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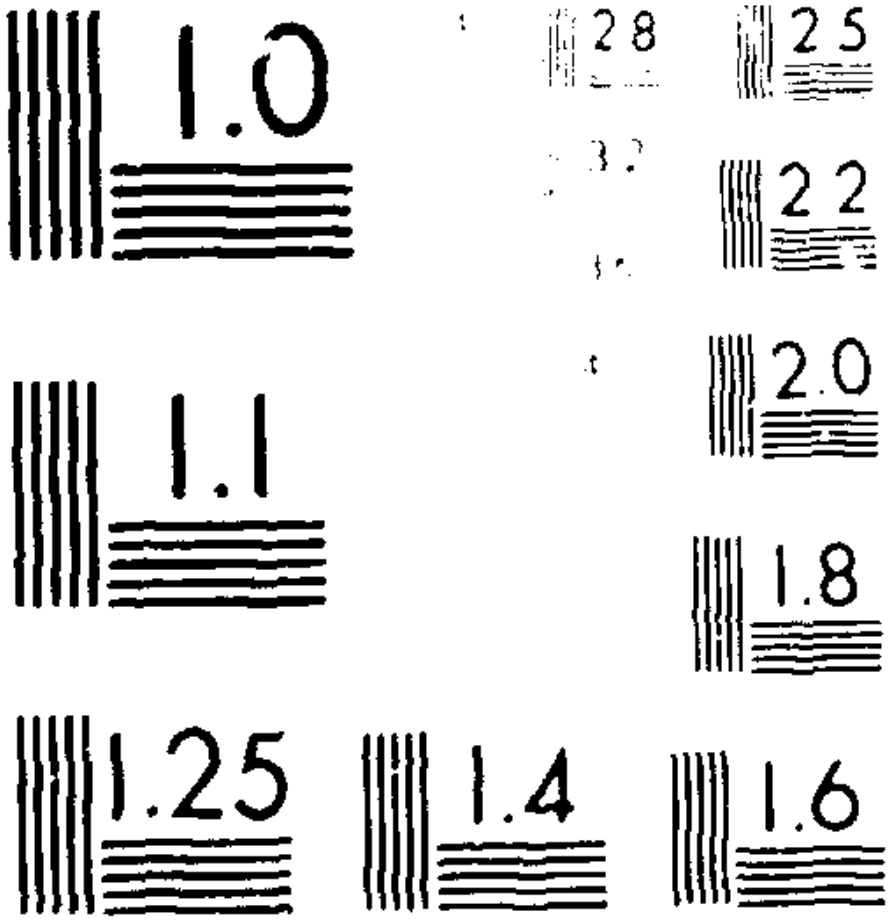
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MINI-HYDRO ELECTRIC GENERATION IN JAMAICA AND OTHER COUNTRIES OF THE CARICOM REGION*

by

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1. STATUS, PROSPECTS AND PLANS

1.1 Status

In Jamaica, about 4% of the 280 MW capacity of the electricity supply comes from three small hydro stations. The remainder of the power is supplied by thermal plants burning imported oil. The Island of Dominica with less than 20 MW generating capacity has an installed hydro capacity of about 12 MW. The only other English speaking CARICOM territories with commercially operating small or other hydro stations are St. Vincent, Belize, Guyana and St. Lucia. In none of the four last named territories is the capacity greater than 200 KW. A characteristic of all these commercially operating plants is that although they are by definition minihydro plants they were all built over twenty years ago and are, in effect, miniaturized conventional Hydro. Consequently, the technology utilized is such that the plants are all expensive due to the fact that the economies of scale peculiar to very large plants are the determinants of the costs of these small plants. In other words, these are not really mini-or micro-hydro plants in design philosophy or required costs. This is highlighted by the following features of all our commercial plants:

a) Costly and often extravagant civil works;

b) Speed control by inelegant and expensive mechanical or hydraulic feedback devices;

c) Electromechanical equipment imported from faraway places;

d) Parts that are not readily repaired in the locality and often impossible to repair in the territory;

e) Inattention to environmental and ecological factors in their sitting and construction.

1.2 Prospects

The economic factors and, to a lesser extent, the other negative features so far mentioned caused small hydro-sources to become a neglected resource in our countries until the mid-seventies when the oil bite began to sink in. Today, interest in mini-hydro and, indeed, the other renewable resources, has grown with an urgent vengeance.

Surveys are underway in Jamaica, Dominica, Belize, Guyana, St. Vincent, St. Lucia and Grenada to determine the extent of this resource. In Jamaica, over seventeen good sources have already been identified for grass-roots plants. The survey is less than 10% complete. Jamaica's local utility, Jamaica Public Service Company has recently received permission to develop three sites for power generation in the one megawatt range.

The renewable Energy Development (R.E.D.) Division of the Scientific Research Council of Jamaica has constructed one small station in the ten kilowatt range which has a number of new features relative to technology presently being used in the region. The Division is also spearheading a further survey of all large gravity fed pipeline systems with a view to harnessing excess hydraulic energy for electricity generation from the flow in already existing potable and irrigation water supply systems.

One of our waterworks, the entire Hermitage Water conduit system which feeds the city of Kingston has a harnessable potential of over seven megawatts in a tunnel and from the lines.

1.3 Plans

Both the Government and the Opposition (at this time of national elections) have announced grand plans to develop mini-hydro to the fullest extent using the most up-to-date technology in order to cut costs and propagate rural electrification and supplement the thermally supplied electric power.

Part of the planning calls for isolated units serving rural farming communities or minigride serving such areas. In areas proximal to the National Electricity Grid the plan is to network in the small supplies but, perhaps, the greatest, unsolved technical problems relate to optimally designing network, switching and frequency controls for these types of plants.

The Renewable Energy Development Division recognizes this and has recently begun a programme of work aimed at solving the networking/frequency control problem by the use of appropriate electronic circuiting configured about microprocessors, thyristors and "dummy" or balast loads.

2. ORGANIZATION, DIVISION OF RESPONSIBILITIES-JAMAICA

The present organizational set-up for minihydro, as for other Alternative Energy Development in Jamaica is not good. But what is evolving approximates to the following:

Policy: The Ministry of Mining and Energy
R,D+D: The Scientific Research Council's R.E.D. Division
Project Implementation: Petroleum Corporation of Jamaica
Long Term Operation: Jamaica Public Service Company
Planning some Construction: Scientific Research Council, (R.E.D. Division)
Construction: Private firms, public sector bodies

It is not untrue to say, however, that most of the effort is devoted to feasibility studies and more feasibility studies. This is perhaps due to lack of confidence borne out of lack of experience with this effectively new technology to Jamaica.

The simplest tasks in hydro development are often delayed because of interminable meetings. The cost of importing foreign "experts" often approaches the contemplated capital expenditure for the proposed project.

3. TECHNICAL, ECONOMIC AND ENGINEERING DATA ON A RECENT PLANT BUILT AT GRIFFIN IN ST. ANDREW PARISH, JAMAICA

Type of Source:	Existing Gravity Fed Pipeline
Position Head:	240 ft
Flow:	200 i.g.p.m.
Prime Mover:	Centrifugal Pump reversed operation
Alternator:	Single phase, belt driver, 12 KVA
Power output:	Below 9 KW
Cost of Equipment:	Ja$ 4,200 for pump Second hand alternator, metal base, and galvanized steel piping
Cost of Labour:	Free from R.E.D. Division, the community, the Local Government Authority (KSAC) and the Jamaica Defence Force
Operating Costs:	None yet
Purpose:	An isolated demonstration plant with fixed resistive loads. However, a 2 KVA inductive load was often attached to the plant in the early days of its operation
Built by:	The Renewable Energy Development Division of the Scientific Research Council in collaboration with the KSAC and the J.D.F. Village plumbers were used.
Ownership:	The Community via the K.S.A.C.
Managed by:	The R.E.D. Division of S.R.C.
Financed by:	Scientific Research Council

Footnotes:

(a) The station operated successfully for over eight months. Speed control was effected by simply varying the field excitation current of the alternator manually. But with fixed loads, most of the time, this was not a major disadvantage.

(b) The alternator's fan mechanism was ruined by overspeeding induced by a water surge which occured where one of the villagers who had not been properly trained in the station's operation attempted to clear thrash from the intake at the impoundment without first diverting the supply around the electro-

mechanical unit via the valves and piping specifically installed for this by-pass function.

Damage to the station is not great but it is unsafe to operate it in its present condition. Since there are to be two other phases to this project which are planned to incorporate appropriate safeguards and controls for villager operation it has been decided to await funding for the subsequent phases before effecting the repairs necessary.

4.0 SALIENT TECHNO-ECONOMIC FEATURES OF EXTANT SYSTEMS

As noted before, the MHG plants in operation throughout the region on a commercial basis are of old technology. Their control mechanism are bulky and very costly. The capital outlay for that type of plant is still distinctly above that of a modern thermal plant.

But the major costs are civil works so that much of the technological development needed for minihydro plants has to do with the design of low cost impoundments, dams, penstocks etc. The requirements on civil works development are quite rigorous in our region because of the frequent occurence of flash flooding and hurricane conditions.

5.0 CAPACITIES AND CAPABILITIES FOR LOCAL MANUFACTURE

There is little capacity for manufacturing Pelton wheels Francis Turbines, Kaplan Turbines and other of the more traditional prime-movers.

However, we do have the capability and capacity to manufacture cross flow turbines. This would of course be greatly facilitated if a set of standards were developed for such simple turbines so as to encourage simplification and systematization of their fabrication.

Interestingly enough, Jamaica and indeed, the rest of the region has ample capability and some capacity for switchgear and even alternator manufacture. The local assembly of electronic controls does not present a problem once norms on these have been tested and decided.

The use of centrifugal pumps operating in reverse has so far been pursued by Jamaica for the following reasons:

(a) The pumps are inexpensive for high head operation and can be easily inserted in pipeline systems. Typically pumps are a quarter the price of the indicated turbine and the loss in efficiency of conversion is more than offset by the advantage of low capital cost. The relative life cycle costs, of course vary and the comparison ought to be made in each case before selecting a prime mover.

(b) There are now over twelve pump-repair establishments in Jamaica and sources of mechanists who can do major repairs on pumps of all the simpler kinds.

(c) The life of a centrifugal pump operating as a prime mover is comparable to or greater than its life in conventional pumping applications.

(d) Centrifugal pumps are available "off the shelf" whereas many turbines still have to be custom made.

(e) The maintenance of pumps is quite simple and can be grasped by rural folk of little mechanical sophistication.

6.0 EXISTING PROGRAMMES FOR DEVELOPMENT AND TRAINING

6.1 Development

The R.E.D. Division has been engaged in source surveys along with the Geological Survey Division and the Water Resource Agencies.

The Research Effort on Networking and speed control of small isolated and integrated systems has had to slow down considerably due to lack of funding.

Even when government releases the local funding necessary, there is always the problem of obtaining requisite foreign exchange in a country in severe economic difficulties such as ours.

Private interests are also involved in the development work but their initiatives are blunted because the banking community is understandably cautious about these "new" energy technologies.

6.2 Training

No systematic training now takes place in MHG within the region. The welcome efforts of UNIDO and USAID has resulted in no more than four individuals including the author being exposed by means of a conference, a seminar, one study tour all lasting less than a month to MHG.

7.0 RENEWABLE ENERGY DEVELOPMENT STATION JAMAICA/CARICOM

Fortunately, the Governments of the CARICOM States are about to establish a regional centre of excellence called the rurally located Renewable Energy Development Station which is intended to work in R, D+D and extension for indigenious energy sources, implement pilot plants, train personnel, do limited commercial engineering design and project management and be one of the centres through which public and other technical assistance funding for regional renewable energy work may be funnelled.

The proposed station, which is to be governed by a regional board is planned to become self financing within five years through earnings generated from its services.

The Swedish and Jamaican Government have entered into a bilateral Agreement to fund a study of the feasibility of operating such a station in Jamaica.

The Region has agreed to put the project as a first priority for funding under the United Nations Interim Fund for Science and Technology Development and other sources.

If and when this station comes into being work on MHG will be one of its principal functions.