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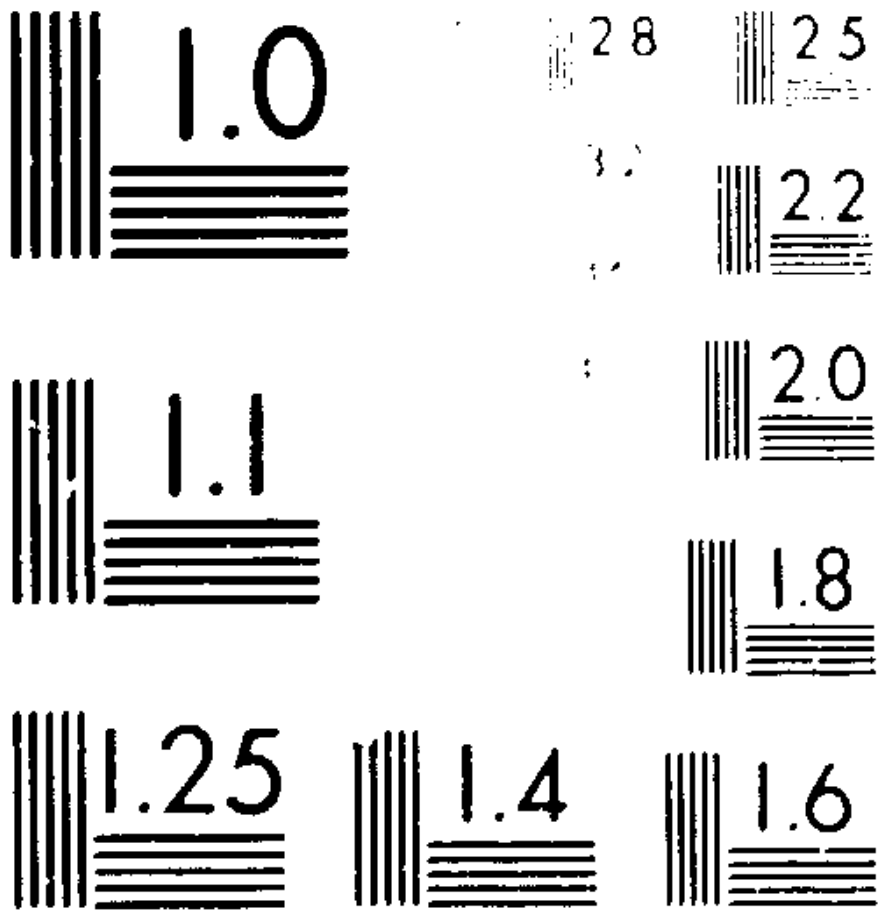
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MINI-HYDROPOWER GENERATION (MHG) IN TURKEY*

by

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SUMMARY

The Mini Hydropower Generation (MHG) units have been utilized in Turkey since 1926. From 1950 to 1980 decade owning and operating units in 0-100 KW category were economically very sound and rendered high contribution to the Turkish economy especially during the fast progressing years of the Country where the national per capita income were about 400 dollars per year. The economical feasibility of the small units lasted until 1970. But when the national per capita income become as high as 1350 dollars per year, at the begining of 1980, the small units have lost their economical feasibility due to high overhead and operational costs.

Turkey aims to tie up all of her Cities and Villages to the national grid which is owned by the State and Operated by Turkish Electricity Authority (TEK).

For the developing countries, where the national per capita income is more than 400 dollars, it seems more economical for them to build MHG units within the range of 101-5000 KW capacity.

aaa, Mini-hydropower generators have been utilized in small towns and Villages from 1926 up to 1980. Between 1950-1960 decade, it has been the most economical hydroelectrical energy source and for this reason it has been used extensively. All of the generators that installed have been in run-off type.

The MHG type plants that were utilized, generally, have been in enlightening small towns and villages and to running small industrial plants.

The utilization of MHG has been very effective up to 1970 where the per capita national income was around 400 dollars per year. But when the per capita national income reached 1350 dollars in 1980 it has lost its popularity. Especially, the small units, in the ranges of 0-100 KW have been dropped from the service completely. The galloping inflation in the labor wages and the eventual high operational cost has been the dictating factor for this policy.

Presently the main goal of Turkey is to connect the electrical systems of all of the towns and villages to the National Interconnected Network.

The status of the Mini Hydropower Generation (MHG) and Big Hydropower Generation (BHG) as the economical potential in Turkey is classified into Three Categories according to power generation ranges : 0-100 KW, 101-1000 KW and 1001-5000 KW as indicated in Table 1.

<u>0-100 KW Capacity Units</u> : 40,000 Units are the most expensive ones in operation-wise and in the development period they will be considered only at turning over of this century. Due to this high operational cost factor, the present MHG plants have been dropped from the service. Only a few auto-producer plants are still at use.

<u>101-1000 KW Capacity Units</u> : Of these units only those which consist one section of the multipurpose projects will be built up to 2000 A.D. Then the energy-purpose units will be started and construction of them will continue until 2010 A.D.

<u>1001-5000 Kw Capacity Units</u> : Construction of this category units, either multi-purpose or for energy purpose only, will go on until 2005 A.D. and they will be completed at that date.

For comparison the capital investment costs of big hydropower generators are also provided in Table 1. The big hydropower generators in the last category, either multi-purpose or for energy purposed only, will be completed until 2000 A.D.

Table 1 : Classification of Generating Units in Plants According to Their Installed Capacities as Economic Potential

Installed capacity KW	Municipal Plants Auto-producer plants			Regional Plants			Total			Capital Investment (Including Transmission lines excluding city networks) $/KW
	Number of units	Installed capacity MW	Annual output GWH	Number of units	Installed capacity MW	Annual output GWH	Number of units	Installed capacity MW	Annual output GWH	
0-100	40 000	3 000	10 000				40 000	3 000	10 000	1500-2500
101-1000	2 000	1 500	5 000	6 000	4 500	15 000	8 000	6 000	20 000	1500-2000
1001-5000	100	350	1 000	1 900	6 650	19 000	2 000	7 000	20 000	1400-1800
MHG Sub - total	42 100	4 850	16 000	7 900	11 150	34 000	50 000	16 000	50 000	1450-2000
5001-10000				1 000	8 000	20 000	1 000	8 000	20 000	1200-1600
10001-50000				280	10 000	25 000	280	10 000	25 000	1000-1400
50001-over				150	15 000	45 000	150	15 000	45 000	800-1200
BHG Sub - Total				1 430	33 000	90 000	1 430		90 000	960-1360
Grand Total	42 100	4 850	16 000	2 220	44 150	124 000	2 430	49 000	240 000	1120-1570

MHG : Mini Hydro Generation
BHG : Big Hydro Generation

Table 2 : ORGANIZATIONAL SET LIP OF THE MINI - HYDRO POWER GENERATION

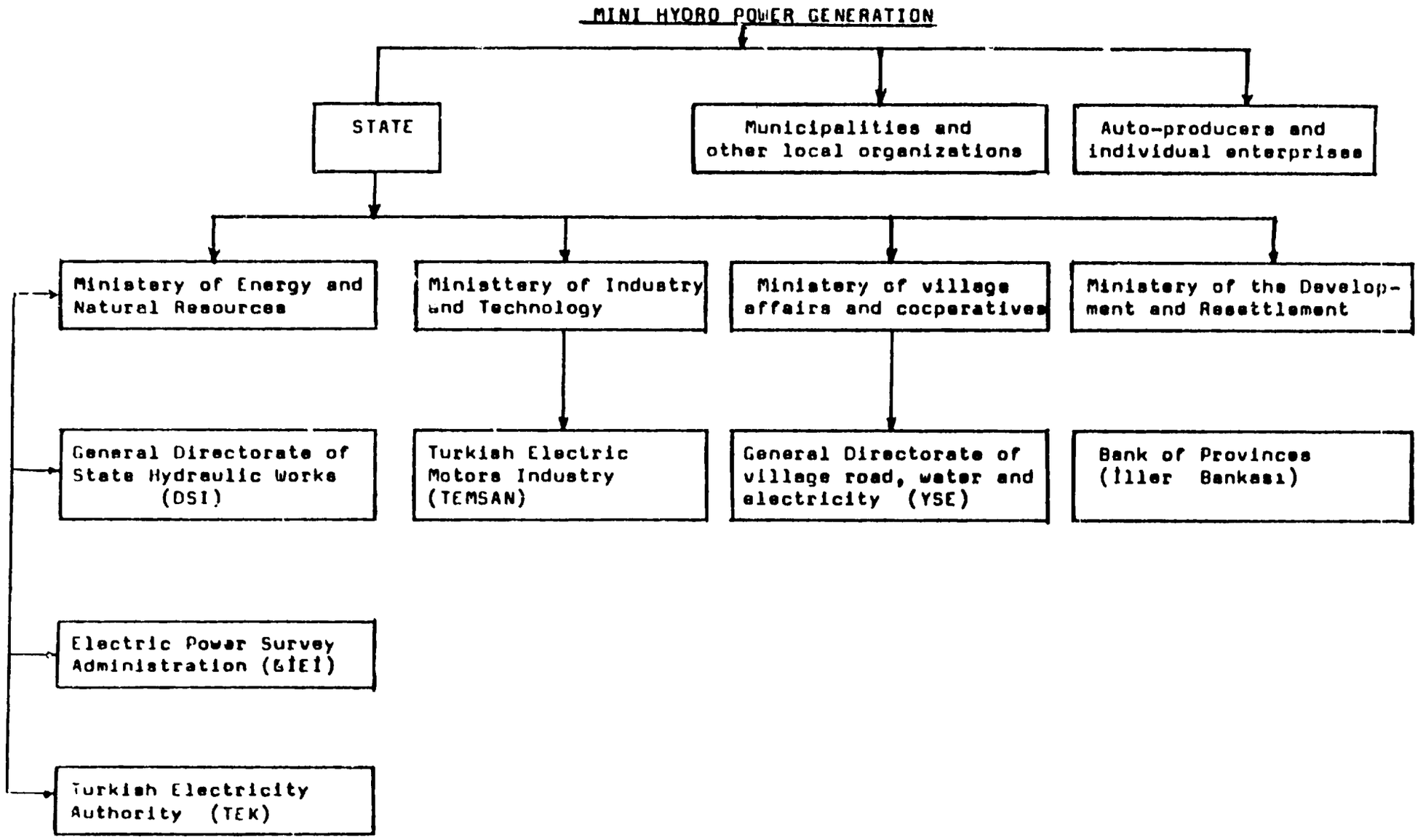

Table 3 : Division of Responsibilities of Government Organizations Engaged with Mini Hydropower Generators

Responsibilities / Institutions	Planning		Design		Construction		Management and Operation	Manifacture	City and village networks construction
	Plants	Transmis-sion Lines	Plants	Transmis-sion Lines	Plants	Transmis-sion Lines			
General Directorate of State Hydraulic orks (DSI)	+	+	+		+				
General Directorate Electric Power survey Administration (EİEI)	+	+	+						
Turkish Electricity Authority (TEK)		+		+		+	+		
Turkish Electric Motors Industry (TEMSAN)									
General Dirctorate of village roads, water and Electricity (YSE)	+	+					+		
Bank of Provinces (İller Bankesi)	+	+	+	+	+	+			+
Municipalieties and Local organizations							+		
Auto-producer and (*) individual enterprises	+	+	+	+	+	+	+	+	

- The responsibilies of the institutions
* These activities are discontinued since 1970

bbb. The Organizational set up of the public and quasi-public institutions and the division of their responsibilities are summarized in Table 2 and Table 3, respectively. Most of the plants which equipped with MHG units are built by the Bank of Provinces (İller Bankası). The Bank of Provinces have been in the process of building the MHG networks for only cities and towns since 1970.

ccc. All the works which are performed in the field of MHG are summarized in Tables 4 and 5. Besides the works done up to 1968 and 1980, these tables also indicate the purposes for which the subject matter generators to be utilized.

After 1968, there have been a remarkable development in regional plants while the construction of municipal and auto-producer plants are discontinued. The municipal plants are built by Bank of provinces, regional plants built by Bank of provinces and State Hydraulic Works (DSİ), and yet the auto-producer plants are built by either state or private enterprises. The municipal MHG plants are owned and operated by themselves. Regional plants are owned by State but operated by Turkish Electricity Authority (TEK). Auto-producer plants are owned and operated by the builders.

The construction of all the MHG plants with exception some of the auto-producer plants are financed by the State. Some of the auto-producer plants are financed by the builders. Operation of some of the municipal plants in the range of 0-100 KW are discontinued due to the high operational costs. In Tables 4 and 5 the data on Big Hydropower Generators are also provided for the comparison purpose. Up to 1980, in number 266 units of MHG types with (136 MW Capacity) have been built in verses to 54 units of BHG (with 2017 MW capacity) built and put into operation.

ddd. The Techno-economical Specifications of the MHG Units which are at Use in Turkey.

All of the MHG units are built in the runoff systems. The hight of the water fall varies from 3.5 to 600 meters. These generators are mainly equipped with Francis, propeller, Kaplan and native type of turbines. The unit costs per KW of both MHG and BHG units are given in Table 1 according to 1980 price index.

eee. All of the turbines and their components are imported up to now. Only two turbines are built in the Country. The Turkish Electrical Motors Company (TEMSAN) which is a State organization being equipped with the know-how of Neyrpic-France has been in charge of the manufacturing all turbines within the range of 50-20 000 KW capacity.

fff. Training in the Field of MGH. So far, the training of the personnel who deal with construction and operation mini-hydropower generation have been conducted by the Bank of Provinces (İller Bankası) in Turkey. Presently the State Hydraulic Works (DSİ); Electric Power Survey Administration (EİEİ) General Directorate of Village Road, Water and Electricity (YSE); Turkish Electricity Authority (TEK); and Turkish

Table 4 : Classification of Generating Units in Plants According to Their Installed Capacities in 1968

Installed Capacity KW	Municipal Plants		Regional Plants		Auto-producer Plants		Total	
	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW
0-100	113	6 470					113	6 470
101-1000	90	20 347	12	8 392	2	400	104	29 139
1001-5000	3	3 600	27	75 724	7	11 300	37	90 624
MHG Sub-Total	206	30 417	39	84 116	9	11 700	254	126 233
5001-10000			12	86 720			12	86 720
10001-50000			18	510 200			18	510 200
50001-over								
BHG Sub-Total			30	596 920			30	596 920
GRAND TOTAL	206	30 417	69	681 036	9	11 700	284	723 153

Table 5 : Classification of Generating Units in Plants According to Their Installed Capacities in 1980

Installed Capacity KW	Municipal Plants		Regional Plants		Auto-Producer Plants		TOTAL	
	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW	Number of Units	Installed Capacity KW
0-100	113	6 470					113	6 470
101-1000	90	20 347	21	11 992	2	400	113	32 739
1001-5000	3	3 600	30	81 724	7	11 300	40	96 624
MHG Sub-Total	206	30 417	51	93 716	9	11 700	266	135 833
5001-10000			19	149 620			19	149 620
10001-50000			25	687 420			25	687 420
50001-over			9	1 180 000			9	1 180 000
BHG Sub-Total			54	2 017 040			54	2 017 040
GRAND TOTAL	206	30 417	105	2 110 756	9	11 700	320	2 152 873

Electrical Motors Industry (TEMSAN) are in charge with the training of their own technicians in this field.

ggg. Recommendations to Other Developing Countries. The 0-100 KW capacity MHG units which can be individually installed and operated seem to be economically more feasible only to those countries where per capita incomes would be under 400 dollars per year. However, for those countries whose per capita incomes are higher than 400 dollars should consider building and operating of 101-5000 KW capacity units for the regional plants.