C.S.O.

(Formerly)

SUBJECT :

ELECTRICITY SUPPLY - STANLEY

Murrel River Hydro-electric project

CONNECTED FILES.

NUMBER AND YEAR.	
120/44	Suggestions for harnessing tide for power.
1398	Camp Hydro-Electric Scheme.
1201	Large Scale Generation of Electricity by Wind-Power.

27th May 1955

From Civil Engineer
To The Hon: the Colonial Secretary

Water Power Development - Murrell River..

In accordance with your recent request I carried out an inspection of the MURRELL RIVER on 20.5.55 and measured the flow of the river in the vicinity of the most suitable site for water power development, setting up a temporary gauging run for the purpose. Site is at(921.6-738.2) on Falkland Islands (1:25,000) Sheet 1 A. An alternative site is at (921.6-738.4) which sacrifices a few feet of working "head" being lower downstream but in other respects is almost as good.

2. This report is somewhat lengthy due to an attempt to put data in non-technical language for ease of digestion. Recommendations are summarised in the concluding paragraphs but I must emphasize that a detailed survey is necessary before plans can be finalized.

3. Althouga the detailed layout of the hydraulic plant required for water development changes with every site the following features - or most of them - are common to all:-

(a) The Dam which impounds the water and regulates the level of the upper pool and by which means the flow is directed towards the water wheels or turbine

(b) The Regulator, commonly called the Head Gates controlling the supply to the water wheels. It is usual to fit screens or racks on the upstream face to prevent the ingress of injurious floating or suspended matter.

(c) The Head Race which may be a pipe or an open lined channel or canal which carries the water to the water wheels.

(d) The Power House which contains the hydraulic machinery.

(e) The Water Wheels, frequently Turbines, which transform the hydraulic energy.

(f) The Draft Tube and Tail Race which discharge the water used back into the river.

Note:- In some hydraulic projects, particularly where the Dam impounds considerable quantities of water, the Power House forms part of the Dam and water is delivered direct to the Water Wheels without passing through a Head Race.

4. At MURRELL RIVER, as at all other sites, the first two things to be determined in considering the problem are (a) the head of water available and (b) the characteristic flow of the river.
The head of water can be determined by levelling and where necessary by reading water level gauges located above and below the site for the proposed development.
The characteristic flow is found by a series of discharge measurements combined with the daily reading of gauges over as long a period as possible. It is the available dependable flow during at least nine months of the year. It is never economical to instal machinery which can use only the minimum flow.

2

5. A series of discharge measurements on 20.5.55 revealed that the river flow was at the rate of 18 million gallons per day - averaging a mean discharge of 33 cubic feet per second. It is obviously not possible to state whether 33 cusecs (33 cubic feet per second) is the characteristic flow but examination of rainfall and meteorological returns shows that May approximates fairly closely to the monthly average as follows:-

	May	Monthly average
Mean Rainfall (inches)	2.5	2.32
Mean maximum fall	.49	.53
Mean minimum fall	0	0
Mean Number of wet days	21	19
Mean Temperature (Farenheit)	39°	42°
Mean Relative Humidity	86%	81%

6. The rainfall recorded at STANLEY during the 12 hour period ending at 8 pm on 19th May was 0.7 mm and during the following 12 hour period ending at 8 am on 20th May was 0.6 mm giving a total precipitation of 1.3 mm (0.5 inches) during the 24 hour period compared with a daily average of 2.5/31 (say) 0.8 inches for this month or 0.76 for the year. The relative humidity and temperature, 94% and 41.9°, were however both above the monthly means.

7. For the purpose of this preliminary report it is assumed that the measured flow on 20th May was of the same order as the characteristic flow of the river i.e that the deviation from characteristic flow would not be greater than 20% - 25%.

8. I calculate that a 36" internal diameter pipe laid at a gradient of 1 in 600 would carry this discharge of 33 cusecs at a velocity of just under five feet per second and I estimated that such a Head Race, which would be about 150 yards in length, could deliver water to the turbines in the Power House with an effective "head" of twelve feet. An increased velocity above 5 f.s. is likely to cause corrosion and incrustation of the Head Race. It is known that upland waters containing peaty acid cause rust in steel and iron pipes.

9. This "head" and discharge would develop 45 theoretical Horse Power, but for practicable purposes, taking into account losses in the turbines and conversion machinery it would be unwise to assume a greater overall efficiency than 80% which would thus produce 36 H.P. and generate 27.85 kilowatts.

10. The total demand at Moody Brook Filtration Plant will be about 15 kilowatts of which 12.68 will be required to operate the pumping machinery and possibly 2.32 k.w for heating, lighting and other domestic purposes in the building.

11. Should it ever be necessary to supplement the Moody Brook supply from the Murrell River, pumping machinery of the order of 15 H.P. will be necessary as the water would have to be lifted over the saddle (elevation 297.0) between Mount Longdon and Two Sisters. This would absorb 11.2 kilowatts

12. In such a contingency a small Hydro-electric scheme on the Murrell River designed on the above basis could provide enough electrical energy to perform these two functions i.e pump raw water from the Murrell River to Moody Brook and, after treatment, pump onwards to the Town Reservoirs, but there would be no electrical supply available for other purposes.

13. As the power transmission line from Murrell River to Moody Brook is just twice the length of that from Moody Brook to the Power House, its cost based on that for the

estimate for the Moody Brook / Power House line would be about £11,500 incuding erection.

14. The Civil Engineering works necessary would include

(a)	A small Dam across Murrell River	£1,500
(b)	1,250 sq. ft steel sheet piling in right bank flood bund @ 8/- sq.ft.	500
(c)	Right Bank flood bund	400
(d)	Head Regulator and gate with grille	500
(e)	450 ft length 36" dia pipe laid	1,260
(f)	Power House with machinery foundations	600
(g)	Outfall and tail race	250
(h)	Miscellaneous Protective works	500
(i)	Temporary Camp and stores	600
(j)	Watching	100
(k)	Local transport	150
(l)	Allow for working in water	200
(m)	Contingencies (allow)	640.
	(Total)	£ 7,500

15. The hydraulic machinery, alternators and generators would probably cost about £2,000, so the estimated total cost of the Project would be £21,000 (£11,500 plus £7,500 plus £2,000).

16. The cost of supplying electricity from the Power Station to operate Moody Brook Filtration Plant daily for a period of five hours, which is the anticipated demand, at present charges of 3d per unit plus £1 per quarter will be £346 per annum, and it would not be until the water demand of Stanley town doubled that interest charges on this capital sum would bear comparison with the cost (£688) of a ten-hour daily supply of electricity.

17. From the financial and economic aspect, this small scheme is not attractive and I have accordingly given some consideration to a larger project which, though initially more expensive, should produce more favourable results.

18. On the assumption that the characteristic flow in the river is 33 cusecs, and since the velocity in the head race should not exceed five feet per second for the reason given in para 8, the only means whereby increased power can be generated at Murrell River would be (a) by increasing the height of the Dam, or (b) by extending the length of the head race, or (c) by a combination of (a) and (b)

19. A Dam across the river to a height of 16 ft above bed would require to be 100 ft in length and might cost £10,500 instead of £1,500 given in (a) of Para 14 and further to obtain increased head it might benecessary to extend the Head Race by an additional 900 ft, adding £2,520 to item (e) of same para:. If, as anticipated by these improvements, the effective "head" is increased to 25 ft, 75 kilowatts would be generated, and the cost of the hydraulic machinery etc should be about £4,000 making a total estimated cost of the project in the neighbourhood of £34,520.....Power Line £11,500, C.E.Works £19,020, and machinery £4,000.

20. Detailed investigation may reveal that the Dam need not be raised to this extent - the length of head race is

the length of the head a relatively minor consideration compared with the cost of and in such circumstances the total cost of the Civil Engineering works (and of the complete scheme) would be reduced.

21. The generation of 75 kilowatts constantly throughout the year would enable 60 kilowatts to be fed into the Power House when the Filtration Plant is operating and this would very materially reduce the cost of the Town supply as it would provide 525,600 kilowatts at negligible cost.

22. Assuming a fuel cost of 1d per kilowatt, which may be possible now that fuel is being delivered in bulk, the saving would be £2,190 but from this must be deducted the cost of maintenance of the Civil Engineering works (value £19,020)@ 1½% per annum... £285 and depreciation of machinery (value £4,000) @ 15 years' life or @ 6.67% per annum...£267 resulting in a nett saving of £1,638 per annum.

23. In addition there would be the saving in cost of supply to the Filtration Plant, vide para 16, amounting to £346 per annum and possibly rising to £688 per annum, at present charges

24. With the present total demand on the Power House of some 550,000 kilowatts per annum, the feeding back of 525,600 units would mean that during many hours of low demand, no generation need take place at the Power House and except during peak load periods, one unit could run at half throttle whenever the load exceeded 60 kilowatts, or at its most economical speed which is substantially less than full throttle.

25. Provided therefore that a survey of the site for the Hydro-electric project reveals conditions which will produce 825 effective units (product of effective Head & Discharge whatever their combination may be, the scheme will be a very attractive proposition, for a capital outlay not exceeding £34,520 should result in an annual saving of at least £2,000.

26. It may well be that the cost of the Civil Engineering works can be reduced or the estimate of effective units increased when survey plans have been examined.

27. If a surveyor can be placed at my disposal - about one week's field work may be necessary - I would be very pleased to direct his activities and subsequently report in greater detail.

28. I recommend that such an engineering survey be carried out.

A.P.Weir
Civil Engineer

R/oh.

In order to arrive at the true cost of production of 1 unit, it is necessary to take into account amortisation of the construction loan in addition to depreciation. The report takes into account depreciation but not amortisation - and that puts a somewhat different aspect on the scene.

C.E., with whom I have discussed this point - will look at the report again and comment. In the meantime N.F.A.

8/6.

30/6

9/6.

5.

No.

It is requested that, in any reference to this memorandum the above number and date should be quoted.

MEMORANDUM.

0428/D

9th June 1955

Civil Engineer

Stanley, Falkland Islands.

The Hon. the Colonial Secretary

SUBJECT :- MURRELL River - Water Power Development

Ref telephone conversation yesterday and further to my memo of 27th May 1955, the following amounts show the annual peyments required to repay a loan of £34,520 within a period of 30 years at various rates of interest:-

4½% interest.....£2,110; 4% interest.....£1996.

3½% interest.....£1,877; 3% interest.....£1761

These amounts of annual payment include principal and interest.

2. If the loan is liquidated within 30 years, the indications are, vide paras 22 & 23 of my memo, that the project would be self-balancing with 4% loan interest and possibly with 4½%

Civil Engineer.

AHP/10/6

6

Y.H.

(1) to (6).

Does Y.H. wish the survey mentioned in paras 27 & 28 & (4) to proceed?

H. 17/6

C.S.

1. Too late time as there is no F.I.D.S. ranger available at the moment.

2. But what is required is an assessment - on a financial basis - as to whether the project would be an economic proposition. It looks doubtful to me.

3. Supt. Base Hope - who has a copy of 1-4 (but not ~~John~~ J.S.) should consider the full implications and submit his considered views in detail. Perhaps you would then look at the figures and let me have your views.

D.G.I.S.

17/6.

S. P. H.

1-6.

Please submit your detailed views.

D/1. 25/6

765.

It has been shown by the C.E. that annual payments to include repayment of capital and interest on a loan of £34,520 over a period of thirty years @ 4½% amount to £2,110 or @ 3% £1,761.

Using the basis of 75KW being available throughout 8,760 hours of the year the Hydro Station would produce 525,000 units annually, with fuel costs at 1d per unit this, as first thought, would save £2,190 in fuel costs, or an annual saving of £80 in the case of a 4½% loan and £431 with a 3% loan. There are however some other factors which should be considered. a) Assuming 525,000 units are available it would not be possible, owing to the nature of the load at present, to consume this amount, perhaps not more than 75% of this. b) In addition to the payments by sinking fund and interest, there would be the additional annual costs for maintenance of civil engineering works, estimated by the CE @ £285. and, (I am not certain whether this should be included), depreciation of machinery, estimated @ £267. From this it would appear that the proposed project is not economically sound. It should be noted however that the figure of a 1d per unit will not in my opinion be lower and may even reach double this, or what we have been paying in the past. Also if a more detailed survey is carried out and instead of 75Kw being available it is found that something greater than this is possible, then instead of the project standing in the balance as I believe it does now, it would then be economically sound. One other factor of importance is that in time of hostilities it is a sure form of power for essential services, i.e. communications, water supply, and medical services.

22-6-55.

0428/D.

CIVIL ENGINEERING DEPARTMENT,

STANLEY, FALKLAND ISLANDS.

10th October 19 55

Possibilities of Hydro-Electric and Aero-generation

Y.H.

Reference your minute of 28.9.55

The Chief Meteorological Officer and I visited the Murrel River on 7th October, 1955 and opportunity was taken to gauge the flow. It amounted to 4.3 cubic feet per second only.

It will be noted that the weather had been particularly dry in the preceeding weeks.

2. This low flow may not materially alter the "characteristic flow" of the river which in my memorandum I assumed to be 33 cusecs but it does mean that there can be no hope whatever of a hydro-electric scheme on the Murrel meeting the total power demand of Stanley without an impounding reservoir of magnitude

In these circumstances I suggest that xxxxxxxxxx (iii) on page 5 of your draft memo be amended by deletion from the ninth line onwards to end of paragraph.

3. In view of the difficulty of transport I estimate that the cost of constructing a measuring weir on the Murrel River Item A (i) page 10 would be £100, and the cost of taking periodic gaugings for one year, i.e. three times weekly during dry season of six months and once weekly during wet season of 6 months @ £1 per visit would be £100... Item A (ii)... £100 per annum.

4. The items of expenditure in the summary on page 11 would be :-

Capital

(i) Measuring Weir - Murrel River £100.

(ii)

Recurrent

(i) Periodic readings at the Murrel River measuring weir ..... £100.

Civil Engineer.

c.c. Hon C.S.
C.M.O.

9

Colonial Secretary ✓
Civil Engineer
Chief Meteorological Officer
Superintendent Power and Electrical Installations

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10 — 21

I attach for preliminary consideration a draft Memorandum for Executive Council and Standing Finance Committee on the subject of the possibilities of hydro-electric and aero-generation.

The Memorandum sets out to do two things :-

(i) To summarise the effect of the recommendations of the Walker Report.

(ii) To make the case - as regards policy and the requisite finance - for carrying out certain investigations that are necessary before the matter can again be considered.

I should be glad if C.E., C.M.O., and Supt. P. & E.I. would have a careful look at the figures quoted and make certain that the sums are right - completing the sums where necessary.

I should also be glad if :-

✓ (i) C.E. would estimate cost of measuring weir for the Murrel and collection of data and readings.

(ii) C.M.O. would list and estimate cost of equipment required for wind data.

(iii) C.M.O. would draft a brief paragraph for inclusion in the aero-generation part of the Memorandum indicating there may be advantages in harnessing aero-generation to the heating of certain plants and buildings, and indicating that this is being investigated.

Finally, this is a draft for amendment and purports only to be a first attempt at crystalising the problem.

Comments and suggestions by 15th October, please.

C.M.O. is redrafting portion of Exco circ. with DAG.

E.G.T.T.

28th September, 1955.

Copies filed in relevant files 21

No. 1201
Circ. No. 4. November, 1955.

To: All Members of Exec. Co.
From: The Colonial Secretary, S.F.C. (Cour No.1).

Subject: Power Resources in the Falkland Islands.

1. As Honourable Members are aware Mr. J.H. Walker, the London Manager of Gilbert Gilkes and Gordon Ltd., recently carried out a survey of hydro-electric and other power resources in the Falkland Islands. This Memorandum summarises, for the information of Members, certain recommendations and conclusions made and formed by Mr. Walker in his report. It also summarises the conclusions reached by Government after consideration of the Walker Report.

2. In general terms Mr. Walker concluded that there are a number of sites in the Falkland Islands where small water power schemes would be possible but that few of these are deserving of further consideration on account of various factors. He has recommended that measuring weirs should be constructed in certain streams which might be harnessed and flow readings should be taken for twelve months and then analysed in conjunction with rainfall figures, in order to determine whether hydro-electric plants should be installed on the farm stations concerned. The report contains advice to farm managers as to how records should be obtained. Finally, the Walker Report indicates the possibility, subject to more data, of the development of wind power.

3. Specifically the Walker Report examines the cost of production of electricity in Stanley (at the time Mr. Walker collated his information the basic cost of the fuel component was 1.9 pence per Kw. Hr. as compared to .99 pence per Kw. Hr. now that oil is purchased in bulk) and suggests that it would be well worth while investigating the possibility of some power being obtained by other means i.e. hydro or aero generation.

4. After a visit to the Murrel River, Mr. Walker concluded that it would be worth while installing a measuring weir in the river and arranging for readings to be taken. He had in mind that subject to satisfactory data being obtained over a year or so, it might prove an economic proposition, as an adjunct to the present Stanley supply, to install a small diversion dam that would lead water into a contour channel, in turn feeding a pressure penstock to convey water down to a turbine. A hydro-electric installation such as this would be automatic in the sense that its output would be automatically adjusted according to the available water supply. It could be so designed that a visit would only be necessary every few days and continuous attendance would not be required. But, before the full costs and economics of such a scheme could be established, a detailed survey of the area would be necessary.

5. The Walker Report and the question of utilising the power resources of the Falklands have been referred to and considered by the Civil Engineer, the Superintendent of the Power and Electrical Department and the Chief Meteorological Officer. The situation as it exists today

/and

See 34

and the conclusions reached by the technical officers concerned are summarised in the paragraphs that follow:-

I. STANLEY.

6. Electricity is at present generated from diesel engines at a cost of 4.73d. per unit, made up as follows:-

		Annual Cost	Cost per Unit.
1.	Wages	£4600	2.00
2.	Replacement	1500	0.65
3.	Maintenance	1000	0.44
4.	Distribution	1500	0.65
5.	Fuel	2250	0.99
	Total	£10850	4.73

The above fuel component, (previously 1.9d. per unit) is based on the latest bulk price of oil and it is very probable that it is as low a figure as can be achieved with diesel plant in the Falklands. Demand is rising at about 16% per annum (80,000 units) and several heavy loads may be expected in the near future (the hospital electrode boiler, the water pumping station, the Falkland Islands Company peat bricketting plant and possibly the ancillary equipment for a Falkland Islands Company slipway, which, it is understood, is under consideration by the Company). Present indications are that the demand may reach a maximum of 10^6 units per annum several years hence, although it may be expected to increase beyond this figure if any substantial reduction in the cost per unit could be achieved. It will be appreciated from the above data, that costs of production are closely related to consumption. Thus, if the consumption doubled, components 1-4 would be spread over more units and a reduction in the cost per unit could be achieved.

7. There are four possible methods of generation:

1. Diesel
2. Steam, fired by peat.
3. Water Power.
4. Wind Power.

In any event wind power cannot provide a continuous supply and must be linked with one of the other three forms of generation. It is, in effect, a fuel saver.

8. Peat has been used effectively in a number of countries (including Ireland and Russia) and about 4,000 yards would be required to produce the present demand of 550,000 units per annum, assuming the same order of efficiency as in the case of the existing diesel plant (i.e. 30%). However, this type of plant is not likely to be as flexible as the diesel engine and it may be necessary to generate at full output for most of the day to meet peak demand. If this is necessary then up to twice the fuel would be required but as the demand increases the load distribution should become smoother and the consumption of fuel should become closer to 8,000 yards per million units. At present Government contract rates, peat costs about £230 per 1,000 yards and the fuel component cost of meeting the present demand for .55 x 10^6

/units

units per annum should lie between £900 and £1,840 per annum (approximately .4 to .8d. per unit), which compares favourably with the £2,250 spent on gas oil (.99d. per unit). Replacement and maintenance costs might also be rather less than with diesel plant, but it is not possible to estimate these components accurately. Wages and distribution would be as for diesel plant. The problem with peat would be to ensure a regular supply (especially for a large plant) and this would become increasingly more difficult as peat in the proximity of the town is worked out. However, the potentially low fuel component might justify further enquiries from the Department of Scientific and Industrial Research, Fuel Research section, to see whether conversion to peat might be worthwhile when the question of replacing the existing diesel plant arises in fourteen or fifteen years time.

Hydro Plant.

9. This type of generation has of course important advantages over both diesel and steam in that it can be semi-automatic in operation (cost of wages might be reduced), the maintenance costs are low and there is no fuel component. Mr. Walker estimated a flow of 50 cusecs during his visit and, from a study of the contours, thought that a fall of 50ft. might be obtained in a distance of about 500 yards. A flow measurement made later by the Civil Engineer gave 33 cusecs and a more recent one in October yielded only 4.3 cusecs. Assuming a fall of 50ft. this minimum flow would yield only about 15 kw. in the absence of a large storage dam. Mr. Walker warns against the use of large storage dams because of the nature of the foundation material and, in view of this and the very small flow obtained recently, it is considered that there can be no possibility of the Murrel providing a regular source of power for the whole of Stanley unless a dam of considerable size were to be constructed. However, if the average flow is of the order of 20 - 30 cusecs, the Murrel stream could provide a useful booster supply for Stanley, amounting in effect to a fuel saver and could in all probability meet the requirements of Stanley over a long period.

10. It is impossible to provide reliable estimates until a careful survey of both flow and fall have been carried out and related to the demand, but the following figures will indicate the probable order of cost and the financial implications of a hydro-electric "booster" scheme that would generate 75 kw.

Hydro Plant to generate 75 kw.

Transmission line from Murrel to Moody Brook +	£11,500
Civil Engineering Works	19,500
Hydraulic Machinery	4,000
Total	£35,000

Present indications are that, assuming a 50ft. fall is available, this plant would operate at full output for at least nine months each year and when the new water works are in operation the Stanley load is never likely to fall below 70-75 Kw, so that the entire output from the hydro plant could be used. The plant should therefore

/replace

+Line Moody Brook/Stanley will be provided in any event for the new water works.

replace about .5 x 10^6 units per annum, which would otherwise be provided by diesel. It is possible that a C.D. & W. grant might be obtained for this project but, assuming the necessary capital was obtained by loan, the immediate financial implications would be :-

Estimated Annual Saving		Estimated Annual Expenditure	
Saving of diesel fuel p.a.	£2,080	Amortisation payments (for 30 years)	£2,15
Saving in depreciation and replacement of existing diesel plant	£500	Replacement Dam	1
		Replacement generators	2
		Maintenance of Plant & extra lines	3
Total	£2,580	Total	£2,84

The installation would be automatic in operation and need only be visited once every few days. No extra staff would be required.

11. From the above, and assuming that it would be necessary to service a loan, the scheme would not appear to be an economic proposition. However, once the loan has been paid the estimated annual savings and expenditure would be £2,580 and £695, i.e. a net saving of £1,385 p.a. The latter represents a fuel component cost of .3d. per Kw. The following factors should also be borne in mind:-

(i) Hydro-electric generation, in the circumstances of the Falklands (and assuming of course that survey and other data indicate a satisfactory source of power) is an assured source of supply and it is not dependent on the importation of fuel from overseas which, in time of emergency, might be difficult and might in certain circumstances cease for some time. On the other hand, with the installation of the new storage tanks a two year supply is assured unless there is a substantial increase in consumption or heavily increased demands from other sources. Consequently this factor is important but need not be overstated.

(ii) The basic cost per Kw. Hr. in the case of oil fuel generated power is calculated on the present price of imported fuel - £14. 15. 0. per ton in bulk. It is unlikely that this price will decrease in future. It may, in fact, increase and in that case hydro-electric generated power would present a more attractive proposition.

(iii) If the Murrel River yields a flow of the order of 30 cusecs for nine or ten months during the year then it would be possible, by storage of water overnight for use on the following day (and this would not require a very large dam), to provide hydro power for the whole of Stanley for the greater part of the year. It would still be necessary to retain the diesel plant for use in the dry spring months but there would be an appreciable drop in maintenance and replacement costs and a reduction in the cost of electricity to the consumer might perhaps materialise. However, the possibilities could only be assessed after relating the flow in the Murrel to the

actual demand and a good deal of further thought would have to be given to the matter.

Electricity from Wind Power.

12. The tests so far carried out at Sapper Hill indicate that this site compares with the best so far investigated in the British Isles, and it would be capable of yielding 4,500 units of electricity per annum for each kilowatt of rating. Therefore a plant rated at 70 Kw. would produce 315,000 units per annum, all of which would be absorbed after the water pump is installed and as the general consumption rises. The cost of the plant would be about £7-9,000 plus £3,000 for power lines to Stanley. The wind plants are expected to give thirty years' service with virtually no maintenance. Therefore, assuming that the sum of £12,000 is borrowed for thirty years at 4½%, the estimated costs would be:-

Annual Saving on Diesel Plant.		Annual Expenditure	
Saving on gas oil (315,000 units)	£1,310	Amortisation on £1200	£740
Saving on depreciation and replacement of existing diesel plant	300	Maintenance of plant and extra power lines	£100
Total	£1,600	Total	£840

The annual saving would therefore be of the order of £800. No allowance is made for replacement of plant, which is regarded as consumable over a period of 30 years and the annual cost of £840 may be regarded as the "fuel component" in the production of 315,000 units i.e. $\frac{£840}{315,000}$ = .64d. per unit. Figures as low as .3d. per unit have been suggested by the British Electricity Authority in their preliminary reports. From paragraph 10 it will be seen that these compare with £ $\frac{2845}{.5 \times 10^6}$ = 1.36d. per unit for hydro power, dropping to .3d. after the initial loan is cleared.

13. A further possibility is that with the utilisation of wind power as a fuel component it may be possible to utilise surplus electricity for the heating of buildings. It will be seen from paragraph 12 that it may be possible to produce electricity from wind power at a fuel component cost of around .3d. - .6d. per unit, in which case surplus production from a generator larger than 70 kw. could be used economically for heating furnaces. This would ensure that there was no loss as a result of the greater capital expenditure on a larger plant and much of the output from a larger plant could be absorbed by the town when demand exceeded the minimum of 70 Kw. A preliminary investigation suggests that a plant of the order of 200 Kw. might be obtained for a maximum capital outlay of £30,000 (£1,850 p.a. for 30 years) and a net saving on gas oil of nearly £1,000 per annum might be expected at the Power House and in heating furnaces, plus about £350 p.a. on depreciation of diesel engines. The 70 Kw. and 200 Kw. plants would therefore compare as follows:-

	Annual Expenditure	Net Saving
70 Kw.	£840	£770
200 Kw.	£1,850	£1,350

It should be borne in mind, however, that it will be some years before aero generators of suitable rating for use

at Sapper Hill are in production, and then it would be advisable to wait a short period after the first production models are available for the design to be perfected.

Summary and Comparison of the different methods.

14. (i) Peat and gas oil are the only two certain sources of power because it appears that neither hydro power nor wind power can be obtained in sufficient amounts at all times.

(ii) Peat would appear to be capable of yielding a fuel component between .4 and .8d. per Kw., which is appreciably less than can be achieved with gas oil (.99d. per unit) but there may be over-riding difficulties in winning the quantity required and preparing it in a form suitable for automatic stoking.

(iii) Hydro power is capable of yielding a fuel component of about .3d. per Kw. after the initial loan is cleared but the cost would be 1.36d. per Kw. if a loan had to be serviced.

(iv) Wind power should yield a fuel component of between .3 and .64d. per Kw. and the capital outlay is much less than for a hydro plant. However, the output from a wind generator will be liable to short period variations and the diesel plant must be available at all times to take over the load; whereas the hydrogenerator output will change comparatively slowly and there may be long periods in the winter when the diesel plant could be dispensed with (see paragraph 10).

II. The Camp.

Hydro Power.

15. The Walker Report indicates a number of places where hydro power might be developed economically and gives details of how to measure potential output. Hydro power is only likely to be available at a few stations and the alternative for the remainder is wind power.

Wind Power.

16. The results at Sapper Hill suggest that exposed sites in the Falklands will yield 4,500 units per kilowatt of rating and it seems reasonable to suppose that the majority of farms could find sites within a short distance of their settlements, capable of producing 2,500 units per annum. It is not intended that wind power should be used as the only source of supply, as this would require very large battery storage to provide against long periods of calm, but aero-generators might be used effectively with existing diesel and battery plant, to save fuel. Also it is understood that new designs of wind plant are being tested and it is possible that these may prove more reliable than the small plants used in the Colony for many years. The cost is likely to be of the order of £150 - £200 per kilowatt of rating and assuming that the plant gives only ten years of service the fuel component cost per unit could be $\frac{£200}{2,000 \times 10}$ = 2.4d. per unit.

This is less than can be achieved by small diesel plant and a figure of less than 1d. per Kw. might be attainable on good sites, if the plant has a life of 20 - 30 years. Many farms would find the output of 2,000 units per annum from a plant of 1 Kw. rating sufficient for the whole of their requirements and the diesel plant would only be required for periods of calm and periods of heavier load, beyond both the wind generator and the storage batteries.

17. In these circumstances, the C.M.O. has recommend that:-

(a) Cheap cup counter wind instruments should be installed at Stanley, Darwin, Fox Bay and Pebble Island to bring out any important variations in wind speeds over the area as a whole.

(b) The measurements taking place on Sapper Hill should be continued for a further twelve months so that comparisons can be made with the simultaneous records from the Camp stations.

(c) Long term averages should be extracted from existing Stanley records to derive more representative power curves for Stanley and, by comparison with the camp stations, for the area as a whole.

18. In addition consideration has been given (and further advice is being obtained from the Colonial Research Laboratory) on the possibilities and implications of linking diesel plant, such as that installed in a number of farm settlements, which is capable of carrying a maximum load with a smaller wind plant and storage batteries capable of dealing with the average load. Preliminary calculations and estimates suggest that some such system, if practicable, would result in a substantial saving in fuel oil. The principle would be that the batteries would "float" between both the wind driven and diesel generators and the switching of both generators would be automatic.

General Summary and Conclusions.

19. The following summary and conclusions are suggested for the consideration of Honourable Members:-

i. On the information available there would appear to be some possibilities and potentialities with regard to both hydro-electric power and aero-generated power so far as the supply of electricity to Stanley is concerned and it would be worth while carrying out further investigations.

ii. There might be possibilities with regard to small hydro electric schemes on individual farms. The potentialities should be left to the farms to explore and take whatever action is necessary and required.

iii. There appear to be possibilities in linking aero-generation with diesel plant and these should be given further examination. It might be worth giving consideration when further information has been obtained to the installation of a small pilot wind plant of about 2 Kw. at Fox Bay where full records of output and fuel consumption can be maintained. This would provide a practical test

/of

of the type of plant now available and might assist farmers in deciding whether it would be to their advantage to install similar equipment.

If Honourable Members are in agreement with these conclusions, expenditure of the following order would be required:-

A). Hydro-Electric.

1. A measuring weir should be constructed on the Murrel River. Estimated cost £100

2. Readings should be taken for a minimum of 12 months. Estimated cost £100

Total £200

Note:

(a) A survey of the Murrel River area between a point above the 150 ft. contour to a point below the 100 ft. contour. This survey can be undertaken at no cost by a F.I.D.S. surveyor passing through Stanley and it is proposed that the necessary arrangements for this should be made. This survey was recommended in the Walker Report.

(b) The installation of measuring weirs (where necessary) measuring notches and the collation of data at points on individual farms (as recommended by the Walker Report) as preliminaries to the possible installation of small hydro-electric projects on individual farms should be left to the farms concerned should they desire to take further action.

B). Aero-Electric.

1. The installation of cup counter anemometers at Darwin, Fox Bay and Pebble Island. Estimated cost £100

2. Replace anemometer at Sapper Hill Estimated Cost £20

Note: Further enquiries to be made with regard to the desirability of installing a 2 Kw. wind generator at Fox Bay

Total £120

COLONIAL SECRETARY.

ADT/VP

28A

COPY

(Original filed in 1201 - Large Scale Generation of Electricity by Wind-Power).

Extract from the Minutes of a Meeting of Executive Council held 15th November, 1955.

1201

6. Power Resources in the Falkland Islands.

21 After discussion Council adopted Executive Council Circular No. 4 of 9th November, 1955, and advised that the proposals set out in paragraph 19 be put into effect.

(Sgd) J. Bound

Clerk of the Executive Council.

Original filed in 1040/A/II - S.F.C.
Minutes of Meetings.

29

MINUTES OF A MEETING OF STANDING FINANCE COMMITTEE
HELD IN THE OFFICE OF THE COLONIAL SECRETARY ON
FRIDAY THE 25th NOVEMBER, 1955.

Present:- The Honourable the Colonial Secretary (Chairman)
The Honourable Mr. S.C. Luxton
The Honourable Mr. A.L. Hardy, B.E.M., J.P.
The Honourable Rev. W.F. McWhan, M.B.E.
The Honourable Mr. K.W. Luxton, J.P.

Minutes

The Minutes of the Meetings held on 14th September, 26th September and 7th October were confirmed.

Arising out of Minutes

The Chairman informed the Meeting that it was Government's intention to amend the Old Age Pensions Ordinance to enable pensioners to draw pension in the United Kingdom and other countries. The Secretary of State had raised the question of extending to the Falkland Islands the reciprocal agreements at present in force between the United Kingdom and a number of other Colonies with regard to Old Age and Sickness Benefits. The Chairman informed members that this matter was being taken up with the Colonial Office with a view to examining the full implications.

A.I.S.E's.

The Committee approved Additional provision as shewn on the attached schedule.

Purchase of Houses at Ajax Bay

The Chairman informed members that Government considered it desirable to tender for the Manager's house and bungalows at Ajax Bay with a view to easing the housing shortage in Stanley. If obtained they would be used for housing Government Staff. The Committee agreed to the purchase but considered the estimated figures shown in the Memorandum were too low, with regard to both the proposed tender figures and the estimated amount required for dismantling and re-erection. The Committee recommended the following :-

(1) That Government tender for 4 bungalows @ £900 each plus furniture £225 making a total per bungalow of £1,125.
(2) That Government tender for one unfurnished bungalow at £900.
(3) That Government tender for the Manager's house for £2,800 plus £500 for furniture. (£3,300 complete).
(4) If Government acquired the houses, Government should endeavour to arrange for dismantling and re-erection by contract on the understanding that the same contractor would be required to both dismantle and re-erect. The advice of the Committee should be sought as to which tender should be accepted. The Hon. Mr. S.C. Luxton and the Hon. Mr. A.L. Hardy agreed to make enquiries with regard to persons able and willing to tender.
(5) Government should tender for the remaining two bungalows when the Receiver puts them up for sale.
(6) In the event of Government being unable to arrange for dismantling and re-erection by contract, Government should proceed on the basis of the recommendation made in Memorandum No. 5.

Sighting of Vessels from Cape Pembroke Lighthouse

The Committee agreed to the payment to Keepers at Cape Pembroke Lighthouse of a fee of 7/6d for reporting the presence of ships other than H.M. Ships, "Fitzroy" and locally registered craft. Additional provision amounting to £10 was approved for the remainder of the year.

David Alazia

The Committee agreed to expenditure from Public Funds amounting to £390 per annum together with £78 per annum in respect of holidays for a training course in the School for

30

the Blind, Liverpool, for David Alazia with the proviso that no further committments would be involved.

Government House Car

The Committee were asked to consider the purchase of a car for H.E. the Governor to replace the present one which is in a bad state of repair. The cost of a new car landed at Stanley was estimated at £707 and additional expenditure was approved by the Committee. With regard to the present vehicle it was agreed that the question of it being converted for the purpose of a hearse be left in the hands of the Colonial Secretary who would approach the Falkland Islands Co. Ltd. regarding conversion. In the event of the cost of this work being much in excess of £100 the matter would be referred back to Committee. Approval of a moderate amount over and above the £100 was left to the Colonial Secretary's discretion.

Salary Adjustments

Committee were asked to consider the following increases in salaries :-

(a)	R/T Operator	from £270 - £290
(b)	District Nurse	from £240 - £275
(c)	Clerk Treasury	accelerated promotion from £300 to £345 and then £360, £375, £390, £400.

The Committee recommendations were as follows :-

(a)	R/T Operator	from £270 - £320 w.e.f. 1st October, 1955.
(b)	District Nurse	from £240 - £300 " " " "
(c)	Clerk Treasury	from £300 - £345 " " " " and then £360, £375, £390, £400.

Power Resources in the F. Is.

The Committee considered a Memorandum dealing with a survey carried out by Mr. J.H. Walker in connection with hydro-electric and other power resources in the Falkland Islands. It was recommended that further investigations with regard to both Hydro-Electric and Aero-Electric power should be followed up on a moderate scale for a period of two years. The recommendations made in Memoradnum No. 2 were approved.

Copies in 1201 1398

Roads and Water Filtration Projects

The Committee considered a Memorandum regarding Stanley Roads and Water Filtration Projects. The unanimous opinion was that a qualified engineer should be appointed to complete the road programme after the expiry of the contract of the present Engineer.

Port Howard School

The Chairman informed the Meeting that it was likely that the cost of the West Falkland school at Port Howard would exceed the estimate by some £500 - it was possible, however, that the amount might be reduced by the purchase of a second hand generator from Port Howard and a stove from Albemarle.

Peat Survey

The Chairman produced a letter in which the Falkland Islands Co. Ltd. asked if Government would be prepared to meet half the cost of a survey on peat carried out by Mr. Ohrstram, a peat expert, and amounting to £693. 5s. 0d. Committee were unable to recommend any payment by Government.

Messengers

The Committee agreed that the salary scale for messengers should be converted to a fat £70 per annum. Salaries would be adjusted accordingly.

Materials ex Ajax Bay

The Chairman informed the meeting that Government wished to purchase certain stores from Ajax Bay and asked Committee's approval to spend up to £1,000. The Committee agreed and intimated that further funds would be made available for this purpose if required.

Chairman

Secretary

32.

CIVIL ENGINEERING DEPARTMENT,

STANLEY, FALKLAND ISLANDS.

18th January 1956

MURRELL RIVER & WATER POWER DEVELOPMENT.

Hon: Colonial Secretary,

Please refer to the third paragraph on page 10 of Mr.J.H.Walker's report on Hydro Electric and other Power Resources of the Falkland Islands.

2. The most suitable stretch in the Murrell River for the purpose has to-day been measured and levels taken, and it has been ascertained that the river bed falls 27 ft 8 inches only in a length of 2,500 feet. This rules out the project as an economical proposition as in view of the small volume of water at all times available much greater "head" would be needed

3. Mr Foster of FIDS assisted me with the survey.

Civil Engineer

See 34

No. 0428/T

34

21st May, 1956.

Memorandum No. 5 for Executive Council.

Hydro-Electric supply for Stanley.

It will be recalled by Honourable Members that one of the conclusions set out in Executive Council Memorandum No. 4 of November 1955 - Power Resources in the Falkland Islands - was that on the information available (from Mr. Walker's report and surveys carried out by the Civil Engineer) there appeared to be possibilities and potentialities with regard to hydro-electric power for Stanley and that it would be worth while carrying out further investigations.

21

2. A survey of the most suitable reach in the Murrell River for the purpose of a small hydro-electric scheme was carried out in January of this year by the Civil Engineer and a Falkland Islands Dependencies Surveyor and it was found that the river falls only 27 ft. 8 inches in a length of 2,500 feet. In the opinion of the Civil Engineer this rules out the project as an economic proposition in view of the low flow and the fact that a very much more substantial head of water would be required.

See 32

COLONIAL SECRETARY.

ADJ/VM

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Extract from the Minutes of a Meeting of Executive Council held 30th May, 1956.

0428/D. 9. Hydro-electric Power Scheme.

Council were informed of the findings of the survey of the Murrell River undertaken by the Civil Engineer which ruled out the project as an economic proposition.

D.R. Morrison

Acting Clerk of the Executive Council.

B.

M.C.S.

Ex. Co. at 28A advised that the proposals of Ex. Co Circular No. 4, para. 19, page 27 should be put into effect.

Sub-para (iii) should be pursued?

D.R.

17/6

C.

There are funds in the Supt. P. & E.'s Vote for the purpose - please check.

L. Wiff

22.6.

D.

M.C.S.

There is provision for expenditure of £500.

D.R.

22/6/56

E.

Then B.H. 6 months time for a report from Supt. P. & E. after

36

A

S.P.E.I.

For report called for on 35 E. pl.

15/12/56

B.

HCS

No cup counters for continuous recordings have been kept but the C.M.O. is producing for me single readings taken daily. Rather than order direct from him, I suggest it better that I make enquiries at suitable time early next year, for a suitable generating set and if I consider it satisfactory be authorised to purchase it through the CAs.

17-12-56.

C

Supt. P. & E.

Yes, I agree. But please ensure that you insert the necessary funds in your estimates next year - otherwise we won't get the money. You had better make a note of it on your Estimates file.

18/12/56.

D

HBS:

There is £500 under XIV Miscellaneous, 15. "Wind Generator Port Bay" in the 1956-57 Estimates, I will have instructions for this to be worked.

19-12-56.

17/12/56

Rec 20/12/56

S.E.D.

E

Presumably D has now been dealt with?

28/2

HCS:

Yes.

2-4-57.

CROWN AGENTS
FOR OVERSEA GOVERNMENTS AND ADMINISTRATIONS
TELEPHONE: 01-222 7730 TELEX No. 916205

4, MILLBANK,
WESTMINSTER,
LONDON, S.W.1.

37

Q.1021/4/1

19th January, 1971.

Dear Mr. Gutteridge,

Micro-Hydro Generators

I have heard from Mr. Weaver of the discussion he had with you when you visited our offices towards the end of last year and I understand you were interested in the Micro-Hydro Scheme that we are engaged on in Indonesia. I thought therefore that you might like a brief description of the project and we can then send you more details on any aspect that may be of interest to you.

The first phase of the present scheme is to install single hydro-electric generating units at remote villages in each of six Provinces in Indonesia where they can be used as demonstration centres for all other villages in the province. This type of installation has been chosen instead of small diesel generating plant because of the high cost of fuel in remote areas of Indonesia, and also the relative ease with which they can be operated and maintained by villagers in such rural areas is a considerable advantage.

There are large areas in that part of the world where both the rainfall and terrain favour the development of small scale hydro-schemes. These are principally in the mountainous regions of central and south Java and similar parts of Sumatra, West Kalimantan, Bali and other Islands where there is a fairly uniform distribution of rainfall throughout the year and more or less constant evaporation. Volcanic rock is usually found in these areas overlain by permeable strata with fairly thick surface foliage. Such conditions produce stream flow characteristics that are favourable to hydro-development of this sort.

/For

E.G. Gutteridge, Esq.

SU 39
(reply)

For the first phase we are installing 13½" and 16½" Francis Turbines coupled to generating sets with outputs of between 80 and 120 KW. The gross heads under which they will operate range from 10 to 18 metres and the normal flows are between 660 and 1050 litres per second.

Some typical layouts are shown on the attached drawings. The one at Balapusah (Drawing No. 1) is in fact for a very small 17 KW turbine that was installed by the Indonesians about two years ago. For the installations we are putting in, the pressure conduit leading to the turbines will be either 24" or 30" steel tube that is produced locally. The remaining civil engineering construction work is all done by the local villagers under the supervision of a young engineer who remains until the project is complete and the plant has been set to work. They also install the distribution system and provide the necessary poles.

The civil engineering works are fairly simple and require only a weir across the stream or irrigation canal with an intake chamber alongside it to collect stones and screen out floating debris. In Indonesia the sites are so chosen that the water is then dropped directly from the chamber through pressure conduit to the station and then discharged via the draught tube and tailrace into the stream lower down. There is no appreciable storage of water provided upstream of the turbine in any of the in installations proposed for the first phase.

Typical F.O.B. prices are £8500 for 13½" turbines and £12000 for 16½" turbines. The generators to which they are coupled by Poly-Vee belt drive range from 80 to 125 KW at prices between £1750 and £1975. The turbine prices quoted include for a governor, Vee belt drive, main inlet valve and slip joint.

I hope the description given will be of some value to you. To amplify this a little I enclose some sketches and other information about the installations in Indonesia and also literature provided by manufacturers. Please let me know if there is anything more you require or if we can assist in any way.

Yours sincerely,

E Lawrence

E.D. Lawrence

PMD.

39

CAS. Ref: 1021/4/1.

17th March 71.

Dear Mr Lawrence, Micro-Hydro Generators.

37

Thank you for your most interesting letter of the 19th January, 1971 concerning the Micro-Hydro Schemes which you are engaged upon in supplying and installing in Indonesia. I have read with much interest the literature on the above subject that you enclosed. It is disappointing to know that there are only two sites in this Colony where such schemes might be possible, this was discovered when some years ago, I believe in 1951, the Colonial Government together with the Falkland Islands Company commissioned Gilbert, Gilkes and Gordon. as consultants to carry out a survey at various settlements and in the vicinity of Stanley with the object of discovering whether there was any potential energy of this form that could economically be converted into electrical energy. There is abundant water in streams and rivers, few are fast flowing and it was found that the civil works involved to form catchment areas would be so costly that the recurrent economies associated with hydro generation would be more than offset by amortization of the capital costs involved. It is however possible that in the event of a new settlement being established the area chosen might yield or have potential energy of this type. The information you sent I will keep on file to use as a reference should I get enquiries from farmers concerning small hydro units.

Again my thanks for forwarding out the literature.

E.D. Lawrence Esq.,
O. Dept., Crown Agents,
4, Millbank,
LONDON. S.W.1.

Yours sincerely,

Supt. Power & Electrical Department.

c.c. The Colonial Secretary.

ECG