

RAILWAYS,
TELEGRAPHS AND HARBOURS
SENATE
1944

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1944 SESSION

THE SENATE OF CANADA



PROCEEDINGS

OF THE

STANDING COMMITTEE

ON

RAILWAYS, TELEGRAPHS AND HARBOURS

ON

Senate

The Possibilities of Developing Tidal Power at the Confluence
of the Petitcodiac and Memramcook Rivers in the Province
of New Brunswick.

WITNESSES:

Mr. J. F. Parsons, President, Board of Trade, Moncton, N.B.

Honourable J. Walter Jones, Premier of the Province of Prince Edward
Island.

Dr. W. R. Turnbull, Mechanical Engineer, Rothesay, N.B.

OTTAWA
EDMOND CLOUTIER
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1944

THE STANDING COMMITTEE ON RAILWAYS, TELEGRAPHS
AND HARBOURS

The Hon. A. B. COPP, P.C., K.C., Chairman

The Honourable Senators

Ballantyne	Griesbach	McGuire
Barnard	Hardy	McRae
Beaubien (<i>Montarville</i>)	Harmer	Michener
Bench	Hayden	Molloy
Black	Horner	Moraud
Blais	Hugessen	Murdock
Bourque	Hushion	Paterson
Calder	Johnston	Raymond
Cantley	Jones	Robicheau
Copp	King	Robinson
Dennis	Lacasse	Sinclair
Duff	Lambert	Smith
Duffus	Macdonald (<i>St. Peters</i>)	(<i>Victoria-Carleton</i>)
Fafard	MacLennan	Stevenson
Farris	Marcotte	Sutherland
Gouin	Marshall	Turgeon
Green	McDonald (<i>Shediac</i>)	

ORDER OF REFERENCE

EXTRACT from the Minutes of the Proceedings of the Senate, Tuesday, March 21, 1944.

“Pursuant to the Order of the Day, the Senate resumed the adjourned debate on the motion of the Honourable Senator Robinson that it be—

Resolved,—That in the opinion of the Senate it is desirable that the Dominion Government should cause a thorough investigation to be made by a firm of eminent Hydro Electric engineers into the possibilities of developing tidal power at the confluence of the Petitcodiac and Memramcook Rivers in the Province of New Brunswick.

After further debate, and—

On motion of the Honourable Senator Robinson—

The said motion was referred to the Standing Committee on Railways, Telegraphs and Harbours.”

REPORT OF THE COMMITTEE

WEDNESDAY, 22nd March, 1944.

The Standing Committee on Railways, Telegraphs and Harbours have in obedience to the Order of Reference of 21st March, 1944, considered the following motion:—

“That in the opinion of the Senate it is desirable that the Dominion Government should cause a thorough investigation to be made by a firm of eminent Hydro Electric engineers into the possibilities of developing tidal power at the confluence of the Petitcodiac and Memramcook Rivers in the Province of New Brunswick.”

From evidence adduced your Committee is satisfied that an investigation by competent engineers into the possibilities of developing tidal power at the confluence of the Petitcodiac and Memramcook Rivers in New Brunswick is warranted, and as a post-war project merits immediate action to determine the practicability of the development.

All which is respectfully submitted.

A. B. COPP,
Chairman.

EVIDENCE OF WITNESSES

THE SENATE

WEDNESDAY, March 22, 1944.

The Standing Committee on Railways, Telegraphs and Harbours met this day at 4 p.m., on the following reference:—

“That in the opinion of the Senate it is desirable that the Dominion Government should cause a thorough investigation to be made by a firm of eminent Hydro Electric engineers into the possibilities of developing tidal power at the confluence of the Petitcodiac and Memramcook Rivers in the Province of New Brunswick.”

Hon. Mr. COPP in the Chair.

The CHAIRMAN: Honourable senators, as you are all aware, this is more or less an informal gathering of this Committee to hear representations from persons who we hope have a good deal of knowledge in reference to tidal development in New Brunswick, which Senator Robinson brought to the attention of the Senate at the end of last week. Perhaps Senator Robinson would say a word or two in introducing the gentlemen who are to speak to us.

Hon. Mr. ROBINSON: Mr. Chairman, I have induced Mr. Parsons, the President of the Board of Trade of Moncton, to come here, and I believe he has induced Premier Jones, of the province of Prince Edward Island, to be present. We also have with us Dr. Turnbull, who may give us engineering data about the proposal. I would suggest that first we hear from Mr. Parsons.

Mr. J. F. PARSONS, President of the Board of Trade of Moncton, New Brunswick: Mr. Chairman, honourable senators, in introducing the subject I feel that we would save the time of your honourable body if I read the remarks that have been prepared. They will be a little closer to the point than if I spoke without notes.

We come before your honourable body to-day to present for your consideration and solution a proposal for the development of tidal power on the Petitcodiac river. As background to the discussion we would first refer to the great need.

In New Brunswick in particular, and the Maritimes in general, we have not been able to develop our natural resources profitably or build up an earning power in industrial or manufacturing activities, because of the lack of low cost and sufficient power. The result of this lack of low cost power has been very forcibly demonstrated to all during the last 25 years when developed horse-power in Ontario and Quebec increased from 2½ million H.P. to 14 million of low cost electrical energy. During these years the Maritime provinces lost approximately 300 manufacturing industries, and our production basic industries likewise dropped.

Industries that at one time flourished in this and other Maritime provinces prior to the beginning of cheap power in the early twenties in Ontario and Quebec have long since closed their doors, not being able to compete. Low wage rates have favoured a few industries, textiles, confectionery, cast iron

moulders, and some others, but now that the process of the National War Labour Board has levelled wage rates across the Dominion, they too will disappear.

The greatest handicap from the standpoint of present day production is that suffered by our basic industries, the agriculturist, dairying and fisheries. While no recent provincial trade statistics are available on which to base a figure, it was made known by a Royal Commission in 1926, and supported later in 1934, that our imports into the Maritimes were approximately 20 million dollars annually. That report was based on railway and steamship figures only. Our production of these basic items is not only down, but we are not now able to convert what we do and can produce into consumer goods because of lack of low cost power. Therefore, agriculturally and industrially, we have experienced a severe unfavourable trade balance for 25 years. This is basically uneconomic and extravagant, depleting our provinces of population, they moving to larger areas of production and steadier employment.

Because of the level topography of New Brunswick and the Maritimes in general, no large hydro developments are possible, and the small streams are now practically all developed. Consequently, with no parent development or surplus of power, drought conditions could not be met; agricultural and industrial expansion cannot be proceeded with on a competitive basis.

This Peticodiac development provides the necessary power for such conditions sufficient for New Brunswick, Prince Edward Island and Nova Scotia, Prince Edward Island particularly, the greatest agricultural area of the Maritimes, where very little power is available is in great need; Nova Scotia to a similar degree.

At this point it might be interesting to note the percentage increase in population, developed horse-power, and developed horse-power per capita, as taken from the *Canada Year Book*, as follows:—

Percentage Increase in Population

1931-1941 Census

Maritime Provinces	10% average
Quebec and Ontario.....	16% average

Increase in Developed Horse-Power

1931-1941 Census

Maritime Provinces	16% average
Quebec and Ontario.....	78% average

Developed Horse-Power Per Capita

Maritime Provinces	18% average
Quebec and Ontario.....	120% average

It will therefore be readily seen that the Maritime provinces have not enjoyed the increase in population that might be expected, nor have we developed industrially as indicated by the increase in the developed H.P. over the past ten years in Quebec and Ontario. It is therefore apparent that on the basis of developed H.P. per capita we can never hope to pull our weight unless we have low cost and sufficient power that will place us in a competitive bracket with the more highly industrialized sections of Canada.

Now let us consider some of the benefits. Nature has endowed us with a river where the tide ebbs and flows twice in twenty-four hours, the rise and fall of which is approximately 44 feet and is never failing. This is one of four known possible tidal powers in the world, and according to world renowned

engineers the most practicable and definitely the most feasible. We have reason to believe that the harnessing or development of this tidal power on the Petitcodiac river will produce 445,000 H.P. of the lowest cost power in Canada, if not the world.

Among the outstanding reasons why this will be the lowest cost power in Canada are:—

- (1) no storage dams, large or small for water control required;
- (2) taking over of large flowage areas unnecessary;
- (3) high and expensive reinforced concrete main dam not necessary;
- (4) material for construction of main dams within stone's throw of the site at low cost;
- (5) the use of low head turbines and draft tubes, cheaper than high head equipment as is used in almost all fresh water developments;
- (6) because of low head draft tubes and turbines, height of power house is reduced, consequently lesser cost.

The need for low cost power has been briefly touched on, and some reasons why the power will be low cost.

The development of 445,000 H.P. at low cost to the consumer will immediately provide power for our agriculturists in farm homes, power equipment on the farm: make possible cold storage facilities for farm products so that these might be kept in perfect condition and not all placed on the market at and during the harvesting season of any of the crops. It would permit orderly marketing.

In the years to follow, the processing of agricultural products will be one of the main features of marketing, such as juice extraction of fruits and vegetables; canning, dehydrating and special freezing processes. This is not now possible.

It will furnish low cost electrical energy for the fishing villages and provide for them electrical power for cold storage facilities and thereby eliminate the crowding of markets and make a continuity of fresh fish over the entire year, which is highly desirable. It will also provide low cost power for the canning and processing of fresh fish.

At the present time nothing is done in the way of processing our waste wood and sawdust. It is estimated that 15 per cent of our forest products are lying in sawdust piles, treetops and limbs. This should be and can be utilized if low cost power is available for the manufacture of plastics and chemicals.

We have within the three provinces, more particularly New Brunswick, the highest grade of calcium lime on the North American continent. This up to the present time has only been used in small quantities in the construction industry as lime for masonry and plastering. Low cost power would immediately convert these lime deposits into a highly remunerative industry.

We also have in Maritime Canada the largest and purest salt deposit in Canada, near the site of the proposed tidal development. This could immediately be converted into the largest electro-chemical plant in Canada and also provide salt for our fisheries and other uses.

It is only natural to expect that with a tidal development in the midst of our many and varied resources, and being on the seaboard, the immediate development of our natural resources, our industrial and manufacturing life would take place, thereby increasing the national income and the prosperity of the Maritime provinces in general. None of the items referred to is possible of development at this time, because of insufficient power and the high cost of what is available at present.

Now our purpose in laying this matter before you is to solicit your earnestness and aid in:—

- (1) providing funds to determine engineering data as to feasibility, costs, reports, etc.;
- (2) if engineering reports and data indicate that favourable results can be expected, that the work proceed without delay by the New Brunswick Hydro Commission and that moneys be made available by the Federal Government so that it may be developed for the benefit of Maritime Canada.

The urgency of the need almost dictates that moneys be provided at an early date for the commencement of securing expert engineering details and reports, as this will consume probably eight months. After that considerable time will be required for financing, drawing working details and taking tenders.

Long before the war ends we shall be subjected to a depressed condition in employment. This development will provide, direct and off site, employment for approximately 4,440 men for three years.

It is our opinion that approximately \$50,000 will be required for the engineering proposed, and that your Government should share with the New Brunswick Government on a 25-75 per cent basis in the cost.

In conclusion, may it be known that the Petitcodiac Tidal Power Company is formed only for the purpose of a holding company or vehicle by which its promotion may be fostered, and the Directors and shareholders have recorded in the minutes of the said company their willingness to surrender all rights to an operating company or the Government without gain or profit.

Hon. Mr. ROBINSON: Before getting down to the engineering features of this project, we should like to hear something from Premier Jones of Prince Edward Island.

Premier JONES: Mr. Chairman and honourable senators, I came here, I suppose, out of curiosity to see what the engineers have to say about Petitcodiac. We are hard put to it to get electricity upon Prince Edward Island, and if sites, such as the Petitcodiac and Passamaquoddy, were developed, the power would be generated not more than eighty miles from the centre of population in Prince Edward Island.

At first it occurred to me it might be difficult to cross the Northumberland Straits, of which you have heard so much, with electric cables. I know we cannot cross it with boats very well these days. But I was talking with a gentleman who formerly lived in Denmark, and he told me that the Danes get their power from Sweden. If they can do that, if electricity can be brought across the water separating Denmark from Sweden at a low voltage and stepped up afterwards, it can be done across the Northumberland Straits, and we may hope to get cheap power there. I notice it is not said how cheap it would be. I am told it would be so cheap that the people up here would get jealous of our good fortune.

Almost everything was said in the brief presented to you that could be said. I notice this is described as one of the four greatest tidal power sites in the world and by far the cheapest to develop.

I am a farmer, and a few years ago I was able to get a power line out by our farm, the power being steam generated. This costs me now in excess of four cents a kilowatt hour. In spite of this cost I have managed, as fast as I could get hold of a little money, to develop power for 15 motors. I may have missed some; I know of half a dozen more I should like to have. If I lived in Ontario I would spend for that same power only 29 per cent of what I spend now in Prince Edward Island, but I am mighty thankful to have it at the price. Most farmers in Prince Edward Island would also be glad to have power at the going price there. However, if this power development takes place we might get our

power at a quarter of the present price. I am wondering whether the Government of Prince Edward Island could not make some revenue by selling this power to the farmer and putting it into our funds.

Hon. Mr. GRIESBACH: You probably will.

Premier JONES: We will try anyway if we get this power. It is said sometimes that we in the Maritimes have an inferiority complex. Well, before Confederation we had some prosperity down there. The other day I was looking at a hole in a field where we used to build ships. I am told that in 1848 a ship of 500 tons was built there. I found that we built 550 ships in Prince Edward Island in 1848. Then we put our boys on board those ships and sailed them to every port in the world. Half the population of the Island must have been in the ships they themselves built. We had high prosperity under the Reciprocity Treaty with the United States up to 1866. Then came Confederation and our troubles. We could not trade with Canada. We tried to ship overseas. We shipped the fertility of our soil to the world, and we became poorer and poorer. We did not learn to build steel ships, and we ceased to build wooden ships. I have always thought that the decline in our shipbuilding was coincident with the decline of prosperity in the Maritimes; but I am beginning to think that the development of cheap power in Upper Canada and Quebec was just as much the cause of our troubles as the decline in shipbuilding, because people will go where electric power is available at low cost. If we cannot get this power our people will go where there is power to-day, and the Maritimes will decline still further. I do not know whether you people in Canada want that to happen or not. We have put up with the national policy until nearly all our trade has left us, but if you gave us a chance to develop our coastwise shipping with diesel schooners I think we can again achieve prosperity.

I have not anything to add to the brief, and I should not be talking at all, for if there is an engineer present we want to ask him questions as to whether or not this project is feasible. If it is, it is almost too good to be true, and I can see great hope for the Maritimes if this great power development takes place.

Hon. Mr. ROBINSON: Mr. Chairman, I am sure we are greatly indebted to Dr. Turnbull. He has been devoting a great deal of attention to this matter and is not getting very much pay for it, for the simple reason that we have not much money at our disposal. I hope Dr. Turnbull will give us his ideas on this project.

The CHAIRMAN: Dr. Turnbull.

Dr. W. R. TURNBULL (Mechanical Engineer, Rothesay, New Brunswick): Mr. Chairman and honourable senators, I have brought with me three blueprints of our latest ideas on this proposition, but before I deal with them I will make a few preliminary remarks.

My interest in this Petitcodiac tidal power project was first aroused in 1912, when I realized that a very large block of power was running to waste in the Bay of Fundy tides and that this power should be harnessed in the interests of the Maritime Provinces.

Since that time I have made a great many studies as to how this problem should be made practical and believe that I have now arrived at a solution that is practical, both from an engineering and monetary standpoint, and this would seem to be a propitious time to undertake the development since it would give employment to about 3,000 men for a period of about three years.

The site chosen for this development is probably the best in the world, as we have two large tidal estuaries meeting at a point where the tides are among the highest in the world and these estuaries can be improved by a moderate amount of dredging. Some engineering difficulties are present due to the nature of the soil deposited at the mouths of these two estuaries, but dams can be built on this

soil that would be entirely satisfactory, and due to a recent proposal made by my son, Squadron-Leader D. O. Turnbull, the plant, comprising power-house, gates, etc., can all be placed on solid rock and the rock excavated for this purpose can be used in the dams, breakwater, and coffer-dams, and is thus only chargeable once to the cost of the undertaking.

In this report I will not present to you all the studies and calculations that are a necessary part of making up the estimates of costs that are now given, but these estimates give in a condensed form the necessary data for your consideration. These estimates have been prepared with great care but I believe it to be essential that my results should be checked by hydro engineers of high standing and we are fortunate in having such men of wide experience in Canada. Reference is now made to (1) diagram of operations, (2) plan of plant at Hopewell, N.B., of March 13, 1944, (3) blueprint of drawing No. 14, showing the central position of the plant at Hopewell.

TABLE I

General Estimates	Estimated Costs
Western Dam, Length 4,070 ft., Average Width 531 ft., Rockfill and Core..	\$6,840,500
Eastern Dam, Length 3,500 ft., Average Width 350 ft., Rockfill and Core..	2,890,200
Breakwater, Length 3,200 ft., Average Width 260 ft., Rockfill.....	2,780,000
Cofferdams, Length 2,500 ft., Average Width 176 ft., Rockfill and Clay Core	297,000
Foundation (Gates) 800 ft., Average Width 104 ft., Rockfill and Clay Core	23,350
Gates "A", "B", "C" and "D", Total length 5,300 ft.	2,124,000
Power House, Concrete, Size 1,200 ft. by 100 ft.....	1,200,000
Lock, for ships up to 5,000 tons, size 400 ft. by 70 ft.....	300,000
One unit of 20,000 H.P., for initial power equipment.....	720,000
Legal and Engineering Fees.....	350,000
Contingencies	1,000,000
Interest while building, at 1½ per cent.....	486,500
Initial Cost, with one unit of 20,000 H.P.	\$19,011,550
Subsequent Cost—21 units gradually added, as required.....	15,120,000
Subsequent Cost, Dredging, gradually added, as required.....	9,910,000
Total cost for complete development.....	\$44,041,550
Estimated cost per developed Gross Horse Power.....	\$100**
Estimated cost per developed Net Kilowatt.....	\$155
Final output in Kilowatt-hours, per year.....	2,485,000,000
Sales price at power house for 10 per cent return on Capital.....	0.177c per KWH.

**Note on available power:—For 13 per cent of the time (about 3 days at a time) there are subnormal neap tides, when the Gross H.P. would be about 240,000 H.P., but for 87 per cent of the time the power will range between 400,000 H.P. and 450,000 H.P., so that the average Gross Horse Power may be taken at about 400,000 H.P.

The next table is a very long one, but it just carries on with the initial cost of these other units gradually added from time to time, each unit being 20,000 horse-power, with a total installation of 440,000 horse-power. The cost at first is, of course, very high, as it is with any hydro-electric plants that are to serve as a central station, but after six years time it falls off to \$188.50, which is then comparable to the average fresh water powers in Ontario and Quebec. After that it keeps on getting steadily cheaper, until at the time of the full development it is down to \$100 per gross horse-power, which is extremely cheap power.

Premier JONES: How would that compare with Ontario and Quebec?

Dr. TURNBULL: The average in Ontario and Quebec ten years ago was \$181. I understand it is higher now, about \$200; so it would be about half of the development cost in those two provinces.

Then Table Three concerns financing, because I do not see any reason why this should not be a very satisfactory monetary undertaking. The sales prices shown in the last column may be compared with the sales prices in New Brunswick of from three cents to eight cents per kilowatt hour. The highest cost of this development is 1.9 cents. From that figure, as the various units

are added, your eventual cost at the power house with a ten per cent return on your capital is $\cdot 177$ cents; in other words, it is less than two-tenths of one cent.

The sales prices shown in the last column (the highest being 1.684 cents per KWH) may be compared with retail sales prices in New Brunswick of from three to eight cents per KWH, after the fifth period the sales prices become steadily better than those for the average fresh water developments in Ontario and Quebec, and finally reach about one-half of those.

As a reconstruction project, giving work to labour instead of a probable dole, the project should be financed by loans from the proposed Industrial Reconstruction Bank, at say one and three quarters per cent interest, with a sinking fund of say three per cent to retire the loan, and then the ten per cent return on cost, given in the sixth column of Table Three could be allocated as follows:—Three per cent for sinking fund, $1\frac{3}{4}$ per cent for interest, two per cent for operation, two per cent for maintenance, and one and a quarter per cent for a company profit. However, as before pointed out, the essential thing at present is to have the whole matter checked by a first class hydro engineer of wide experience in design and construction.

Hon. Mr. GRIESBACH: Is there any other place in the world where power is developed from tides.

Dr. TURNBULL: Not to any extent. There are a few little plants in England that have been there for many years, where they utilize the tide going into a small basin, and grind corn by means of a water-wheel set on a scow. So far there is not much tidal power development.

Hon. Mr. GRIESBACH: Why would that be?

Dr. TURNBULL: There are two reasons. To begin with, at the Petitcodiac we have a very fortuitous topography. We have two estuaries running in together and joining in Shepody Bay, and you have a high-level basin and a low-level basin, and have power for twenty-four hours. Furthermore, the tide rises forty-five feet at the highest, and twenty-five feet at the lowest, which is higher than the Severn tides, and very much more regular.

Hon. Mr. GRIESBACH: The Severn development is very primitive, isn't it?

Dr. TURNBULL: I don't know that you could call it primitive. I know the British government had a commisison on the Severn going on for several years, and they looked into the matter very thoroughly, but for the reason that they had a single estuary, the only way they could get continuous power was by pumping the water for eight and a half miles to a hilltop, from which it would come back to the power house. Otherwise they would just have to take the power eight hours at a time, and then there would be nothing doing at all till the next high tide. Of course the loss in the pipe-line along the eight and a half miles just knocked the scheme. I think their lowest cost per developed horse-power, if I remember, works out at about \$500 or \$600.

Then, of course, there are large tides out in the Hoogli River, and in various parts of the world; but we do not find elsewhere this fortuitous combination of estuaries meeting, so that you can get continuous power, coupled with the very high tides that we have in the Bay of Fundy.

Hon. C. P. BEAUBIEN: Has the American government not tried a scheme of that kind in the Bay of Fundy?

Dr. TURNBULL: Yes, they did, at the western end of the Bay. There was a proposal for a tidal plant at Passamaquoddy Bay. But there they did not have the two estuaries. There are a lot of little islands scattered about. My son and I visited that plant many years ago, and at that time the United States government had put up \$10,000,000 just for investigation; then they cut it down to \$7,000,000; then they discontinued, because the engineers, were building themselves a very nice colony of summer houses, and there wasn't very much done

on the work. It was not an efficient way to go about a hydro project. They have dropped that now. I don't suppose it will be taken up again. The total cost in that case was about eighty millions, and the cost per developed horse-power came out at a little less than the Severn, something like \$500 per developed horse-power.

Hon. Mr. DUFFUS: Relatively speaking, what would be the likelihood of depreciation of mechanism, construction and equipment, on account of salt water as against fresh water?

Dr. TURNBULL: Undoubtedly it would be higher. I cannot answer that offhand. That is one of the questions that the experts, whom I hope we will engage, would have to go into very carefully. I cannot from my own experience answer that question.

Hon. Mr. DUFFUS: Can you tell us from your own knowledge what would be the relative depreciation of concrete construction?

Dr. TURNBULL: I do not know. Donald, can you say anything on that?

Mr. DONALD TURNBULL: Practically none, sir.

Dr. TURNBULL: They have developed concrete now to such a stage that they know just the right mix to use for salt water.

Mr. HILL, M.P.: The American government has made a very exhaustive study of the effect of salt water on steels. They had a two years' study at Eastport, and in that study they got the finest of all types of metals and steels and hardened steels from the various companies in the United States, and put these under test, forcing the water under pressure so as to accomplish in a week as much deterioration or corrosion as would ordinarily occur in a year under normal pressure. They have records which are unsurpassed, and the results of this survey are available and can be obtained.

Dr. TURNBULL: Yes.

Hon. Mr. BLACK: Did they find that some metals would resist corrosion?

Dr. TURNBULL: They tried out different types, and know how much longer one type will last than another.

Hon. Mr. BLACK: The reason I ask is that I have been informed recently that there is a metal compound which is rust resisting, either in salt water, or any other.

Dr. TURNBULL: A very small percentage of copper put in steel makes a vast difference in the matter of sheet steel piling. I think it is two per cent copper in the sheet steel piling that will ensure a life in salt water of anywhere from fifty to one hundred years. In this project, however, I do not think we have to use any sheet steel piling.

Hon. Mr. ROBICHEAU: The only part affected would be the water-wheel.

Dr. TURNBULL: Yes, and there would be a certain amount of depreciation in the gates and the turbine wheels; but it would probably be very slight, and we would have to have some allowance for depreciation on the parts that would depreciate.

Mr. KINLEY, M.P.: You only use the water running out? You don't use the tide running in. Is that right?

Dr. TURNBULL (describing Plan of March 13, 1944): This is the Petitcodiac River going this way, and that is the Memramcook, and here is Shepody Bay. The Bay of Fundy comes in this direction and around a curve and up here to Port Folly point, which is this point, composed almost entirely of sandstone, between the two rivers. Your mode of operation is this: on the incoming tide the water flows around here and fills the Petitcodiac River, and after a certain time this water flows through the power house, always in the same direction, but

one time it can dump directly into Shepody Bay, but when the water there begins to rise these gates are closed, these other gates are opened, and we dump into the Memramcook basin which previously has been drained of its water at low tide through these gates, so in that way you get a twenty-four hour service, continuous power.

Hon. Mr. McRAE: In that arrangement, what head do you get to your water?

Dr. TURNBULL: On a 35-foot range the head varies from around 29 feet to about 15 feet.

Hon. Mr. McRAE: So you would have as a minimum the power from a 15-foot head at any time during the day or night?

Dr. TURNBULL: For any given tide the power would remain constant. I took up the matter of the turbines with Wm. Cramp & Sons Company, and they furnished me with a design for a special type of turbine that could be used for this variable head. The head is always changing, and they could guarantee a turbine that would be 90 per cent efficient at constant speed.

Hon. Mr. ROBICHAUD: There are governors on the wheels.

Dr. TURNBULL: They use what they call a propeller type of turbine, and by altering the inclination of the blades they get a high rate of efficiency through a wide range of head.

Hon. Mr. ROBICHAUD: There is a lot of silt in that water. Is there any chance of that filtering in?

Dr. TURNBULL: I made careful measurements of the silt at various tides and all across the river. Some dredging might be required near the power house. Otherwise we would like it to accumulate; it helps to fill up the interstices of the dam. That would be no detriment to the operation. The amount of silt there is very small. It is stirred up at present far more than it would be if a dam was built. Once you have a dam built, you have a large salt water lake extending twenty miles up the river, and that would be comparatively quiet water. As it is now, you have the tide rushing in, backwards and forwards, and that keeps the silt more or less suspended.

Hon. Mr. ROBINSON: Have you had Sir Phillip Gibbs down there on the site?

Dr. TURNBULL: Yes; he visited the place with me a matter of twelve to fourteen years ago. Of course, he would not commit himself; no engineer would commit himself off hand as to what he thought of it, but he did say he thought it was a very interesting proposition. I remember one of the points he made was this: He said: "You can get all the rock you want here without any trouble; you could blast off one thousand to two thousand tons of rock at a time." So we could get the rock there cheaply.

Hon. Mr. McRAE: What would the power development be when you had the minimum head of 25 feet?

Dr. TURNBULL: For 13 per cent of the time we do have what are called subnormal neap tides, with 25-foot range, and at that time our power would drop off to 240,000 horse-power. But in the case we are discussing, with an average range of 35 feet, your power does not vary. The amount of water that you use varies from moment to moment, but your power is not varied, because the inclination of your propeller blades is such that you are using more water when the head is low and less water when the head is high; but the speed remains constant and the power remains constant.

Hon. Mr. ROBINSON: Mr. Chairman, someone whispered to me that I might tell the Committee something about Dr. Turnbull. He is really more of an inventor, I believe, than an engineer. Is that not correct, Dr. Turnbull?

Dr. TURNBULL: I don't know. I am pretty crack-pot, I think.

Hon. Mr. ROBINSON: He has made various inventions, one of the most important of which, as I understand, is a device for changing the pitch of airplane propellers. As I understand it, that device is in use on the planes operated by most of the important airplane companies on this continent to-day.

Hon. Mr. McRAE: That would be mechanical engineering.

Hon. Mr. ROBINSON: Dr. Turnbull is very modest about it. He has been a heavy contributor to the Income Tax Department, probably the largest contributor in our province.

Hon. Mr. GOVIN: Mr. Chairman, during the course of his very interesting remarks, Dr. Turnbull said it would be important to have a report from a highly competent hydro-electric engineer. I should like to know the approximate cost of such a report.

Dr. TURNBULL: I had a chat with Mr. Burnett, of the H. G. Acres Company, and tried to get that information from him. He knows the site well; he was born and brought up in that region and is familiar with every square foot of it. He told me that he thought the H. G. Acres Company, if they were appointed to make a report, would study the whole matter, make certain surveys, design the gates and dams and so on, for a charge of approximately \$50,000. I then asked him what that would cover, and he said it would cover a very accurate estimate of the cost of the engineering features, but not the detailed designs that it would be necessary for the contractor to have; they would require a great deal more work and would probably run to \$200,000. That is what I have in my report. You will notice that in my report I gave an estimate of \$350,000 for legal and engineering fees. We know that legal gentlemen are very nice chaps, so probably about \$50,000 would cover their charges; and \$300,000 would pay the engineers' fees, probably, in the ordinary course.

The CHAIRMAN: Are there any other questions, gentlemen?

Hon. Mr. McRAE: Mr. Chairman, if I may make a comment, I should first of all like to say how much I appreciate this presentation that has been made to-day. I have heard about this power before, for many years, and the presentation here this afternoon has been illuminating and encouraging to me. We all anticipate that after the war we shall be faced with a serious labour situation. This tidal development proposal looks like one of the practical things that would give a great deal of employment and at the same time bring about a development that is essential from the point of view of the country's interest. I do not know whether it is in order for the Senate to recommend an expenditure, but if so, I would be in favour of recommending that the Government appropriate \$50,000 to make an initial investigation.

Hon. Mr. SINCLAIR: Mr. Chairman, like Senator McRae I appreciate very much the information we have received here. There is one phase of the proposed development on which I should like to have some enlightenment, if Dr. Turnbull can give it. We who live in Prince Edward Island are interested in knowing whether it is feasible to convey electricity by submarine cable for a distance of twelve to fourteen miles. Some of our engineers tell us that the loss through a submarine cable extending that distance is too great to justify the thing.

Dr. TURNBULL: Some twelve to fifteen years ago I made inquiries of competent engineers on that point. They told me that the proper thing to do was to have step-down transformers on one side of the Northumberland Strait, to step-down your voltage from 66,000 to 22,000, and that then it would be entirely practical to transmit the power through a double-circuit conduit, a lead covered cable, for the six miles that have to be crossed—that is just about the distance at the narrowest point. When the power reached Prince Edward Island it would be stepped up again with another transformer, brought back to 66,000

voltage. The whole thing, with 100 miles of transmission lines, would cost a total of about \$630,000, I estimate, which is a mere bagatelle compared to the total cost.

Hon. Mr. SINCLAIR: Would that figure cover just the cost of carrying the power across the Strait?

Dr. TURNBULL: No. That included the transmission from Hopewell to the Strait, a step-down transformer to cut the voltage from 66,000 to 22,000, a two-circuit cable for the six miles across—

An Hon. SENATOR: Nine miles.

Dr. TURNBULL: No, six miles. However, that does not make any difference. It would also cover setting up the voltage again in Prince Edward Island, and the transmission lines there. I did not know how long those lines would be, so I estimated them at 100 miles, to begin with. The cost for all those items was estimated at about \$630,000.

Hon. Mr. KING: I may say, Mr. Chairman, that I have received from the Department of Mines and Resources an intimation that they have some knowledge of this. They referred to the fact that Mr. Turnbull, a consulting engineer, of Rothesay, New Brunswick, delivered a paper on this subject at a meeting of the Engineering Institute of Canada, at Saint John, New Brunswick, on September 11, 1919, and revision of this paper appeared in the report for 1923 of Smithsonian Institute, Washington, D.C. It is also pointed out that, in brief, Mr. Turnbull's scheme involved the construction of dams with an overall length of about 9,700 feet across Shepody Bay just below the confluence of the Petitcodiac and Memramcook rivers, and so on. I do not need to go into that, because it has been dealt with in Dr. Turnbull's report to the Committee. I merely wish to indicate that the Government thought sufficiently well of this project to have certain borings made in 1924, through the Department of Public Works, for the purpose of ascertaining the character of the soil and the foundation that would be met with if construction were undertaken.

Dr. TURNBULL: That is correct, I think. The dams have to be built on top of the soil; we cannot build on solid rock.

Hon. Mr. KING: Will the boring go down to solid rock?

Dr. TURNBULL: Yes.

Hon. Mr. KING: To what depth?

Dr. TURNBULL: I found from the low-tide level of the Petitcodiac that the soil was down to an average of 18 feet, but after that the average depth from the top of the soil to the top of the rock was about 78 feet.

Hon. Mr. KING: If you have to go to a rock foundation for construction it would be a very serious problem.

Dr. TURNBULL: It would, principally because the head on the dams would be very great; it would be much greater than building surface dams. On that account you would reach an almost prohibitive cost for adequate dams on a site of that kind. With the dams built on the surface—

Hon. Mr. KING: Rock dams?

Dr. TURNBULL:—in the settling of the dams I allowed for 50 feet sinkage. I got that data from the Passamaquoddy people. That is in my cost estimates. After figuring the cost of the dams I doubled the figure to allow 50 per cent sinkage, which is probably about right from the result of their investigations.

Hon. Mr. KING: In the engineering world they are pretty well satisfied with that type of dam under those conditions?

Dr. TURNBULL: That is the oldest type of dam in the world, the dam built on the top of the soil, and if the design is correct there is no trouble with it. Ordinarily speaking, the slopes are very wide, on one side four to one and on

the other side three to one. That is a very common type for dams of that nature where they sit on top of the soil. Of course, in this case if we found any settling, then it is very easy to build up on the top. You would not have to do anything except replace the settling. After two or three years you might get a certain amount of unalignment at the top of the dam.

Hon. Mr. KING: Then you would level off?

Dr. TURNBULL: Yes.

Hon. Mr. ROBINSON: Would it be feasible to have a bridge across the dam?

Dr. TURNBULL: Yes. I have put on the drawing little parallel lines. They would drive right across the dam and save about forty miles in going from Hopewell to Dorchester—if you ever wanted to go to Dorchester.

The CHAIRMAN: Anything else?

Hon. Mr. BLACK: I very heartily approve of the senator's motion, but I think some other member of this committee, outside of the Maritime Provinces, should second that if they feel so disposed.

Hon. Mr. KING: Mr. Chairman, I should be inclined to be very careful about placing any substantial amount in the proposed motion. I think we might indicate to the Government that from the evidence we have heard here we look upon it as a project of great importance, if it is feasible, and that it should receive federal consideration in consultation with the Governments in the Maritimes who are interested in the development, with a view to seeing if some plan of co-operation cannot be worked out for an investigation.

Hon. Mr. ROBINSON: My main object was to get some information before the committee, and I think we have done so. We owe Dr. Turnbull a great debt of gratitude for the tremendous amount of work he has devoted to this subject. We have no conception of the time Dr. Turnbull has given to the investigation of this problem. He has been for years working at it, and I guess sometimes he works on until 2 o'clock in the morning.

Dr. TURNBULL: I do not do so now.

Hon. Mr. ROBINSON: I hope we have made some progress. We took the matter up with the local Government in New Brunswick, and it is prepared to co-operate. In fact the New Brunswick authorities are so impressed with the importance of this project that in the Speech from the Throne the Government expressed its readiness to co-operate.

Hon. Mr. McRAE: Hon. Mr. King's suggestion is all right except for one point. I take it that eight months will be required for the preliminary investigation, and it will be another year before the report is submitted to the Government. Therefore I do not think there is any time to be lost if competent engineers are to be set to work on the proposed investigation. A sum of \$50,000 might not be sufficient, and it might be well to omit a specific amount. But I do think this is a very worthy object, having regard to post-war employment and the needs of the Maritimes. I come furthest from your province, but I come from a province where there is lots of water-power, and I know the need and value of it. I think Senator King's suggestion is all right, as I said, except that there should be some way whereby we can encourage the Government to start an investigation without any undue delay. I repeat, it will be a year before the report will be before the Government to act upon. By that time I hope this after-the-war effort of ours will be ready to proceed.

The CHAIRMAN: Did you make a motion, Senator McRae?

Hon. Mr. McRAE: I did not, but I will make one.

Hon. Mr. BLACK: Mr. Chairman, I would suggest that a committee composed of Senators McRae, Robinson and the Chairman draft a resolution for our approval. It could be done in a very short time.

Hon. Mr. McRAE: I could not approve of this, which says the project is warranted. I would say an investigation is warranted.

Hon. Mr. KING: The Government is giving much thought to the matter. They have set up committees in the various departments to study questions of reconstruction after the war, and there is no doubt from the evidence we have heard to-day of the importance of this matter to the Maritime Provinces, and it should be a project to appeal to the Federal Government. I think we might have a resolution setting forth the fact that we have heard this evidence to-day and are impressed by it, and recommending an immediate, or almost immediate, investigation of the proposal. If you gentlemen would get together and draw up a resolution along that line, and it is accepted here, I think it would be satisfactory.

Mr. PARSONS: May I call attention to the difference in the figures as given by Dr. Turnbull and myself. My quotation of 4,400 men was based on site and off-site labour for three years, while Dr. Turnbull's figure of 3,000 men was based on site labour.

The CHAIRMAN: The motion placed in my hand reads as follows:—

From evidence adduced your committee is satisfied that an investigation by competent engineers into the possibilities of developing tidal power at the confluence of the Petitcodiac and Memramcook rivers in New Brunswick is warranted and as a post-war project merits immediate action to determine the practicability of the development.

Is that satisfactory to the committee?

Several Hon. MEMBERS: Carried.

The CHAIRMAN: Gentlemen, I am sure that on behalf of the committee I can say that we are delighted to have this information before us. We are also glad to have present not only members of the Senate who are not members of this committee but as well members of the House of Commons to hear this report, and I hope from the information they have received they will be able to give us their support in this very important matter.

