SMALL HYDRO POWER PLANTS

Utilising Water Release from Irrigation Tanks

The concerted cut backs in production and price increases of oil from late 1973 and subsequent fears that most of the world's oil reserves may be exhausted before the end of the century has excited much interest in alternative sources of energy. In Sri Lanka too, despite the availability of a high hydro-electricity potential and other possible energy sources, our increasing dependence on oil as a major source of energy has caused growing concern. The fact that the oil wells will be running dry seems to be more a cause for optimism that it does for gloom for those who have faith in simple technology and alternative energy sources such as plant wastes, the sun's warmth, rushing wind and falling water. The research into alternative renewable energy sources has been stepped up in most countries, and one area that is receiving wide attention is the exploitation of small hydro-power sources. Electricity can be generated on a small scale for local use with turbines adapted to slower, or lower, volumes of water. They are once again gaining popularity in the West; and small generators for units under 50 KW, have been installed in China by the thousands for village use.

The small hydro-power plant and its wide use in China has come into prominence in recent times with the Government's intention to send out a team of engineers to study the Chinese experience in this regard. A brief survey of the current technology reveals the existence of a large number of turbine manufacturers in several countries which offer small hydro-electric units with outputs as small as ½ KW. Even in countries such as U.S.A., turbine manufacturers have developed hydro-electric units with outputs as small as ½ KW. A turbine manufacturer in the United States offers suitable "packaged" hydro-electric units off the shelf with electrical outputs ranging from 0.5 KW to 10 KW. For each power output, several turbine designs are offered, to suit varying heads from 8 feet to 25 feet. These packaged units employ propeller-type turbines with fixed blades and are directly connected to the electric generator. In addition to these packaged units, the same manufacturer offers the traditional type of 'Francis' turbines. One model available develops 15 KW at 294 r.p.m. under a head of 10 feet. Its low speed requires a belt or gear connection to the electric generator. The Soviet Union builds fixed-propeller units very similar to those described above. A firm in England offers small units of capacities even as low as 10 KW operating under heads of 10 feet and above. There are several firms in Canada, West Germany, France, Switzerland, Hungary, Japan and India that manufacture small hydro-electric units for outputs from 3 KW upwards at heads ranging from 4 metres and above.

Published information indicates a rather widespread and reliable technology of small-scale, low head hydro-electric plants in the People's Republic of China. The literature has also indicated their growing popularity in rural areas where thousands of units of less than 100 KW capacity have been installed, including one wooden turbine for a 10 KW hydro-electric plant.

South of the 24th parallel; China is a country of heavy rainfall and sharp relief suited to the development of hydro-electricity. By 1975, some 60,000 small hydro plants had been constructed, over 95 per cent being located in the wet, southern part of the country.

Most of these plants are very small, averaging about 42 kilowatts — enough to provide energy for four North American cooking stoves. The Chinese do not use this precious energy for cooking. Instead, it is husbanded for household lighting (one or two 15 to 40 watt bulbs per house) for irrigation pumping (12 kilowatts can power local irrigation and drainage facilities), and for rice husking and milling — all labour intensive activities. One county in South China reports one million work days a year saved by

mechanised grain processing from locally generated hydro-electricity.

Following guidelines of self-reliance and self-sufficiency, the majority of small hydro plants are constructed by local peasants from local materials. A particular interesting use of an irrigation canal has been made in Linhsien, in China where a series of 26 small hydro-electric plants have been built along the 12th channel of the No. 1 Branch canal of the Red Flag Canal irrigation system, taking advantage of the progressive drop in elevation. The first plant, capable of generating 250 KW is located at the bottom of a 15 metre drop, at the top of which is a sedimentation basin, to remove the sand and silt. Thereafter, at every 5 metre drop in elevation, one 40 KW turbine has been installed, each one preceded by a sedimentation basin.

Small scale hydro-electric units lend themselves to significant cost reductions through local enterprise.

The technology on small hydro-electric plants has been developed in most countries and such units are being made with outputs even as low as ½ KW. The technology for power units in the range of 250 KW to 3.000 KW is even more developed. For instance, typical mini-hydro plants producing 300 KW under a head of 13 feet and a flow of about 250 cusecs are now available in the market. The production of small standardised turbine units in the range of 500 KW to 3.000 KW at heads ranging from 20 feet to 75 feet is being undertaken by several manufacturers on countries such as Switzerland. India, Japan and France. There are numerous examples in Japan where irrigation water releases are being used to operate small hydro-power plants of capacity 1000 KW and upwards at heads ranging from 20 feet to 70 feet. The unit costs of these plants now compare very favourably with those of the bigger schemes.

Most of the major irrigation tanks in our North Central Province have water releases of 200 cusecs and over at heads ranging from 20 feet to 50 feet. For example. the Minneriya tank has a maximum discharge of 525 cusecs and an average discharge of 230 cusecs. The Parakrama Samudra has an average discharge of 300 cusecs with a maximum discharge of 510 cusecs. Considering the present technology in this field, it would be conveniently possible to install small hydro-power plants operating on the water release of the irrigation tanks.

As far back as 1963. action was initiated by the then Hydro-Development Branch of the Department of Government Electrical Undertakings to construct a small hydro-power plant at Minneriya. The design envisaged a plant of 550 KW capacity. Designs and specifications were prepared and tenders invited. Bids were also received. However, perhaps due to the proposals for the extension of the hydro supply to the Minneriya area from the National Grid, this project for the installation of the small hydro-power plant at Minneriya has not been proceeded with.

With the diversion of the Mahaweli waters to the North Central Province, the prospects for this plant have further improved. This additional controlled supply of water to the Minneriya tank would improve the conditions of head at the outlet sluice and would more than justify the installation of a plant of bigger capacity, say, 1000 KW. It has to be appreciated that such a plant could generate approximately 4 million units of energy per annum, depending on the water releases for irrigation purposes.

The Minneriya power plant could serve as a pilot project and it should be possible to construct similar small hydro-power plants at the other irrigation tanks. Some of the tanks that could be studied for the installation of such hydro-power plants are Kalawewa, Rajangana, Parakrama Samudra, Padaviya, Kaudulla, Huruluwewa and Nachchaduwa.

In addition to these major tanks, there are almost 300 irrigation tanks of moderate size where small hydro-power plants of suitable capacity could be installed.

In considering the energy options for Sri Lanka it is very necessary that the hydro-power potential in the water released from the irrigation tanks be fully utilised by the installation of suitable small hydro-power plants. Action could also be taken to exploit similar potential in the small streams of the hill country, which until a few years ago, were harnessed on several tea estates to operate small hydro-power plants.