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POTENTIALS AND PROSPECTS OF DEVELOPING MINI HYDRO ELECTRIC GENERATION IN ZAMBIA*

by

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ELECTRICITY GENERATION IN ZAMBIA

The largest of the hydro-electric development has been implemented by the Zambia Electricity Supply Corporation a quasi-government body. The Central African Power Corporation is responsible for the Kariba South Bank Power Station and 220 kv and 330 kv transmission system, the Kariba North Bank Power Company is responsible for Kariba North Bank Power station and development, while Copperbelt Power Company is solely responsible for supplying the copper mines.

The Zambezi river where it forms the common boundary between Rhodesia (Zimbabwe) and Zambia supplies the major portion of the power requirements of these two countries from the Kariba Dam. The Zambezi rises at an elevation of nearly 1400 m in the region where the borders of Angola, Zambia and Zaire meet. It flows for a distance of about 2700 km to its mouth in the Indian Ocean. The total catchment area of the Zambezi is about 1.2 million km^2 and includes parts of eight territories: Angola, Zambia, Rhodesia, South West Africa, Botswana, Malawi, Tanzania and Monzambique.

The Kafue river rises north-east near the border between Zambia and Zaire. The rainfall in this area is averaging 43000 mm per year. The Kafue river is the biggest and longest river wholly confined within Zambia, with a total length of about 1600 km from source to mouth.

General direction of the flow from the source is South-easterly until Kitwe where it turns into a South-westerly direction as far as Itezhi-tezhi on the eastern boundary of the Kafue National Park. From here, which is mainly east until it discharges into the Zambezi river nearly 1000 km from its mouth in the Indian Ocean. From the source the Kafue river descends 115 m to its outlet on the Zambezi river. The Kafue river is the second largest source of hydro-electric power generation in Zambia.

The catchment area of the Kafue river basin is 154,000 km^2 The Luswishi, Lukanga, Lunga and Lufupa rivers are the main tributaries of Kafue river, but some of them contribute little to the run-off as most of the drainage is lost through evaporation and transportation in swamps.

PRESENT STATUS, POTENTIALS AND PORSPECTS OF DEVELOPING MINI-HYDRO ELECTRIC GENERATION

The main industrialised sections of Zambia follow the cource of the original railway line from the South built originally to exploit the Copper deposits in what is now known as the Copperbelt Province. This route passes through Kafue, the Capital Lusaka and Kabwe. The present and future development of the main sources of power are the three main rivers of Zambia; Zambezi , Kafue and

Luapula (down stream called Congo river).

ZAMBEZI RIVER SCHEMES

(a) Major Schemes Present Status:

Kariba South Bank Present Capacity	:	705 MW
Kariba North Bank Present capacity	:	600 MW
Victoria Falls Present capacity	:	108 MW

(b) Major Schemes Potentials and Prospects (future)

Mpata Gorge	:	1000 MW
Devil's Gorge	:	1240 MW
Batoka Gorge with Katombora Storage	:	1040-1600MW
Victoria Falls addition	:	140-250 MW
Kariba North Bank addition	:	300 MW

(c) Mini Schemes Potentials and Prospects (future)

Nangweshi	:	12 MW
Ngonye Falls	:	12 MW

KAFUE RIVER SCHEMES

(a) Major Schemes Present Status:

Kafue Gorge present capacity	:	900 MW

(B) Major Schemes Potentials and prospects (future)

Kafue Gorge stage III	:	450 MW
Itezhitezhi Dam	:	80 MW

(c) Mini (medium) Schemes potentials and prospects (future)

Nil

LUAPULA RIVER SCHEMES

(a) Major Schemes present Status:

Nil

(b) Major Schemes Potentials and prospects (future)

Mumbotuta Falls	:	111-228 MW
Mambilima Falls	:	111-152 MW

KALUNGWISHI RIVER SCHEMES

Medium Schemes potentials and prospects (future)

Lumangwe Fall	:	60 MW
Kabweluma falls	:	54 MW

OTHER MINI ISOLATED SCHEMES PRESENT STATUS:

Lusiwasi present capacity	:	12 MW
Chishimba falls present capacity	:	6 MW
Musonda falls present capacity	:	5 MW
Lunzua present capacity	:	0.6 MW

In that to investigate, arrange finance for and build new hydro-electric projects, and if special problems are involved, the time needed to supply the main scattered districts could have taken much longer, Zambia Government undertook to build 10 Diesel power plants as part of its accelerated Rural Electrification Development Programme at the following rural district centres:-

Kasempa, North Western Province	:	400 KW
Kabompo, " " "	:	400 KW
Zambezi, " " "	:	400 KW
Mwinilunga, " "	:	400 KW
Isoka, Northern Province	:	400 KW
Chinsali, " "	:	400 KW
Nakonde, (non district)	:	200 KW
Lundazi, Eastern Province	:	400 KW
Luangwa, Lusaka Province	:	200 KW
Kaoma, Western Province	:	200 KW

Thermal power is also generated in the Copperbelt by waste heat and direct fired boilers that generate 140 KWh per annum.

Stand by gas turbines of 82 MW capacity that can cater for the emergency requirement of the Copper mines in case of serious breakdown of the above generating plants in transimission lines, are also installed at the Copperbelt.

Zambia total domestic requirement for 1977 was estimated to be 6396 GWh with a surplus to export of around 3374 GWh.

In 1982 our consumption may increase to 9090 GWh with surplus to export of about 1910 GWh.

The transmission network start from Kariba South and North Bank Power Stations by two 330 KV circuits leading to Leopards Hill switching station near Lusaka where it is connected by two 330 KV lines from Kafue Gorge power station. Thr e lines also at 330 KV are continued to Kitwe in the Copperbelt. The existing Victoria/Kafue Town line would be uprated to 330 KV in the coming years. This interconnection form the Main Grid of Zambia. There are step-down stations at Lusaka, Kabwe and Kitwe from where lines at 88 KV and 33 KV are extended to other parts of the country.

Probably I would be right to state that Zambia is one of the rich countries in hydrological resources in Africa, if not the richest. It has hundreds of all weather scattered rivers, streams, rivulets, waterfalls etc. except in the Eastern Province and Southern Province where most of the rivers dryup from the month of August to November. For instance in the upper reaches of the Kabompo river there is a possibility of constructing mini hydroelectric station up to 10 MW in capacity and further schemes at Mutinondo Falls in Nothern Province, at Chimpempe Falls on Kalungishi river, at Chilambwe Falls, Kafubu river, Nothern Province etc. Zambia is therefore in a very much stronger position regarding the availability of hydroelectric power resources. Zambia has been probing into about 40 sites in the country which showed signs of hydro-potential in the rural interior.

At the present time, Zambia has electricity available at every provincial headquarters. The commissioning of six diesel generators in 1976 meant that there are now only 3 of the 54 district centres in Zambia without electricity.

PROBLEMS AND CONSTRAINTS IN DEVELOPMENT OF MINI HYDRO ELECTRIC GENERATION

In most cases rural electrification by itself cannot be a profitable investment for a considerable lengt of time. Due t the high cost of supplying individual consumers and the low demand, rural electrification will have to be subsidised for a considerable length of time. Even if the capital costs were born by the Government, the rural population would not afford to pay for the internal wiring of their houses, electricity connection fee and service charges to the suppliers. Most of the houses build in the rural areas are of mud-poles or unburnt bricks with grass thatched roofs, these does not permit the supply of electricity. The cost of building materials in Zambia are very high and very few rural inhabitants can afford to build suitable houses. This state of affairs will continue for some decades to come. The poor returns achieved from rural electrification is one of the reasons why private companies are unwilling to take up large rural electrification schemes.

Even in developed countries it was found that rural electrification would require Government participation as private utilities side-stepped the issue. It was to meet the need to cover the overall non-profit activities in the rural areas that the Rural Electrification Programme was started by the Government.

Although Zambia has the necessary hydroelectric potential, it is unable to develop its resources due to shortage of trained manpower, Even if Zambia produced many technicians on a pilot project, the requisite funds to finance the projects would not be found.

The difficulties are many in development of mini hydro electric generation uncertain response i rural areas, th lack of sophisticated data, high cost, difficulty of finding local finance, the chance of institutional failure.

At the present time Zambia Electricity Supply Corporation in particular and Zambia Government in general is faced with daunting problems. Economic recession and high fuel costs have meant that electricity prices have to go up and hit the consumer's pocket hard. But the phenomenon of high electricity charges is pushing the demand down resulting in the electricity utilities making poor returns to execute new hydro electric projects in the rural areas.

It is difficult to give an idea of the number of villages and their exact location in Zambia. This is in part due to the fact that many villages shift with the moving cultivation in the tribal areas. Villages are also built around a chief and when there is a change in the Chieftainship the villages are likely to change their locations.

Village regrouping and relocation of villages has been met with strong opposition in some tribal areas due to ancestory belief and customs. Some villagers cannot live in the same village because of fear of witheraft and hatred. It would be uneconomic to construct hydro electric scheme for say a village with a population of less than 50 men.

In Zambia most of the industries are centralized. Unless decentralization is implemented in all respects, decentralization of power generation has no future prospections.

The present power economies are partly inhibited by a number of administrative agencies whose piecemeal and uneconomic form of development has been encouraged by the organisation structure.

The constrainte in development of mini hydro electric resources are mainly related to the lack of funds and materials.

SUGGESTIONS FOR A SOLUTION TO THE PROBLEMS

It is inescapable that Government should subsidise rural electrification to achieve desired goals.

Establishment of Rural Electrification Programme Agency should be examined. The Agency should have the blessing of the Central Government. This body should act as a lending agency of the central Government and loans to rural electrical co-operatives be fixed at a low rate of interest. The interest rate should be fixed say at 2% per annum and loans repayable over a period of 25 years. The loans can be utilised for construction and operation of generating plants, transmission lines and distribution lines to provide electrical energy to persons in the rural areas. Loans could also be utilised to finance wiring in homes or to purchase electrical appliances or equipment. Government should appoint an administrator to ensure continuity of the programme.

Under the guidance of the Agency a community of people should set up their own rural co-operatives which are completely locally owned and controlled. The co-operatives should be responsible for the setting up and operation of electric systems in their area. Apart from the share capital by the members of the co-operative, the co-operative should be allowed to borrow from the Rural Electrification Programme Agency.

However, co-operative movements have not been very successful in Zambia for various reasons.

Alternatively each rural Province should on trial basis operate as an individual unit, both physcally and economically, each with its own races based on the cost of the service. The Central Government should pay a grant-in-aid to the rural consumers approximately equal to 50% of the entire cost of transmission lines and equipment necessary to deliver power to them.

Government has already launched a programme for each individual to build a burnt brick house with corrugated iron-sheet roofs. If village regrouping programme has to be put into a reality Government should first provide basic facilities such as mini-hydro electric generators and piped water at selected centres to instil a sense of belonging to people living in the rural areas. People will then move to the centres voluntarily people will become more definitely happy and contented. Availability of power will bring up the standard of living and also act as an impetus to the growth of village industries.

United Nations Industrial Development Organization should spearhead financial, technical and personnel assistance programme of decentzalization of power generation in the Third World countries which are suffering a great deal from the grobal burden of balance of payments and inflation.

UNIDO should consider attaching Administrators to the countries that will declare their intention to establish mini hydro electric generation units on the basis of the thinking of the sponsors of the seminar.

Developing countries must start thinking of development on a truly national scale through decentraliza ion of industry, introduction of intermediate technology for local industry, regional development planning and co-ordinated self-help programme, if decentralization of power generation has to become an economic success. Zambia is at present moving in this direction to revitalize village life as the phenomenon of rural-urban migration was of great concern to unindustrialised nations.

Investigations on the present organisational structure of the power sector have been made and recommendations put forward for the sector to be reoganised in the interest of efficiency and development of power generation, transmission and distribution.

After several investigations carried out in order to show the resulting costs of developing local hydro power as compared with extension of the interconnected system. It has been found that the economic solution for Zambia is an increased utilisation of the rich potentials of hydro electric resources in the country before a large extension of the interconnected system to cover the country can be considered.

Investigations have shown that in the rural areas development of local hydro stations could compete favourably with major hydro stations on the interconnected system including necessary long transmission lines. The erection of transmission for high voltages to cover the country and to connect the isolated areas with the intergrated system should wait until it is economically justified and can only be done gradually as soon as generation sites and loads develop.

UNIDO should collect information on the necessary future mini hydro electric schemes in the participating countries so that choice can be made by the international Financial Institutions based on their financial lending policies.

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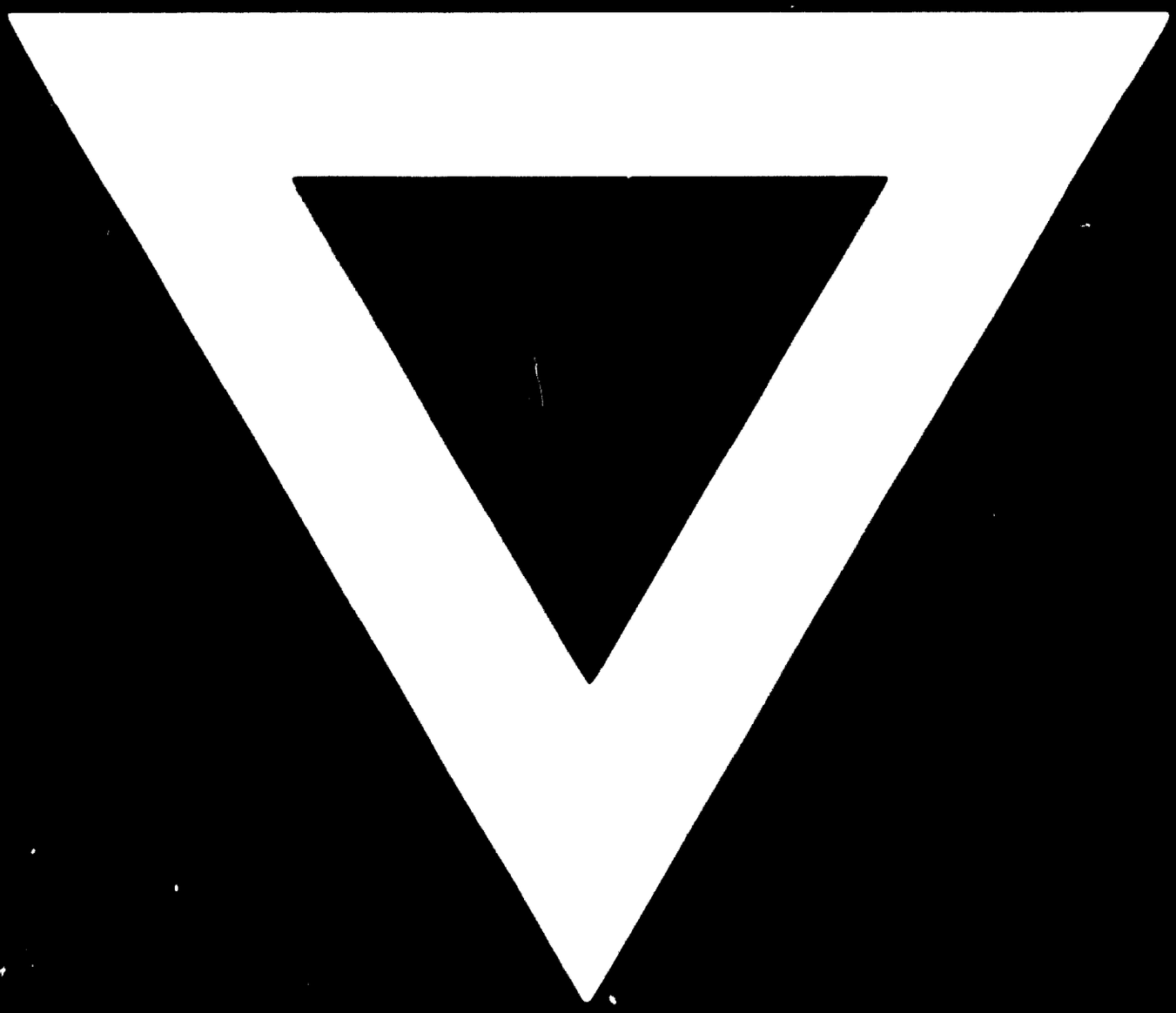

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