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SOME CONSIDERATIONS FOR INTRODUCING MICRO-HYDRO-ELECTRIC  
POWER PLANTS IN SIERRA LEONE\*

by

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## Introduction

Sierra Leone has a high potential for the establishment of decentralized micro-hydro electric plants as the basis for the electrification of its rural areas. However, not much has been done to exploit this valuable energy resource. Hitherto, there are only two operating plants, but even these are part of a water supply scheme.

There is no substantial energy resource within the borders of Sierra Leone other than water power. But virtually all electrical generating plants are diesel driven. Fuel oil prices are expected to fluctuate but in the long term, are likely to follow the fluctuations of the world market prices of crude oil. These prices have risen considerably in recent years and there are no signs that this rising trend will fall.

Except for a few mining activities, all of which are of course high energy consuming industries, the country's economy is based primarily on agriculture and Government emphasis is on agriculture as the backbone of the economy in the long term. However, most agricultural activities are on small-scale subsistence basis in rural areas. Electrical or non-manual forms of energy for developing agricultural processing industries and hence improving output are largely non-existent in rural areas. There is thus the need to improve the quality of life in rural areas through the introduction of certain amenities that would improve agriculture's output in these areas.

Rural electrification can facilitate easier realization of many rural development projects. Such electricity supplies must be planned such that the poor of the rural population stand to gain equally as the comparatively better-off. Common sense prevails that if the cost of such supplies is high as it is presently in the electrified areas of the country, it would be very unlikely to achieve the desired goal. Rural electrical supplies must be planned such that rural inhabitants can afford and be able to use it; so that the demand will continue to rise. The poor earning power of rural inhabitants would dictate that if such a scheme is to have any marked effect on agricultural output or the general social and economic welfare on

the rural population; thus the usual test of economic returns on investment must not be the basis for determining its viability at least at these initial stages. Ideally, rural inhabitants should acquire their own supply facilities through aided self-help efforts. The purpose of the scheme would be to augment or replace present rural energy sources and to make it possible for small-scale industries to be introduced in rural areas. In so doing, the price for the electricity supplied must be less than present sources so as to encourage rural inhabitants to adopt electricity as a more desirable and versatile available energy supply. At the moment in Sierra Leone, no alternative can be envisaged that would meet these criteria other than micro-hydro power where the resources are available.

Present Status, Potentials and Prospects of Developing Micro-Hydro-Electric Generation in Sierra Leone.

Sierra Leone has achieved only a low level of electrification. Rural Electrification is limited to a few large towns. The expansion of the power market for power suppliers in these has been limited by two main factors. Firstly, there are only a few specific development projects at a sufficiently advanced stage of planning, whose demands would require large generating facilities. Secondly, the average income per family head in these areas is very low and an extensive system would be grossly underused. Where the resources are available, micro-hydroelectric plants would be very suitable for providing power for these areas. Almost all electrification at present is based on diesel driven generators. There are two micro-hydro plants currently operating in the country but these are part of a water supply scheme. One of these, a 100 KW plant is used to provide power for the water treatment plant. The other, having a capacity of 2.4 MW is used six months in the year to feed part of the electricity requirements for the capital Freetown and its surroundings. There

There is a high potential in Sierra Leone for the use of micro-hydro plants for electrification but so far there are no operating plants except for the two specialized plants mentioned earlier. This potential was highlighted in a UNEP report that was prepared by the Lima Motor-Columbus Consulting Engineers in 1971. The report was primarily a hydrological study on the hydro-electric potentials of the main rivers of the country.

It was however noted and recommended that the topology of the country presents an attractive feature for the use of micro-hydro-electric plants. An earlier study by a Chinese team of micro-hydropower Engineers also suggested that the use of the country's water resources for the establishment of micro-hydro-electric plant is an attractive alternative to the establishment of electricity supplies to these areas by means of small thermal or diesel driven plants. The high cost of fuel oil and the continuing rise in crude oil prices would also favour the use of micro-hydro-electric plants where the potential exists. Recent developments and concepts in micro-hydro plant technology resulting in dramatic cost reductions and increasing the possibilities for local manufacture of components further bring us to the realization that the exploitation of this energy resource would be most meaningful in the long-term. Internally, renewed interest in research and development in micro-hydro-electric power plants and the rehabilitation and expansion of the National Workshop further render the establishment and adoption of micro-hydro plants in the near future, a likely possibility.

The Problems and Constraints in the Development of Such Resources Within Sierra Leone and Some Suggestions for a Solution to These Problems.

Like any new social development programme the potentials and benefits of which are not yet fully realized by the majority of the population, especially for that part of the population to whom it is primarily intended, there are many problems in the establishment and acceptance of micro-hydro-electric power to meet the energy needs of the rural population in Sierra Leone. In addition to its feasibility and viability both in its social and economic aspects, the rural population must be convinced that the scheme will provide a substitute energy source that is more suitable for their requirements and that the substitute energy is cheaper than present sources. The energy needs existing in rural areas are cooking, heating, lighting, provision of water supplies and agricultural applications e.g. food drying for preservation, grinding grains etc. Wood supplies most energy needs for cooking and heating purposes, kerosene for lighting and solar drying is common for food preservation. Most other energy needs are provided by muscular energy. Before the acceptance of micro-hydro plants to provide electric energy to meet these needs, it has to be ascertained

that the resulting electricity would be cheaper than wood, kerosene, and that the cost of acquiring end-use appliances is worthwhile in view of the circumstances i.e. availability of cheap electricity. Realizing this initial problem, our local research team views the provision of cheap electricity as only part of an overall rural development programme. In addition to ensuring that such electricity supplies are within the purchasing power of the rural population due regard is also given the development of cheap appliances that would depend on the resulting electricity supply for energy input.

Since the primary consideration for the establishment of rural electricity supplies is the equipment, installation and operating costs which have a direct influence on the cost of the resulting electricity, home manufacture of components and the provision of free local labour is contemplated with the object to effect the necessary reduced costs. But such electrical plant must be well proven both for their reliability and safety especially for the fact that they are meant primarily for use in rural areas where technical manpower availability would be a problem in itself. Ideally, an unmanned plant or one that would require minimal expert surveillance would be most suitable. In an industrialized state, there would be few problems in designing and developing such plant to suit local conditions. On the contrary, Sierra Leone has not yet attained the level of industrialization that would facilitate easy and quick solutions to the many problems of manufacturing and testing components especially at these initial stages. Although the basic human and infrastructural resources for the manufacturing or replication of some basic components or plants exist in the country, a lot of time-saving and efficiency would be attained if some collaboration is established with industries or organizations that have had a longer standing experience in micro-hydro plant technology. A lot can also be learnt on developments in other parts of the world with longer involvement, through participation by members of our local research team in conferences and seminars on rural technology and development. This is particularly important at the initial stages when mistakes are most likely to be made. Under such collaboration, it would be possible for some members of the local research team to make visits to existing operating sites and to undergo some first-hand training on developments in the developed country. This would be essential since the only two operating micro-hydro-plant installations in the country are of a specialized type and their costs

would inhibit their suitability for use in our rural areas. For this reason, some collaboration has been established with the London based Intermediate Technology Development Group. As a result of this collaboration, a member of the local research team received three weeks training on plants that have been installed by the Group in the West of England. In addition, the ITDG has also offered to provide some technical assistance at the various stages of the project. In particular, the ITDG has offered to help in setting up a pilot demonstration plant and also to help in establishing and improving our manufacturing capabilities. A pilot demonstration plant would be a suitable starting point from where more fundamental developments and modifications would be made to suit our local conditions. It is envisaged that after the successful demonstration of an operating pilot plant, success in the wider application of this scheme would require Government support. As a result, the aspirations of this project has been conveyed to Government through its ministries and para-statal most likely to be interested or involved; and they will also be kept up to date on any progress as regards this project. Besides the prospects of Government assistance for a continued involvement in micro-hydro plant research and development, the involvement of Government would provide the research team with many necessary information and skills available in its various ministries and it would also make the task of organizing and enlisting local support much easier.

Before however, decisions of components can be contemplated, it has to be ensured that such an industry would have a large enough market in the long term. It would thus be necessary to carry out detailed hydrological surveys and feasibility studies of all potential sites near potential users. No such study has been undertaken in the past and it would be a pre-requisite for any project that aims at a widespread and continued involvement in the installation of micro-hydro-electric plants. A market study can be carried out concurrently with the hydrological study. Such hydrological schemes might not be as detailed as those required for large hydro-electric schemes but nonetheless, there must be enough guarantees that in the dry seasons, streams do not dry up completely or underground water supplies are not exhausted completely to render the value of installed plants minimal. There is thus a need for a country-wide survey of possible sites and some hydrological studies on the suitability of these sites.

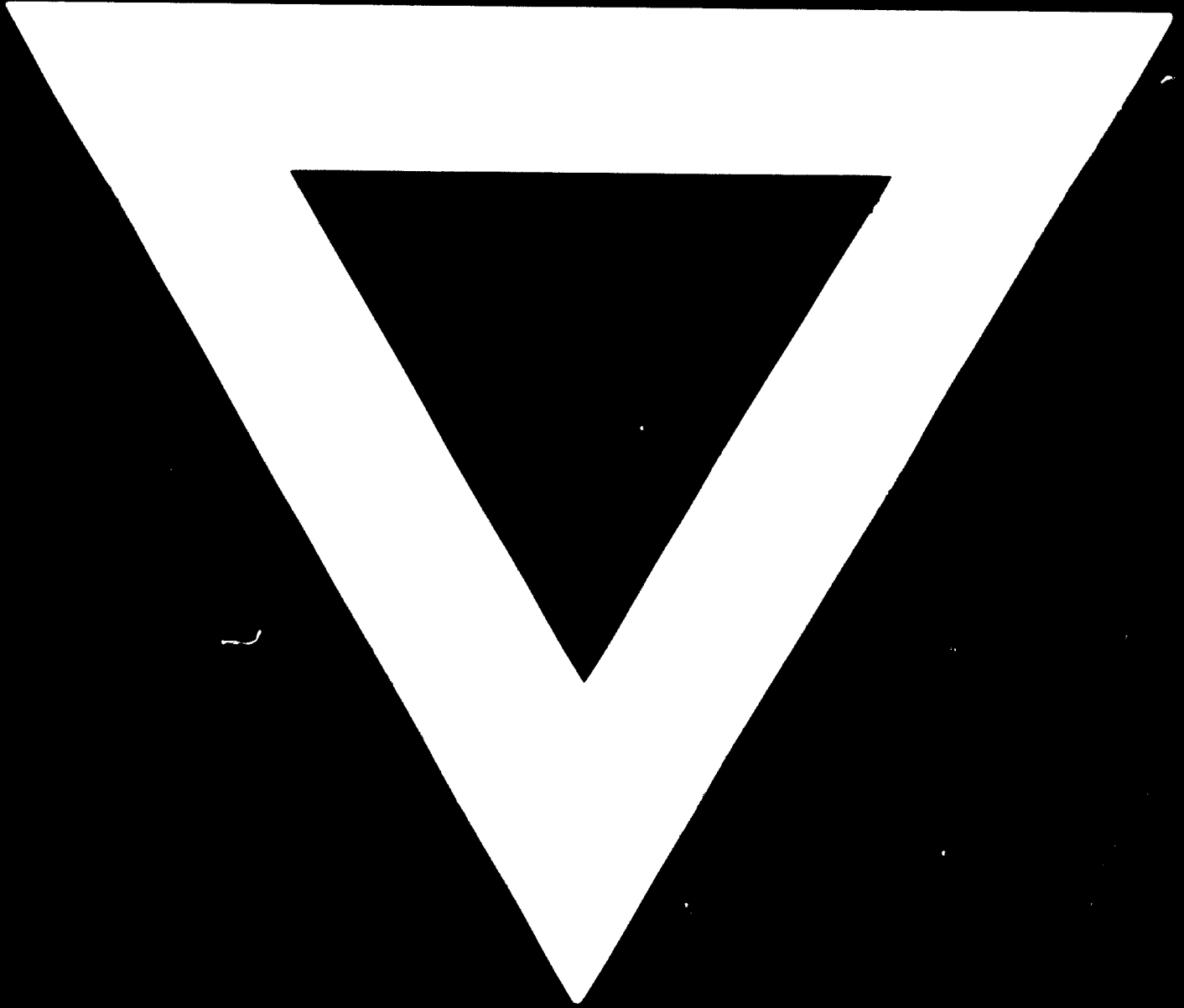
The most immediate problem and constraint on progress has been the acquisition of funds to initiate the project. It is expected that the first stage i.e. the identification of a few sites for experimentation will be funded internally. The University and some local aid-organizations have showed some interest in providing funds for this stage but nothing has yet been obtained. Some external organizations notably the ITDC and UNIDO have also expressed interest in providing technical and financial assistance in developing the manufacturing capabilities and improving present facilities to enable local manufacture of plant components. These will be pursued after a few suitable experimental sites have been identified.





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