstream part)
° Daricukuru (headrace tunnel work; downstream part)
° Power plant site

The two cases below are conceivable as power distribution schemes for construction.

Case A: Addition of one circuit to the existing 34.5-kV Kozan - Imamoglu - Karsanti distribution line, with new 34.5-kV distribution lines to be constructed from Karsanti to the Dam site and Kup site. New 34.5-kV distribution lines are to be strung from Kozan to the Power Plant site and the Daricukuru site.

Case B: A 34.5-kV distribution line is to be newly constructed from Kozan to the Dam site via the Power Plant site. The Daricukuru and Kup sites are to be supplied branching out from this distribution line on the way.

Regarding the two cases above, when securing of a power supply for the dam and telecommunication line routes after start of operation of the power plant is considered, and not only supply during construction, Case B will be more advantageous.

ZAMANTI GÖKTAŞ HYDROELECTORIC POWER DEVELOPMENT PROJECT

TRANSPORTATION ROUTE

Fig. 12 - 1

12.1.2 Construction Planning and Construction Schedule

Assuming that the year of commissioning of this Project is to be 2001, it would be necessary for preparations and start of construction to be roughly in accordance with the schedule below.

Nov. 1987 -	Oct. 1989	Feasibility study (2 years)
Jan. 1990 -	Dec. 1990	Provision and award of final design (1 year)
Jan. 1991 -	Dec. 1992	Final design (2 years)
Jan. 1993 -	Jun. 1994	Finance formalities (1.5 years)
Jul. 1994 -	Dec. 1995	Bidding and award of contract for construction (1.5 years)
Jan. 1996 -		Start of construction
	Dec. 2001	End of construction

The quantities of the principal civil works in this Project are as shown in Table 12-1. The major items of machinery and equipment expected to be required at the peak of the construction work are given in Table 12-2.

Table 12-1 Principal Civil Works

Item	Description	Civil Works	
Diversion Tunnel	D = 6.8 m L = 370 m	Tunnel ex. Lining con.	23,700 m^3 6,300 m^3
Cofferdam		Concrete	41,200 m^3
Dam	H = 148 m	Ex. in open Dam concrete	290,000 m^3 800,000 m^3
Power Intake		Ex. in open Concrete	31,700 m^3 8,500 m^3
Headrace Tunnel	D = 6.8 m L = 15,680 m	Tunnel ex. Lining con.	942,000 m^3 316,000 m^3
Surge Tank	D = 12.0 m H = 75 m	Ex. in open Tunnel ex. Shaft ex. Concrete	18,800 m^3 14,000 m^3 13,500 m^3 11,600 m^3
Penstock	D = 6.8 - 2.6 m L = 600 m	Ex. in open Tunnel ex. Shaft ex. Concrete	23,600 m^3 8,200 m^3 3,100 m^3 13,700 m^3
Powerhouse	D = 22.0 m H = 30 m	Ex. in open Shaft ex. Concrete	176,000 m^3 37,000 m^3 30,700 m^3
Switchyard		Ex. in open Concrete	70,000 m^3 9,100 m^3
Substation		Ex. in open Concrete	6,000 m^3 3,000 m^3

Note: Ex. = excavation

Table 12-2 Principal Machinery

Machinery		Specification	No.
Cable crane (Travelling type)		20 t ($6\ m^3$ bucket)	2
Concrete plant	Dam	$3\ m^3$ x 4 Forced action type	1
	Headrace tunnel	$1.5\ m^3$ x 2 Forced action type	2
Cement silo	Dam	1,000 t x 2	1
	Headrace tunnel	600 t	2
Aggregate plant		500 t/hour	1
Cooling plant		400 RT	1

As a result of study considering the sacle of the construction work, the layout of structures, etc., it is thought a period of approximately 6 years will be needed, including preparatory works. The layout of temporary facilities for construction and construction schedule are shown in Fig. 12-2 and Fig. 12-3, respectively.

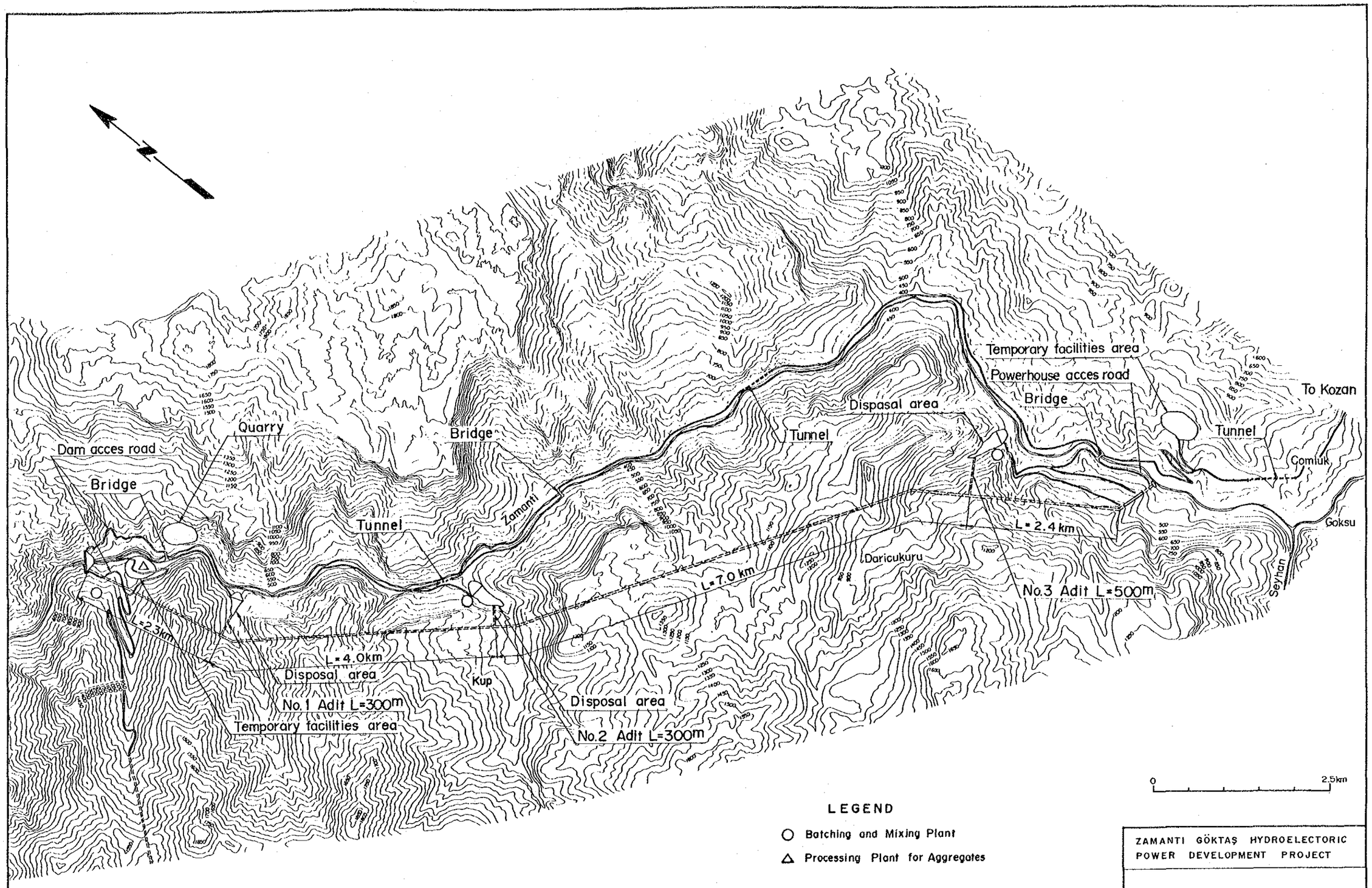
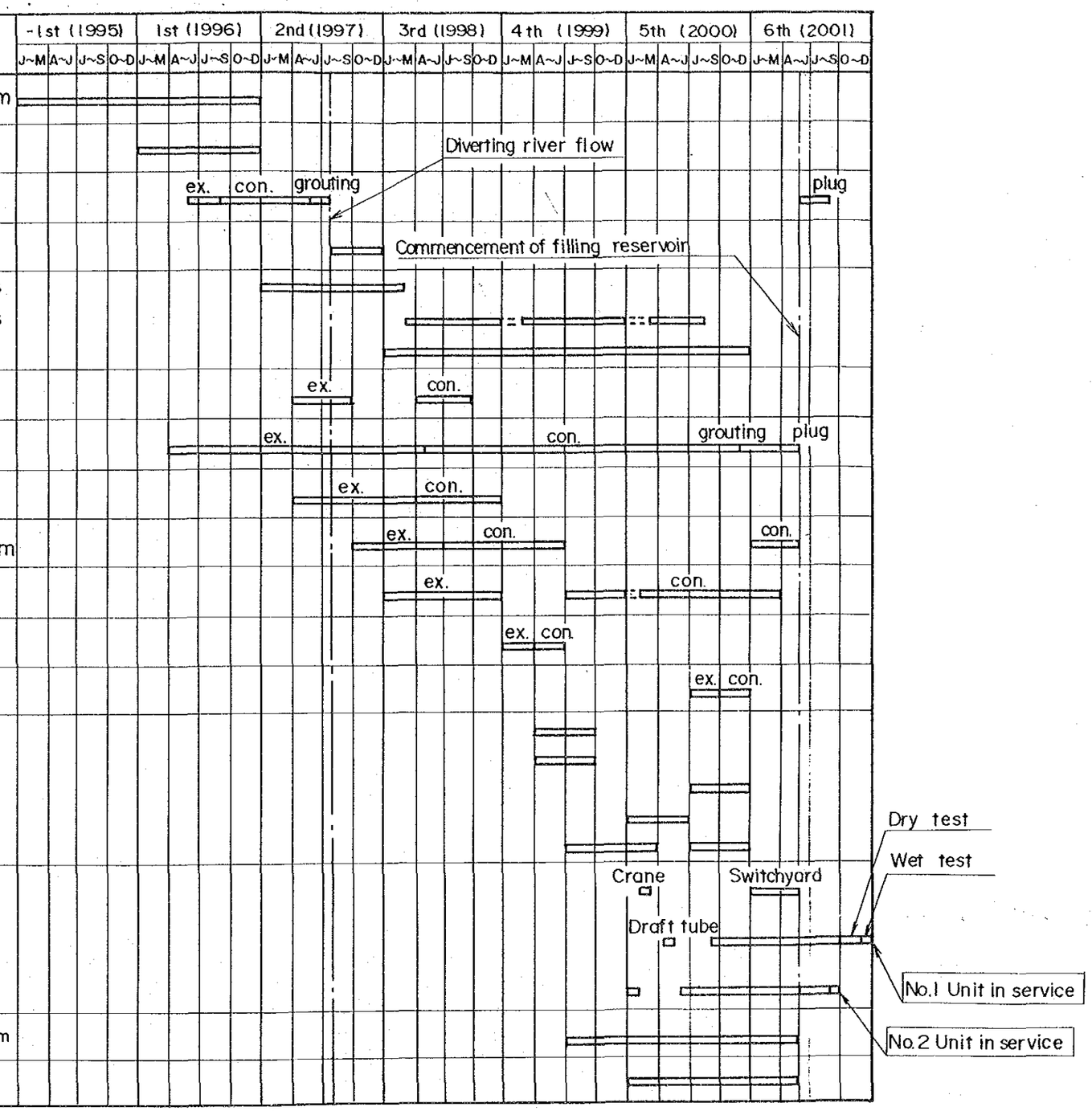

Quarry
Dam acces road
Bridge
Bridge
Tunnel
Zamanti
Tunnel
Dispasal area
Temporary facilities area
Powerhouse acces road
Bridge
To Kozan
Tunnel
Comluk
Goksu
Seyhan
Daricukuru
L=2.4km
No.3 Adit L=500m
L=7.0km
L=2.3km
L=4.0km
Disposal area
No.1 Adit L=300m
Temporary facilities area
Kup
Disposal area
No.2 Adit L=300m
0
2.5km
LEGEND
Batching and Mixing Plant
Processing Plant for Aggregates
ZAMANTI GÖKTAŞ HYDROELECTORIC POWER DEVELOPMENT PROJECT
LOCATION OF TEMPORARY FACILITIES
Fig. 12- 2

Fig. 12-3 Construction Schedule

Item	Quantity
Preparatory Works & Camp Facilities	Road for Construction: 64km
Access Road	L= 3 km
Diversion Tunnel	D=6.8m L=370m
Cofferdam (Upstream)	
Dam	Excavation 290,000m³ Concrete 800,000m³ Drilling & Grouting
Power Intake	
Headrace Tunnel	D=6.8m L=15,680 m
Surge Tank	D= 12m H= 75m
Penstock	D=6.8m~ 2.6m L=600m
Powerhouse	D=22m H=30m
Tailrace Tunnel	L=50 m x 2
Switchyard	
Hydraulic Equipment	Intake Gate 2 Units Outlet Gate 1 Unit Spillway Gate 3 Units Draft Gate 4 Units Penstock L=600m
Electromechanical Equipment	No. 1 Unit No. 2 Unit
Transmission Line	380kV L=25km, 154kV L=10km
Substation (Akarca)	154/380kV 450MVA



Outlines of the construction program and construction schedule are described below.

First Year

Completion of access roads for headrace tunnel construction prior to starting construction is indispensable for carrying out construction work smoothly. Simultaneously with start of construction, procurement of materials, construction of access roads along the Zamanti River to the dam site, temporary bridges, offices and housing facilities of the owner and contractor, materials storage yard, etc., site development for temporary facilities such as dam concrete placement crane, concrete plant, aggregate plant, and cement silo, and assembly of apparatus are to be commenced.

Excavation of the diversion tunnel is to be started immediately after completion of the temporary bridges and access roads required for the diversion tunnel work. Excavation of three adits is to be started for the headrace tunnel, followed by excavation of the main tunnel. Of the excavation muck, material that can be utilized is to be temporarily stored at a disposal area to use as aggregates.

These excavation works would be carried out at a plural number of locations in the project area and work must be executed paying attention to securing safety of the operations.

Second Year

The diversion tunnel work, headrace tunnel work, and temporary facilities works are to be continued, along with which open excavation for the dam is to be commenced. The diversion tunnel work is to be completed by the low-water season. Diversion of the river to the diversion tunnel is to be done immediately. After completion of diversion, construction of the upstream and downstream cofferdams, and in step with progress in construction of the cofferdams, excavation of the river bed and foundation treatment are to be done.

Excavation for the intake and excavation of an adit for surge tank work are to be commenced. After completion of excavation of the

adit, excavation of the vertical shaft and the water chamber is to be started in succession. Excavation for the surface part of the penstock is to be started.

Third Year

After completion of the cofferdams, and following excavation of the river-bed portion of the dam and foundation treatment, concrete placement for the dam is to be started. Concrete placement for the intake is to be performed. At the headrace tunnel, after completion of excavation, placement or lining concrete is to be started. With regard to the penstock, after completion of excavation of the horizontal tunnel portion at the bottom, excavation of the vertical shaft portion is to be started, with excavation muck hauled out through the bottom horizontal tunnel. After completion of the surface portion of the penstock, placement of concrete of anchor blocks for installation of steel pipes is to be carried out. Excavation of the surface portion of the powerhouse is to be performed, following which excavation of the vertical shaft is to be started from the top.

Fourth Year

Concrete placement and foundation treatment for the dam, and placement of lining concrete of the headrace tunnel are to be continued. In step with progress in placement of dam concrete, outlet valves in the dam are to be installed. In succession to excavation for the penstock, installation of steel pipe and placement of fill concrete are to be performed. Installation of intake gates is to be started.

After completion of excavation of the vertical shaft portion of the powerhouse, excavation for the tailrace tunnels and placement of lining concrete are to be done. Following this, placement of sidewall concrete of the powerhouse is to be commenced.

Construction of the transmission line is to be started.

Fifth Year

After completion of dam concrete placement, installation of spillway gates is to be started. Installation of tailrace gates is to be started.

Installation of the crane for electrical equipment installation is to be done in step with progress in placement of powerhouse sidewall concrete. After completion of crane installation, draft tube installation is to be started. Electrical equipment installation and assembly are to be done in succession to draft tube installation.

Foundation works for the outdoor switchyard on the opposite side of the powerhouse and the substation at Akarca are to be started.

Sixth Year

After completion of grouting of the headrace tunnel and plugging of adits, plugging of the diversion tunnel is to be done in parallel with impoundment of water in the reservoir. During impoundment, observations of the behaviors of the ground around the reservoir must be carried out with care.

Installation and assembly of electrical equipment to be located at the outdoor switchyard and substation at Akarca are to be performed. The transmission line work is to be continued. At the powerhouse, after installation and assembly of electrical equipment, dry tests are to be done in sequence, followed by wet tests. Operation is to be commenced upon passing the wet tests.

12.2 Cost Estimation

The construction cost of the Project was estimated based on the design and construction methods and materials in accordance with the technological level that can be expected at the present time and considering the geological conditions of the project sites, regional conditions, project scale, etc. The cost estimate was based on prices as of June 1988. (US$1 = 1,300 TL)

12.2.1 Fundamental Matters

(1) Construction Cost Estimation Items

(a) Civil Works

- Care of River	:	diversion tunnel, cofferdams
- Dam	:	main body, foundation treatment, etc.
- Waterway Structures	:	intake, headrace tunnel, surge tank, penstock, etc.
- Powerhouse and Switchyard	:	civil and architectural works
- Access Roads	:	powerhouse access, dam access roads, etc.
- Camp Facilities	:	office and lodging facilities, etc.
- Preparatory Works	:	access road, electric power transmission facilities for construction, etc.
(b) Hydraulic Equipment	:	gate, penstock, etc.
(c) Electromechanical Equipment	:	turbine, generator, auxiliary equipment, switchgear, etc.
(d) Transmission line construction	:	all costs related to transmission line

(e) Project Controlling : planning, survey, management, administration costs

(f) Land Acquisition : land, buildings, etc. in water impoundment area

(g) Interest during Construction: interest during construction period

(2) Criteria for Cost Estimate

(a) Civil Works

Unit prices in 1988 established by DSI, unit prices of existing, under construction and definite study level hydroelectric power development projects in Turkey, and those of similar hydroelectric power development projects in Japan are examined and compared.

Further, the labor costs, material costs and machinery costs, etc. that are necessary for construction works are estimated on the basis of conditions in Turkey by analysis of each item of work according to the construction procedure.

i) Unit Labor Cost and Unit Material Costs

The labor costs and material costs in Turkey applied to the abovementioned work are given in Table 12-3 and 12-4.

Table 12-3 Labor Cost

Item	Unit Cost (TL/day)
Foreman	8,760
Labor	4,320
Pit Man	5,760
Operator and Driver	6,960
Carpenter	6,080
Welder	6,080
Electrician	6,080
Apprentice	3,360

Table 12-4 Construction Materials Cost

Item	Unit	Unit Cost
Portland Cement (bulk)	TL/ton	49,500
Portland Cement (Bag)	TL/ton	50,600
Trass Cement (Bulk)	TL/ton	45,100
Trass Cement (Bag)	TL/ton	47,300
Dynamite	TL/kg	2,750
Gasoline	TL/ℓ	332
Light Oil	TL/ℓ	257
Reinforcement (Round Steel Bar)	TL/kg	323
Shaped Steel	TL/kg	322
Lumber (Pine)	TL/m^3	20,350

The transportation cost of cement, reinforcing steel, and shaped steel were calculated using unit costs furnished by the DSI.

Value added taxes (VAT 10%) are included in the unit materials costs.

ii) Construction Machinery

The principal construction machines such as dump truck, bulldozers, large-sized cranes for concrete placement, aggregate plant, batching plant, cooling plant, and boring and grouting machines are all to be imported, with the costs calculated based on the CIF prices at Mersin Port.

iii) Access Road

The construction cost of access roads is to be calculated based on unit construction costs of the Highway Department.

(b) Hydraulic Equipment

High-pressure valves are to be imported from abroad, while penstock pipes, spillway gates, intake gates, and outlet gates are to be manufactured in Turkey.

(c) Electromechanical Equipment

Electromechanical equipment such as turbines, generators, and transformers are to be imported, while outdoor steel structures and overhead travelling cranes are to be procured in Turkey. The transportation cost to the powerhouse site and installation costs are to be included in these costs.

(d) Transmission Line Construction Cost

The transmission line construction cost are to refer to unit costs furnished by TEK (through the DSI).

(e) Project Controlling

Project controlling costs of 15% of construction costs including contingencies are considered.

(f) Land Acquisition

Compensation costs such as land acquisition cost are to be calculated based on data furnished by the DSI.

(g) Interest during Construction

Interest during construction is to be 9.5 percent for both local and foreign currencies in accordance with discussions with the DSI.

(h) Import Duty and Various Taxes

Customs on construction machinery and electromechanical equipment such as turbines and generators which need to be imported will not be considered as a result of discussions with the DSI. For materials and equipment procured in Turkey, value added tax of 10 percent is to be included.

(i) Contingency Cost

Based on discussions with the DSI, contingency cost is to be 15 percent of civil works construction cost and 10 percent of electromechanical equipment cost.

(3) Division of Local and Foreign Currency Requirements

(a) Civil Works Construction Cost

Cement, steels such as reinforcing bars and structural steel, steel products, and explosives, which are the principal materials for civil works are to be domestic products paid for with local currency.

Of equipment for civil works, heavy dump trucks and bulldozers, and temporary facility equipment such as concrete plant, aggregate plant, concrete placement cranes, cooling plant, etc. are all to

be imported and their construction costs listed under foreign currency. Special machinery such as boring machines, grout pumps, and compressors are to be provided through imports, and are to be paid for with foreign currency.

(b) Hydraulic Equipment

All hydraulic equipment, except for special items, is to be paid for with local currency.

(c) Electromechanical Equipment and Transmission Line

Main electromechanical equipment and transmission line equipment and materials are to require foreign currency, while cranes and steel structures are to be paid for with local currency. The inland transportation costs and installation costs of these are to be local currency requirements.

(d) Project Controlling

These are to be 55 percent local currency requirements and 45 percent foreign currency requirements.

(e) Compensation Costs

Compensation costs are all to be local currency requirements.

(f) Interest during Construction

Interest amounts in proportion to the local and foreign currency requirements are to be respectively calculated.

12.2.2 Estimated Construction Cost

The domestic and foreign currency portions of construction costs and the construction costs by year are respectively given in tables 12-5 and 12-6 for the Project.

Table 12-5 Estimated Construction Cost

(Unit: 10^6 TL)

Item	Foreign Currency	Local Currency	Total
Civil Works			
Care of River in Dam	2,208	3,955	6,163
Dam	26,828	40,983	67,811
Waterway	44,590	84,756	129,346
Powerhouse and Switchyard	5,143	10,124	15,267
Access Road	549	654	1,203
Camp Facilities	1,657	6,957	8,614
Preparation Works	12,371	17,450	29,821
Contingency (15%)	14,002	24,732	38,734
Sub-total	107,348	189,611	296,959
Hydraulic Equipment	2,425	10,928	13,353
Electromechanical Equipment	56,930	11,670	68,600
Transmission Line and Sub-station	9,632	6,687	16,319
Total (Direct Cost)	176,335	218,896	395,231
Project Controlling	26,450	32,834	59,284
Land Acquisition	0	250	250
Total (Project Cost)	202,785	251,980	454,765
Interest during Construction	51,072	77,478	128,550
Grand Total (Investment Cost)	253,857	329,458	583,315

Table 12-6 Fund Requirement in Each Year (1/2)

F: Foreign Currency
L: Local Currency
T: Total

(Unit: 10^6 TL)

Item	Year	-1st year	1st year	2nd year	3rd year	4th year	5th year	6th year	Total	Remarks
Civil Works										
Care of River in Dam	F		586	1,575				47	2,208	
	L		1,206	2,666				83	3,955	
	T		1,792	4,241				130	6,163	
Dam	F			794	6,364	15,164	4,506		26,828	
	L			544	9,828	23,428	7,183		40,983	
	T			1,338	16,192	38,592	11,689		67,811	
Waterway	F		6,176	9,038	8,648	5,901	10,429	4,398	44,590	
	L		13,102	18,763	18,435	14,142	17,471	2,843	84,756	
	T		19,278	27,801	27,083	20,043	27,900	7,241	129,346	
Powerhouse and Wsitchyard	F				1,597	532	2,440	574	5,143	
	L				2,301	1,246	5,410	1,167	10,124	
	T				3,898	1,778	7,850	1,741	15,267	
Access Road	F		549						549	
	L		654						654	
	T		1,203						1,203	
Camp Facilities	F		1,657						1,657	
	L		6,957						6,957	
	T		8,614						8,614	
Preparation Works	F	8,722	3,649						12,371	
	L	11,779	5,671						17,450	
	T	20,501	9,320						29,821	
Sub-total	F	8,722	12,617	11,407	16,609	21,597	17,375	5,019	93,346	
	L	11,779	27,590	21,973	30,564	38,816	30,064	4,093	164,879	
	T	20,501	40,207	33,380	47,173	60,413	47,439	9,112	258,225	
Cotingency	F	1,308	1,893	1,711	2,491	3,240	2,606	753	14,002	
	L	1,767	4,138	3,296	4,585	5,822	4,510	614	24,732	
	T	3,075	6,031	5,007	7,076	9,062	7,116	1,367	38,734	
Sub-total	F	10,030	14,510	13,118	19,100	24,837	19,981	5,772	107,348	
	L	13,546	31,728	25,269	35,149	44,638	34,574	4,707	189,611	
	T	23,576	46,238	38,387	54,249	69,475	54,555	10,479	296,959	

Table 12-6 Fund Requirement in Each Year (2/2)

F: Foreign Currency
L: Local Currency
T: Total

(Unit: 10^6 TL)

Item	Year	-1st year	1st year	2nd year	3rd year	4th year	5th year	6th year	Total	Remarks
Hydraulic Equipment	F					2,425	0	0	2,425	
	L					3,957	6,728	243	10,928	
	T					6,382	6,728	243	13,353	
Electromechanical Equipment	F				3,700	14,650	18,800	19,780	56,930	
	L				0	2,500	3,530	5,640	11,670	
	T				3,700	17,150	22,330	25,420	68,600	
Transmission Line	F					348	1,322	978	2,648	
	L					811	1,734	600	3,145	
	T					1,159	3,056	1,578	5,793	
Sub-station	F						1,079	5,905	6,984	
	L						1,500	2,042	3,542	
	T						2,579	7,947	10,526	
Total (Direct Cost)	F	10,030	14,510	13,118	22,800	42,260	41,182	32,435	176,335	
	L	13,546	31,728	25,269	35,149	51,906	48,066	13,232	218,896	
	T	23,576	46,238	38,387	57,949	94,166	89,248	45,667	395,231	
Project Controling	F	1,504	2,177	1,968	3,420	6,339	6,177	4,865	26,450	
	L	2,032	4,759	3,790	5,272	7,786	7,210	1,985	32,834	
	T	3,536	6,936	5,758	8,692	14,125	13,387	6,850	59,284	
Land Acquisition	F	0							0	
	L	250							250	
	T	250							250	
Total (Project Cost)	F	11,534	16,687	15,086	26,220	48,599	47,359	37,300	202,785	
	L	15,828	36,487	29,059	40,421	59,692	55,276	15,217	251,980	
	T	27,362	53,174	44,145	66,641	108,291	102,635	52,517	454,765	
Interest during Construction	F	548	1,889	3,398	5,359	8,913	13,472	17,493	51,072	
	L	752	3,237	6,350	9,651	14,406	19,867	23,215	77,478	
	T	1,300	5,126	9,748	15,010	23,319	33,339	40,708	128,550	
Grand Total (Investment Cost)	F	12,082	18,576	18,484	31,579	57,512	60,831	54,793	253,857	
	L	16,580	39,724	35,409	50,072	74,098	75,143	38,432	329,458	
	T	28,662	58,300	53,893	81,651	131,610	135,974	93,225	583,315	

CHAPTER 13. IMPACT ON ENVIRONMENT

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CHAPTER 13. IMPACT ON ENVIRONMENT

13.1 Preface

Based on the location survey and literature study carryed out by DSI the for natural and social environments of the Goktas project area and it's surroundings, the effects of the Goktas project on it's environments are qualitatively evaluated.

13.2 Method of Investigation

The investigation was mainly carried out referring to DSI's reports "ZAMANTI-GOKTAS HEPP PROJECT PLANNING REPORT OF EXPROPIATION" (ADANA June/1988), "REPORT ZAMANTI-GOKTAS HEPP PROJECT ENVIRONMENTAL AND SOCIAL ASPECTS" (1988 ADANA) and to the location survey that was partially conducted.

13.3 Outline of Project

This project is to generate max. electricity 270 MW by the powerhouse constructed at right bank of Zamanti river using the water stored by the concrete dam at about 20 km up the confluence of Gokus and Zamanti rivers, and then introduced by power tunnel of approx. 16 km.

The switch yard is going to be installed at left river bank directly from down the powerhouse and to transmit electricity to Adana district.

The construction materials and machine parts are going to be transported from Adana district via Kozan into the project area and to be carried by the construction road which is newly founded between the powerhouse and dam site.

The pine tree is mainly afforested at the project area and it's surroundings which take the form of high slopes having rocks in some places.

There are no rare plants and animals taken under protection.

13.4 Current Conditions of Environment

13.4.1 Natural Environmental Conditions

(1) Nature Conservation

There are no national parks, environment conservation areas, or wild life protection areas in the reservoir area. For information, the nature conservation areas in the district are as follows:

Sultansazligili Water Birds and Nature Conservation area of 13,000 Ha. near Kayseri-Yahyali District; and it is intended to protect Aleppo pines and sea tortoises in Camlik Nature Conservation area at Adana-Yumurtalik. Yellow pine species are protected at Melikgazi Forest conservation area at Kayseri Pinarbasi; and various types of vegetation and animals are protected at Hacer Forest Conservation area (1,821 ha) at Yahyali district. Apart from these, on Aladags in the north west of reservoir area, there are Wild Goat Conservation and Breeding areas at Aladags and Urkeklik and Conservation and Breeding areas at Catalan, Alageyik and Turcect. All such protection areas are outside the project area and therefore are not affected.

(2) Natural Scenery

(a) Dam Site

Dam site takes the form of high slopes having rocks in some places. There are thinly settled pine trees at both sides of the riverbank. The stream of river is almost rapids.

(b) Powerhouse Site

At upper levels at both sides of the bank in powerhouse site, there are calm slope places scattered with houses.

Land near the river bank takes the form of high slopes having rocks in some places.

River stream is rapid and at the bottom of the right bank there is beach accumulated by sands.

Pine tree is mainly used for vegetation. Near the houses, there are fruit trees such as olive, fig tree and pomegranate, and popla trees used for vegetation.

(3) Vegetation

Red pines and black pines are mostly used for vegetation at the reservoir area and platanus trees are afforested nearly the river bed.

There are several virgin forests at several elevations in the reser voir area.

The forest below an elevation of 900 m, consists of the red pine tree, and between 900 and 1,300 m of elevation there is a forest of black pines.

Between 1,300 and 2,000 m of elevation there are juniper, ladin, chion, turpetive and at a higher elevation than 2,000 m there are abandoned lands that are sterile.

In the reservoir area there is no forest tree taken under protection or designated.

(4) Animals

(a) Land Animals

Land animals inhabit the reservoir area are as follows:

i) Mammals

Bear, Deer, Wild boar, Fox, Rabbit, Squirrel, Marten, Hedgehog, Jackal, Beaver

In addition, Cattle, Horse, Sheep, Goat, Ass, Mule are breeded.

ii) Aves

Hawk, Falcon, Magpie, Owl, Eagle, Crow, Woodpecker, Pigeon, Partridge, Starling, Swallow, House sparrow

iii) Reptiles

Snake, Lizard, Turtle

iv) Amphibians

Salamander, Frog

v) Insects

Dragonfly, Butterfly, Cicada, Grasshopper, Bee, Mousefly, Mosquito

Moreover, bee keeping is carried on in surrounding dwellings. In addition, there are other insects such as Scorpion and Millepede.

There are no rare animal species under conservation in the reservoir area. As mentioned before, certain animals such as wild goat and deer are protected at Hacer forest.

(b) Aquatic Animals

Aquatic animals inhabit the reservoir area as follows:

i) Fishes

Trout, Carp, Sheat-fish, Crab

ii) Others

Plecoptera, Ephemeroptera, Trichoptera, Crustacea, Diptera, Coleoptera

(5) Water Quality

(a) Status of Water Quality

The environmental act which is a frame law, was promulgated on August 9, 1983 and laid down the concept of environmental protection in it's guidelines.

This act sets the general environmental policy and establishes the institutions and mechanisms for coordinated management of the environment. But these are to be regulated in detail by the subsidiary legislation, i.e. by regulations.

One of these regulations "Regulation for Water Pollution Control" was promulgated on September 4, 1988.

According to this regulation, all inland waters are classified in four quality classes and the utilization purpose of each class and the standards for water quality parameters are given in Table 13-1.

Limit values for some water quality parameters which are important for eutrophication control are stated in Table 13-2.

Groundwater resources are also classified according to their quality in the same section of the regulation.

Table 13-1 Water Quality Criteria According to the Classes of Inland Water Resources

Water Quality Parameters		Water Quality Classes I	II	III	IV
A) Physical and inorganic chemical parameters					
1- Temperature	(℃)	25	25	30	>30
2- pH	(-)	6.5~8.5	6.5~8.5	6.0~9.0	6.0~9.0
3- Dissolved oxygen	(mg/ℓ) *1	8	6	3	<3
4- Oxygen saturation	(%) *1	90	70	40	<40
5- Cl	(mg/ℓ)	25	200	400 *2	>400
6- SO_4	(mg/ℓ)	200	200	400	>400
7- NH_4-N	(mg/ℓ)	0.2 *3	1 *3	2 *3	>2
8- NO_2-N	(mg/ℓ)	0.002	0.01	0.05	>0.05
9- NO_3-N	(mg/ℓ)	5	10	20	>20
10- PO_4-P	(mg/ℓ)	0.02	0.16	0.65	>0.65
11- Total dissolved solids	(mg/ℓ)	500	1500	5000	>5000
12- Color		5	50	300	>300
13- Na	(mg/ℓ)	125	125	250	>250
B) Organic parameters					
1- COD	(mg/ℓ)	25	50	70	>70
2- BOD	(mg/ℓ)	4	8	20	>20
3- Organic carbon	(mg/ℓ)	5	8	12	>12
4- Total K-N	(mg/ℓ)	0.5	1.5	5	>5
5- Emulsified oil & grease	(mg/ℓ)	0.02	0.3	0.5	>0.5
6- Methylene blue active substances	(mg/ℓ)	0.05	0.2	1	>1.5
7- Phenolic substances	(mg/ℓ)	0.002	0.01	0.1	>0.1
8- Mineral oils & derivatives	(mg/ℓ)	0.02	0.1	0.5	>0.5
9- Total pesticide	(mg/ℓ)	0.001	0.01	0.1	>0.1
C) Inorganic pollution parameters *4					
1- Hg	(μg/ℓ)	0.1	0.5	2	>2
2- Cd	(μg/ℓ)	3	5	10	>10
3- Pb	(μg/ℓ)	10	20	50	>50
4- As	(μg/ℓ)	20	50	100	>100
5- Cu	(μg/ℓ)	20	50	200	>200
6- Cr (Total)	(μg/ℓ)	20	50	200	>200
7- Cr ($^{+6}$)	(μg/ℓ)		20	50	>50
8- Co	(μg/ℓ)	10	20	200	>200
9- Ni	(μg/ℓ)	20	50	200	>200
10- Zn	(μg/ℓ)	200	500	2000	>2000
11- CN	(μg/ℓ)	10	50	100	>100
12- F	(μg/ℓ)	1000	1500	2000	>2000
13- Cl_2	(μg/ℓ)	10	10	50	>50
14- S	(μg/ℓ)	2	2	10	>10
15- Fe	(μg/ℓ)	300	1000	5000	>5000
16- Mn	(μg/ℓ)	100	500	3000	>3000
17- B	(μg/ℓ)	1000 *5	1000 *5	1000 *5	>1000 *5
18- Se	(μg/ℓ)	10	10	20	>20
19- Ba	(μg/ℓ)	1000	2000	2000	>2000
20- Al	(mg/ℓ)	0.3	0.3	1	1
21- Ci	(pCi/ℓ)				
α		1	10	10	>10
β		10	100	100	>100
D) Bacteriological parameters					
1- Fecal coliforms	(MPN/100 mℓ)	10	200	2000	>2000
2- Total coliforms	(MPN/100 mℓ)	100	20000	100000	>100000

(Notes)

*1 It is sufficient to apply only one of the concentration or saturation percentage standards.

*2 It might be necessary to reduce the limit for chloride concentration in the irrigation water for plants which are sensitive to chloride.

*3 Free ammonia-nitrogen concentration depending on the pH value, should not exceed 0.02 mg NH_3-N／ℓ.

*4 The criteria in this group specify the total concentrations of the chemicals.

*5 It might be necessary to reduce the standard up to 300 μg／ℓ for the irrigation of boron sensitive plants.

The above stated limits should not be exceeded with 90% probability.

Water quality classes and their utilization purposes are given below:

CLASS I: High quality water

i) Potable water supply with disinfection only

ii) Recreational purposes (including water contact sports such as swimming)

iii) Trout production

iv) Water for livestock

v) Others

CLASS II: Fairly polluted water

i) Potable water supply with a suitable treatment process

ii) Recreational purposes

iii) Fish production, except trout

iv) Irrigation water supply in the case that irrigation water quality standards are satisfied

v) All other purposes except the purposes of class I

CLASS III: Polluted water

Industrial water supply except for industries requiring high quality water, with suitable treatment.

CLASS IV: Highly polluted water

Surface waters of which the quality is worse than the qualities of other classes.

Table 13-2 Standards for Eutrophication Control in Lakes, and Dam Reservoirs

Parameters	Utilization Purpose	
	Nature Preservation and Recreation	Different Uses
pH (-)	6.5 - 8.5	6.0 - 10.5
COD (mg/l)	3	8
DO (mg/l)	7.5	5
Suspended Solids (mg/l)	5	15
Total Coliform (MPN/100 ml)	1,000	1,000
Total Nitrogen (mg/l)	0.1	1
Total Phosphorus (mg/l)	0.005	0.1

(b) Records of Water Quality

Water quality analysis results by DSI are shown in Table 13-3. Details are given in the Appendix. In addition, aquatic animals are surveyed for evaluation on water quality by considering inhabitant conditions. Items of survey are as follows: Plecoptera, Ephemeroptera, Trichoptera, Crustacea, Diptera, Oligo, Coleoptera, Misc, Mollusca and Hirudinea.

According to survey results of aquatic animals surrounding dam site carried out in June 1988, inhabitants such as Plecoptera, Ephemeroptera, Trichoptera, Crustacea, Diptera and Coleoptera were confirmed.

Table 13-3 Water Analysis Data

Item	Unit	GS : 1802	GS : Dam Site	GS : 1806
Discharge	m^3/s	18 ~ 30.7	38 ~ 68	55.5~ 552.0
Temperature of Water	℃	16 ~ 23	15 ~ 18	11 ~ 18
pH	——	7.34 ~ 7.98	8.1 ~ 8.4	7.9 ~ 8.3
Electrical Conductivity	mhos/cm	355 ~ 443	322 ~ 362	290 ~ 399
Total Soluted Solids	mg/ℓ	227 ~ 284	203 ~ 234	184 ~ 286
Suspended Solids	mg/ℓ	173 ~ 563	55 ~ 847	25 ~ 3258
Total Solids	mg/ℓ	400 ~ 800	273 ~ 1050	288 ~ 3442
Meta Oranj Alkalinity	mg/ℓ	100 ~ 140	80 ~ 135	100 ~ 130
Phenolphtalein Alkalinity	mg/ℓ	0	10 ~ 40	0 ~ 50
Chloride	mg/ℓ	17.7 ~ 27.6	17.73 ~ 21.27	7.09 ~ 28.36
Ammonia Nitrogen	mg/ℓ	0.11 ~ 6.0	0.15 ~ 0.33	0.20 ~ 0.36
Nitride Nitrogen	mg/ℓ	0 ~ 0.013	0 ~ 0.005	0 ~ 0.001
Nitrate Nitrogen	mg/ℓ	0 ~ 1.6	0.56 ~ 0.76	0.63 ~ 1.01
Soluted Oxygen	mg/ℓ	—	8.7 ~ 9.9	7.5 ~ 11.0
Permanganate Value	mg/ℓ	0.6 ~ 6.8	1.12 ~ 3.6	0.64 ~ 5.44
Biochemical Oxygen Value	mg/ℓ	—	0.6 ~ 2.8	0.6 ~ 2.7
Total Hardness	mg/ℓ	15.5 ~ 17.5	145 ~ 175	145 ~ 1905
Ortho-Phosphate	mg/ℓ	0 ~ 2.1	0 ~ 0.17	0 ~ 0.09
Sulphate	mg/ℓ	49 ~ 88.2	13.92 ~ 33.60	17.76 ~ 35.04
Free Carbondioxide	mg/ℓ	—	—	—
Iron	mg/ℓ	0.62	—	0.25
Mangan	mg/ℓ	0.20	—	0
Natrium	mg/ℓ	10.6 ~ 20.24	8.51 ~ 11.54	4.14 ~ 23.40
Kalium	mg/ℓ	1.6 ~ 2.3	1.56 ~ 1.95	1.17 ~ 1.56
Calcium	mg/ℓ	40.0 ~ 58.1	30 ~ 44	26.0 ~ 52.0
Magnesium	mg/ℓ	7.3 ~ 14.6	14.59 ~ 23.10	10.91 ~ 30.4
Bacterial Analysis	MPN/ 100mℓ	24	—	2400
Organic Nitrate	mg/ℓ	—	—	0.22
Fluorine	mg/ℓ	—	—	0
Boron	mg/ℓ	—	—	—
Phenol	mg/ℓ			—
Oil	mg/ℓ			—

(6) Noise

Noise control was prepared on the basis of Item 14 of the Environment Act.

This regulation is applied in both rural and urban areas. Noise control is applied in the following order:

. In the source of noise.

. In the environment which is under the influence of noise.

. The person who is affected by the noise.

The representatives of the government in that region and mayors are responsible for the application of this regulation, and the General Directorate of the Environment is responsible for coodinating the relevant authorities on the subject of noise control.

Different sources of noise and maximum tolerable noise levels are given in the Appendix of the regulation. The maximum tolerable noise levels from a health point of view are also specified in the Appendix. If these levels are exceeded, the employer should take the necessary precautions.

In this regulation, it is also stated that noise problems should be considered during the construction of highways. The other prohibitions related to noise are also considered in the regulations. For the equipment stated as the source of noise in the regulation, the producers and users are supposed to make and document the routine noise levels.

The relevant laws are applied to control whether the limitations and restrictions are satisfied or not and to give the required permission.

13.4.2 Social Environmental Conditions

(1) Local Communities

(a) Population

There is no settlement area in the reservoir area. However, there are 6 plateau houses in the place where the Kapuzbasi springs are located, which serve as a summer resort for the Buyukcakir village located at a higher elevation. These houses are located at an elevation of 640 m.

They are simple wooden structures and are used 3 - 4 months during the year.

Around the dam reservoir there are 4 village centers. There are 2 villages for each river bank and the existing house numbers in these four villages are 470.

Population is shown in Table 13-4.

Table 13-4 Population in the Villages Around Reservoir

(Unit: Person/Year)

Village Centers	1975 Y.	1985 Y.
Buyukcakir	648	910
Kapuzbasi	286	366
Balcicakir	383	531
Cukurharman	501	668
Ergenusagi	988	907
Koprucuk	595	629

(b) Industrial Activities

i) Agriculture

In the reservoir area and it's surroundings dry farming is carried out with grains and vinicultures grown.

Farmlands in the reservoir area are located only on the sides of Suarasi stream. In this area, vegetables are planted for family consumption; these vegetables are tomatoes, cucumber, pumpkin and beans.

The population living in the surroundings of the reservoir earn a part of their living by raising stock. Each family has on average 20 to 25 sheep and goats and 1 - 2 cattle. They use the milk and meat of these animals.

Forest areas are used as pasturage.

ii) Commerce (Trade)

There are only small commercial activities at the reservoir area and in the area immediately around it. District people buy what they need from Yahyali and Kozan towns.

Their own animal products are bought by the traders from their own place.

iii) Industry

In the area of study there is only rug weaving as industrial activity. In each house they have a weaving machine and each family weaves about 15 - 30 m^2 rugs per year based on their manpower.

(2) Transportation and Public Facilities

(a) Main Transportation

Access to the dam site from Adana is gained by Adana - Karsanti highway. It is approximately 105 km, of which 85 km is asphalt and 20 km is stabilized. The road between Karsanti and the dam site is 35 km of forest road. The road, being a dirt road and it climbing to an elevation of 1,500 m before reaching the dam site, makes access in winter difficult. Because in this area, there is snow fall above an elevation of 1,200 m.

Adana - Karsanti highway will be partially inoperational due to the construction of Catalan dam on Seyhan river and the construction of Yadigoze dam.

The General Directorate of Highways has started construction of the road which will connect Karsanti to Adana via Karaisali.

(b) Public Facilities

There is an elementary school in each of the village centers in the vicinity of the dam site. There is electricity in the village centers.

However, connection to quarters is in the design stage. There is telephone connection between Kapuzbasi and Buyukcakir.

Telephone connection between Kapuzbasi and Buyukcakir is being completed.

(3) Land Use

About 87% of the area around the reservoir is forest, 2% farm land and the remaining parts rocky and abandoned lands. 91% of the land in the reservoir (below elevation 650 m) is forest, about 2% is farm lands and the remaining areas are river beds and non-utilized lands.

The farm-lands around the reservoir are areas cut open in the forest, with high slopes, on which the dry farming is carried out.

In these dry lands only grain is planted and the production is for domestic consumption only. Lands are tilled one year and left to fallow the next. Viniculture is only for family needs.

Total agricultural area that will remain under water after the construction of the Goktas dam is 43 da, 14 da of which is vineyard and 29 da farm lands.

These lands belong to Buyukcakir village and are located along Suarasi river. The total area of the village is 3,200 da.

(4) Water Utilization

There are three mills working water power located at Kapuzbasi springs. Two of them are between an elevation of 640 and 650 m, the other is at a higher elevation. These mills are releasing the water back to the bed after using it.

(5) Cultural Assets and Recreational Facilities

There are no cultural assets or recreational facilities around the reservoir area. Efforts to develop the Kapuzbasi springs as a recreational area have been made. There is the Mother Mary cave at easterns skirts of Aladags which is 20 km distant from the reservoir. Both locations have transportation problems.

13.5 Environmental Impact Assessment

13.5.1 Qualitative Environmental Evaluation

Qualitative impacts on the environment have to be made clear by the method which Aegerter and Messerli propose.

For clalifying method, the following 3 predicates are defined.

i) Actions: All action attended to the project.

ii) Effects: Environmental effects by working project.

iii) Impacts: Change of environmental peculiarity and impacts on human health and well-being.

The survey is to predict, confirm and to clarify qualitatively, the actions attended to the project and impact areas on the environment. Projects as objects are divided into the following 3 phases.

i) Preparation phase

Preparation phase includes pre-survey.

ii) Construction phase

This includes all civil construction consisting of main and sub-construction and also measures corresponding with people in the area i.e. social, cultural and economic activities.

iii) Operation phase

This phase includes maintenance-management of facilities, generation of electric power, ordinary employment and fish breeding in the reservoir, etc. after the project accomplishment.

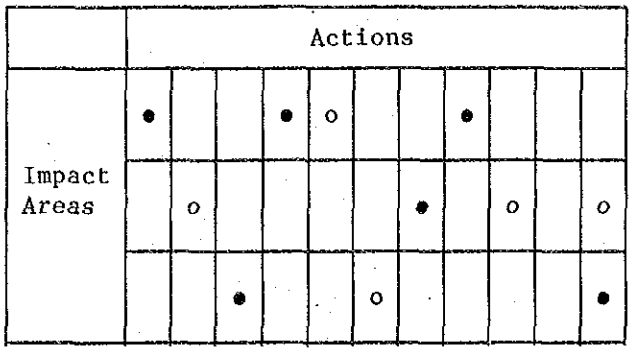
Detailed contents of activities are shown in Table 13-5.

Impact areas which might be affected directly or indirectly by the activity, are divided into nonbiotic area of creatures, biotic area of creatures, social area, cultural area, economic area, and political area and are shown in Table 13-6.

Relevance of actions and impact areas by project can be explained by matrix figure illustrated below.

Evaluation results of this project are shown in Figure 13-2 and the outline of results is described in following 13.5.2 "Natural Environment" and 13.5.3 "Social Environment".

Fig. 13-1 Relevance Matrix



The matrix figure indicates only district impact areas of affectable areas corresponding to each action, but not indicating whether the effects in selected impact areas are striking.

Conspicuous effects are made clear through repeated consideration by subjective judgement.

In respect to each action, the effects in all the clarified impact areas are repeatedly to be considered by matrix figures.

Repeated consideration is to be carried out, until no chain impacts are detected under repeatedly consideration.

Fig. 13-2 Relevance Matrix

● : certain effect is expected ○ : effect is possible

Impact Areas	Actions																																									
	Preparation Phase					Construction Phase																			Operation Phase																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Non - Biotic Area																																										
1.Air	○		○		○	○	○		●	●	●	●	○	○	○	○		●									○															
2.Water	○		○	○	○	○	○				●	●	●	●	●			○				○	○	○								○	○	○	○				○		
3.Soil & Rock	●		●		○	○	○				●	●	●	●	●	●	○	●	○	○	○	○	○	○																	
4.Underground	○										●	●	●	●	●																											
5.Surface	○	●	●	●	○	○	●	○	○		●	○	○	○	○	●	●	○	○	○	●	●	●	●																	
6.Climate																								○																		
Biotic Area																																									
7.Surface Fauna Ecosystem	○	●	○	○			○				○										●	○		○			○															
8.Plant Formations	○	●	○	○			○				○										●	●		○			○															
9.Aquatic Ecosystem											●													●											○							
Social Area																																									
10.Populatin Structure																													●	○												
11.Populatin Movement																											○		○	○												○
12.Aesthtic	○	●	●	●			●	○	○		●	○	○	○		●	●	○	○	○	●	●	○	●			●															
13.Communication	○									○															○	●	●		○			○	○	○							●
Cultural Area																																									
14.Institutions																																									
15.Traditions & Customs																																○	○	○							
Economic Area																																									
16.Professional Structure																									○	○	○		○	○									○			
17.Agriculture & Forestry				○																				○			○														○
18.Trade									○																○		○		○	○								○			○
19.Industry																												○													
20.Tourism																								○			○				○	●	●	●							○
21.Public Service																											○	○	●	○												○
22.Infrastructure		●				○	○																			○	●	○													○
Political Area																																									
23.Interest of Population	○	○								○														○	○		○	○	○		○							○			○

Table 13-5 List of Actions

Preparation Phase

1. Engineering Studies (Field Activities: Seismic Prospecting, Boring, Survey)

Construction Phase

2. Land Use of the Entire Plant
3. Quarries (Stone and Gravel)
4. Timber Cutting
5. Storage and Deposit of Construction Material
6. Improvement or Modification of Existing Road
7. Road (Road, Bridge)
8. Protective Measures
9. Parking
10. Transportation by Vehicles, Airplane, Helicopter
11. Dam (Diversion Tunnel, Coffer Dam, Dam & Spillway)
12. Intake
13. Waterway (Power Tunnel, Surge Tank, Penstock, Tailrace)
14. Powerhouse
15. Outlet
16. Switchyard
17. Erection of Towers and Installation of H/V Line
18. Blasting & Cleaning of Loose Rock
19. Erection of Protective Construction against Rock Falling
20. Protective Works for Land Slide
21. Reforestation
22. Landscaping
23. Temporary Accommodation

Operation Phase

24. Reservoir
25. Buildings and Constructions
26. Transmission Line
27. Road
28. Energy Production
29. Permanent Jobs
30. Contract for Maintenance & Repair
31. New Supply of Service & Consumer Goods
32. Outdoor Activities & Sport
33. Fishing
34. Hiking & Camping
35. Seasonal Variation of Water Level
36. Emergency Drainage
37. Dredging of Reservoir
38. Production of Fish
39. Change of Erosion Process
40. Loss of Water
41. Maintenance of Breaks (Pressure Ducts and Power Line)
42. Transport of Goods and Persons

Table 13-6 List of Impact Areas

Non-Biotic Area

1. Air (Pollution, Noise & Vibration Intensity)
2. Water (Surface Water, Underground Water)
3. Soil & Rock (Cultivated Soil, Natural Soil, Rawsoil and Rock)
4. Underground
5. Surface (Landscape)
6. Climate (Sunshine, Micro-climate)

Biotic Area

7. Surface Fauna Terrestrial Ecosystem
8. Plant Formations of Terrestrial Ecosystem (Forest, Grassland)
9. Aquatic Ecosystem (River & Brook, Reservoir)

Social Area

10. Population Structure (Age, Profession)
11. Population Movement
12. Landscape
13. Communication

Cultural Area

14. Institutions (School, Cultural Sites)
15. Traditions and Customs
    (Festival, Traditional Land Use, Art Craft, Habit, Natural Features to be protected)

Economic Area

16. Professional Structure
17. Agriculture and Forestry
18. Trade
19. Industry
20. Tourism
21. Public Service
22. Infrastructure (Roads, Public Bldg. + Installations, Supply Service)

Political Area

23. Interest of Indigenous Population (Development, Administration)

13.5.2 Natural Environmental Conditions

(1) Nature Conservation

There are no national parks, environment conservation areas, or wild life protection areas in the planning site. Therefore, all such protection areas are outside the project area and are not affected thereby.

(2) Natural Scenery

Most of the area around the reservoir is forest and remaining part is rocky abandoned land and small farm land. Most of the forest consists of the pine tree. River stream is rapid.

Impact resources in execution of the plan seem to be sampling of earth and stone, forest felling, construction of work roads, dam, powerhouse, switch yard and transmission tower etc., during the construction phase, and existence of the dam and reservoir respectively, after starting operation. The impacts thereby are able to be reduced by countermeasures such as keeping changes as small as possible, etc. In addition, the existence of dam and reservoir seem to make a new natural scenery.

(3) Vegetation

Most of the forest around the reservoir is pine tree and there is no forest tree to be protected. Forest will be felled for setting up the powerhouse structure, but impacts can be reduced by utmost minimizing the felling forest area, tree planting after the construction, etc.

(4) Animals

(a) Land Animals

Land animals that inhabit the reservoir area are boars, squirrels, hawks, snakes, frogs and bees, etc., but there is no rare animal to be designated for protection.

These animals might be affected by forest felling for construction and the sound of construction machines. However, impacts

can be reduced by minimizing the felling forest area and sound generation, and tree planting after the construction.

(b) Aquatic Animals

Aquatic animals that inhabit the reservoir area are trout, carp and crabs, etc. However, there is no rare aquatic animal species conserved in the reservoir area.

Aquatic animals might be affected by turbid water generated from construction works and by existence of the reservoir. However, these impacts are able to be reduced by countermeasures such as water treatment of turbid water from construction works.

In addition, creation of new environment for aquatic animals is expected by the existence of the reservoir.

(5) Water Quality

According to results of water quality analysis enforced by DSI June - September, 1988, most of items except chlorine and NO_2 - N (Nitrate - Nitrogen) values satisfy the Class I standard value. Most of Total - Nitrogen value, SS, and a part of COD values exceed limit-concentration, in comparison with limit value as water quality parameter for prevention of the eutrophication.

According to results of aquatic animals' survey to evaluate, the water quality, it was observed aquatic animals prefer living in a relatively clean environment.

Major sources of impact on the water quality during construction are concrete plant, water discharging and excavation from the temporary plants such as spray plant, etc., water discharging from concrete construction. Impacts of discharged water can be reduced by water treatment before discharging.

It is considered that frequency of water exchange in the reservoir after starting operation is very much and there is no remarkable contamination source coming into the flow. Therefore, there are no possibilities for changing water temperature, long turn discharging of turbid water and eutrophication.

As SS is settled by reducing the flow in the reservoir, it is expected that more cleaned water is discharged down stream.

(6) Noise and Air Pollution

Major sound and air pollution sources are construction equipment and trucks for transporting materials; but for enforcement of construction, these impacts can be reduced by using equipment of low noise type, avoidance of concentrated construction and speed limitation of mobile driving in the areas close to dwellings.

As there is little equipment generating sound and there is no equipment causing air pollution after starting operation, no impact is expected.

13.5.3 Social Environmental Conditions

(1) Industrial Activities

(a) Agriculture

Small scale agriculture is carried out in the reservoir area and surroundings, and there grains and vinicultures are grown. Forest area is used as pasturage and sheep, goats and cattle are breeded there. This produce is for family consumption.

Total area submerged by the reservoir is 43 da, 29 da of which is farm land and 14 da vineyard.

For enforcement of the project, it is desirable to deliberate fully with the persons concerned and to make optimum compensation.

(b) Commerce (Trade)

There are only small commercial activities at the reservoir area, but it is expected that traffic will become busy and commerce will be in full activity during construction and after starting operations.

(c) Industry

Handicrafts particularly rug production is wide-spread around the reservoir area. Each family weaves about 15 - 30 m^2 rugs based on their work force.

It is expected that there is no serious impact on industry around the reservoir area after starting operation.

(2) Transportation and Public Facilities

(a) Main Transportation

New construction road is expected to be made along a river from the powerhouse to dam site, to transport main materials for construction. Recent traffic conditions are the same as mentioned in 13.4.2 "Social Environment". The existing road might be used under enforcement of the construction.

Although the traffic volume is temporarily expected to increase, there is no serious impact on the general traffic, as recent traffic volume is not so high.

(b) Public Facilities

There is no main public facility except a primary school in each village center around the reservoir.

There is no serious impact on public facilities under construction.

(3) Land Use

About 87% of the area around the reservoir is forest, 2% farm land and remaining part rocky and abandoned land. 91% of the land below an elevation of 650 m is forest, about 2% is farm land and remaining areas are river beds and non-utilized lands.

Total area submerged by the reservoir is 43 da, 29 da of which is farm land and 14 da vineyard.

For enforcement of the project, it is desirable to deliberate fully with the persons concerned and to make optimum compensation.

(4) Water Utilization

Water consumption in the surroundings of the reservoir is not in question. There is no expected requirement for water consumption in surrounding areas in the future except the upriver part of the reservoir. There are three mills working with water power located at Kapuzbasi Springs. Two of them are between elevations 640 and 650 m, the other is at a higher elevation. These mills are releasing the water back to the bed after using it.

As shown above, there is no serious impact on recent water utilization for enforcement of the project. New fishing is expected through the existence of the reservoir.

(5) Cultural Assets and Recreational Facilities

Recently, there are no cultural assets or recreational facilities around the reservoir area, as mentioned in 13.4.2 "Social Environmental Conditions". After starting operation, dam site, powerhouse and their surrounding areas are expected to be used for recreational facilities.

13.6 Evaluation Results

This survey is quantitatively performed based on the limited location study and sampled materials.

According to evaluation results, there is no serious impact on natural and social environments, except impact on the people whose farm lands are submerged by the reservoir.

It is necessary to accomplish the project successfully, lest the environment should be affected unexpectedly, and the fundamental living rights of the people concerned be violated by executing the project.

Therefore, impacts on the natural environment during construction have to be reduced. In addition, it is desirable to perform optimum monitoring mainly for the water quality during construction and after starting operations.

CHAPTER 14. ECONOMIC EVALUATION

CHAPTER 14. ECONOMIC EVALUATION

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CHAPTER 14. ECONOMIC EVALUATION

14.1 Economic Evaluation

14.1.1 Methodology

(1) Basic Approach

In general, economic evaluation of a development project is designed to measure its socio-economic impacts on the country as a whole by comparing two cases; the project is implemented and the project is not implemented.

The economic evaluation employs indices such as net present value of the project, benefit/cost ratio and economic internal rate of return which are calculated from benefits and costs of the project by using the Discounted Cash Flow method.

To determine benefits and costs of a project, market prices obtained should be converted to real benefits and costs, since these are generally distorted due to taxes, government subsidies, import control, import duties, public charges, minimum wages, and other government intervention and monopolistic pricing.

The World Bank and other international financing organizations employ international market prices to estimate real project costs and benefits. A method of economic evaluation employed by the World Bank and other international financing organizations may be summarized as shown in Fig. 14-1.

Phase 1: To exclude items to be transferred to national income from market prices

Phase 2: To convert market prices for trade goods, non-trade goods, skilled labor, unskilled labor and other items to real (border) prices

Phase 3: To determine the internal rate of return on the basis of real benefits and costs, and compare it with opportunity cost of capital in the country

Phase 4: To carry out socio-economic evaluation in consideration of national saving and income distribution.

For this project, economic evaluation up to Phase 3 is carried out (See Fig. 14-1).

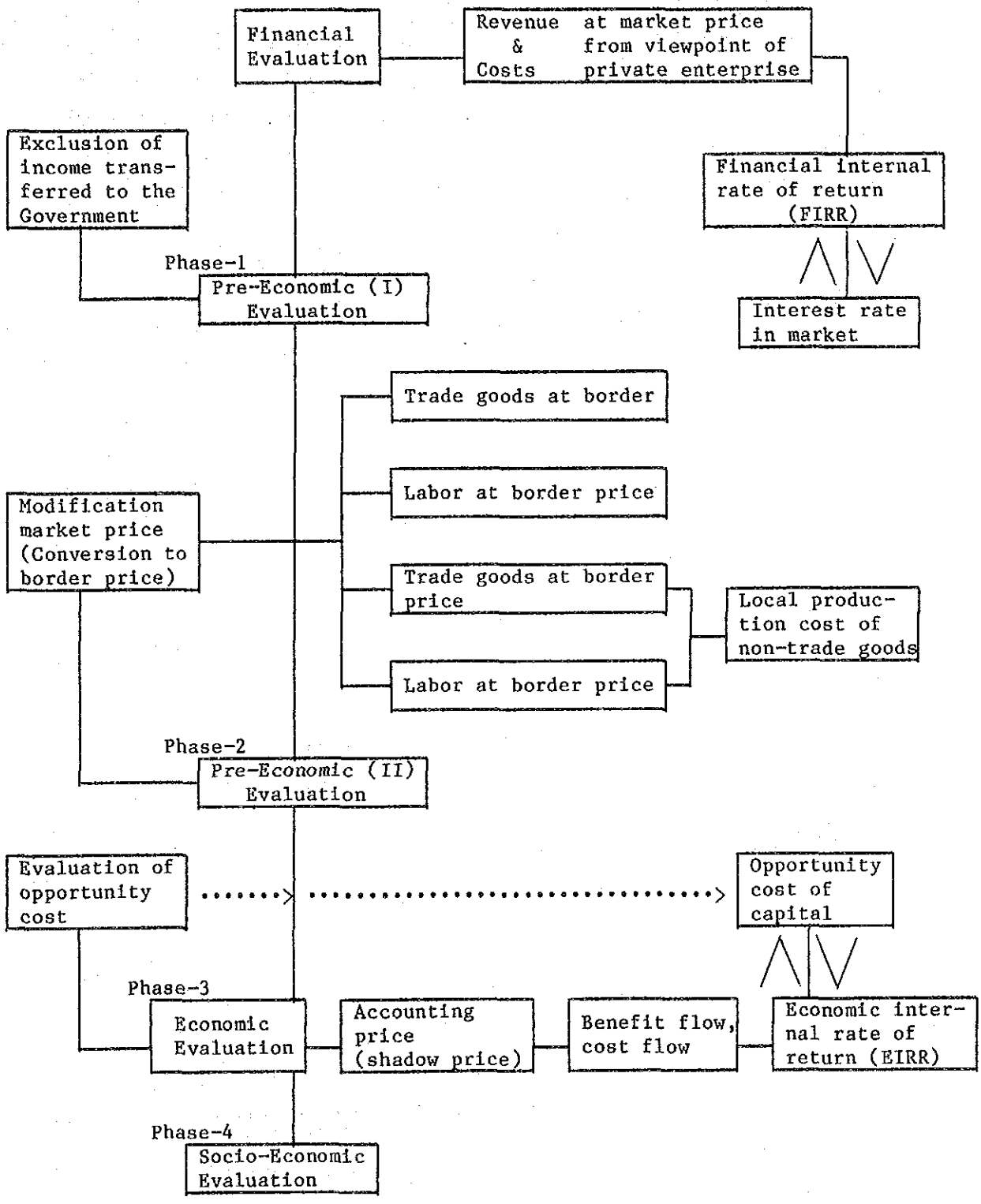
For this project, the alternative plant approach is employed by the following sentence.

If the project is incorporated in a long range electric power development program which is a part of national socio-economic development policy to satisfy future power demand (i.e., if the project is not implemented, it will be substituted for by other means of power supply), an alternative plant approach will be employed to measure and evaluate economic costs of the proposed project and the alternative project.

(2) Conversion Factors to Determine Economic Costs

When project benefits and costs are evaluated at international market prices, goods and services consumed for the project should be converted to border prices. In simple terms, a border price for imported goods is expressed as CIF price at a unloading port and that for exported goods as FOB price at a shipping port. As for non-trade goods, economic prices for each good and service are determined by using its opportunity cost and evaluated by international market prices. However, this process is very difficult to carry out, so that conversion factors are used instead.

Fig. 14-1 Flow Chart of Economic Evaluation of Project



Skilled and unskilled labors obtained locally are converted to border prices by using shadow wage rates. The conversion factors can be calculated in proportion to weighted averages of values of major export and import items, import duties, export subsidies, and import control. The standard conversion factor determined from total values of major export and import items is used as a general indicator to show distortion of domestic prices from international market prices, and the conversion factor based on values of consumption goods exported and imported is called a consumption goods conversion factor.

Conversion factors applied to Turkey are already published on "Staff Working Paper No.392, May 1980" of the World Bank. This parameters were calculated by economic statistical material of 1974 - 1978.

This time, based on the economic statistical material of 1982 - 1986 (Statistical Year Book of Turkey 1987: PMSIS), parameters estimated by JICA Team are as follows.

National Parameters

Parameters	JICA
Standard conversion factor (SCF)	0.70
Conversion factor for consumption goods (CF_C)	0.91
Conversion factor for intermediate goods (CF_I)	0.64
Conversion factor for capital goods (CF_K)	0.63
Marginal product of capital	12 %
Shadow wage rates (SPI)	
Rural sector	0.66
Urban informal sector	0.65
Urban formal sector	0.68

Based on parameter which JICA calculated, conversion factors to determine economic costs of the project are established as follows.

Table 14-1 Conversion Factors to Determine Economic Costs

Currency	Item	Conversion Factor
Domestic	Skilled Labor	0.91
	Unskilled Labor	0.66
	Material Cost (Trade goods)	0.91
	" (Non-trade goods)	0.64
	Transportation Cost	0.70
	Land Cost	0.70
	Project Controlling Cost	0.91
Foreign	Imported Plants (CIF)	1.0
	Expatriate Labor	1.0
	Project Controlling	1.0

(3) Selection of an Alternative Thermal Power Plant

Lignite-fired thermal power is considered to be the primary candidate among thermal power facilities to be developed in the future. Lignite is already used as a major energy source in the country's thermal power generation. Estimated reserves of lignite in the country is approximately 13 billion tons. However, a half of the reserve is low-grade coals (950 - 1,000 kcal/kg) which require relatively large capacity plants for combustion, drying and handling facilities as well as high station service use, therby increasing power generation costs. Although use of lignite offers advantages in saving of foreign currency and incentive to industrial development, after completion of Beysehir and Elbistan B Projects, it is not likely that lignite will continue to play a major role in thermal power generation on an intermediate and long term basis, in consideration of favorable world coal supply.

Therefore, lignite is not considered appropriate for an alternative thermal power plant.

On the other hand, fuel oil used for thermal power generation is all imported. The import accounted for approximately 17% of total

export revenues of the country in 1987 although its share has slightly been decreased in recent years because of drastic drop of price on the international oil market. If the oil price continues to be at present low level, oil fired thermal power can be considered as a main thermal in the electric system in the future. However, international oil market prices are often affected by political as well as economic or military factors, so that the price is not free from the risk of fluctuation and short supply in the mid and long term. This means, stable supply of fuel oil, which is essential to power generation, is not assured in terms of price and quantity. Thus, oil-fired thermal cannot be considered as an appropriate alternative thermal power plant.

Nuclear power may be considered as a major energy source in the future for the country which does not have natural resources other than lignite and hydropower. However, the country does not have nuclear power technology and human resources required for siting, planning, design, construction, operation, maintenance, fuel transport and loading into reactor. As a result, there is much uncertainty to select it as an alternative thermal power plant.

The most appropriate alternative power plant, for the time being, between lignite-fired thermal power and nuclear power appears to be imported coal-fired thermal power. Coals are widely produced around the world. If power stations are sited along the coast, a wide variety of sources of import can be selected to ensure stable supply in terms of quality, quantity and price. Coal-fired thermal power stations recently constructed have considerably upgraded equipment and technology, with efficient operation and maintenance as well as high combustion efficiency being attained by using computer systems. As a result, these plants are capable of handling diversified fuels in the most efficient way and accomplishing reduction of overall power generation costs.

Based on the above reasoning, a thermal power plant using imported coals is selected as an alternative plant in this economic evaluation.

14.1.2 Economic Cost of the Project

The economic cost of the Project is obtained by applying the economic cost conversion factor of Table 14-1 to the financial cost that was obtained in Chapter 12 "Construction Planning and Cost Estimation", according to the method described in 14.1.1. The economic cost of the Project thus obtained is presented below.

The operation and maintenance cost is obtained by applying the following values to the economic construction cost.

Civil facility construction cost	0.5%
Hydraulic equipment cost	1.5%
Electro-Mechanical equipment cost	1.5%
Transmission line and sub-station cost	1.5%

Economic Cost of the Project

As indicated in Table 14-2, the initial investment in the economic cost of this Project is 383,435 x 10^6 TL.

The total cost throughout the project life (615,495 x 10^6 TL) and the flow of economic costs in each year are as presented in Table 14-3.

14.1.3 Parameters and Economic Costs of Alternative Thermal Power Plant

As discussed earlier, an imported coal fired thermal power plant was assumed as the alternative facility with which the economic benefit of this Project is calculated.

In this evaluation method, the economic costs of this alternative thermal power plant are regarded as the benefit to be realized by this Project, and they are compared to the economic costs of this Project.

As most of the output of this Project will be transmitted to the large load centers such as Ankara, the alternative thermal power plant which is taken as the basis of the economic evaluation was assumed to be located at the Yumurtalik site on the coast of the

Mediterranean Sea, which is approximately 40 km to the southeast of Adana, and the output of this thermal power plant was assumed to be transmitted to Adana.

The alternative thermal power plant was assumed to be capable of supplying power at the same service level as this Project (in terms of effective dependable capacity and annual available energy).

In addition, it was assumed that the reference point at which the Project and the alternative thermal power plant are compared was Adana to which the output of the Project is to be supplied, as stated above. The basic criteria used in this evaluation are presented in Table 14-4.

The construction cost of a standard thermal power plant (300 MW x 1 unit) of 355,677 x 10^6 T.L (excluding interest during construction), which was introduced in "Chapter 9, Development Plan", was used as the construction cost of the standard coal fired thermal power plant (300 MW x 1 unit). The construction cost of this standard alternative thermal plant was used as the basis of estimating the construction cost of the alternative thermal power plant having potentials equivalent to this Project. The power generated by this alternative thermal power plant was assumed to be transmitted to Adana sub-station by 154 kV x 2 cct transmission line.

Table 14-2 Economic Costs in Initial Stage for Goktas Project (1/2)

F: Foreign Currency
L: Local Currency
T: Total

(Unit: 10^6 TL)

Item	Year	-1st year	1st year	2nd year	3rd year	4th year	5th year	6th year	Total	Remarks
Civil Works										
Core of River in Dam	F		586	1,575				47	2,208	
	L		842	1,961				62	2,865	
	T		1,428	3,536				109	5,073	
Dam	F			794	6,364	15,164	4,506		26,828	
	L			366	6,760	16,119	4,945		28,190	
	T			1,160	13,124	31,283	9,451		55,018	
Waterway	F		6,176	9,038	8,648	5,901	10,429	4,398	44,590	
	L		9,245	13,241	12,770	9,635	12,140	2,131	59,162	
	T		15,421	22,279	21,418	15,536	22,569	6,529	103,752	
Powerhouse and	F				1,597	532	2,440	574	5,143	
Wsitchyard	L				1,615	858	3,730	944	7,147	
	T				3,212	1,390	6,170	1,518	12,290	
Access Road	F		549						549	
	L		445						445	
	T		994						994	
Camp Facilities	F		1,657						1,657	
	L		4,552						4,552	
	T		6,209						6,209	
Preparation Works	F	8,722	3,649						12,371	
	L	8,076	3,903						11,979	
	T	16,798	7,552						24,350	
Sub-total	F	8,722	12,617	11,407	16,609	21,597	17,375	5,019	93,346	
	L	8,076	18,987	15,568	21,145	26,612	20,815	3,137	114,340	
	T	16,798	31,604	26,975	37,754	48,209	38,190	8,156	207,686	
Cotingency	F	1,308	1,893	1,711	2,491	3,240	2,606	753	14,002	
	L	1,211	2,849	2,336	3,172	3,991	3,122	470	17,151	
	T	2,519	4,742	4,047	5,663	7,231	5,728	1,223	31,153	
Sub-total	F	10,030	14,510	13,118	19,100	24,837	19,981	5,772	107,348	
	L	9,287	21,836	17,904	24,317	30,603	23,937	3,607	131,491	
	T	19,317	36,346	31,022	43,417	55,440	43,918	9,379	238,839	

Table 14-2 Economic Costs in Initial Stage for Goktas Project (2/2)

F: Foreign Currency
L: Local Currency
T: Total

(Unit: 10^6 TL)

Item	Year	-1st year	1st year	2nd year	3rd year	4th year	5th year	6th year	Total	Remarks
Hydraulic Equipment	F					2,425	0	0	2,425	
	L					2,538	4,315	156	7,009	
	T					4,963	4,315	156	9,434	
Electromechanical Equipment	F				3,700	14,650	18,800	19,780	56,930	
	L				0	2,048	2,709	4,375	9,132	
	T				3,700	16,698	21,509	24,155	66,062	
Transmission Line	F					348	1,322	978	2,648	
	L					655	1,191	635	2,481	
	T					1,003	2,513	1,613	5,129	
Sub-station	F						1,079	5,905	6,984	
	L						1,404	1,386	2,790	
	T						2,483	7,291	9,774	
Total (Direct Cost)	F	10,030	14,510	13,118	22,800	42,260	41,182	32,435	176,335	
	L	9,287	21,836	17,904	24,317	35,844	33,556	10,159	152,903	
	T	19,317	36,346	31,022	47,117	78,104	74,738	42,594	329,238	
Project Controling	F	1,504	2,177	1,968	3,420	6,339	6,177	4,865	26,450	
	L	1,741	4,117	3,281	3,854	6,633	6,183	1,763	27,572	
	T	3,245	6,294	5,249	7,274	12,972	12,360	6,628	54,022	
Land Acquisition	F	0	0	0	0	0	0	0	0	
	L	175	0	0	0	0	0	0	175	
	T	175	0	0	0	0	0	0	175	
Total (Project Cost)	F	11,534	16,687	15,086	26,220	48,599	47,359	37,300	202,785	
	L	11,203	25,953	21,185	28,171	42,477	39,739	11,922	180,650	
	T	22,737	42,640	36,271	54,391	91,076	87,098	49,222	383,435	

Table 14-3 Economic Cash Flow of the Project

(Unit: 10^6 TL)

Year	Investment Cost				Operation & Maintenance	Total
	Generating Facility	Transmission Line	Sub-Station	Sub-Total		
-1	22,737			22,737		22,737
1	42,640			42,640		42,640
2	36,271			36,271		36,271
3	54,391			54,391		54,391
4	89,915	1,160		91,075		91,075
5	81,333	2,904	2,862	87,099		87,099
6	38,935	1,878	8,409	49,222		49,222
7					2,550	2,550
8					2,550	2,550
9					2,550	2,550
10					2,550	2,550
26					2,550	2,550
27					2,550	2,550
28					2,550	2,550
29					2,550	2,550
30			2,862	2,862	2,550	5,412
31			8,409	8,409	2,550	10,959
32					2,550	2,550
33					2,550	2,550
34					2,550	2,550
35					2,550	2,550
36					2,550	2,550
37					2,550	2,550
38	4,255			4,255	2,550	6,805
39	25,049	1,160		26,209	2,550	28,759
40	29,985	2,904		32,889	2,550	35,439
41	28,058	1,878		29,936	2,550	32,486
42					2,550	2,550
43					2,550	2,550
44					2,550	2,550
45					2,550	2,550
51					2,550	2,550
52					2,550	2,550
53					2,550	2,550
54					2,550	2,550
55					2,550	2,550
56					2,550	2,550
Total	453,569	11,884	22,542	487,995	127,500	615,495

Table 14-4 Basic Criteria for Economic Study

Item	Description
Method of Analysis	Discounted Cash Flow Method
Study Period	50 Years plus Construction Period
Discount Rate	9.5%
Escalation	Not Considered
Shadow Price Factor (Conversion Factor)	Considered
Service Life of Facility	
Dam & Reservoir	50 Years
Hydro-power Plant	35 Years
Coal-fired Thermal Plant	25 Years
Substation	25 Years
Transmission Line	35 Years
Conversation Rate of Currency (As of July, 1988)	US$1.00 = 1,300 T.L

Parameters and Economic Costs of Alternative Thermal Power Plant for the Project

(a) Plant parameters

The plant parameters of the alternative thermal power plant having potentials equivalent to the Project are presented in Table 14-5.

(b) Initial Investment Cost

The initial investment cost required for construction of the alternative thermal power plant (324.5 MW) was estimated as shown in the following table.

Unit: (10^6 TL)

	1st Year	2nd Year	3rd Year	4th Year	Total
Financial Cost (excluding tax and interest during construction)					
Foreign currency	31,163	32,318	34,626	17,313	115,420
Domestic currency	72,714	75,407	80,793	40,396	269,310
Total	103,877	107,725	115,419	57,709	384,730
Economic Cost					
Foreign currency	25,935	26,896	28,817	14,409	96,057
Domestic currency	72,714	75,407	80,793	40,396	269,310
Total	98,649	102,303	109,610	54,805	365,367

The initial investment on the transmission line for the alternative thermal power plant (154 kV x 2 cct. x 40 km) was estimated as below.

Unit: (10^6 TL)

	1st Year	2nd Year	3rd Year	Total
Financial Cost (excluding tax and interst during construction)				
Foreign currency	480	1,880	120	2,480
Domestic currency	200	800	520	1,520
Total	680	2,680	640	4,000
Economic Cost				
Foreign currency	307	1,431	95	1,833
Domestic currency	200	800	520	1,520
Total	507	2,231	615	3,353

(c) Annual Operation, Maintenance and Repair Cost

Thermal power plant; $365,367 \times 10^6 \times 0.03 = 10,961 \times 10^6$ T.L

Transmission line ; $3,353 \times 10^6 \times 0.015 = 50 \times 10^6$ T.L

Total $11,011 \times 10^6$ TL.

(d) Fuel Cost

Unit Fuel Cost ; 22.181 TL/kWh

Annual Fuel Cost; 22.181 TL/kWh x $1,230.2 \times 10^6$ kWh

$\approx 27,287 \times 10^6$ TL

(e) Economic Cost

The economic cost flow of the alternative thermal power plant, which is the benefit of the Project, is presented in Table 14-6.

Table 14-5 Alternative Thermal Power Plant for Studying Economic Justification (for Stage I)

Item	Unit	Coal-fired Thermal Power Plant	Goktas Hydroelectric Project
Installed Capacity	MW	324.5	270.0
Dependable Capacity	MW	324.5	267.5
Losses	%	21.4	4.6
Effective Dependable Capacity	MW	255.2	255.2
Annual Energy Production	10^6 kWh	1,230.2	1,159.7
Station Service Use	%	5.6% for kW, 6.3% for kWh	1.7% for kWh
Transmission Loss	%	1.4% for kW, 1.1% for kWh	
Annual Available Energy	10^6 kWh	1,140.0	1,140.0
Fuel Consumption Rate (Coal)	kg/kWh	0.353	
" (Oil)	"	0.011	
Unit Fuel Price 1/ (Coal)	TL/kg	58.5	
" (Oil)	"	139.1	
Construction Cost 2/	10^6 TL	384,730	
Unit Construction Cost 2/	TL/kW	1,185,590	
O&M, Administration Cost	10^6 TL/yr.	11,011	
Fuel Cost	10^6 TL/yr.	27,287	

1/ not including taxes
2/ not including interest during construction including project controlling cost

Note:

1. Installed Capacity

$$= \frac{\text{Effective Dependable Capacity}}{(1-\text{Station Service Use})\times(1-\text{Failure Loss})\times(1-\text{Repair Loss})\times(1-\text{Trans. Loss})}$$

$$= \frac{255.2\ \text{MW}}{(1-0.056)\times(1-0.04)\times(1-0.12)\times(1-0.014)} = 324.5\ \text{MW}$$

2. Annual Energy Production

$$= \frac{\text{Annual Available Energy}}{(1-\text{Station Service Use})\times(1-\text{Trans. Loss})} = \frac{1,140}{(1-0.063)\times(1-0.011)}$$

$$= 1,230.2 \times 10^6\ \text{kWh}$$

Table 14-6 Benefit Flow of the Project

(Unit: 10^6 TL)

Year	Alternative Thermal Power Plant				Transmission Line			Total
	Investment Cost	O & M Cost	Fuel Cost	Sub-total	Investment Cost	O & M Cost	Sub-Total	
1								
2								
3	98,649			98,649				98,649
4	102,303			102,303	507		507	102,810
5	109,610			109,610	2,231		2,231	111,841
6	54,805			54,805	615		615	55,420
7		10,961	27,287	38,248		50	50	38,298
8		10,961	27,287	38,248		50	50	38,298
⋮		⋮	⋮	⋮		⋮	⋮	⋮
27								
28	98,649	10,961	27,287	136,897		50	50	136,947
29	102,303	10,961	27,287	140,551		50	50	140,601
30	109,610	10,961	27,287	147,858		50	50	147,908
31	54,805	10,961	27,287	93,053		50	50	93,103
32		10,961	27,287	38,248		50	50	38,298
⋮		⋮	⋮	⋮		⋮	⋮	⋮
39		10,961	27,287	38,248	507	50	557	38,805
40		10,961	27,287	38,248	2,231	50	2,281	40,529
41		10,961	27,287	38,248	615	50	665	38,913
42		10,961	27,287	38,248		50	50	38,298
⋮		⋮	⋮	⋮		⋮	⋮	⋮
53		10,961	27,287	38,248		50	50	38,298
54		10,961	27,287	38,248		50	50	38,298
55		10,961	27,287	38,248		50	50	38,298
56		10,961	27,287	38,248		50	50	38,298
Total	730,734	548,050	1,364,350	2,643,134	6,706	2,500	9,206	2,652,340

14.1.4 Economic Evaluation of the Project

As described in 14.1.1, the economic evaluation of this Project is evaluated by the net present value (NPV), the benefit cost ratio (B/C) and the economic internal rate of return (EIRR) which are calculated by the discounted cash flow method. These indices are obtained by the following methods.

* Net Present Value (NPV) Method

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

where: B_t ; the benefit in the "t"th year.

C_t ; the cost in the "t"th year.

r ; the discount rate.

n ; the period of calculation.

* Benefit-Cost Ratio (B/C) Method

$$B/C = \frac{\sum_{t=0}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=0}^{n} \frac{C_t}{(1+r)^t}}$$

where: B_t ; the benefit in the "t"th year.

C_t ; the cost in the "t"th year.

r ; the discount rate.

n ; the period of calculation.

* Economic Internal Rate of Return (EIRR) Method

$$\sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} = 0$$

where: B_t ; the benefit in the "t"th year.

C_t ; the cost in the "t"th year.

r ; the discount rate (the internal rate of return).

n ; the period of calculation.

The amounts of benefit and cost expressed for each year throughout the project life are called the cash flow. In presenting a cash flow, including the project cost incurred during the construction period, the operation, maintenance and fuel costs after the commencement of operation while capital costs such as interest and depreciation are excluded from the flow. The benefits and costs in the cash flow are expressed by the boarder prices. When the benefit of a hydroelectric project is not expressed by the amount of electric tariff which the consumers are willing to pay, but is expressed in the cost of an alternative thermal power plant, the economic internal rate of return of the hydroelectric project is called the equalized discount rate (EDR) as the hydroelectric project cost and the alternative thermal plant cost (benefit) becomes equal at that discount rate.

Together with the EDR method, the evaluation by the economic internal rate of return was also studied where the benefit of the hydroelectric power was the assumed expected revenue from the electricity sales, rather than the amount the customers are willing to pay as discussed above.

Economic Evaluation of the Project

(a) Net Present Value (B-C) and Benefit-Cost Ratio (B/C)

The flow of economic costs of this project throughout the project life is presented in Table 14-3, and the net present value in the first year of the project is 327,599 x 10^6 TL (C) at a discount rate of 9.5%.

The net present value (B) of an alternative thermal power plant is 555,075 x 10^6 TL.

Consequently, the net present value (B-C) of the Project is 227,476 x 10^6 TL, and the Benefit-Cost Ratio (B/C) is 1.69.

As indicated by these two indices, the cost of construction and operation of this Project is smaller than those of an alternative thermal plant which can provide equivalent service, and it can be concluded that the Project is superior than the alternative plan.

(b) Economic Internal Rate of Return (EDR and EIRR)

The discount rate at which the present values of the investments on this Project and on the alternative thermal power plant becomes equal in the first year of the projects (that is, EDR), is 23.82% as indicated in Table 14-7. Thus it can be concluded that this Project is superior unless the discount rate does not exceed 23.82%. On the other hand, if the expected electricity sales revenue is to be used in estimating the benefit of this Project for calculation of the economic internal rate of return, the amount of revenue is 81,328 x 10^6 TL/year. The value of the economic internal rate of return based on this revenue is 14.38% as indicated in Table 14-8.

This rate exceeds the capital opportunity cost 12% in Turkey. Thus this Project can be regarded to have sufficient economic value for investment.

14.2 Financial Evaluation

14.2.1 Method of Financial Evaluation

In conducting the financial evaluation of this Project, the cash flow at market prices was developed for all costs including the capital invested in this Project, taxes, operation and maintenance costs, replacement costs, Project controlling costs, etc. This cost cash flow was compared to the benefit cash flow that was obtained by the expected income from the sales of electricity generated by this Project, and the financial internal rate of return was calculated by the discounted cash flow method (DCF method).

The discount rate for the DCF method was determined as 9.5% in consultation with DSI.

14.2.2 Financial Cost of the Projects

The amount of initial investment and the replacement cost were obtained from Chapter 12, "Construction Planning and Cost Estimation". The following values were selected as the operation and maintenance cost.

Operation and Maintenance Cost:

Civil facilities construction cost x 0.5%
Hydraulic equipment cost x 1.5%
Electro-Mechanical equipment cost x 1.5%
Transmission line and sub-station cost x 1.5%

Financial Cost of the Project

The total expenditure (the total of cash outflow) of this Project is 715,728 x 10^6 TL as shown in Table 14-9, of which the amount of initial investment is 454,765 x 10^6 TL (excluding interest during construction). The operation and maintenance cost is as follows:

Civil facilities	296,959 x 10^6 x 0.005 =	1,484.8 x 10^6
Hydraulic equipment	13,353 x 10^6 x 0.015 =	200.3 x 10^6
Electrical equipment	68,600 x 10^6 x 0.015 =	1,029.0 x 10^6
Transmission Line and sub-station facilities	16,319 x 10^6 x 0.015 =	244.8 x 10^6
Total:		2,958.9 x 10^6 TL
		(≒ 2,959 x 10^6 TL)

14.2.3 Financial Evaluation of the Project

The financial income of this Project is the electric sales revenue. The revenue was calculated based on TEK's average tariff of 82.4 TL/kWh. (This value was obtained by deducting 5.3% from uniform rate system, 87 TL/kWh, as of August, 1988. This percentage was tentative value, which include consumption tax, value added tax, and substation/distribution costs; 87 (1 + 0.05)(1 + 0.10)(1 - 0.18) = 82.4)

The evaluation was made at the receiving end of Adana Substation. It was assumed that the average annual available energy of this

Project throughout its life is the amount of electricity that can be sold, and the financial income of this project was calculated based on the tariff rate quoted above.

Financial Evaluation of the Project

The average annual available energy of the Project is estimated to be 1,140.04 x 10^6 kWh. Thus the revenue was calculated at the average rate of 82.4 TL/kWh which amounts to 93,939 x 10^6 TL/year. On the other hand, the financial cost of the Project is shown in Table 14-9.

The discount rate at which the financial cost equals the income (that is, the financial internal rate of return) is 14.02%. When this rate is compared to the expected average interest rates of 9.5% for borrowings for both domestic and foreign currencies, it can be concluded that this Project is sound from the financial point of view.

Table 14-7 Estimation of Equalizing Discount Rate (EDR) of the Project

Discount Rate (%)	Benefit - Cost Analysis			
	Cost (C) (10^6 TL)	Benefit (B) (10^6 TL)	B - C (10^6 TL)	B/C
9.5	327,599	555,075	227,476	1.6944
15.0	284,637	367,568	82,931	1.2914
15.5	281,572	366,924	85,352	1.3031
16.0	278,602	346,755	68,153	1.2446
16.5	275,722	337,248	61,526	1.2231
17.0	272,925	328,270	55,345	1.2028
17.5	270,207	319,776	49,569	1.1834
18.0	267,564	311,725	44,161	1.1650
18.5	264,992	304,081	39,089	1.1475
19.0	262,486	296,811	34,325	1.1308
19.5	260,044	289,888	29,844	1.1148
20.0	257,663	283,284	25,621	1.0994
20.5	255,340	276,977	21,637	1.0847
21.0	253,073	270,944	17,871	1.0706
21.5	250,859	265,168	14,309	1.0570
22.0	248,697	259,629	10,932	1.0440
22.5	246,584	254,314	7,730	1.0313
23.0	244,518	249,207	4,689	1.0192
23.5	242,498	244,295	1,797	1.0074
* 23.82	241,214	241,214	0	1.0000
24.0	240,522	239,567	-955	0.9960
24.5	238,589	235,010	-3,579	0.9850
25.0	236,697	230,616	-6,081	0.9743
25.5	234,845	226,374	-8,471	0.9639
26.0	233,031	222,277	-10,754	0.9539
26.5	231,256	218,316	-12,940	0.9440
27.0	229,516	214,484	-15,032	0.9345
27.5	227,812	210,775	-17,037	0.9252
28.0	226,142	207,182	-18,960	0.9162
28.5	224,506	203,699	-20,807	0.9073
29.0	222,902	200,320	-22,582	0.8987
29.5	221,329	197,042	-24,287	0.8903
30.0	219,787	193,859	-25,928	0.8820

Table 14-8 Estimation of Economic Internal Rate of Return (EIRR) of the Project

Discount Rate (%)	Benefit - Cost Analysis			
	Cost (C) (10^6 TL)	Benefit (B) (10^6 TL)	B - C (10^6 TL)	B/C
5.0	392,367	1,163,315	770,948	2.9649
5.5	382,339	1,053,595	671,256	2.7557
6.0	373,290	957,896	584,606	2.5661
6.5	365,071	874,044	508,973	2.3942
7.0	357,560	800,246	442,686	2.2381
7.5	350,655	735,019	384,364	2.0961
8.0	344,271	677,129	332,858	1.9668
8.5	338,338	625,546	287,208	1.8489
9.0	332,797	579,408	246,611	1.7410
9.5	327,599	537,991	210,392	1.6422
10.0	322,702	500,681	177,979	1.5515
10.5	318,071	466,961	148,890	1.4681
11.0	313,676	436,388	122,712	1.3912
11.5	309,492	408,587	99,095	1.3202
12.0	305,498	383,233	77,735	1.2545
12.5	301,674	360,050	58,376	1.1935
13.0	298,006	338,797	40,791	1.1369
13.5	294,479	319,267	24,788	1.0842
14.0	291,082	301,278	10,196	1.0350
* 14.38	288,591	288,591	0	1.0000
14.5	287,804	284,673	-3,131	0.9891
15.0	284,637	269,314	-15,323	0.9462
15.5	281,572	255,080	-26,492	0.9059
16.0	278,602	241,863	-36,739	0.8681
16.5	275,722	229,571	-46,151	0.8326
17.0	272,925	218,119	-54,806	0.7992
17.5	270,207	207,432	-62,775	0.7677
18.0	267,564	197,445	-70,119	0.7379
18.5	264,992	188,099	-76,893	0.7098
19.0	262,486	179,341	-83,145	0.6832
19.5	260,044	171,123	-88,921	0.6581
20.0	257,663	163,402	-94,261	0.6342

Table 14-9 Financial Cash Flow of the Project (without Interest during Construction)

(Unit: 10^6 TL)

Year	Investment Cost				Operation & Maintenance	Total
	Generating Facility	Transmission Line	Sub-Station	Sub-Total		
-1	27,362			27,362		27,362
1	53,174			53,174		53,174
2	44,145			44,145		44,145
3	66,641			66,641		66,641
4	106,958	1,333		108,291		108,291
5	96,155	3,514	2,966	102,635		102,635
6	41,563	1,815	9,139	52,517		52,517
7					2,959	2,959
8					2,959	2,959
9					2,959	2,959
10					2,959	2,959
26					2,959	2,959
27					2,959	2,959
28					2,959	2,959
29					2,959	2,959
30			2,966	2,966	2,959	5,925
31			9,139	9,139	2,959	12,098
32					2,959	2,959
33					2,959	2,959
34					2,959	2,959
35					2,959	2,959
36					2,959	2,959
37					2,959	2,959
38	4,255			4,255	2,959	7,214
39	27,062	1,333		28,395	2,959	31,354
40	33,417	3,514		36,931	2,959	39,890
41	29,512	1,815		31,327	2,959	34,286
42					2,959	2,959
43					2,959	2,959
44					2,959	2,959
45					2,959	2,959
51					2,959	2,959
52					2,959	2,959
53					2,959	2,959
54					2,959	2,959
55					2,959	2,959
56					2,959	2,959
Total	530,244	13,324	24,210	567,778	147,950	715,728

Table 14-10 Estimation of Financial Internal Rate of Return (FIRR) of the Project

Discount Rate (%)	Benefit - Cost Analysis			
	Cost (C) (10^6 TL)	Benefit (B) (10^6 TL)	B - C (10^6 TL)	B/C
5.0	463,790	1,343,703	879,913	2.8972
5.5	452,362	1,216,969	764,607	2.6903
6.0	442,034	1,106,430	664,396	2.5030
6.5	432,639	1,009,576	576,937	2.3335
7.0	424,040	924,335	500,295	2.1798
7.5	416,123	848,994	432,871	2.0402
8.0	408,793	782,127	373,334	1.9133
8.5	401,972	722,546	320,574	1.7975
9.0	395,590	669,254	273,664	1.6918
9.5	389,602	621,414	231,812	1.5950
10.0	383,949	578,319	194,370	1.5062
10.5	378,600	539,369	160,769	1.4246
11.0	373,521	504,056	130,535	1.3495
11.5	368,678	471,944	103,266	1.2801
12.0	364,052	442,659	78,607	1.2159
12.5	359,621	415,881	56,260	1.1564
13.0	355,367	391,332	35,965	1.1012
13.5	351,274	368,773	17,499	1.0498
14.0	347,330	347,995	665	1.0019
* 14.02	347,170	347,170	0	1.0000
14.5	343,522	328,815	-14,707	0.9572
15.0	339,840	311,075	-28,765	0.9154
15.5	336,276	294,633	-41,643	0.8762
16.0	332,822	279,368	-53,454	0.8394
16.5	329,469	265,169	-64,300	0.8048
17.0	326,214	251,941	-74,273	0.7723
17.5	323,049	239,597	-83,452	0.7417
18.0	319,969	228,062	-91,907	0.7128
18.5	316,971	217,267	-99,704	0.6854
19.0	314,051	207,150	-106,901	0.6596
19.5	311,204	197,657	-113,547	0.6351
20.0	308,427	188,739	-119,688	0.6119

14.3 Sensitivity Analysis

The sensitivity analysis was implemented for the following cases considering varying financial conditions that will raise Construction Costs of the Goktas Project 5%, 10%, 15% and 20%.

The evaluation of B-C, B/C were calculated on the basis of a Discount Rate of 9.5%. The Results of each evaluation of B-C, B/C, EDR, EIRR and FIRR are presented in Table 14-11.

Table 14-11 Results of Sensitivity Analysis

Rise of Construction Cost	B - C (10^6 TL)	B/C	EDR (%)	EIRR (%)	FIRR (%)
0%	227,476	1.69	23.82	14.38	14.02
Case 1: 5% UP	211,096	1.61	21.77	13.84	13.50
Case 2: 10% UP	194,716	1.54	19.98	13.35	13.01
Case 3: 15% UP	178,336	1.47	18.43	12.88	12.56
Case 4: 20% UP	161,956	1.41	17.07	12.44	12.13

CHAPTER 15. LOAN REPAYMENT SCHEDULE

CHAPTER 15. LOAN REPAYMENT SCHEDULE

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CHAPTER 15. LOAN REPAYMENT SCHEDULE

15.1 Basic Considerations

In general, construction of an electric power facility requires a large amount of initial investment during the construction period, and the return to that investment starts only after the construction is completed. The time required to recover the investment is much longer than that required for production of durable consumer goods. Accordingly, it is quite usual to obtain loans having low interest rate, long grace period and repayment period.

It can be assumed that a large portion of the fund required for implementation of this Project will be supplied by international financing institutions, and the rest by domestic financing agencies. As the proportions of the foreign and domestic funds can not be predicted at this moment, the JICA Team consulted with DSI to assume the following financing conditions, and the repayment schedule was formulated based on these assumptions.

Interest rate: 9.5% for both foreign and domestic funds, with no considerations for commitment charge.

Terms of repayment: Repayment is deferred during the period of construction of the Projects. Repayment of principal and interest in equal amounts in 20 years.

15.2 Required Amount of Fund

The required amount of fund is estimated based on the prices as of 1988, though this Project is scheduled to be connected to the power grid in 2001. Thus the escalation of the prices upto and including the construction period must be taken into account as additional cost, however, price escalation in Turkey in the recent years is rather abnormal compared to those in other major countries, and it is difficult for the JICA Team to make any projection of the price escalation in the future. For this reason, the loan repayment schedule was formulated based on the amount of fund requirement estimated at 1988 prices.

Goktas Project (including the construction cost of the transmission line from the project site to Yedigoze Substation)

Domestic currency:	$329,458 \times 10^6$ TL
Foreign currency :	$253,857 \times 10^6$ TL
Total:	$583,315 \times 10^6$ TL

15.3 Income and Cost

The return on investment is the income from electricity sale. It is assumed that the electric power generated by this Project will be supplied to demand area through Adana Substation. The present tariff system of TEK consists of two types of contracts and the customer has freedom of selecting one of them: The two stage tariff consisting of a fixed charge and energy charge and the uniform rate contract. The tariff rates differ from one supply area to another.

As it was difficult to find out the average tariff rate as of 1988 for the whole TEK power system, the uniform rate of TEK as of August 1988, which is 82.4 TL/kWh (Refer 14.2.3) was used as the basis of revenue calculation.

The annual operation and maintenance cost of the facilities of this Project was assumed as below.

Civil facility construction cost	x 0.5%
Hydraulic equipment cost	x 1.5%
Electro-Mechanical equipment cost	x 1.5%
Transmission facility cost	x 1.5%
Sub-station facility cost	x 1.5%

The depreciations are calculated by the straight line method with zero residual values and the facility lives assumed as below.

Civil facilities;	50 years
Hydraulic equipment;	35 years
Electro-Mechanical equipment;	35 years
Transmission facilities;	35 years
Sub-station facilities;	25 years

15.4 Loan Repayment Schedule

The source of funds for loan repayment is to be the operating income (the electricity sales revenue minus operation and maintenance cost, depreciation, interest, etc.) and the reserve for depreciation.

The yearly projections of the income statements of this Project are presented in Table 15-2.

The yearly projections of loan repayment schedule (cash flow statement) are presented in Tables 15-1 and 15-3 for the Project.

As indicated in the tables, the capital costs are recovered from revenues in the 4 years after the commencement of operation, and thereafter revenues exceed capital costs producing profits. Thus it is judged that the capital investment on this Project can be safely recovered.

Table 15-1 Funds Procurement and Repayment Schedule of the Project

(Unit: 10^6 TL)

No.	Year	Fund Procurement			Repayment Schedule								Remarks
					Foreign Currency				Local Currency				
		Foreign	Local	Total	Interest	Principal	Total	Balance	Interest	Principal	Total	Balance	
-1	1995	11,534	15,828	27,362	(548)				(752)				Repayment Condition
1	1996	16,687	36,487	53,174	(1,889)				(3,237)				FC and LC Interest
2	1997	15,086	29,059	44,145	(3,398)				(6,350)				rate = 9.5% annum
3	1998	26,220	40,421	66,641	(5,359)				(9,651)				Grace Period
4	1999	48,599	59,692	108,291	(8,913)				(14,406)				= 6 year
5	2000	47,359	55,276	102,635	(13,472)				(19,867)				
6	2001	37,300	15,217	52,517	(17,493)			202,785	(23,215)			251,980	Repayment Method
7	2002				19,265	3,747	23,011	199,038	23,938	4,656	28,594	247,324	20 years with
8	2003				18,909	4,103	23,011	194,935	23,496	5,098	28,594	242,226	principal and
9	2004				18,519	4,493	23,011	190,443	23,011	5,582	28,594	236,644	interest in equal
10	2005				18,092	4,919	23,011	185,524	22,481	6,113	28,594	230,531	installment
11	2006				17,625	5,387	23,011	180,137	21,900	6,693	28,594	223,838	Capital recovery
12	2007				17,113	5,898	23,011	174,239	21,265	7,329	28,594	216,508	factor = 0.113476
13	2008				16,553	6,459	23,011	167,780	20,568	8,026	28,594	208,483	
14	2009				15,939	7,072	23,011	160,708	19,806	8,788	28,594	199,695	Note:
15	2010				15,267	7,744	23,011	152,964	18,971	9,623	28,594	190,072	
16	2011				14,532	8,480	23,011	144,484	18,057	10,537	28,594	179,535	Figures in parenthe-
17	2012				13,726	9,285	23,011	135,198	17,056	11,538	28,594	167,997	ses are interest
18	2013				12,844	10,168	23,011	125,031	15,960	12,634	28,594	155,363	during construction
19	2014				11,878	11,133	23,011	113,897	14,759	13,834	28,594	141,529	
20	2015				10,820	12,191	23,011	101,706	13,445	15,149	28,594	126,380	
21	2016				9,662	13,349	23,011	88,357	12,006	16,588	28,594	109,792	
22	2017				8,394	14,617	23,011	73,740	10,430	18,164	28,594	91,628	
23	2018				7,005	16,006	23,011	57,733	8,705	19,889	28,594	71,739	
24	2019				5,485	17,527	23,011	40,207	6,815	21,779	28,594	49,961	
25	2020				3,820	19,192	23,011	21,015	4,746	23,848	28,594	26,113	
26	2021				1,996	21,015	23,011	0	2,481	26,113	28,594	0	
Total		202,785	251,980	454,765	257,442	202,785	460,227		319,897	251,980	571,877		

Table 15-2 Income Statement of the Project

(Unit: 10^6 TL)

No.	Year	Operating Revenue (A)	Operating Expenses			Operating Income (A)-(B)=(C)	Financial Expenses			Note Income (C)-(D)=(E)	Remarks
			OM	Depreci-ation	Total (B)		FC	LC	Total (D)		
-1	1995						(548)	(752)	(1,300)		Operating Revenue:
1	1996						(1,889)	(3,237)	(5,126)		
2	1997						(3,398)	(6,350)	(9,748)		Energy Sold: 1,140.04 x 10^6 kWh
3	1998						(5,359)	(9,651)	(15,010)		Unit Price : 82.4 TL/kWh
4	1999						(8,913)	(14,406)	(23,319)		Total : 93,939 x 10^6 TL
5	2000						(13,472)	(19,867)	(33,339)		
6	2001						(17,493)	(23,215)	(40,708)		OM: Operation and Maintenance
7	2002	93,939	2,959	10,202	13,161	80,778	19,265	23,938	43,203	37,575	2,959 x 10^6 TL
8	2003	93,939	2,959	10,202	13,161	80,778	18,909	23,496	42,404	38,374	
9	2004	93,939	2,959	10,202	13,161	80,778	18,519	23,011	41,530	39,248	Depreciation : 10,202 x 10^6 TL
10	2005	93,939	2,959	10,202	13,161	80,778	18,092	22,481	40,573	40,205	
11	2006	93,939	2,959	10,202	13,161	80,778	17,625	21,900	39,525	41,253	
12	2007	93,939	2,959	10,202	13,161	80,778	17,113	21,265	38,378	42,400	Note: Figures in parentheses are interest during Construction period.
13	2008	93,939	2,959	10,202	13,161	80,778	16,553	20,568	37,121	43,657	
14	2009	93,939	2,959	10,202	13,161	80,778	15,939	19,806	35,745	45,033	
15	2010	93,939	2,959	10,202	13,161	80,778	15,267	18,971	34,238	46,540	
16	2011	93,939	2,959	10,202	13,161	80,778	14,532	18,057	32,588	48,190	
17	2012	93,939	2,959	10,202	13,161	80,778	13,726	17,056	30,782	49,996	
18	2013	93,939	2,959	10,202	13,161	80,778	12,844	15,960	28,804	51,974	
19	2014	93,939	2,959	10,202	13,161	80,778	11,878	14,759	26,637	54,141	
20	2015	93,939	2,959	10,202	13,161	80,778	10,820	13,445	24,265	56,513	
21	2016	93,939	2,959	10,202	13,161	80,778	9,662	12,006	21,668	59,110	
22	2017	93,939	2,959	10,202	13,161	80,778	8,394	10,430	18,824	61,954	
23	2018	93,939	2,959	10,202	13,161	80,778	7,005	8,705	15,710	65,068	
24	2019	93,939	2,959	10,202	13,161	80,778	5,485	6,815	12,300	68,478	
25	2020	93,939	2,959	10,202	13,161	80,778	3,820	4,746	8,566	72,212	
26	2021	93,939	2,959	10,202	13,161	80,778	1,996	2,481	4,477	76,301	
Total		1,878,780	59,180	204,040	263,220	1,615,560	257,442	319,897	577,340	1,038,220	

Table 15-3 Cash Flow Statement of the Project

(Unit: 10^6 TL)

No.	Year	Cash Inflow				Cash Outflow						Balance		Remarks
						Repayment of Principal								
		Fund Procurement	Net Income	Depreciation	Total	Construction	F.C	L.C	Sub Total	I.D.C	Total	Yearly	Accumulation	
-1	1995	27,362			27,362	27,362				1,300	28,662	-1,300	-1,300	
1	1996	53,174			53,174	53,174				5,126	58,300	-5,126	-6,426	
2	1997	44,145			44,145	44,145				9,748	53,893	-9,748	-16,174	
3	1998	66,641			66,641	66,641				15,010	81,651	-15,010	-31,184	
4	1999	108,291			108,291	108,291				23,319	131,610	-23,319	-54,503	
5	2000	102,635			102,635	102,635				33,339	135,974	-33,339	-87,842	
6	2001	52,517			52,517	52,517				40,708	93,225	-40,708	-128,550	
7	2002		37,575	10,202	47,777		3,747	4,656	8,403		8,403	39,375	-89,175	
8	2003		38,374	10,202	48,576		4,103	5,098	9,201		9,201	39,375	-49,800	
9	2004		39,248	10,202	49,450		4,493	5,582	10,075		10,075	39,375	-10,426	
10	2005		40,205	10,202	50,407		4,919	6,113	11,032		11,032	39,375	28,949	
11	2006		41,253	10,202	51,455		5,387	6,693	12,080		12,080	39,375	68,324	
12	2007		42,400	10,202	52,602		5,898	7,329	13,228		13,228	39,375	107,699	
13	2008		43,657	10,202	53,859		6,459	8,026	14,484		14,484	39,375	147,073	
14	2009		45,033	10,202	55,235		7,072	8,788	15,860		15,860	39,375	186,448	
15	2010		46,540	10,202	56,742		7,744	9,623	17,367		17,367	39,375	225,823	
16	2011		48,190	10,202	58,392		8,480	10,537	19,017		19,017	39,375	265,198	
17	2012		49,996	10,202	60,198		9,285	11,538	20,823		20,823	39,375	304,572	
18	2013		51,974	10,202	62,176		10,168	12,634	22,802		22,802	39,375	343,947	
19	2014		54,141	10,202	64,343		11,133	13,834	24,968		24,968	39,375	383,322	
20	2015		56,513	10,202	66,715		12,191	15,149	27,340		27,340	39,375	422,697	
21	2016		59,110	10,202	69,312		13,349	16,588	29,937		29,937	39,375	462,072	
22	2017		61,954	10,202	72,156		14,617	18,164	32,781		32,781	39,375	501,446	
23	2018		65,068	10,202	75,270		16,006	19,889	35,895		35,895	39,375	540,821	
24	2019		68,478	10,202	78,680		17,527	21,779	39,305		39,305	39,375	580,196	
25	2020		72,212	10,202	82,414		19,192	23,848	43,039		43,039	39,375	619,571	
26	2021		76,301	10,202	86,503		21,015	26,113	47,128		47,128	39,375	658,945	
Total		454,765	1,038,220	204,040	1,697,025	454,765	202,785	251,980	454,765	128,550	1,038,080	658,945	658,945	

CHAPTER 16. FURTHER INVESTIGATIONS

CHAPTER 16. FURTHER INVESTIGATIONS

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CHAPTER 16. FURTHER INVESTIGATIONS

It is considered that investigations listed below will be required as a minimum at the sites of the principal structures of this Project in order for detailed design to be carried out hereafter.

16.1 Topographic Surveying

- o Dam site : Supplementary surveying for existing topographic maps (1/1,000)
- o Dam to powerhouse : Provision of triangulation control points site and entering of the points in existing 1/5,000 and 1/1,000 topographic maps (including Kup and Daricukuru sites)
- o Dam to projected Kavsak Dam site : Rechecking of levelling

16.2 Geological Investigations

- o Upstreammost part of reservoir : Drilling investigations for grasp of rock character and permeability of limestone comprising upstreammost part of reservoir and of groundwater table. Also continuous measurement of groundwater table using drillholes.

  Number of drillholes

Zamanti R., left bank	3 holes
Zamanti R., right bank	1 hole

- o Dam site : Drilling investigations and adit explorations for more detailed grasp of rock character of peridotite comprising dam site, degree and continuity of serpentinization, permeability as dam basement.

Number of drillholes

Zamanti R., left bank	2 holes
Zamanti R., right bank	1 hole

Number of adits

Dam, left bank	1 adit
Dam, right bank	2 adits

- o Headrace tunnel route : Drilling investigations for grasp of geological properties and the thickness of the Devonian (D) at the headrace tunnel route.

  Number of drillholes 2 holes

- o Surge tank, penstock and Powerhouse sites: Drilling investigations for grasp of geological properties of sandstone and shale strata assumed to be distributed in the vicinity of the surge tank, and to confirm the thickness of alluvium in the Zamanti River bed at the powerhouse outlet from among the three sites.

  Number of drillholes

Surge tank vicinity	1 hole
River bed vicinity	3 holes

The locations of drillholes and adits are shown in Fig. 16-1.

16.3 Materials Investigations

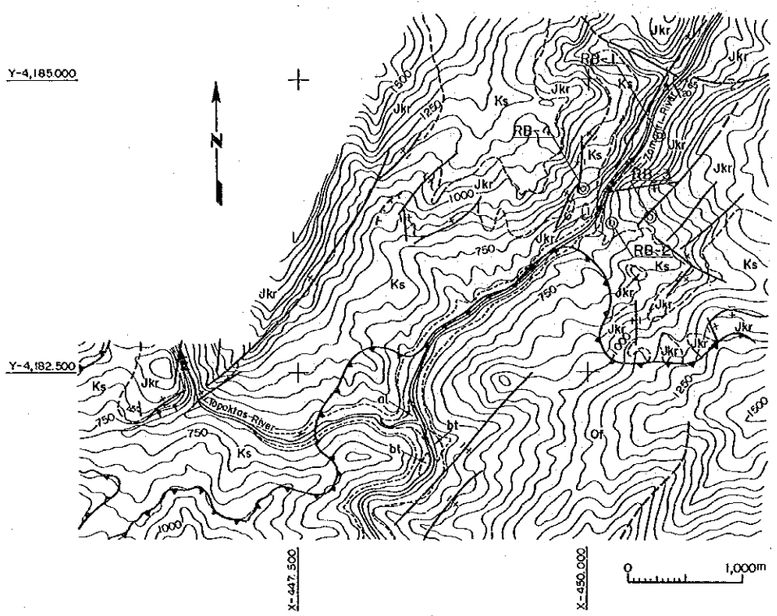
It is thought necessary for the following investigations to be made on rock at the KAYA-1 site considered a promising candidate for quarrying concrete aggregates.

- o Crushing tests
- o Mix-proportioning of dam concrete using the crushed stone

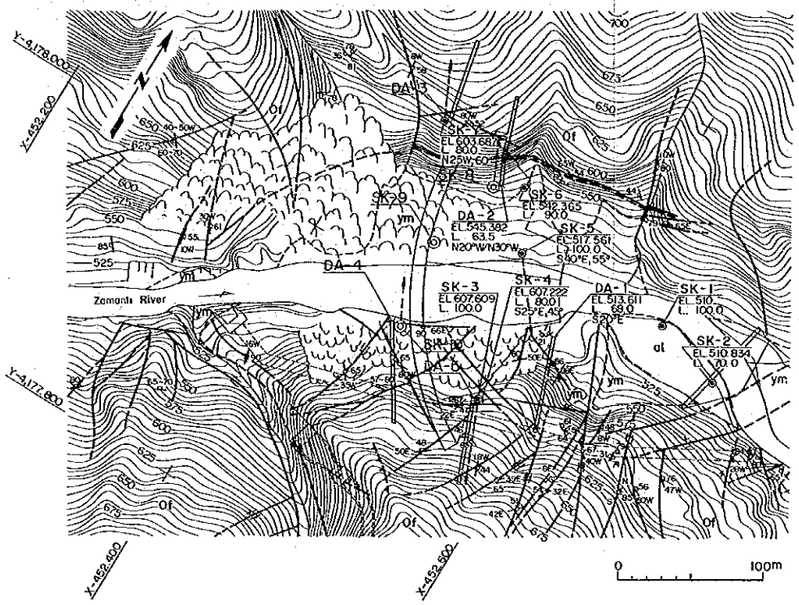
16.4 Water Level, Runoff Observations

- o Dam site : Continuation of runoff gauging
- o Powerhouse site : Water level observations

RESERVOIR AREA



DAM SITE



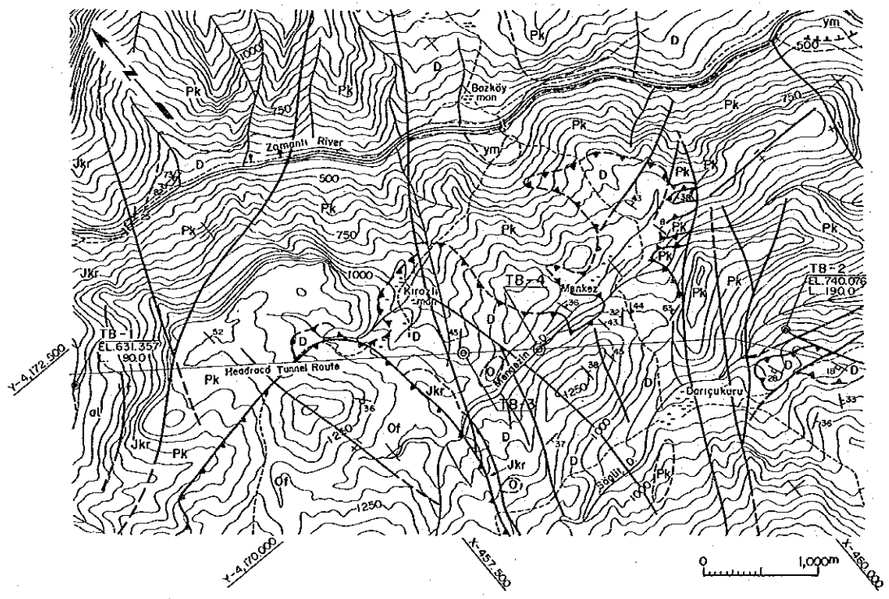
LEGEND

- ◎ Proposed drillhole
- ⟼ Proposed adit

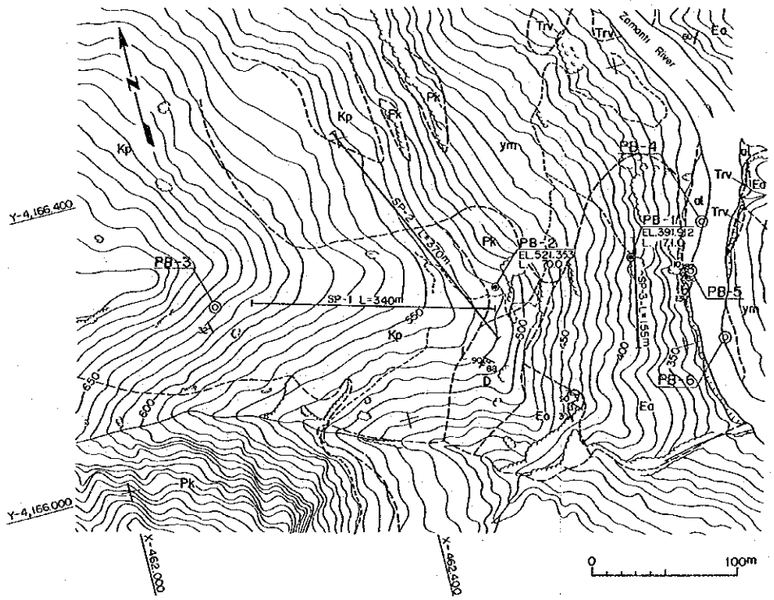
LIST OF DRILLHOLES AND ADITS (PROPOSED)

		Coordinate	Elevation (m)	Length (m)	Direction
Drillhole	RB-1	X: 450.600 Y: 4,184.525	690	190	Vertical
	RB-2	X: 450.200 Y: 4,183.770	710	210	"
	RB-3	X: 450.520 Y: 4,183.820	800	300	"
	RB-4	X: 449.955 Y: 4,184.080	800	250	"
	SK-8	X: 452.492 Y: 4,178.087	550	70	N25°W60°
	SK-9	X: 452.475 Y: 4,178.033	525	80	Vertical
	SK-10	X: 452.485 Y: 4,177.971	515	80	N30°W65°
	TB-3	X: 458.540 Y: 4,170.260	1040	200~500	Vertical
	TB-4	X: 459.060 Y: 4,169.880	1000	200~450	"
	PB-3	X: 462.170 Y: 4,166.215	635	90	"
	PB-4	X: 462.863 Y: 4,166.160	330	30	"
	PB-5	X: 462.832 Y: 4,166.100	330	30	"
	PB-6	X: 462.857 Y: 4,165.998	320	30	"
Adit	DA-3	X: 452.443 Y: 4,178.108	645	60	N10°W
	DA-4	X: 452.485 Y: 4,177.971	515	70	N30°W
	DA-5	X: 452.556 Y: 4,177.954	605	60	S25°E

HEADRACE TUNNEL ROUTE



SURGE TANK, PENSTOCK AND POWERHOUSE SITES



ZAMANTI GÖKTAŞ HYDROELECTRIC POWER DEVELOPMENT PROJECT

LOCATION MAP OF PROPOSED INVESTIGATION WORKS

Fig. 16-1