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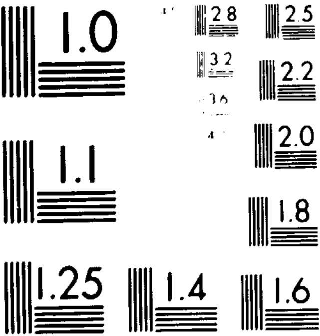

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COUNTRY EXPERIENCES IN MHG FOR ETHIOPIA*

by

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Introduction

Electricity in Ethiopia is in the main provided by the Ethiopian Electric Light and Power Authority (EELPA), a Stututory Corporation wholly owned by the Ethiopian Government. EELPA was set up by Charter in 1956 for the purpose of generating and distributing electric power for sale to the Ethiopian public.

The nationalisation of ex-SEDAO and ex-CONIEL electricity supply undertakings that were operating in the Eritrea Administrative Region of Ethiopia effected by the Provisional Military Administration Council on February 2, 1975 has extended the responsibility of EELPA to cuver the length and breadth of Ethiopia.

An Eritrea Region Electricity Supply Agency (ERESA) has now been established under the control of EELPA.

Institutional changes made by Provisional Military Administration Council to consolidate public utilities under the relevant Ministries has also incorporated EELPA under the Ministry of Mines, Energy and Water Resources with EELPA still retaining its autonomy.

EELPA has grown considerably since the time of its establishment in 1956, but it has still a long way to go before it achieves its ultimate desirable goal of making electricity available to all urban and rural communities in Ethiopia.

Present Status

Present EELPA operations can be devided into two main parts. The first and the most important part is known as the Inter-Connected System (ICS). This consists of the large generation plants which serve the major load areas of the towns of Addis Abeba, Nazareth, Dire Dawa and Harar using a high voltage transmission grid.

The installed capacity of the ICS is 225.3 MW of which nearly 95% is hydroelectric (See Table 1)

The latest generation plant addition to the ICS is the Finchaa hydroelectric plant which was commissioned in 1973.

For future expansion of the ICS the feasibility study of the Malka Wakana hydroelectric project and the Amarti River **diversion** into the Finchaa reservoir have been completed. The Malka Wakana capacity is 152 MW and the Amarti Diversion shall additional production of 170 GWH annually in the ICS.

The second and at present the most expensive part of EELPA operations is known as the Self Contained System (SCS). The SCS consists of several, local and isolated service areas which are widely distributed arround the country. At present, these service areas number about 45 and have an aggregate installed capacity of 77.765 MW 90% of which is diesel electric and the rest run of river type hydro electric (See Table 2).

In the past few years EELPA has been incurring significant financial losses on the sale of high cost diesel generated power throughout the SCS.

Mini Hydroelectric Generation

Ethiopia is fortunate enough to possess abundant rainfall and numerous streams with steep gradients and waterfalls which could be developed for installation of small and large hydroelectric generation plants. There are 14 river basins with an aggregate hydroelectric generation potential very roughly estimated at 50,000 GWH per year.

The climate is temperate with temperature ranges from a minimum of 4°C to a maximum of 38°C and average annual rainfalls from 1000 to 2,500 mm.

Based on preliminary studies conducted only on two of the large river basins it is estimated that there are over 2000 sites favourable for construction of dams and creation of reservoirs. It is also generally accepted there would be no shorage of suitable sites for the development of small and mini hydroelectric generation plants in the major portion of the country.

In the past several years EELPA's established mode of electricity supply to small towns in the rural area has been the installation of diesel generation units. Because of uncertainties of predicting future demand and costs, power generation alternatives are commonly evaluated at current levels for both capital and operating costs and this practice usually favoured the diesel alternative which generally had lower investment cost and higher operating costs. In addition to this the design of small diesel generation units could be repeated for several others without significant changes affording a measure of simplicity and availability for quick installations.

In recent years, however the prospects of developing small and mini hydroelectric generation in Ethiopia are being viewed with growing interest. This interest has been sparked by a number of developments within and outside the country.

With the formation of collective farms following guide lines pronounced by Government new SCS supply areas are expected to mushroom all over the country and to demand electricity supply. The general agro-industrial development campaign launched by Government requires cheap and adequate electrical energy supply to improve the quality of rural life, lack of which will only hamper and retard the development plans. Soloing the problem of cheap and adequate electrical energy generation for supply to rural areas is therefore central to the economic development plans of the country.

The rapid rise in the price of imported oil used for generation of electrical power in the SCS, and the limiting effects of fuel transport costs for the SCS to reach remote rural areas are other major factors which are now pressing EELPA to put greater emphasis on the study of small and mini hydroelectric generation plants and their implementation to replace existing diesel generation units in SCS wherever possible. This mode of generation for new SCS supply centres is expected to be the future mode of generation in the SCS.

Demand growth rates in the existing SCS are at present encouragingly high for implementing hydroelectric generation plants to replace the existing diesel generation units. Inspite of curtailed supply due to limitations in the provision of diesel generating capacities and shortage of fuel supply, the demand growth rate is exceeding 15% in places and in order to meet the constrained demand a total of 20 diesel generating units with an aggregate capacity of 6500 KW may have to be purchased for installation in 20 centres shortly

Demand in new SCS is also estimated to be high.

Problems and Constraints

Hydroelectric development studies and designs are widely varied both in regard to the combination of natural conditions encountered and in relation to the solutions that could be proposed to the problems encountered in the course of the work. Meticulous survey and investigations leading to careful weighing of alternatives is an essential requirement before irrevocable decisions are made in regard to their implementation.

Lack of trained manpower required to carry out such studies is a major problem EELPA is faced with in regard to hydro electric development studies. The training Institute established by EELPA is limited to catering for operating technicians. Proffessional engineers, hydrologist, geologists, surveyors and coordinators experienced in the various disciplines are not locally available for recruitment.

Hydrological records, topographical and geological maps are not available in the extent and quality sufficient at least for identification of sites. The mountanous nature of the country and lack of access entails considerable costs on preliminary studies.

Nevertheless if facilities for field survey teams can be made available several sites could receive preliminary investigations which would enable selection and determination of the potentials of several sites. Among the required facilities are those for transport surveying, rain gauging and flow measurements, soils testing and rock drilling and camping.

For analysis of survey data and preparation of plans and project documents office facilities,aids,technical documents on present nydroelectric technology would expedite the work.

Suggestions

It is not difficult to suggest assistance by the provision of experienced coordinators and experts in hydroelectric development projects to work with and train available engineers in the country is one of the best ways in which the long and arduous task of harnessing the numerous streams in the country for energy supply in the rural areas. The presence of such experts in a team of development study creates the required confidence on the Authority to permit expenditure without constraints.

Leading experts with expereince in the field can confidently short cut procedures reducing time and money expenditures on the studies. The ranges of technical possibilities concerned with the design of hydroelectric structures and the possible modifications to the schemes by proper arrangements are continually varying and could be taken into account only by an experienced expert in the field.

Such assistance has been experienced in the past and is being experienced currently but not in sufficiently great number of potential sites. A small dam to store water for irrgation was completed in a very short time using donated earth moving equipment and a small number of expatriate experts. A hydroelectric plant scheme is being studied on the Chemoga river with an earth dam just up stream of the existing run-of-river plant that is at present supplying the town of Debre Markos. This study team consists of five expatriate experts assisted by EELPA engineers and surveyors. The design of the project is expected to be completed one year from the start.

UNIDO could play an important and useful role by assisting governments to remove major constraints in the financing and or provision of expertise and materials required for the study of MHG aimed at exploiting the water resource of the country.

Table 1

Inter-Connected System

Hydro Electric Plants	Capacities Installed	(MW) Firm	Energy Firm	GWH/Yr. Average
Aba Samuel	6.6	4.8	18	23
Koka	43.2	34.5	80	110
Awash II	32.0	32.0	135	182
Awash III	32.0	32.0	135	182
Finchaa	100.0	100.0	449	521
Hydro Total	213.8	203.3	810	1018
Thermal Plants				
Addis Abeba (Steam)	5.0	5.0	35	35
Alemaya (diesel)	2.0	2.0	14	14
Dire Dawa (diesel)	4.5	4.5	25	25
Thermal Total	11.5	11.5	74	74
Grand Total	225.3	214.5	891	1092

Notes:- Due to rainfall pattern difference for Awash and Finchaa total hydro firm energy exceeds arithmetic sum. System smulation study gives 900 GWH as total hydro firm energy.

The Addis Abeba Steam Station unit is obsolete. As a result the dependable total capacity would become 209.8 MW.

Table 2

Self Contained System

	Existing Supply Centres	Installed Capacity (KW)	Additional Required Capacity (KW)	Remarks
1.	Adigrat	435	-	
2.	Agarro	570	500	
3.	Arba Minch	640	150	
4.	Asbe Teferri	540	150	
5.	Assab	1100	-	
6.	Axum	545	500	
7.	Bale Goba	370	-	
8.	Bati	270	-	
9.	Belesa	20000	-	15000 Steam and 5000 diesel
10.	Bonga	315	-	
11.	Buno Bedelle	217	-	
12.	Debre Markos	934	150	Including existing 184KW hydro Capacity
13.	Debre Birhan	2342	500	Including existing 100KW hydro Capacity
14.	Debre Tabor	238	-	
15.	Dembi Dollo	334	150	Including existing 184KW hydro Capacity
16.	Dessie	2388	500	
17.	Dilla	721	-	
18.	Fiche	390	-	
19.	Gajiret	5800	-	Temporary Mobile sets each of 580 KW
20.	Gelemso	270	-	
21.	Ghimbie	269	150	
22.	Ghion (Wollisso)	449	150	Including existing 148KW hydro Capacity
23.	Gode	55		
24.	Gondar	2001	500	
25.	Gore	64	-	
26.	Hagere Hiwot (Ambo)	860	-	Including existing 168KW hydro Capacity
27.	Hossaena	390	-	
28.	Jijiga	650	500	
29.	Jimma	3110	-	Including existing 140KW hydro Capacity

Table 2 (Continued)

	Existing Supply Centres	Installed Capacity (KW)	Additional Required Capacity (KW)	Remarks
30.	Kagnew	6000	-	4 No. 1500 KW units
31.	Kebri Dehar	67	150	
32.	Kebre Mengist	219	150	
33.	Makalle	1251	500	
34.	Massawa	9400	-	4 No 1100KW units + 1 No 5000KW unit very old and ready for scrap
35.	Mettu	435		
36.	Negelle Borena	421	150	
37.	Nekemptie	901	150	
38.	Shambu	219	-	
39.	Shashamane	2524	-	
40.	Setit Humera	150	500	
41.	Tis Abbay	7600	-	2 No 3800KW hydro-electric units
42.	Wolaita Soddo	837	500	
43.	Woldia	270		
44.	Yirgalem	900	-	
45.	Zeway	301	-	

	Planned Supply Centres		Installed Capacity (KW)	
1.	Adi Caieh	-	180	In two stages
2.	Adi Quala	-	120	In two stages
3.	Adi Ugri	-	270	In two stages
4.	Agordat	-	270	In two stages
5.	Assaita	-	300	
6.	Assossa	-	300	
7.	Debark	-	300	With 15KV extension to Dabat
8.	Decamere	-	270	In two stages
9.	Dejen	-	300	With 15KV extension to Bichena

Table 2 (Continued)

	Planned Supply Centres		Installed Capacity (KW)	Remarks
10.	Finto Selam	-	300	With 15KV extensions to Jiga, Dembecha and Bure
11.	Gambella	-	300	
12.	Keren	-	510	In two stages
13.	Labibella	-	300	
14.	Maichew	-	300	With 15KV extensions to Wukro & Agula
15.	Mega	-	300	
16.	Mendi	-	300	With 15KV extension to Tobo
17.	Mizan Teferi	-	300	
18.	Moyale	-	300	
19.	Segeneiti	-	120	In two stages
20.	Tesseney	-	180	In two stages
21.	Yabello	-	300	

Note:- All hydroelectric plants as run-of-river type with no poundage.