Table 13-3 Water Utilization Purposes in Each Water Quality Class

Class I (Clean Water)	a) Drinking water used after sterilization only b) Recreation (including water required to be touched by human bodies in swimming, etc.) c) Cultivation of trout d) Breeding of animals and farms' demand e) Others
Class II (Slightly-Contaminated Water)	a) Drinking water used after proper purification b) Recreation c) Cultivation of fishes other than trout d) Irrigation water (subject to the water quality standards of irrigation water) e) All kinds of water utilization other than those mentioned in Class I.
Class III (Contaminated Water)	Industrial water used after proper purification except industries which need water of good quality satisfactory for food, fiber, etc.
Class IV (Very-Contaminated Water)	Surface water lower in quality according to water quality parameters explained in Class I, Class II and Class III mentioned above.

Table 13-4 Water Quality Classification of Lakes, Reservoirs, Ponds and Dam Lakes

Parameters		Utilization Purpose	
		Class G II	Class G III
		Preservation and Recreation	Different Uses
pH	(---)	6.5 ~ 8.5	6 ~ 10.5
COD	(mg/ℓ)	3	8
D.O.	(mg/ℓ)	7.5	5
Suspended Solid	(mg/ℓ)	5	15
Total Coliform	(MPN/100mℓ)	1000	1000
T-N	(mg/ℓ)	0.1	1
T-P	(mg/ℓ)	0.005	0.1

13.3.6 Natural Scenery

The project area is located in the neighborhood of a ravine zone, having scenic aspects such as Oltu River with turbid water, flatland stretching along the river, bare mountains with exposed base rock, sporadically-existing small villages, green cultivated land along the river, rows of poplars around lots of cultivated land, meadows with scarce grass, etc. The width of the ravine does not differ at both dams and both reservoirs, but they have similar scenic aspects. The green ravine contrasts distinctly with brown, magnificent and steep mountains, showing a dry plateau as a whole.

13.3.7 Preservation of Nature

No section is designated as a national park in the project area. There is a section located in Erzurum Province, which is designated to have regulations on the fishing period of the year and the length of caught fishes (trout, etc.). But this section is not applicable to the project area. Besides that, there is the Erzurum-Oltu Wild Goat Preservation and Production Region including the Artvin-Yusufeli-Çoruh Valley Hunting Animals Preservation and Production Area whose border runs on National Road No. 060.[6)]

The Project area located on the northern side of the road is included in the above-mentioned regulated area.

13.3.8 Cultural Assets and Recreation

According to question-answer surveying of recreational facilities and sections in the project area, there are hiking courses and campgrounds between mountains in the neighborhood of Olmanağzı Village and Sinnek Forest near Iriağaç Village. Additionally,

there are Tortum Lake and a large water fall at the lower reaches of the lake.

Since these facilities are far away from major cities and do not have enough accommodations, the number of people using them is said to be small.[6]

There are remains at three places (Oglan Castle, Kiz Castle and Düzkon Ruin) in Olur Area and a remain of old church has been confirmed near Taslıköy.

13.3.9 Population

(1) Vicinity of the Project Area

Erzurum Province, where the project area is located, has several districts such as Olur with a population of 19,074 (23 people/km^2), Oltu with a population of 43,397 (31 people/km^2), Tortum with a population of 46,987 (24 people/km^2), Narman with a population of 25,005 (29 people/km^2 and Senkaya with a population of 36,370 (25 people/km^2), according to the population of those districts (population density) as of 1985. Among them, the population of Olur, Narman and Senkaya Districts tends to decrease while the population of Oltu and Tortum Districts tends to increase.[7]

(2) Project Area

As for changes in the population of villages with relatively-many people in the neighborhood of the project area, which were surveyed once every five years from 1955, the population of Çataksu, Taslıköy and Köprübasi Villages tended to increase until 1980, but started decreasing in 1985. The population of Ormanağzi village started decreasing in 1975.[7]

Among villages in the neighborhood of the project area, there are villages located inside Ayvalı Reservoir, such as Tasliköy, Çatger, Asağı, Sefkar, Yenibag, Dokens, etc. The population of these villages is estimated at about 3,000.

There are also villages located inside Olur Reservoir such as Kaledibi, Sağlicak, Keçili, Toklu, etc., and the population of these villages is estimated at about 1,200.[8)]

13.3.10 Industries

(1) Vicinity of the Project Area

According to the results of the national census, the labor population of Erzurum Province is 374,465 as of 1985, and about 70% of them are engaged in agriculture and livestock-farming. As of 1978, the agricultural, forestry and livestock industries, commerce and the mining and manufacturing industries account for 52%, 11% and 9.6% of the total production respectively in the order of productive size. Livestock farming is the main industry in the agricultural, forestry and livestock industries. Fishery accounts for less than 0.1% of the total production, carps are regarded as main target fish and about 112 tons of them are caught a year.[9)] As for the situation of livestock farming in Narman, Olur, Oltu and Senkaya Districts, Sheep, Cattle, Goats, Water Buffaloes, etc., are raised as domestic animals in the order of numerical size, and poultry farming and apiculture are also kept.

Agriculture consists mainly of fruit growing, the main types of fruits are apples, walnuts, grapes, pears, etc., and wheat, barley, peas, beets, etc., are also grown.[9)]

(2) Project Area

According to the question-answer survey made by Oltu Agricultural Office, livestock-farming in Ayvalı Dam Reservoir Area is mainly conducted by pasturage and cattle, sheep, goats, etc. The number of cattle, both sheep and goats, and poultry is 4,300, 840 and 462 respectively in the order of numerical size.

Irrigation agriculture is conducted by growing cucumbers, tomatoes, beans, pepper, pumpkins, watermelons, melons, etc., and tomatoes and cucumbers in large quantity are grown. Peaches, apricots, pears, quinces, apples, mulberries, plums, grapes, etc., are grown, and among these fruits, plums, mulberries, grapes and quinces are grown in large quantity.

Domestic animals, which are similar to the types in Ayvalı Reservoir area, are pastured in Olur Reservoir area. In agriculture, the similar types of fruits are grown in both areas in addition to wheat in small quantity. Wheat farms are seen in areas further upstream from the Olur Reservoir.

Crops and fruits similar to the types of them in both reservoir areas are grown on irrigated land located in the section with a future decrease in the capacity of water between Ayvalı Dam and Olur Dam. Special products are not seen.

As for the method of production of irrigated land, dung and chemical fertilizer are used. In Ormanağzi Village dung of 4 to 5 tones/Da and 100 to 150 kg/Da of phosphatic and ammonium fertilizer are used.[9)]

Agricultural products are consumed in the area, and they are partly sold in Göle District, Kars Province as well.[8)]

There is no factory in the project area.

13.3.11 Land Utilization

(1) Vicinity of the Project Area

As for the situation of land utilization in the five districts in the vicinity of the project area, meadows account for 50% of the entire land, followed by forests and rocky land. In Olur District, meadows, forests and shrubbery zones account for 48%, 20% and 9% of the entire land respectively. Cultivated land and orchards account for 11% of the entire land. 4% of cultivated land and orchards consist of irrigated land.[9)]

(2) Project Area

According to site investigation of the situation of land utilization in the project area, irrigated land is mainly seen in Olur Reservoir area, followed by land satisfactory for meadows. In Ayvali Reservoir area, orchards and irrigated land are mostly seen. Irrigated land is widely distributed especially near Çataksu Village (Table 13-5).

13.3.12 Water Utilization

(1) Industrial Water

According to site investigation and question-answer surveying of the situation of water utilization in Oltu River, water is mainly used for irrigation as well as dynamic force for water mills small in size. Water is used for power generation in Tortum River, a tributary of Oltu River in the lower reaches of the river.

As for water utilization in the project area, water in Oltu River is used for irrigation, and a part of water in marshes in the vicinity of this area is also used. The situation of water utilization in six villages including the section with a future decrease in the capacity of water is as shown in Table 13-6.

According to Table 13-7, the capacity of irrigation water in the five villages mentioned below is 0.07 to 0.12 m^3/s. The period of water irrigation lasts five months from April to September excepting August. To give the example of Yesilbaglar Village, those irrigation facilities are in operation for about 12 hours a day.

Water in Oltu River is used for not only irrigation but also for dynamic force for water mills small in size. According to question-answer surveying in this area, no fishery is conducted in the main course of Oltu River. Water in Tortum River, a tributary of Oltu River is used as power generation through the height of a natural lake.

(2) Life Water

Water in the main course of Oltu River is not used for drinking, water in marshes and springs is used through small water-supply systems, and water in wells is partly used for drinking as well.

Table 13-5 Situation of Land Utilization in Reservoir Areas

(1,000 m^2)

Type of Land Use	Ayvalı Reservoir	Olur Reservoir
Mixed Orchard	1,144.9	89.6
Irrigated Field of First Class	-	771.0
Irrigated Field of Second Class	1,049.6	1,512.4
Irrigated Field of Third Class	-	278.5
Arid Field Second Class	-	189.9
Arid Field Third Class	41.7	-
Grassland	230.7	-
Degenerated Pasture	24.1	1,231.2
Poplar Grove	133.1	86.6
Settlement	79.4	118.8
Total	2,703.5	4,278.0
Grand Total		6,981.5

Table 13-6 Source of Irrigation Water

Village	Source (%)
Tosliköy	Oltu River (50), Springs (50)
Ormanağzı	Oltu River (50), Springs (50)
Yesilbaglar	Oltu River, Olur River (100)
Köprübasi	Oltu River (100)
Coskunlar	Oltu River (100)
Ayvalı	Oltu River (70), Upper Mountain Spring (30)

Table 13-7 Irrigation Capacity

Village	Area to be Irrigated	Irrigation Capacity
Tosliköy	90 ha.	0.120 m^3/s
Ormanağzı	60 ha.	0.110 m^3/s
Yesilbaglar	112 ha.	0.115 m^3/s
Coskunlar	80 ha.	0.100 m^3/s
Ayvalı	60 ha.	0.070 m^3/s

13.3.13 Transportation and Public Facilities

(1) Transportation

As for the main route to the project area, there are the methods of using National Road No. 060 by way of National Road No. 010, which passes through Trabzon on the coast of the Black Sea, and of using National Road No. 060 by way of National Road No. 950 which passes through Erzurum. All roads are paved. National Road No. 060, which passes through the project area, has one lane on each side. All bridges over Oltu River are in concrete construction so that large-sized cars can pass through them. As for the volume of traffic on National Road No. 060, about 50 to 100 vehicles consisting of large-sized cars used for transport, automobiles for residents' riding and everyday use, small-sized tracks, etc., pass through the road a day. There are roads diverging from National Road No. 060, which are connected to the neighbor areas.

There are airports in Erzurum, the capital city of Erzurum Province and Trabzon.

(2) Public Facilities

According to question-answer surveying, there are public facilities in the project area, such as schools, mosques, graveyards, meeting places, post offices. Among them, each one of all the fifteen surveyed villages has at least a school, a mosque and a graveyard, and a meeting place and a post office exist in most villages. Five health centers provide medical service.

13.3.14 Others

(1) Energy

1) Vicinity of the Project Area

Electric power is supplied to about 53% of the villages located in Oltu District. As for other energy sources, wood, domestic animals' dung and coal are mainly used as heat sources. Electric power is supplied to only about 13% of the villages in Olur District.[10)]

2) Project Area

According to question-answer surveying in Tasiliköy Village, Köprübasi Village and Ormanağzı in the neighborhood of the project area, coal and wood are used as main energy sources and wood is obtained from neighbor forests.

(2) Public Health

According to documents for 1981, malaria was reported to have occurred in two villages in Senkaya District in the past.[4)]

As mentioned in the section of Water Utilization, water service is provided from small water-supply systems and wells.

According to question-answer surveying, waste water from everyday life is treated in small underground permeation systems.

13.4 Measures for Environment Conservation and Evaluation of Impact

Table 13-8 shows the relationship between environmental factors and environmentally-affected items, based on the outline of Oltu River Hydraulic Power Plant Development Project and the results of the investigation in the project site, according to the "Guidelines on the General Format of Environmental Assessment" prescribed in the environmental law titled the "Environmental Assessment Law" in the Republic of Turkey for evaluating the impact of the project on the project site and its surrounding environment. The impact of the project on the environment was decided to be evaluated according to the relevance table especially by paying attention to the items (with " ● " in the table) expected to be affected.

13.4.1 Necessary Considerations after the Start of the Commercial Operation of the Power Plants

(1) Meteorological Conditions

One of the environmental factors in affecting meteorological conditions is water vapor from the reservoirs. Since humidity is expected to rise only on the reservoirs, the project does not seem to affect meteorological conditions in a wide area.

(2) Atmosphere

Cars are not expected to emit a lot of pollutant. Since the present air pollution level is low, and pollutant does not seem to stay for a long time owing to the state of topography, the project is not expected to affect the atmosphere much.

(3) Hydrology

A submerged section will appear in each one of the areas upstream from Olur Dam and Ayvalı Dam, together with the completion of the power plants. A water reducing section will also appear between Olur Dam and Olur Power Plant's outlet and between Ayvalı Dam and Ayvalı Power Plant's outlet respectively.

Table 13-8(1) Relevance Matrix(Construction Phase)

Characteristics of Exposed Environment \ Activities for Construction	Excavation and Ground Leveling	Excavation of Hydrosphere	Collection of Aggregate	Waste	Construction Machines	Tree Trimming	Irrigation and Drainage Facilities	Irrigation and Drainage	Used for Construction Construction of Roads	Transport of Materials	Transportation Line Construction	Hazardous Material	Workers	Lodging for Workers	Dust and Exhaust Gas	Fuel Storage	Noise and Vibration
Natural Environment																	
Meteorological Conditions																	
Atmosphere	○		○	○	○	○			○	○					○		
Topography and Geology	○		△	○			○										
Underground Water	○																
Hydrological Conditions		●					○	○									
Water Quality		●						●						○			
Aquatic Organisms		△						△						○			
Animals and Plants	△		△		○	△			○	○	△	○			○		○
Nature Preservations		△	△	△					△		△						
Natural Scenery	△		△	△		△			△		△						
Social Environment																	
Communities: Population	△												●				
Communities: Industry (Agriculture)	△										△						
Communities: Industry (Dairying)	△										△						
Communities: Industry (Forestry)											△						
Communities: Industry (Mining)																	
Communities: Other Industries														○			
Communities: Land Utilization	△															○	
Communities: Cultural Assets and Recreation																	
Communities: Water Utilization		△						○									
Transportation	△									○			○				
Public Facilities	△												△				
Public Health												○	○		○		○

● : Items expected to be environmentally affected

○ : Items which may be environmentally affected
(Their influence on the environment is small enough to be ignored in this case)

△ : Items expected to be environmentally affected during the construction period and after the start of the operation

Table 13-8(2) Relevance Matrix (Operation Phase)

Characteristics of Exposed Environment \ Activities for Installation			Dam Reservoirs	Water Reduction Sections	Facilities	Devices and Equipment	Drainage	Land Transportation	Transmission line	Employees	Lodging for Employees	Noise and Vibration
Natural Environment												
	Meteorological Conditions		○									
	Atmosphere							△				
	Topography and Geology											
	Underground Water											
	Hydrological Conditions		●	●								
	Water Quality		●	●			○				○	
	Aquatic Organisms		●	●			○					
	Animals and Plants		●	●		○		○	○			○
	Nature Preservations		○						○			
	Natural Scenery		●		●				●			
Social Environment												
	Communities	Population	●	●						○		
		Industry (Agriculture)	●	●					○			
		Industry (Dairying)	●	○					○			
		Industry (Forestry)							○			
		Industry (Mining)							○			
		Other Industries									○	
		Land Utilization	●	●								
		Cultural Assets and Recreation										
		Water Utilization	●									
	Transportation		●	○						○		
	Public Facilities		●		○					○		
	Public Health		●									○

● : *Items expected to be environmentally affected*

○ : Items which may be environmentally affected
(Their influence on the environment is small enough to be ignored in this case)

△ : Items expected to be environmentally affected during the construction period and after the start of the operation

(4) Flora and Fauna

1) Vegetation

According to vegetation surveying in the project area, this area is very poor in vegetation except orchards and rows of poplars seen on some mountain summits and on flatland along the river, whose trees have been planted for production activity. There are no prominent groups of plants, and plants regarded as precious are not seen either. The construction of the dams can be considered to have no great environmental impact by giving consideration to the situation of vegetation in the project area and the vertical structure of vegetation in the vicinity of the project area. It is desirable to cut down existing fruit trees and poplars to prevent operational failure in the facilities, water quality deterioration in the lakes and scenic deterioration in carrying out the project.

2) Animals

According to question-answer surveying in the project area, mammals and birds which move in a wide range of areas seem to exist in this area. The appearance of the reservoirs is imagined to decrease the sphere of habitats for animals existing in the project area. But since most animals are considered to inhabit mountains rather than flatland along the river, the project does not seem to have great impact on their habitable environment. Some animals such as rabbits, etc., live on flatland along the river, but they are widely distributed in mountain areas.

The appearance of the reservoirs may cut off animal trails between both sides of the river. Since the sections with a future water capacity decrease will

appear as new animal trials between both sides, their appearance will not greatly affect animals in the project area.

There is a hunting prohibition area on the northern side of National Road Route 060 which passes through the project area. However, since a part of the project area including a new route in replacement of the present National Road Route 060, which is applicable to the hunting prohibition area, is very small, the project does not seem to run counter to the purposes of designating the hunting prohibition area.

Since power generating facilities are installed on the solid foundation, they seem to have no noise and vibration which will have influence on the surroundings.

As for fish in Oltu River in the project site, fish in the carp family are known. The flow rate is expected to decrease in the water reduction sections and then to affect fish to some extent, but there seems to have almost no influence on fish since they can move in a wide range and new reservoirs are expected to appear.

The appearance of the reservoirs will newly provide fish with habitats. There seems to have no influence on trout which are believed to live in the upper reaches of Catakasu River, one of Oltu River's tributaries since they are regarded as land-locked ones according to data on the distribution of trout in the relevant area.

(5) Water Quality

It is characteristic of water quality in Oltu River in the project area that the transparency of water is extremely

low. Among measuring objects, T-P resulted in being extremely high. As for the classification of water quality corresponding to the utilization purposes of water in the river based on the results of water investigation, most measuring objects belong to Class II in comparison with the classes of surface water sources and the water quality standards except T-P while most of them are also applicable to Class G II according to the water quality classification of lakes, reservoirs, ponds and dam lakes.

SS is extremely high, indicating that water is contaminated. As shown in the characteristics of soil in the upper reaches of the river, water contamination seems to be caused by severe soil erosion. As for T-P, there are also some areas with a high outflow of phosphorus in soil (as P_2O_5), especially around Senkaya District in the upper reaches of the river. This phenomenon is considered to be related to phosphorus contained in fertilizer to some extent. Insects indigenous to areas with clean water are seen in Oltu River in the project area, but the number of them existing in this area is small.

As for the evaluation of turbid water, the ratio of fine silt and clay to others contained in SS in Oltu River is high, and they smoothly precipitate in a gentle stream along the river-banks. In qualitatively estimating the contamination of water discharged from the dam reservoirs in consideration of the present situation of precipitation, contaminated water is expected to stay longer in both dam reservoirs than that in the present river, the percentage of suspended solids precipitating toward the bottom of the lakes will certainly become higher, and the present contamination of water will not be maintained in the reservoirs or as discharged water. Water in Ayvalı Dam reservoir downstream from Olur Dam is expected to further become purified, losing its muddiness.

The eutrophication of water in the dam lakes is regarded as one of the issues of water quality. This issue should also be investigated by giving consideration to water utilization purposes.

The purpose of the project is to generate electric power. In addition to this propose, other future purposes such as the creation of recreational zones for tourist resort development regarded as one of the regional development plans, the cultivation of carps, etc., should be considered to tackle the issue of water eutrophication.

To give the example of Tortum Lake in the vicinity of the project area, the estimation of future eutrophication in both dam reservoirs can be mentioned as follows. The amount of plankton in Tortum Lake was very small, showing no indications of red tides. The concentration of T-P in water flowing into Tortum Lake was extremely low at the mouth of Tortum River and in the lake, and T-N and inorganic nitrogen was almost equivalent to the level of them in Oltu River. Water in Tortum Lake is classified as medium eutrophication by estimating it based on T-N and inorganic nitrogen in a general way. Some of the reasons for the amount of plankton being small in Tortum Lake are that the lower T-P is a factor in preventing plankton from increasing, and the amount of organic matter decomposing is small at the lower part of the lake since water has an extremely low temperature below the thermocline. In this regard, water in both Olur and Ayvalı Dam reservoirs can not be expected to result in severe eutrophication since the concentration of inorganic nitrogen lower than that of T-N is expected to become a factor in preventing plankton from increasing in contrast to the case of Tortum Lake, and the amount of plankton is therefore estimated to correspond to the concentration of inorganic nitrogen in Oltu River. However, consideration should be given to artificially-added nitrogen which would flow from Oltu

River itself and the sections with a future water capacity decrease.

Since water quality in Oltu River was investigated only once, it is desirable to investigate the concentration of T-P, PO_4-P, K-N, NO_3-N, NO_2-N, NH_4-N.

Water temperature is regarded as another issue. It is necessary to partly discharge water for irrigation from the lakes into the sections with a future water capacity decrease in tying to achieve heat exchange fully.

(6) Natural Scenery

Natural scenery in the project area is a magnificent mountain spectacle, consisting of a dry plateau, a steep and shaped ravine, villages sporadically existing along the river, pastures and mountains standing behind them.

A part of green areas such as orchards and others will disappear together with the completion of the reservoirs while blue spaces or hydrophytic spaces equivalent to Tortum Lake will be created as new scenic aspects. In addition to Tortum Lake, these new spaces can be used as future tourist sources together with the construction of accommodation facilities in the project area.

(7) Local Communities

The population of residents in Ayvalı Dam reservoir area and Olur Dam reservoir area are estimated at 3,000 and 1,200 respectively. These residents will lose their production and living areas with the construction of the dams and reservoirs, and sufficient measures for compensation should, therefore, be taken.

The industrial structure in the project area consists mainly of self-sufficient livestock farming and irrigation cultivation. Since only a part of pastures will disappear, the execution of the project is expected to have no great impact on livestock farming in the project area. If a necessary capacity of water is supplied to irrigated land from the dam reservoirs, there will be also no great impact on residents in the sections with a future water capacity decrease.

A part of agricultural products are shipped to Göle Subdistrict, Kras Province. The execution of the project is expected to submerge a part of cultivated land, decreasing a part of shipped agricultural products, but there are agricultural products similar to the types of those in the vicinity of the project area and there are no special products. Therefore, the project is expected to have no great impact on the vicinity of the project area. The execution of the project will provide the opportunity of employment to residents in the project area and its vicinity, who have no major industries other than livestock farming and irrigation cultivation.

Since all the confirmed three mines existing in the project area are not applicable to the submerged sections, there will be no impact on them.

Since the two future created reservoirs can be applied to water-area utilization purposes such as fishery, etc., it is necessary to coordinate the reservoirs with a part of the hunting prohibition area, which is located in the project area.

(8) Transportation and Public Facilities

A part of the present National Road No. 060 which runs along Oltu River is applicable to the submerged sections,

and it will become impossible to use the road sufficiently. Therefore, it is necessary to construct roads substituting for National Road No. 060 as well as roads for residents' every day life on the remaining land in the project area. It is also necessary to construct public facilities substituting for the existing ones located inside the submerged sections based on residents' needs.

(9) Public Health

The construction of the reservoirs will create new submerged sections. Malaria, which is generally carried by mediators, is known to have occurred several times in the vicinity of the project area in the past. It is necessary to carefully take countermeasures against the occurrence of mediators or insects which carry this disease in trying to prevent duckweed and plants on the banks of the lakes from growing.

(10) Cultural Assets and Recreation

In the project area, there are three places with historical remains in Olur Reservoir area as well as another place in Ayvalı Reservoir area. Among those remains, Tasliköy Village in Ayvalı Reservoir area has the remains of a church located on the higher ground. The surface of water in Olur Reservoir is expected to reach as high as the basement rock of the castle wall in remains at one of the three places, but will not submerge the remains of the castle wall.

Recreation facilities in the neighborhood of Olmanağzı Village and a forest located in Iriağaç Village will not be submerged either.

13.4.2 Necessary Consideration under the Construction Stage

Alterations in the natural environment can not be avoided because of the construction work regardless of their size. They can be divided into permanent alterations such as topographical and vegetational ones and temporary alterations such as noise and vibration which occur only during the period of the construction work. As for the former, the area of altered places should be minimized as the most fundamental policy and various measures should be taken promptly without leaving the altered place as bared land. As for the latter, it is necessary to select the best construction work methods and the best construction work machines.

Since the survey is feasibility study, the fundamental policy of environmental conservation measures is indicated and the power station's own problems are estimated here based on the past experience in the construction of existing power stations in trying to estimate the impact of the construction work on the environment and to examine its measures.

(1) Natural Conservation

Various sites such as temporary facility sites, aggregate-collecting sites, spoil banks, etc., required for the construction work should be arranged and reduced to the irreducible minimum of necessity as far as possible. It would be possible to use river-bed sediment and muck as concrete aggregate sand dam construction materials to minimize the collection of aggregates from those sites. In addition to measures such as the reinforcement, tree-planting, etc., of the slopes of spoil banks to prevent earth and sand from flowing out of there in the future, the possibility of using earth and sand inside the extrados of the dam for public facility sites, as construction materials, should be considered as well.

(2) Topography

Concrete aggregates and dam-construction materials should be collected from the submerged area of the reservoir as far as possible in place of aggregate-collecting sites to avoid damaging its neighboring natural scenery. Since the project site is located in a very steep area, the reasonable route lines of roads should be selected and slope protection work and drainage work should be conducted sufficiently in trying to construct new roads or improve existing ones.

(3) Vegetation

As mentioned in the paragraph of Natural Conservation, the area of altered land surface in construction should be reduced as far as possible to minimize the impact of the construction work on vegetation.

(4) Animals

Since it is imagined that animals in this region may temporarily evacuate from the vicinity of the project site in the construction of the power station, its artificial impact on the natural environment should be minimized during the period of the construction work and the impact should be removed as a temporary matter in trying to recover the natural environment swiftly after the completion of the power station. The concrete measures are as follows:

1) Prevent noise, vibration and night lighting in construction from affecting the ecology of animals badly.

2) Educate construction-related people on the protection of animals, prohibit them from bringing hunting tools

such as nares, etc., in the construction area and prevent them from catching animals unnecessarily.

3) Restore order inside the construction area and clean it up, remove construction materials and waste matter at the completion of the power station and keep the river in good condition to protect the ecology of animals.

(5) Aquatic Organisms

Since the impact of the construction work on aquatic organisms is caused mainly by water quality deterioration, waste water discharged from the construction work site should be properly managed.

(6) Water Quality

Muddy water from earth excavation, treated-waste water from concrete plants and non-industrial waste water from the site office can be the causes for changes in water quality. Muddy water is expected to occur when earth and sand which are discharged by earth excavation, transport and dumping work in the construction of the dam, the tunnel and roads, make contact with underground water and rainwater and flow into the rivers.

In the construction of the dam, the occurrence of muddy water on a large scale can be avoided in trying to discharge clean water directly into the river downstream form the dam site by letting river water pass through the bypass tunnel to prevent it from flowing into the construction work section before the construction work starts. It is desirable to treat muddy water in the sedimentation pond, which is brought about by underground water and rainwater, and discharge its supernatant water into the river. It is also desirable to discharge water

into the river after muddy water discharged from the construction of the tunnel and aggregate plants, waste water from concrete plants and water used for washing concrete mixer cars, are treated in the sedimentation pond in the same way.

After treating waste water discharged from construction-related people in the sedimentation pond, it will be discharged into the river. It is desirable to treat excrement in the purification facilities. But if it is impossible, waste matter should be prevented from flowing directly into the river by impregnating it in the ground.

(7) Noise

The machines regarded as the sources of noise during the construction period consist of the aggregate plants, concrete plants and construction machines, but since the construction work section is considerably away from houses, the construction work is expected to have almost no impact on residents. Dynamite should be set in the time zone other than early morning and night time.

It can be imagined that wild animals may temporarily evacuate from the construction area, but the construction work is expected to have almost no impact on then in the long run.

(8) Vibration

Dynamite setting is regarded as of the sources of noise during the construction period, but it is expected to have almost no impact in the long in the same way as other sources of noise

(9) Transportation and Public Facilities

1) Transportation

The volume of traffic is expected to increase rapidly after the construction of the power station starts since people, equipment and materials are required to be transported frequently. Traffic safety measures such as the observance of safety speed, etc., should be taken.

2) Public Facilities

A lot of people are expected to be engaged in the construction work in a short period of time. Therefore, public facilities such as hospitals, meeting places, etc., required for workers as well as people related to the construction, who will sometimes come and go, seem necessary to be constructed.

(10) Water System Utilization

Since the power station project site and rivers in its vicinity are not used for fishery, water-borne traffic, etc., its construction work will have no impact on them.

Water of Oltu River is mainly used for irrigation, therefore, construction plan should be considered to such agricultural activities.

(11) Public Health

During the construction work, the maintenance inspection and management of construction machines should be carefully conducted, workers should be educated on safety and they should be appointed as persons in charge of dangerous work such as dynamite setting, etc.

Workers should be sufficiently educated on fires, fire fighting equipment should be prepared and walk-around checks should be made.

Workers should be educated on sanitation ideas facilities for keeping drinking water, food, clothes, houses, clean, etc. Puddles suitable for the breeding of harmful insects should be eliminated to prevent a lot of workers form falling ill at one time.

13.5 Monitoring

As for the present situation of environment and the project's environmental impact assesment, the appearance of the reservoir and the sections with a future water capacity decrease are expected to have the greatest impact on local communities among the impacts on the surrounding environment, which are considered to be the establishment of the power plants.

13.5.1 Considerations after the Start of the Commercial Operation of the Power Plants

(1) Flora and Fauna

Since fishes (types and numbers of fishes) in the reservoirs are useful as indexes to changes in water quality including nutrient salts in the reservoirs and plants (plants at the waterside) becoming homes for harmful insects, attention should be paid to them. The occurrence of harmful insects should be investigated as required.

(2) Water Quality

The construction of the power plants will change the situation of the river. The reservoirs will create vast still-water areas as well as water reducing sections between the dams and the power plants' outlets. Water quality in the reservoirs should be investigated as required to confirm that water quality is not deteriorating.

In addition to the items of investigation, such as the situation of water temperature, turbidity, pH, electric conductivity, dissolved oxygen, nutrient salts, etc., the situation of phyto-plankton should be investigated as required.

13.5.2 Considerations during the Construction Works

(1) Water Quality

The turbidity of water, pH in water, etc., should be investigated at the outlets of temporary sedimentation ponds and at the outlets of tank filters for everyday life's waste water as measures for water pollution control during the construction works. It is necessary to control the quality of waste water discharged from these places by determining the concentration of dissolved ones as the standard.

(2) Noise and Vibration

It is desirable to investigate the situation of noise and vibration at measuring points designated in villages in the vicinity of the project area as required.

13.6 Compensation

(1) Compensation Objects

Compensation targets in the project are largely divided into cultivated land and houses.

(2) Calculation of Appraised Compensation

According to the Report of the EİE (Report on Expropriation Value for Power Stages of Oltu Tributary of ÇORUH RIVER prepared by the Directorate of the Project Division of Dams and HPPs, written up on the bases of the 1991 unit prices), Compensation Costs required for the project, etc. are as follows.

1) Cultivated Land

The appraised compensation for cultivated land should be calculated based on the types of land utilization by giving consideration to the types of agricultural products, their unit prices and the amount of harvest per unit area. The appraised land values per 1,000 m^2 are as shown in Table 13-9.

2) Houses

The appraised compensation for houses was calculated based on the construction costs, according to the methods mentioned in the Republic of Turkey's gazette (1991, Mar. 29th, No. 20829).

(3) Removal Items

The removal items existing in the planned reservoir areas are as shown in Table 13-10.

(4) Area of Land Required to be Obtained

The contents and area of land required to be obtained are as shown in Table 13-11.

(5) Compensation Costs

The compensation costs required for the project are estimated at 85,860,113,000 TL in total, consisting of 34,106,611,000 TL for Ayvali Reservoir and 51,753,502,000 TL for Olur Reservoir.

Table 13-9 Land Value by Type of Land Use

Type of Land Use	Land Value (10^3 TL/1,000 m^2)
Mixed Orchard	11,596,844
Irrigated Field of First Class	11,133,597
Irrigated Field of Second Class	9,072,325
Irrigated Field of Third Class	7,071,792
Arid Field Second Class	2,358,850
Arid Field Third Class	1,581,800
Grassland	2,339,844
Degenerated Pasture	1,000,000

Table 13-10 Removal Items in the Planned Reservoir Areas

Item	Ayvalı Reservoir	Olur Reservoir
House	249	328
Primary School	2	4
Secondary School	1	-
School	1	-
School Lodgings	2	1
Mosque	1	2
Police Station	1	-
Additional Building	-	-

Table 13-11 Area of Land Required to be Obtained

(1,000 m^2)

Type of Land Use	Ayvalı Reservoir	Olur Reservoir
Mixed Orchard	866.6	89.6
Irrigated Field of First Class	-	771.0
Irrigated Field of Second Class	929.3	1,512.4
Irrigated Field of Third Class	-	278.5
Arid Field Second Class	-	189.9
Arid Field Third Class	38.1	-
Grassland	230.7	-
Degenerated Pasture	24.1	1,231.2
Poplar Grove	109.5	86.6
Settlement	52.6	118.8

13.7 Overall Environmental Assessment

The general impact of the development project on the environment was assessed according to the contents of the project and the results of the investigation into nature and social environment in the project site. The results of environmental assessment are as follows:

(1) Natural Environment

The project will create two new reservoirs and two water reduction sections in the project site. As mentioned in the paragraphs of Topography, Geology, Animals, Plants and Water Quality, the natural environment in the region shows flora in dry and barren land. Since top soil is poor, plants and shrubs are mainly seen. As for the distribution of tall trees, only poplar trees which were planted as a windbreak forest are seen mainly in the basin of Oltu River. Tall trees such as beeches and firs existing on the summits of mountains are not distributed in this region. The existence of many kinds of animals such as rabbits and wild goats was reported. But they are not the kinds of animals peculiar to the region. The appearance of the reservoirs will make the distribution area slightly smaller, but the habitats of those animals will not disappear. The project site is located next to the hunting prohibition section, but the area regarded as a part of the section located inside the project site is very small. As for fish, there seems to have no big influence on carp, since the appearance of the reservoirs is expected to provide carp with new habitats and they move in a wide range. Since trout reported to live in the tributaries of the river are regarded as land-locked ones, the project will not get rid of their habitats. Water is turbid in the upper reaches of Oltu River owing to very severe soil erosion, and the rates of SS, COD and P tend to be high, and they are contained in soil in the upper reaches. Since

especially N and P are the main cause of eutrophication, it is necessary to grasp the entire process of the development project in the upper reaches and to take careful measures for drainage during the construction work period and after the completion of the project. The execution of the project seems to have no severe impact on the natural environment.

(2) Social Environment

The main industries consist of irrigation agriculture conducted using water from Oltu River and dairying located in its surrounding mountain areas, and both of them are small in size. The products in this region are partly traded with other areas, but they are basically consumed by residents in the project site. About 3,000 people live in the future site of Oltu Dam Reservoir and about 1,200 people live in the future site of Ayvalı Dam Reservoir. The execution of the project will get rid of their basic social living environment in this region. The appearance of two new dam reservoirs and the conduit tunnels for power generation water will create two new water reduction sections. Therefore, there seems to have a sever influence on the social environment by lack of water for land with irrigation agriculture since water has been obtained from the future water reduction sections. Since historic remains and recreation facilities are not located inside the future sites of the reservoirs or will not be submerged, there does not seem to be in trouble with these matters including mines in the vicinity of the project site. Since the appearance of the reservoirs is expected to create new problems of transportation for residents and transport of goods, the maintenance work of roads used for the dam construction and the security of transportation for residents and of transport channels will become important issues. The most important issue in the project is to take careful measures for future local development, compensation for land owned by residents inside the project site or the

provision of substitute land in harmony with those residents. It is desirable to pay attention to residents in the region by taking various kinds of necessary measures for environmental impact reduction and by employing them actively.

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Chapter 14 ECONOMIC AND FINANCIAL EVALUATION

Chapter 14

ECONOMIC AND FINANCIAL EVALUATION

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Chapter 14 ECONOMIC AND FINANCIAL 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 impact 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 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.

For this project, the alternative plant approach is employed.

If a project is incorporated in a long range electric power development program which is a part of a national socio-economic development policy to satisfy future power demand

(i.e., if the project is not implemented, another means of power supply is to be substituted for it.), an alternative plant approach will be employed to measure and evaluate economic costs of the proposed project and the alternative project.

(2) Conversion Factor 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 an unloading port and that for exported goods as FOB price at a shipping port. As for non-traded 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.

The standard conversion factor determined from total values of major export and import is used as a general indicator to show distortion of domestic prices from international market prices.

In this economic evaluation, a standard conversion factor (SCF) was calculated based on the latest economic data in Turkey. SCF of 0.90 was obtained as follows:

Calculation of Standard Conversion Factor

(unit: 10^6US$, %)

	Import			Export		
	Import Price (C.I.F.) (a)	Import Tax (b)	Tax Rate (b/a)	Export Price (F.O.B.) (c)	Export Subsidy (d)	Subsidy Rate (d/c)
1985	11,343	1,130	9.96	7,598	642	8.07
1986	11,105	1,485	13.37	7,457	651	8.73
1987	14,158	2,077	14.67	10,190	772	7.58
1988	14,335	1,887	13.16	11,662	718	6.16
1989	15,792	2,002	12.68	11,627	532	4.56
Total (Average)	66,733	8,581	12.86	48,534	3,315	6.83

(SCF)

$$\frac{Ia + Ec}{Ia\,(1 + b/a) + Ec\,(1 + d/c)}$$

- 5 year average (1985-1989): 0.906 ≒ <u>0.90</u>

(cf.)

1985	0.916
1986	0.897
1987	0.895
1988	0.909
1989	0.914

(3) Selection of 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, thereby 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 18% of total export revenues of the country as of 1988 thanks to the trend in 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 terms. 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

Oltu project consists of upperstream Olur Project and downstream Ayvalı Project. The economic evaluation was made on the optimum development plan for both projects as a whole. That is, no evaluation was made on the cases of individually optimized development plan for each project.

The economic cost of the Project is obtained by applying the economic cost conversion factor to the financial cost that was obtained in Chapter 12 "Construction Planning and Cost Estimation".

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 cost	1.5%

The initial investment in the economic cost of the Project, and the total cost throughout the project life are as presented in Tables 14-1 (initial investment) and 14-4 (total cost).

The total cost throughout the project life includes initial investment, investment for renovation, operation and maintenance.

	Initial Investment	Total Cost
(1) Olur Project	527,598	848,383
(2) Ayvalı Project	749,434	1,167,603
(3) Oltu Project	1,277,032	2,015,987

Table 14-1 Initial Investment Cost (1)

1. Market Price

(1) Olur Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	24,748	0	0	24,748	0	24,748
2	56,042	0	0	56,042	0	56,042
3	54,994	0	8,690	63,684	0	63,684
4	113,744	485	0	114,228	0	114,228
5	109,068	7,244	0	116,313	3,073	119,386
6	79,997	27,880	78,209	186,085	2,049	188,134
Total	438,592	35,609	86,899	561,100	5,122	566,222

(2) Ayvalı Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	21,682	0	0	21,682	0	21,682
2	58,029	0	0	58,029	0	58,029
3	53,735	0	0	53,735	0	53,735
4	115,523	0	11,099	126,622	0	126,622
5	164,605	6,503	0	171,108	6,755	177,863
6	191,245	9,239	0	200,483	4,503	204.987
7	47,758	13,592	99,894	161,243	0	161,243
Total	652,576	29,333	110,993	792,903	11,259	804,162

(3) Oltu Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	46,430	0	0	46,430	0	46,430
2	114,071	0	0	114,071	0	114,071
3	108,730	0	8,690	117,420	0	117,420
4	229,266	485	11,099	240,850	0	240,850
5	273,673	13,747	0	287,421	9,828	297,249
6	271,241	37,119	78,209	386,569	6,552	393,121
7	47,758	13,592	99,894	161,243	0	161,243
Total	1,091,169	64,943	197,892	1,354,003	16,381	1,370,384

Table 14-1 Initial Investment Cost (2)

2. Economic Price

(1) Olur Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	22,622	0	0	22,622	0	22,622
2	52,611	0	0	52,611	0	52,611
3	51,940	0	8,542	60,482	0	60,482
4	104,629	436	0	105,065	0	105,065
5	102,495	6,520	0	109,015	2,766	111,781
6	75,830	25,092	76,881	177,803	1,844	179,647
Total	410,127	32,048	85,424	527,599	4,610	532,209

(2) Ayvalı Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	19,795	0	0	19,795	0	19,795
2	55,361	0	0	55,361	0	55,361
3	50,953	0	0	50,953	0	50,953
4	109,096	0	10,890	119,986	0	119,986
5	154,992	5,853	0	160,844	6,080	166,924
6	178,960	8,315	0	187,275	4,053	191,328
7	44,981	12,233	98,007	155,220	0	155,220
Total	614,138	26,400	108,897	749,435	10,133	759,567

(3) Oltu Project

(unit: 10^6TL)

Year	Civil	Hydro Eq.	El-Mecha.	Sub-total	T/L	Total
1	42,417	0	0	42,417	0	42,417
2	107,972	0	0	107,972	0	107,972
3	102,893	0	8,542	111,435	0	111,435
4	213,725	436	10,890	225,051	0	225,051
5	257,487	12,373	0	269,859	8,846	278,705
6	254,790	33,407	76,881	365,078	5,897	370,975
7	44,981	12,233	98,007	155,220	0	155,220
Total	1,024,265	58,448	194,320	1,277,033	14,743	1,291,776

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

The output of the Project will be transmitted to the nearest power system of another hydroelectric power station in the same river. Therefore, the alternative thermal power plant which is taken as the basis of the economic evaluation was assumed to be located at a nearest point on the coast of the Black Sea. Transmission line would be a short power line. The construction cost is assumed to be included in that of the alternative thermal project. The basic criteria used in this evaluation are presented in Table 14-2.

Table 14-2 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 (Standard Conversion Factor: 0.90)
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
Conversion Rate of Currency (As of July, 1991)	US$ 1.00=4,300T.L.

(1) Parameters and Economic Costs of Alternative Thermal Power Plant

1) Plant Parameters

The plant parameters of the alternative thermal power plant having potentials equivalent to Oltu Project are presented in Table 14-3.

Table 14-3 Alternative Thermal Power Plant for Studying Economic Justification

Item	Unit	Coal-Fired Thermal Power Plant	Hydro-electric Power Project		
			Olur	Ayvali	Oltu
Installed Capacity	MW	71.6/140.1/211.7	65	125	190
Dependable Capacity	MW	71.6/140.1/211.7	57.8	113.1	170.9
Losses	%	23.0	4.6	4.6	4.6
Effective Dependable Capacity	MW	55.1/107.9/163.0	55.1	107.9	163.0
Annual Energy Production	10^6kWh	256.2/434.3/690.5	241.5	409.5	651.0
Station Service Use	%	5.6 for kW 6.3 for kWh			
Transmission Loss	%	1.4 for kW 1.1 for kWh	1.7 for kWh	1.7 for kWh	1.7 for kWh
Annual Available Energy	10^6kWh	237.4/402.5/639.9	237.4	402.5	639.9
Fuel Consumption Rate (Coal) (Oil)	kg/kWh "	0.353 0.011			
Unit Fuel Price 1/ (Coal) (Oil)	TL/kg "	205.1 552.0			
Construction Cost 2/	10^6TL	431,032/843,402/1,274,434			
Unit Construction Cost 2/	10^6TL/kW	6.02			
O&M, Administration Cost	10^6TL/yr.	12,708/24,915/37,648			
Fuel Cost	10^6TL/yr.	20,105/34,081/54,185			

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

2) Initial Investment Cost

The economic cost required for construction of the alternative thermal power plant was estimated by applying standard conversion Factor of 0.9 to the Local Currency Portion.

(a) Olur Project

(unit: 10^6TL)

	1st Year	2nd Year	3rd Year	4th Year	Total
Foreign Currency	51,112	133,986	129,605	50,382	365,084
Local Currency	9,496	24,038	17,569	8,250	59,353
Total	60,608	158,024	147,173	58,632	424,437

(b) Ayvalı Project

(unit: 10^6TL)

	1st Year	2nd Year	3rd Year	4th Year	Total
Foreign Currency	100,011	262,171	253,598	98,582	714,361
Local Currency	18,582	47,035	34,376	16,143	116,136
Total	118,592	309,206	287,975	114,725	830,498

(c) Oltu Project

(unit: 10^6TL)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Foreign Currency	51,112	233,996	391,776	303,980	98,582	980,864
Local Currency	9,496	42,620	64,604	42,626	16,143	159,347
Total	60,608	276,616	456,379	346,606	114,725	1,254,935

3) Operation and Maintenance Cost (O&M Cost)

O&M cost was obtained by multiplying 3% into the total economic cost of the project.

a) Olur Project : 424,437 x 0.03 = 12,733 x 10^6TL

b) Ayvalı Project: 830,498 x 0.03 = 24,914 x 10^6TL

c) Oltu Project : 1,254,935 x 0.03 = 37,648 x 10^6TL

4) Fuel Cost

Fuel cost was obtained by multiplying coal price (205.1 TL/kg) and oil price (552.0 TL/kg) into the Annual Energy Production.

a) Olur Project

256.2GWh x (0.353kg/kWh x 205.1TL/kg + 0.011kg/kWh
x 552.0TL/kg)
= 256.2 x 78.47
= 20,105 x 10^6TL

b) Ayvalı Project

434.3GWh x (0.353kg/kWh x 205.1TL/kg + 0.011kg/kWh
x 552.0TL/kg)
= 434.3 x 78.47
= 34,081 x 10^6TL

c) Oltu Project

690.5GWh x (0.353kg/kWh x 205.1TL/kg + 0.011kg/kW
x 552.0TL/kg)
= 690.5 x 78.47
= 54,185 x 10^6TL

5) Total Cost during the Project Life

Total cost during the project life is shown in Table 14-4. The total cost includes initial investment, renovation cost after service life, operation and maintenance and fuel cost.

a) Olur Project 2,490,760 x 10^6TL
b) Ayvalı Project 4,610,769 x 10^6TL
c) Oltu Project 7,101,530 x 10^6TL

14.1.4 Economic Evaluation

The results of economic evaluation based on the method mentioned in 14.1.1 are as shown in Table 14-4.

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

Total cost during project life as well as the present value (discount rate: 9.5%) in the first year of the project for hydroelectric and thermal power projects are as shown below.

(unit: 10^6TL)

	Hydropower Project		Alternative Thermal		Difference		%
	Total Cost	Present Value (C)	Total cost	Present Value (B)	Total	(B-C)	(B/C)
Olur Project	848,383	422,090	2,490,760	559,863	1,642,377	137,774	1.33
Ayvalı Project	1,167,603	567,509	4,610,769	968,679	3,443,165	401,170	1.71
Oltu Project	2,015,987	989,598	7,101,530	1,528,542	5,085,543	538,944	1.54

As indicated by these two indices, the cost of construction and operation of the project is smaller than the alternative thermal power plant with the equivalent service, and it can be concluded that the project is economically superior than the alternative project.

(2) Economic Internal Rate of Return

The discount rate at which the present values of the investments on the Project and on the alternative thermal power plant becomes equal in the first year of the projects (that is, EDR), is as indicated in Table 14-4.

- Olur Project 18.72%
- Ayvalı Project 33.05%
- Oltu Project 26.82%

Thus it can be concluded that this Project is superior unless the discount rate does not exceed the EDR.

Table 14-4(1) Economic Evaluation ((B-C), (B/C), EDR)

Olur Project ECONOMIC EVALUATION (Original Case) (unit: Million Tl.)

No.		Year	Olur Hydro Power Project				Alternative Thermal Project				(B) - (C)
			Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	Construct. Cost	O & M Cost	Fuel Cost	(B) Total cost	
1		1999	22,622	0		22,622					-22,622
2		2000	52,611	0		52,611					-52,611
3		2001	60,482	0		60,482	60,608			60,608	126
4		2002	105,065	0		105,065	158,024			158,024	52,959
5		2003	109,015	2,766		111,781	147,173			147,173	35,392
6		2004	177,803	1,844		179,647	58,632			58,632	-121,016
7	1	2005			3,882	3,882		12,733	20,105	32,838	28,956
8	2	2006			3,882	3,882		12,733	20,105	32,838	28,956
9	3	2007			3,882	3,882		12,733	20,105	32,838	28,956
10	4	2008			3,882	3,882		12,733	20,105	32,838	28,956
11	5	2009			3,882	3,882		12,733	20,105	32,838	28,956
12	6	2010			3,882	3,882		12,733	20,105	32,838	28,956
13	7	2011			3,882	3,882		12,733	20,105	32,838	28,956
14	8	2012			3,882	3,882		12,733	20,105	32,838	28,956
15	9	2013			3,882	3,882		12,733	20,105	32,838	28,956
16	10	2014			3,882	3,882		12,733	20,105	32,838	28,956
17	11	2015			3,882	3,882		12,733	20,105	32,838	28,956
18	12	2016			3,882	3,882		12,733	20,105	32,838	28,956
19	13	2017			3,882	3,882		12,733	20,105	32,838	28,956
20	14	2018			3,882	3,882		12,733	20,105	32,838	28,956
21	15	2019			3,882	3,882		12,733	20,105	32,838	28,956
22	16	2020			3,882	3,882		12,733	20,105	32,838	28,956
23	17	2021			3,882	3,882		12,733	20,105	32,838	28,956
24	18	2022			3,882	3,882		12,733	20,105	32,838	28,956
25	19	2023			3,882	3,882		12,733	20,105	32,838	28,956
26	20	2024			3,882	3,882		12,733	20,105	32,838	28,956
27	21	2025			3,882	3,882		12,733	20,105	32,838	28,956
28	22	2026			3,882	3,882	60,608	12,733	20,105	93,446	89,564
29	23	2027			3,882	3,882	158,024	12,733	20,105	190,862	186,980
30	24	2028			3,882	3,882	147,173	12,733	20,105	180,011	176,129
31	25	2029		0	3,882	3,882	58,632	12,733	20,105	91,469	87,588
32	26	2030		0	3,882	3,882		12,733	20,105	32,838	28,956
33	27	2031		0	3,882	3,882		12,733	20,105	32,838	28,956
34	28	2032		0	3,882	3,882		12,733	20,105	32,838	28,956
35	29	2033		2,766	3,882	6,648		12,733	20,105	32,838	26,190
36	30	2034		1,844	3,882	5,726		12,733	20,105	32,838	27,112
37	31	2035			3,882	3,882		12,733	20,105	32,838	28,956
38	32	2036	8,542		3,882	12,424		12,733	20,105	32,838	20,413
39	33	2037	436		3,882	4,318		12,733	20,105	32,838	28,520
40	34	2038	6,520		3,882	10,402		12,733	20,105	32,838	22,436
41	35	2039	101,973		3,882	105,855		12,733	20,105	32,838	-73,017
42	36	2040			3,882	3,882		12,733	20,105	32,838	28,956
43	37	2041			3,882	3,882		12,733	20,105	32,838	28,956
44	38	2042			3,882	3,882		12,733	20,105	32,838	28,956
45	39	2043			3,882	3,882		12,733	20,105	32,838	28,956
46	40	2044			3,882	3,882		12,733	20,105	32,838	28,956
47	41	2045			3,882	3,882		12,733	20,105	32,838	28,956
48	42	2046			3,882	3,882		12,733	20,105	32,838	28,956
49	43	2047			3,882	3,882		12,733	20,105	32,838	28,956
50	44	2048			3,882	3,882		12,733	20,105	32,838	28,956
51	45	2049			3,882	3,882		12,733	20,105	32,838	28,956
52	46	2050			3,882	3,882		12,733	20,105	32,838	28,956
53	47	2051			3,882	3,882		12,733	20,105	32,838	28,956
54	48	2052			3,882	3,882		12,733	20,105	32,838	28,956
55	49	2053			3,882	3,882		12,733	20,105	32,838	28,956
56	50	2054			3,882	3,882		12,733	20,105	32,838	28,956
TOTAL			645,071	9,220	194,093	848,383	848,874	636,656	1,005,230	2,490,760	1,642,377
Present Value i = 9.5 %						422,090				559,863	137,774
										E.D.R.	18.72%
										B/C	1.33

Table 14-4(2) Economic Evaluation ((B-C), (B/C), EDR)

Ayvali Project ECONOMIC EVALUATION (Original Case) (unit: Million TL)

No.		Year	Ayvali Hydro Power Project				Alternative Thermal Project				(B) - (C)
			Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	Construct. Cost	O & M Cost	Fuel Cost	(B) Total cost	
1		1999	19,795	0		19,795					-19,795
2		2000	55,361	0		55,361					-55,361
3		2001	50,953	0		50,953					-50,953
4		2002	119,986	0		119,986	118,592			118,592	-1,394
5		2003	160,844	6,080		166,924	309,206			309,206	142,282
6		2004	187,275	4,053		191,328	287,975			287,975	96,647
7		2005	155,220	0		155,220	114,725			114,725	-40,496
8	1	2006			5,252	5,252		24,915	34,081	58,995	53,743
9	2	2007			5,252	5,252		24,915	34,081	58,995	53,743
10	3	2008			5,252	5,252		24,915	34,081	58,995	53,743
11	4	2009			5,252	5,252		24,915	34,081	58,995	53,743
12	5	2010			5,252	5,252		24,915	34,081	58,995	53,743
13	6	2011			5,252	5,252		24,915	34,081	58,995	53,743
14	7	2012			5,252	5,252		24,915	34,081	58,995	53,743
15	8	2013			5,252	5,252		24,915	34,081	58,995	53,743
16	9	2014			5,252	5,252		24,915	34,081	58,995	53,743
17	10	2015			5,252	5,252		24,915	34,081	58,995	53,743
18	11	2016			5,252	5,252		24,915	34,081	58,995	53,743
19	12	2017			5,252	5,252		24,915	34,081	58,995	53,743
20	13	2018			5,252	5,252		24,915	34,081	58,995	53,743
21	14	2019			5,252	5,252		24,915	34,081	58,995	53,743
22	15	2020			5,252	5,252		24,915	34,081	58,995	53,743
23	16	2021			5,252	5,252		24,915	34,081	58,995	53,743
24	17	2022			5,252	5,252		24,915	34,081	58,995	53,743
25	18	2023			5,252	5,252		24,915	34,081	58,995	53,743
26	19	2024			5,252	5,252		24,915	34,081	58,995	53,743
27	20	2025			5,252	5,252		24,915	34,081	58,995	53,743
28	21	2026			5,252	5,252		24,915	34,081	58,995	53,743
29	22	2027			5,252	5,252	118,592	24,915	34,081	177,588	172,336
30	23	2028			5,252	5,252	309,206	24,915	34,081	368,201	362,949
31	24	2029		0	5,252	5,252	287,975	24,915	34,081	346,970	341,718
32	25	2030		0	5,252	5,252	114,725	24,915	34,081	173,720	168,468
33	26	2031		0	5,252	5,252		24,915	34,081	58,995	53,743
34	27	2032		0	5,252	5,252		24,915	34,081	58,995	53,743
35	28	2033		6,080	5,252	11,332		24,915	34,081	58,995	47,664
36	29	2034		4,053	5,252	9,305		24,915	34,081	58,995	49,690
37	30	2035			5,252	5,252		24,915	34,081	58,995	53,743
38	31	2036	0		5,252	5,252		24,915	34,081	58,995	53,743
39	32	2037	10,890		5,252	16,142		24,915	34,081	58,995	42,854
40	33	2038	5,853		5,252	11,105		24,915	34,081	58,995	47,891
41	34	2039	8,315		5,252	13,567		24,915	34,081	58,995	45,428
42	35	2040	110,240		5,252	115,492		24,915	34,081	58,995	-56,496
43	36	2041			5,252	5,252		24,915	34,081	58,995	53,743
44	37	2042			5,252	5,252		24,915	34,081	58,995	53,743
45	38	2043			5,252	5,252		24,915	34,081	58,995	53,743
46	39	2044			5,252	5,252		24,915	34,081	58,995	53,743
47	40	2045			5,252	5,252		24,915	34,081	58,995	53,743
48	41	2046			5,252	5,252		24,915	34,081	58,995	53,743
49	42	2047			5,252	5,252		24,915	34,081	58,995	53,743
50	43	2048			5,252	5,252		24,915	34,081	58,995	53,743
51	44	2049			5,252	5,252		24,915	34,081	58,995	53,743
52	45	2050			5,252	5,252		24,915	34,081	58,995	53,743
53	46	2051			5,252	5,252		24,915	34,081	58,995	53,743
54	47	2052			5,252	5,252		24,915	34,081	58,995	53,743
55	48	2053			5,252	5,252		24,915	34,081	58,995	53,743
56	49	2054			5,252	5,252		24,915	34,081	58,995	53,743
57	50	2055			5,252	5,252		24,915	34,081	58,995	53,743
TOTAL			884,731	20,265	262,607	1,167,603	1,660,996	1,245,747	1,704,026	4,610,769	3,443,165
Present Value I = 9.5 %						567,509				968,679	401,170
										E.D.R.	33.05%
										B/C	1.71

Table 14-4(3) Economic Evaluation ((B-C), (B/C), EDR)

Oltu Project ECONOMIC EVALUATION (Original Case) (unit: Million TL)

No.	Year	Oltu Hydro Power Project				Alternative Thermal Project				(B) - (C)
		Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	Construct. Cost	O & M Cost	Fuel Cost	(B) Total cost	
1	1999	42,417	0		42,417					-42,417
2	2000	107,972	0		107,972					-107,972
3	2001	111,435	0		111,435	60,608			60,608	-50,827
4	2002	225,051	0		225,051	276,616			276,616	51,565
5	2003	269,859	8,846		278,705	456,379			456,379	177,674
6	2004	365,078	5,897		370,975	346,606			346,606	-24,369
7	2005	155,220	0	3,882	159,102	114,725	12,733	20,105	147,563	-11,540
8	2006			9,134	9,134		37,648	54,185	91,833	82,699
9	2007			9,134	9,134		37,648	54,185	91,833	82,699
10	2008			9,134	9,134		37,648	54,185	91,833	82,699
11	2009			9,134	9,134		37,648	54,185	91,833	82,699
12	2010			9,134	9,134		37,648	54,185	91,833	82,699
13	2011			9,134	9,134		37,648	54,185	91,833	82,699
14	2012			9,134	9,134		37,648	54,185	91,833	82,699
15	2013			9,134	9,134		37,648	54,185	91,833	82,699
16	2014			9,134	9,134		37,648	54,185	91,833	82,699
17	2015			9,134	9,134		37,648	54,185	91,833	82,699
18	2016			9,134	9,134		37,648	54,185	91,833	82,699
19	2017			9,134	9,134		37,648	54,185	91,833	82,699
20	2018			9,134	9,134		37,648	54,185	91,833	82,699
21	2019			9,134	9,134		37,648	54,185	91,833	82,699
22	2020			9,134	9,134		37,648	54,185	91,833	82,699
23	2021			9,134	9,134		37,648	54,185	91,833	82,699
24	2022			9,134	9,134		37,648	54,185	91,833	82,699
25	2023			9,134	9,134		37,648	54,185	91,833	82,699
26	2024			9,134	9,134		37,648	54,185	91,833	82,699
27	2025			9,134	9,134		37,648	54,185	91,833	82,699
28	2026			9,134	9,134	60,608	37,648	54,185	152,441	143,307
29	2027			9,134	9,134	276,616	37,648	54,185	368,449	359,316
30	2028			9,134	9,134	456,379	37,648	54,185	548,212	539,078
31	2029		0	9,134	9,134	346,606	37,648	54,185	438,440	429,306
32	2030		0	9,134	9,134	114,725	37,648	54,185	206,558	197,424
33	2031		0	9,134	9,134		37,648	54,185	91,833	82,699
34	2032		0	9,134	9,134		37,648	54,185	91,833	82,699
35	2033		8,846	9,134	17,980		37,648	54,185	91,833	73,854
36	2034		5,897	9,134	15,031		37,648	54,185	91,833	76,802
37	2035			9,134	9,134		37,648	54,185	91,833	82,699
38	2036	8,542		9,134	17,676		37,648	54,185	91,833	74,157
39	2037	11,326		9,134	20,460		37,648	54,185	91,833	71,373
40	2038	12,373		9,134	21,506		37,648	54,185	91,833	70,327
41	2039	110,288		9,134	119,422		37,648	54,185	91,833	-27,589
42	2040	110,240		9,134	119,374		37,648	54,185	91,833	-27,540
43	2041			9,134	9,134		37,648	54,185	91,833	82,699
44	2042			9,134	9,134		37,648	54,185	91,833	82,699
45	2043			9,134	9,134		37,648	54,185	91,833	82,699
46	2044			9,134	9,134		37,648	54,185	91,833	82,699
47	2045			9,134	9,134		37,648	54,185	91,833	82,699
48	2046			9,134	9,134		37,648	54,185	91,833	82,699
49	2047			9,134	9,134		37,648	54,185	91,833	82,699
50	2048			9,134	9,134		37,648	54,185	91,833	82,699
51	2049			9,134	9,134		37,648	54,185	91,833	82,699
52	2050			9,134	9,134		37,648	54,185	91,833	82,699
53	2051			9,134	9,134		37,648	54,185	91,833	82,699
54	2052			9,134	9,134		37,648	54,185	91,833	82,699
55	2053			9,134	9,134		37,648	54,185	91,833	82,699
56	2054			9,134	9,134		37,648	54,185	91,833	82,699
57	2055			5,252	5,252		24,915	34,081	58,996	53,744
TOTAL		1,529,802	29,485	456,699	2,015,987	2,509,870	1,882,403	2,709,257	7,101,530	5,085,543
Present Value I = 9.5 %					989,598				1,528,542	538,944
									E.D.R.	26.82%
									B / C	1.54

14.2 Financial Evaluation

14.2.1 Methodology

In conducting the financial evaluation of the Project,the cash flow at market prices was developed for all costs including the capital invested in the 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 electrify generated by the 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 EIE.

14.2.2 Financial Cost of the Project

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 cost x 1.5%

The financial costs of the Project are as shown below.

(unit: 10^6TL)

	Initial Investment	O&M Cost
Olur Project	566,222	4,107
Ayvalı Project	804,162	5,537
Oltu Project	1,370,384	9,644

14.2.3 Financial Evaluation

The financial income of the Project is the electricity sales revenue. The revenue was calculated based on TEK's average tariff of 254.2 TL/kWh, (This value was obtained by deducting 18% from uniform rate system, 310.7 TL/kWh, as of July, 1991.) plus Consumption Tax (5%) and VAT (12%):

$$[310 \times (1+0.05) \times (1+0.12) \times (1-0.18) \fallingdotseq 298.9]$$

It was assumed that the average annual available energy of the Project throughout its life is the amount of electricity that can be sold, and the financial income of the project was calculated based on the tariff rate quoted above.

Financial Evaluation

	Annual Available Energy (GWh)	Tariff TL/kWh	Annual Economic Revenue 10^6TL	Taxes	Annual Financial Revenue 10^6TL
(1) Olur Project	237.4	254.2	60,347	1.17	70,606
(2) Ayvalı Project	402.5	254.2	102,315	1.17	119,709
(3) Oltu Project	639.9	254.2	162,662	1.17	190,315

The results of Financial Evaluation are shown Table 14-5. Financial Internal Rate of Return (FIRR) is

(1) Olur Project 9.87%
(2) Ayvalı Project 11.25%
(3) Oltu Project 10.68%

When this rate is compared to the expected average interest rates of 9.5% for borrowing for both domestic and foreign currencies, it can be concluded that the Project is sound from the financial point of view.

Table 14-5(1) Financial Evaluation (FIRR)

Olur Project (FIRR) (unit: Million TL)

No.		Year	Olur Hydro Power Project				Electric Tariff Revenue	
			Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	(B) Benefit	(B)-(C)
1		1999	24,748	0		24,748		-24,748
2		2000	56,042	0		56,042		-56,042
3		2001	63,684	0		63,684		-63,684
4		2002	114,228	0		114,228		-114,228
5		2003	116,313	3,073		119,386		-119,386
6		2004	186,085	2,049		188,134		-188,134
7	1	2005			4,107	4,107	70,606	66,499
8	2	2006			4,107	4,107	70,606	66,499
9	3	2007			4,107	4,107	70,606	66,499
10	4	2008			4,107	4,107	70,606	66,499
11	5	2009			4,107	4,107	70,606	66,499
12	6	2010			4,107	4,107	70,606	66,499
13	7	2011			4,107	4,107	70,606	66,499
14	8	2012			4,107	4,107	70,606	66,499
15	9	2013			4,107	4,107	70,606	66,499
16	10	2014			4,107	4,107	70,606	66,499
17	11	2015			4,107	4,107	70,606	66,499
18	12	2016			4,107	4,107	70,606	66,499
19	13	2017			4,107	4,107	70,606	66,499
20	14	2018			4,107	4,107	70,606	66,499
21	15	2019			4,107	4,107	70,606	66,499
22	16	2020			4,107	4,107	70,606	66,499
23	17	2021			4,107	4,107	70,606	66,499
24	18	2022			4,107	4,107	70,606	66,499
25	19	2023			4,107	4,107	70,606	66,499
26	20	2024			4,107	4,107	70,606	66,499
27	21	2025			4,107	4,107	70,606	66,499
28	22	2026			4,107	4,107	70,606	66,499
29	23	2027			4,107	4,107	70,606	66,499
30	24	2028			4,107	4,107	70,606	66,499
31	25	2029		0	4,107	4,107	70,606	66,499
32	26	2030		0	4,107	4,107	70,606	66,499
33	27	2031		0	4,107	4,107	70,606	66,499
34	28	2032		0	4,107	4,107	70,606	66,499
35	29	2033		3,073	4,107	7,181	70,606	63,425
36	30	2034	0	2,049	4,107	6,156	70,606	64,450
37	31	2035	0		4,107	4,107	70,606	66,499
38	32	2036	8,690		4,107	12,797	70,606	57,809
39	33	2037	485		4,107	4,592	70,606	66,014
40	34	2038	7,244		4,107	11,352	70,606	59,254
41	35	2039	106,089		4,107	110,196	70,606	-39,590
42	36	2040	0		4,107	4,107	70,606	66,499
43	37	2041			4,107	4,107	70,606	66,499
44	38	2042			4,107	4,107	70,606	66,499
45	39	2043			4,107	4,107	70,606	66,499
46	40	2044			4,107	4,107	70,606	66,499
47	41	2045			4,107	4,107	70,606	66,499
48	42	2046			4,107	4,107	70,606	66,499
49	43	2047			4,107	4,107	70,606	66,499
50	44	2048			4,107	4,107	70,606	66,499
51	45	2049			4,107	4,107	70,606	66,499
52	46	2050			4,107	4,107	70,606	66,499
53	47	2051			4,107	4,107	70,606	66,499
54	48	2052			4,107	4,107	70,606	66,499
55	49	2053			4,107	4,107	70,606	66,499
56	50	2054			4,107	4,107	70,606	66,499
T O T A L			683,608	10,244	205,371	899,223	3,530,304	2,631,081
							F. I. R. R.	9.87%

Table 14-5(2) Financial Evaluation (FIRR)

Ayvali Project (FIRR) (unit: Million TL)

No.	Year	Ayvali Hydro Power Project				Electric Tariff Revenue	
		Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	(B) Benefit	(B)-(C)
1	1999	21,682	0		21,682		-21,682
2	2000	58,029	0		58,029		-58,029
3	2001	53,735	0		53,735		-53,735
4	2002	126,622	0		126,622		-126,622
5	2003	171,108	6,755		177,863		-177,863
6	2004	200,483	4,503		204,987		-204,987
7	2005	161,243	0		161,243		-161,243
8	2006			5,537	5,537	119,709	114,172
9	2007			5,537	5,537	119,709	114,172
10	2008			5,537	5,537	119,709	114,172
11	2009			5,537	5,537	119,709	114,172
12	2010			5,537	5,537	119,709	114,172
13	2011			5,537	5,537	119,709	114,172
14	2012			5,537	5,537	119,709	114,172
15	2013			5,537	5,537	119,709	114,172
16	2014			5,537	5,537	119,709	114,172
17	2015			5,537	5,537	119,709	114,172
18	2016			5,537	5,537	119,709	114,172
19	2017			5,537	5,537	119,709	114,172
20	2018			5,537	5,537	119,709	114,172
21	2019			5,537	5,537	119,709	114,172
22	2020			5,537	5,537	119,709	114,172
23	2021			5,537	5,537	119,709	114,172
24	2022			5,537	5,537	119,709	114,172
25	2023			5,537	5,537	119,709	114,172
26	2024			5,537	5,537	119,709	114,172
27	2025			5,537	5,537	119,709	114,172
28	2026			5,537	5,537	119,709	114,172
29	2027			5,537	5,537	119,709	114,172
30	2028			5,537	5,537	119,709	114,172
31	2029		0	5,537	5,537	119,709	114,172
32	2030		0	5,537	5,537	119,709	114,172
33	2031		0	5,537	5,537	119,709	114,172
34	2032		0	5,537	5,537	119,709	114,172
35	2033		6,755	5,537	12,292	119,709	107,417
36	2034		4,503	5,537	10,040	119,709	109,669
37	2035			5,537	5,537	119,709	114,172
38	2036	0		5,537	5,537	119,709	114,172
39	2037	11,099		5,537	16,636	119,709	103,073
40	2038	6,503		5,537	12,039	119,709	107,670
41	2039	9,239		5,537	14,775	119,709	104,934
42	2040	113,486		5,537	119,023	119,709	687
43	2041			5,537	5,537	119,709	114,172
44	2042			5,537	5,537	119,709	114,172
45	2043			5,537	5,537	119,709	114,172
46	2044			5,537	5,537	119,709	114,172
47	2045			5,537	5,537	119,709	114,172
48	2046			5,537	5,537	119,709	114,172
49	2047			5,537	5,537	119,709	114,172
50	2048			5,537	5,537	119,709	114,172
51	2049			5,537	5,537	119,709	114,172
52	2050			5,537	5,537	119,709	114,172
53	2051			5,537	5,537	119,709	114,172
54	2052			5,537	5,537	119,709	114,172
55	2053			5,537	5,537	119,709	114,172
56	2054			5,537	5,537	119,709	114,172
57	2055			5,537	5,537	119,709	114,172
T O T A L		933,230	22,517	276,833	1,232,580	5,985,457	4,752,877
						F. I. R. R.	11.25%

Table 14-5(3) Financial Evaluation (FIRR)

Oltu Project (FIRR) (unit: Million TL)

No.		Year	Oltu Hydro Power Project				Electric Tariff Revenue	
			Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	(B) Benefit	(B)-(C)
1		1999	46,430	0		46,430		-46,430
2		2000	114,071	0		114,071		-114,071
3		2001	117,420	0		117,420		-117,420
4		2002	240,850	0		240,850		-240,850
5		2003	287,421	9,828		297,249		-297,249
6		2004	386,569	6,552		393,121		-393,121
7		2005	161,243	0	4,107	165,351	70,606	-94,745
8	1	2006			9,644	9,644	190,315	180,671
9	2	2007			9,644	9,644	190,315	180,671
10	3	2008			9,644	9,644	190,315	180,671
11	4	2009			9,644	9,644	190,315	180,671
12	5	2010			9,644	9,644	190,315	180,671
13	6	2011			9,644	9,644	190,315	180,671
14	7	2012			9,644	9,644	190,315	180,671
15	8	2013			9,644	9,644	190,315	180,671
16	9	2014			9,644	9,644	190,315	180,671
17	10	2015			9,644	9,644	190,315	180,671
18	11	2016			9,644	9,644	190,315	180,671
19	12	2017			9,644	9,644	190,315	180,671
20	13	2018			9,644	9,644	190,315	180,671
21	14	2019			9,644	9,644	190,315	180,671
22	15	2020			9,644	9,644	190,315	180,671
23	16	2021			9,644	9,644	190,315	180,671
24	17	2022			9,644	9,644	190,315	180,671
25	18	2023			9,644	9,644	190,315	180,671
26	19	2024			9,644	9,644	190,315	180,671
27	20	2025			9,644	9,644	190,315	180,671
28	21	2026			9,644	9,644	190,315	180,671
29	22	2027			9,644	9,644	190,315	180,671
30	23	2028			9,644	9,644	190,315	180,671
31	24	2029		0	9,644	9,644	190,315	180,671
32	25	2030		0	9,644	9,644	190,315	180,671
33	26	2031		0	9,644	9,644	190,315	180,671
34	27	2032		0	9,644	9,644	190,315	180,671
35	28	2033		9,828	9,644	19,472	190,315	170,843
36	29	2034		6,552	9,644	16,196	190,315	174,119
37	30	2035			9,644	9,644	190,315	180,671
38	31	2036	8,690		9,644	18,334	190,315	171,981
39	32	2037	11,584		9,644	21,228	190,315	169,087
40	33	2038	13,747		9,644	23,391	190,315	166,924
41	34	2039	115,328		9,644	124,972	190,315	65,344
42	35	2040	113,486		9,644	123,130	190,315	67,185
43	36	2041			9,644	9,644	190,315	180,671
44	37	2042			9,644	9,644	190,315	180,671
45	38	2043			9,644	9,644	190,315	180,671
46	39	2044			9,644	9,644	190,315	180,671
47	40	2045			9,644	9,644	190,315	180,671
48	41	2046			9,644	9,644	190,315	180,671
49	42	2047			9,644	9,644	190,315	180,671
50	43	2048			9,644	9,644	190,315	180,671
51	44	2049			9,644	9,644	190,315	180,671
52	45	2050			9,644	9,644	190,315	180,671
53	46	2051			9,644	9,644	190,315	180,671
54	47	2052			9,644	9,644	190,315	180,671
55	48	2053			9,644	9,644	190,315	180,671
56	49	2054			9,644	9,644	190,315	180,671
57	50	2055			5,537	5,537	119,709	114,172
T O T A L			1,616,838	32,761	482,204	2,131,803	9,515,761	7,383,958
							P. I. R. R.	10.68%

14.3 Sensitivity Analysis

Sensitivity analysis for "B-C", "B/C", "EDR" and "FIRR" was carried out in case construction cost of the Projects increased. A discount rate of 9.5% was used for calculating "B-C" and "B/C". The results are shown in Table 14-6.

Table 14-6 Results of Sensitivity Analysis

		(B-C)	(B/C)	(EDR)	(FIRR)
(1) Oluru	Original Case	137,774	1.33	18.72	9.87
	5% up	116,669	1.26	16.36	9.41
	10% up	95,565	1.21	14.52	8.98
	15% up	74,460	1.15	13.04	8.58
	20% up	53,356	1.11	11.82	8.21
(2) Ayvali	Original Case	401,170	1.71	33.05	11.39
	5% up	372,794	1.63	29.30	10.03
	10% up	344,419	1.55	26.04	9.58
	15% up	316,044	1.48	23.23	9.16
	20% up	287,668	1.42	20.85	8.77
(3) Oltu	Original Case	538,944	1.54	26.82	10.68
	5% up	489,464	1.47	23.44	10.21
	10% up	439,984	1.40	20.67	9.77
	15% up	390,504	1.34	18.41	9.37
	20% up	341,024	1.29	16.55	8.99

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 the 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 EİE 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 Project: 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 1991, though the Project is schedule to be connected to the power grid after 2000. 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 mid-1991 prices. Table 15-1 shows fund procurement and repayment schedule.

15.3 Income and Cost

The return on investment is the income from electricity sale. 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 July 1991 for the whole TEK power system, the uniform rate of TEK as of July 1991, which is 254.2 TL/kWh (Refer 14.2.3) was used as the basis of revenue calculation.

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

Civil facilities construction cost	x 0.5%
Hydraulic equipment cost	x 1.5%
Electro-Mechanical equipment	x 1.5%
Transmission facilities 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

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 the Project are presented in Tables 15-2 and 15-3.

As indicated in the tables, the capital costs are recovered from revenues in the 14th year after the commencement of operation and thereafter revenues exceed capital costs producing profits. Thus it is judged that the capital investment on the Project can be safely recovered.

Table 15-1 Funds Procurement and Repayment Schedule

(unit: Million TL)

No.	Year	FUND REQUIREMENT							REPAYMENT SCHEDULE							
		FOREIGN CURRENCY			DOMESTIC CURRENCY				Foreign Currency				Domestic Currency			
		Ayvali	Olur	Subtotal	Ayvali	Olur	Subtotal	Total	interest	Principal	Total	Balance	Interest	Principal	Total	Balance
1	1999	2,814	3,489	6,302	18,868	21,259	40,128	46,430	(299)				(1,906)			
2	2000	31,350	21,734	53,085	26,679	34,307	60,986	114,071	(2,789)				(6,709)			
3	2001	25,912	31,664	57,576	27,823	32,020	59,844	117,420	(8,045)				(12,448)			
4	2002	60,263	22,594	82,858	66,358	91,634	157,993	240,850	(14,716)				(22,796)			
5	2003	68,471	43,338	111,809	109,392	76,047	185,440	297,249	(24,294)				(39,109)			
6	2004	68,397	103,265	171,662	136,590	84,869	221,459	393,121	(37,759)				(58,436)			
7	2005	101,013		101,013	60,230		60,230	161,243	(36,094)			584,304	(52,065)			786,080
8	2006								55,509	10,796	66,305	573,508	74,678	14,524	89,202	771,556
9	2007								54,483	11,822	66,305	561,687	73,298	15,904	89,202	755,652
10	2008								53,360	12,945	66,305	548,742	71,787	17,415	89,202	738,237
11	2009								52,130	14,174	66,305	534,567	70,133	19,069	89,202	719,168
12	2010								50,784	15,521	66,305	519,046	68,321	20,881	89,202	698,287
13	2011								49,309	16,995	66,305	502,051	66,337	22,864	89,202	675,422
14	2012								47,695	18,610	66,305	483,441	64,165	25,037	89,202	650,386
15	2013								45,927	20,378	66,305	463,063	61,787	27,415	89,202	622,971
16	2014								43,991	22,314	66,305	440,749	59,182	30,020	89,202	592,951
17	2015								41,871	24,434	66,305	416,315	56,330	32,871	89,202	560,080
18	2016								39,550	26,755	66,305	389,560	53,208	35,994	89,202	524,086
19	2017								37,008	29,297	66,305	360,263	49,788	39,414	89,202	484,672
20	2018								34,225	32,080	66,305	328,184	46,044	43,158	89,202	441,514
21	2019								31,177	35,127	66,305	293,056	41,944	47,258	89,202	394,256
22	2020								27,840	38,465	66,305	254,592	37,454	51,747	89,202	342,509
23	2021								24,186	42,119	66,305	212,473	32,538	56,663	89,202	285,845
24	2022								20,185	46,120	66,305	166,353	27,155	62,046	89,202	223,799
25	2023								15,804	50,501	66,305	115,851	21,261	67,941	89,202	155,858
26	2024								11,006	55,299	66,305	60,552	14,807	74,395	89,202	81,463
27	2025								5,752	60,552	66,305	-0	7,739	81,463	89,202	-0
Total		358,219	226,085	584,304	445,942	340,138	786,080	1,370,384	865,790	584,304	1,326,098		1,191,424	786,080	1784034.8	

Note: Figures in parentheses are I.D.C.

Remarks: Repayment condition - 9.5% annum

Repayment method : 20 years with principal and interest in equal installment
Grace Period : 7 years (construction period)

Table 15-2 Profit and Loss Statement

(unit: Million TL)

No.	Year	Operating Revenue (A)	Operating Expenses		Total (B)	Operating Income (C)=A-B	Financial Expenses*		Total* (D)	Net Income (E)=C-D
			O & M	Depreci-ation			F.C.	D.C.		
1	1999						(299)	(1,906)	(2,205)	
2	2000						(2,789)	(6,709)	(9,498)	
3	2001						(8,045)	(12,448)	(20,494)	
4	2002						(14,716)	(22,796)	(37,511)	
5	2003						(24,294)	(39,109)	(63,403)	
6	2004						(37,759)	(58,436)	(96,195)	
7	2005	70,603	4,107	14,724	18,831	51,772	(36,094)	(52,065)	(88,159)	-36,387
8	2006	190,306	9,644	35,260	44,904	145,403	55,509	74,678	130,186	15,216
9	2007	190,306	9,644	35,260	44,904	145,403	54,483	73,298	127,781	17,622
10	2008	190,306	9,644	35,260	44,904	145,403	53,360	71,787	125,147	20,255
11	2009	190,306	9,644	35,260	44,904	145,403	52,130	70,133	122,263	23,140
12	2010	190,306	9,644	35,260	44,904	145,403	50,784	68,321	119,105	26,298
13	2011	190,306	9,644	35,260	44,904	145,403	49,309	66,337	115,647	29,756
14	2012	190,306	9,644	35,260	44,904	145,403	47,695	64,165	111,860	33,543
15	2013	190,306	9,644	35,260	44,904	145,403	45,927	61,787	107,714	37,689
16	2014	190,306	9,644	35,260	44,904	145,403	43,991	59,182	103,173	42,229
17	2015	190,306	9,644	35,260	44,904	145,403	41,871	56,330	98,201	47,201
18	2016	190,306	9,644	35,260	44,904	145,403	39,550	53,208	92,758	52,645
19	2017	190,306	9,644	35,260	44,904	145,403	37,008	49,788	86,796	58,606
20	2018	190,306	9,644	35,260	44,904	145,403	34,225	46,044	80,269	65,134
21	2019	190,306	9,644	35,260	44,904	145,403	31,177	41,944	73,121	72,281
22	2020	190,306	9,644	35,260	44,904	145,403	27,840	37,454	65,295	80,108
23	2021	190,306	9,644	35,260	44,904	145,403	24,186	32,538	56,725	88,678
24	2022	190,306	9,644	35,260	44,904	145,403	20,185	27,155	47,340	96,062
25	2023	190,306	9,644	35,260	44,904	145,403	15,804	21,261	37,064	108,338
26	2024	190,306	9,644	35,260	44,904	145,403	11,006	14,807	25,812	119,590
27	2025	190,306	9,644	35,260	44,904	145,403	5,752	7,739	13,491	131,911
Total		3,876,728	196,987	719,918	916,905	2,959,823	865,790	1,191,424	2,057,214	1,131,915

*Note: Figures in parentheses are I.D.C.

Remarks: Operating revenue : 639.9GWh x 297.4TL/kWh =190306.26 million TL/year
Operation and Maintenance: see 14.2.2
Depreciation: construction cost including I.D.C.

- Civil (50 years):	1,336,543	/ 50 =	26,731
- Hydro (35 years):			
- Elec. (35 years):	298,510	/ 35 =	8,529
- T/L (35 years):			
Total			35,260

Table 15-3 Cash Flow Statement

(unit: Million TL)

No.	Year	Cash Inflow				Cash Outflow						Balance	
		Fund Requirement	Net Income	Depreciation	Total (A)	Construction cost	Principal Repayment F.C.	Principal Repayment D.C.	Principal Repayment Subtotal	I.D.C.	Total (B)	Yearly (A)-(B)	Accummulation
1	1999	46,430	0	0	46,430	46,430	0	0	0	2,205	48,635	-2,205	-2,205
2	2000	114,071	0	0	114,071	114,071	0	0	0	9,498	123,568	-9,498	-11,703
3	2001	117,420	0	0	117,420	117,420	0	0	0	20,494	137,913	-20,494	-32,197
4	2002	240,850	0	0	240,850	240,850	0	0	0	37,511	278,362	-37,511	-69,708
5	2003	297,249	0	0	297,249	297,249	0	0	0	63,403	360,652	-63,403	-133,111
6	2004	393,121	0	0	393,121	393,121	0	0	0	96,195	489,316	-96,195	-229,306
7	2005	161,243	-36,387	14,724	139,580	161,243	0	0	0	88,159	249,403	-109,823	-339,129
8	2006	0	15,216	35,260	50,476	0	10,796	14,524	25,320	0	25,320	25,156	-313,973
9	2007	0	17,622	35,260	52,881	0	11,822	15,904	27,726	0	27,726	25,156	-288,817
10	2008	0	20,255	35,260	55,515	0	12,945	17,415	30,360	0	30,360	25,156	-263,662
11	2009	0	23,140	35,260	58,399	0	14,174	19,069	33,244	0	33,244	25,156	-238,506
12	2010	0	26,298	35,260	61,557	0	15,521	20,881	36,402	0	36,402	25,156	-213,351
13	2011	0	29,756	35,260	65,016	0	16,995	22,864	39,860	0	39,860	25,156	-188,195
14	2012	0	33,543	35,260	68,802	0	18,610	25,037	43,647	0	43,647	25,156	-163,039
15	2013	0	37,689	35,260	72,949	0	20,378	27,415	47,793	0	47,793	25,156	-137,884
16	2014	0	42,229	35,260	77,489	0	22,314	30,020	52,333	0	52,333	25,156	-112,728
17	2015	0	47,201	35,260	82,461	0	24,434	32,871	57,305	0	57,305	25,156	-87,572
18	2016	0	52,645	35,260	87,905	0	26,755	35,994	62,749	0	62,749	25,156	-62,417
19	2017	0	58,606	35,260	93,866	0	29,297	39,414	68,710	0	68,710	25,156	-37,261
20	2018	0	65,134	35,260	100,393	0	32,080	43,158	75,238	0	75,238	25,156	-12,106
21	2019	0	72,281	35,260	107,541	0	35,127	47,258	82,385	0	82,385	25,156	13,050
22	2020	0	80,108	35,260	115,368	0	38,465	51,747	90,212	0	90,212	25,156	38,206
23	2021	0	88,678	35,260	123,938	0	42,119	56,663	98,782	0	98,782	25,156	63,361
24	2022	0	98,062	35,260	133,322	0	46,120	62,046	108,166	0	108,166	25,156	88,517
25	2023	0	108,338	35,260	143,598	0	50,501	67,941	118,442	0	118,442	25,156	113,672
26	2024	0	119,590	35,260	154,850	0	55,299	74,395	129,694	0	129,694	25,156	138,828
27	2025	0	131,911	35,260	167,171	0	60,552	81,463	142,015	0	142,015	25,156	163,984
Total		1,370,384	1,131,915	719,918	3,222,217	1,370,384	584,304	786,080	1,370,384	317,465	3,058,233	163,984	