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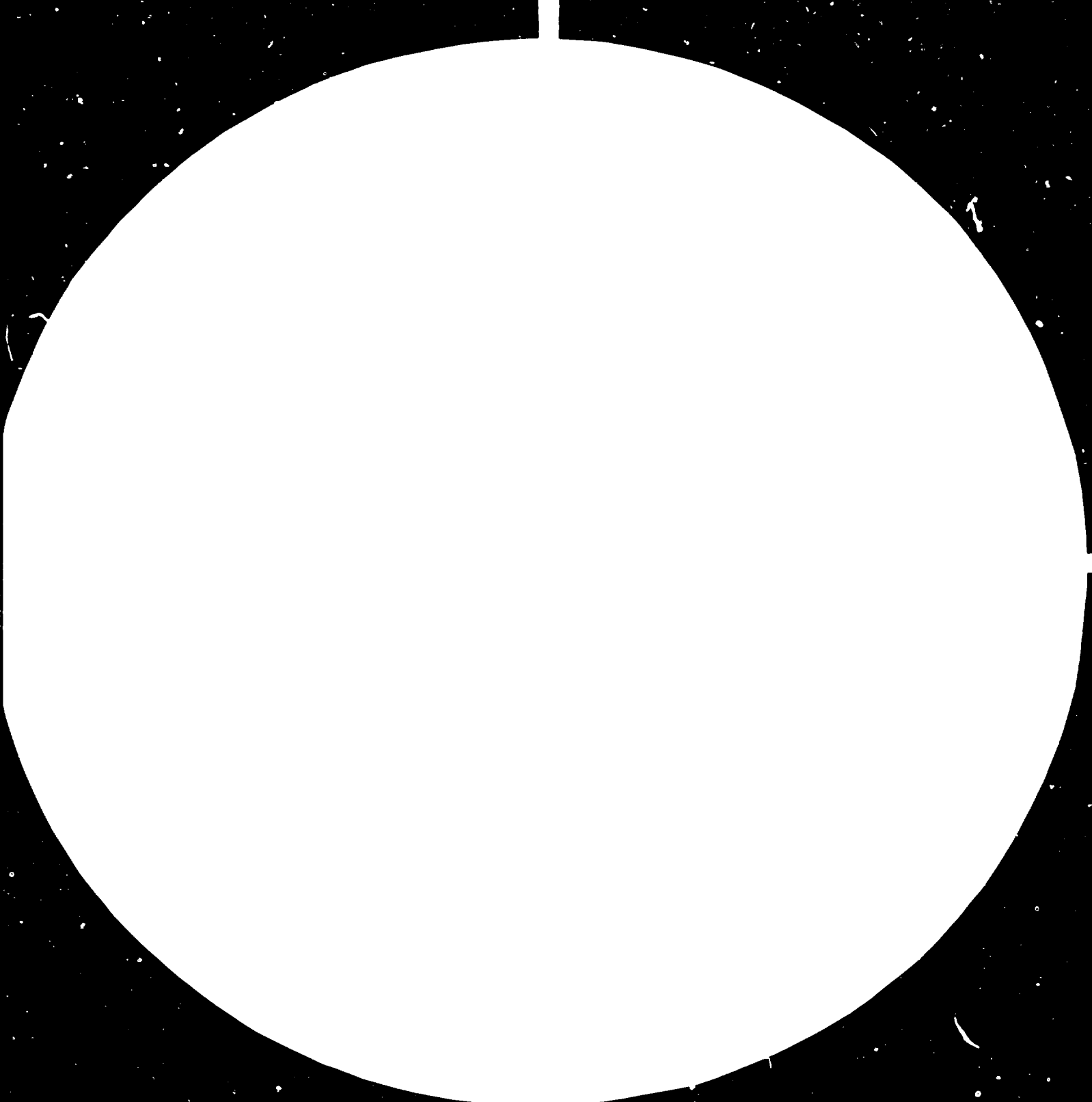

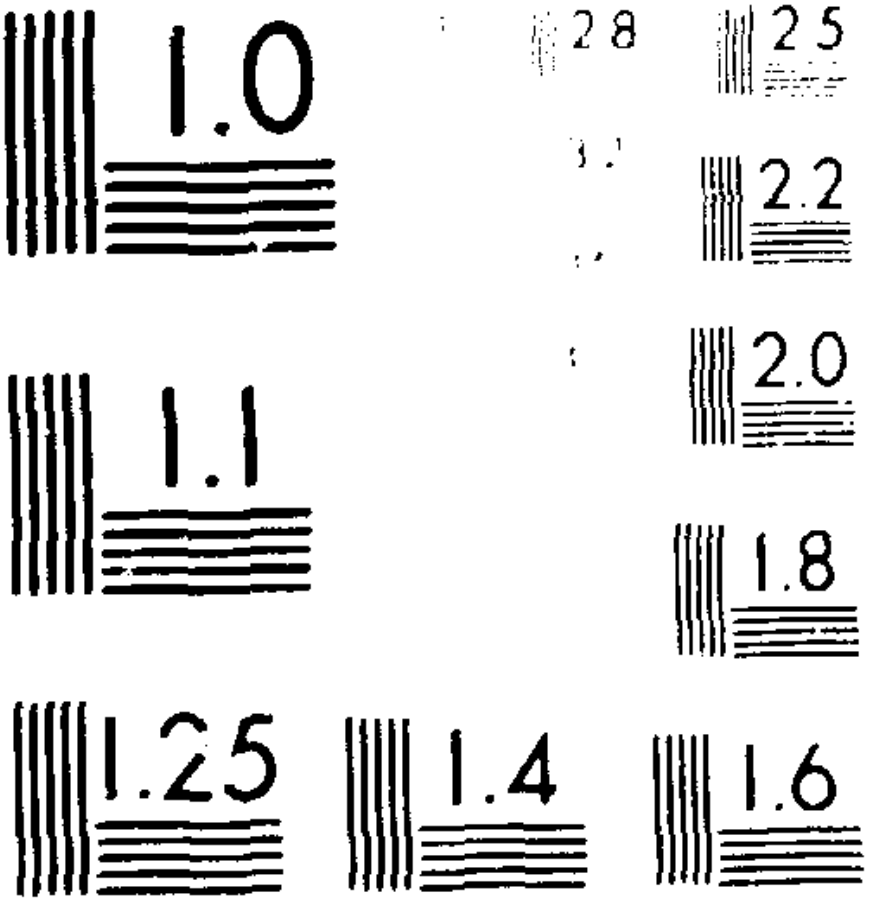
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Second Seminar-Workshop/Study Tour in the Development and Application of Technology for Mini-Hydro Power Generation (MHG)

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DEVELOPMENT IN MINI-HYDRO POWER GENERATION IN THE REPUBLIC OF ZAMBIA*

by

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Present Status and Potential prospects

Zambia's electricity is generated almost entirely from hydro sources. The Central system consists of four major generating power stations, with total capacity of 1600MW and annual output of more than 8000GWhs of electricity. Sixty per cent of the consumption is accounted for by industry, mainly the Copper mining industry. In addition to the three 330KV transmission lines to the Copper mines, isolated systems, with hydro and diesel generation and distribution systems, supply the rest of the rural areas of the country, accounting for less than two per cent (2%) of national consumption.

The bulk of rural generation is accounted for by four hydro stations of Lusiwasi (12MW), Musonda Falls (4MW), Chishimba Falls (4MW) and Lunzua Falls (750KW). Apart from Lusiwasi Power station of 500 metres head all the stations have less than 100 metres head. The total annual energy output for the hydro stations is 76.4GWhs, of which fifty per cent (50%) comes from Lusiwasi. As a result of the recommendations of the Kathmandu Seminar/Workshop on decentralisation of mini hydro electric generation units based upon village development and initiation of more development activities in a larger and less densely populated rural areas. Necessary action is being taken to bring the development of mini hydro generation into a reality. Zambia Electricity Supply Corporation a public corporation was instructed to initiate feasibility studies on the rivers and water falls in the country starting in the North Wester Province where all power generation from the diesel power plants at four district centres are located.

Memorandum of Agreement was entered into in November, 1979 between the Zambia Electricity Supply Corporation (ZESCO) and a local company. The main reason for ZESCO was to purchase professional services from that company, which by implication, were not available within the corporation. A recent close examination of what the company can offer the corporation shows that there is basically very little. The company has hardly broad experience in terms of hydro technology. It is felt that by employing the company it would be acting no more than a broker in this instance and ZESCO will be terminating the present agreement and look for other locally based international consulting engineering companies who have the basic knowledge of the country's hydrological conditions who would competently carry out

feasibility studies in a short period of time.

It is therefore felt that Zambia should ask for specific assistance from United Nations Industrial Development Organisation and the Ministry of Power, Transport and Communications has already recommended to the National Commission for Development Planning in Zambia that the Commission should ask UNIDO for financial assistance for anticipated next stages, namely; the designing and construction of mini hydro electric power generation units and necessary training while feasibility studies should be carried out by local consulting companies.

The greater emphasis of the current National Development Plan 1979/83 is on Agriculture and Industry. The objectives are to minimize the inherited imbalance between the urban and rural sectors, develop production in agriculture and small scale (village) industries to increase rural incomes and reduce the country's dependence on Copper exports.

The principles that will govern the strategy for irrigation programmes during the Plan are: small-scale (village) schemes using simple methods and requiring small capital investment will be developed on self-help basis, medium-sized irrigation schemes restricted to specialised crops and large scale irrigation schemes. Investigations are currently being carried out to establish rural small-scale industries in each district numbering about sixty. The type of industries to be built during the Plan will be advised in the very near future and the majority of the works if not all will require electricity.

Technical, economic and engineering data

Over 8,000 consumers (out of total 10,000) are supplied from the above mini-hydro stations with consumption distributed between rural industry (55%), commercial (13%) and residential (32%). Consumption in the agricultural sector accounts for two (2%) of total consumption. The low percentage of agricultural consumption in relation to the total sales indicates the low agricultural production in the rural areas. With the farming programme being initiated by the

Government agricultural electricity consumption may rise considerably in the next few years. Industrial activity in the rural areas is accounted for mainly by Government or quasi-Government schemes set up to arrest the rural-urban migration of people. The Government has had priority on stepping up Industrial activity in the rural areas and should the programme succeed - and there are indications that it will succeed-there will be considerable increase in electricity supply demand for the rural Industries.

The high cost of transmission lines over long distances does not allow more than a few interconnections at a time, and current investigations in establishing potential of small rivers for further construction of mini-hydro stations are intended to find an alternative to interconnection. Studies will be initiated which will result in the construction of mini-hydro generation units in the North Western Province where exisiting diesel stations have proved uneconomic to operate as a result of the rising costs of oil. Existing stations consist of 4 x 100 KW diesal engines at each district centres. Initial investigations had established the possibility of five sites for mini-hydro stations with an output ranging from 600 KW to 2 MW with heads of 14 to 30 metres. Although interest in the scheme started more than a year ago little progress has been made to-date because of the difficulty in finding experienced firms locally.

These investigations will be extended to all other parts of the Country and where initial surveys have indicated potential for mini-hydro generation such as the small rivers in the areas close to diesel stations of Isoka (400 KW), Chinsali (400 Kw) and Nakonde (200KW) in the Northern Province.

Organizational set up.

Rural Electrification in Zambia is financed by the Central Government through the Ministry responible for energy by grants and subsidies to the Zambia Electricity Supply Corporation. The Ministry is reponsible for policy making and decision making on programmes and priorities in power development. The Zambia Electricity Supply Corporation was established in 1970 and operates on Commercial basis. The National Energy Council which was enacted by Parliament in August, 1980 will advise the Minister for Power, Transport and Communications on the development and economic use of all forms of energy. Both diesel stations and mini-hydro stations are adminstered by Government owned Zambia Electricity Supply Corporation, through the Rural Division which was established in 1975 to manage generation and distribution in isolated rural places. The Division has planning and construction departments as well as operations and maintenance in addition to supporting engineering services of another division of the Corporation. Financing of the rural min-hydro schemes has in the past been provided by Government Treasury while civil works construction and machine installations are usually given to tender. MHG stations are owned by Zambia Electricity Supply Corporation.

Technical-economic features.

MHG systems applied in Zambia are economically viable and especially that Government is intensifying agricultural development to achieve considerable food exporting targets in the next few years. But the technical-economic draw-back is the Country's own lack of human resources and funds and consequently it has to depend on outside manpower, technology, equipment and borrowed funds which has to be repayed with interests.

Local manufacturing of equipment, components and parts.

Capacitities and capabilities for local manufacturing of equipment, components and parts let alone cables, poles and other structures are remote today. But it is hoped that Government's present plans to develop local industry through decentralisation of industry, introduction of intermediate technology for local industry will eventually alter the present situation.

Existing programmes for development and training.

The existing programmes for development and training in the fields of MHG are as I have discussed in paragraph 4 above of this paper. A number of youngmen employed by LAWSCO have undergone different courses in the maintenance, instrumentation and operation of the existing hydro power stations and there has been no operational problems. Operational problems of MHG units cannot therefore be anticipated.

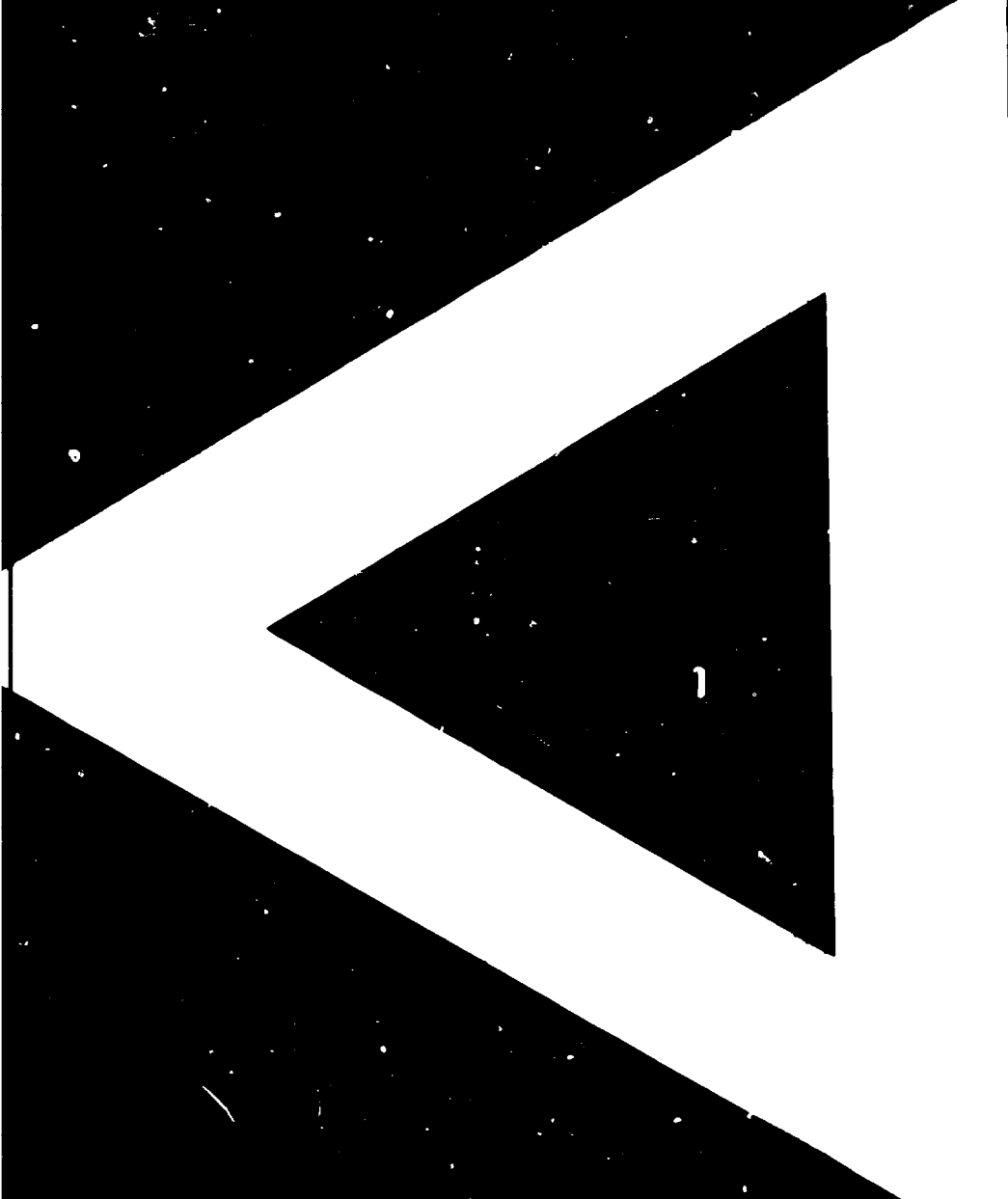
MHG in Finiland.

A study tour in June, 1979 by East African delegates of Finiland proved that Finiland has developed advanced technology in the design and economic application of mini-hydro power generation units which could find extensive use in remote rural areas of the participating developing Countries in the Seminar/Workshop.

Tampella Company in Finiland designs and manufactures Kaplan turbines for low-head application and some francis turbines for medium heads, as well as gates and other structures for hydro electric power stations. The capacity of turbines ranges from small 100 KW to 50 MW.

As a result of the flat terrain in Finiland the Country has in operation a large number of small hydro stations or mini-hydro stations utilizing heads of as low as five meters. Out of about 250 hydro power plants less 20 had capacity of more than 50 MW while 150 are of less than 10MW capacity. Only six stations had more than 40MW head, and the average head was 16 meters. The technology applied in Finiland in the MHG could be applied to Zambia and other developing Countries with advantage for distant areas where prospects of interconnection are remote on account of small loads to be connected and prohibitive high costs of transmission lines.

Under its present efforts in the MHG UNIDO would pave a better future for the children of the Third World countries.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