Passamaquoddy Tidal Power Project

Q: Upon returning to the United States, you were surprised at your assignment as chief of the Engineering Division for the Passamaquoddy Tidal Power Project. Do you want to repeat that story?

A: Well, as I said, I had been sent over there primarily to be briefed and prepared to take over the hydraulic laboratory at Vicksburg, Mississippi, which we thought was very, very important to the Corps of Engineers in connection with future developments and research and improvements and so on. And so, knowing that we were going there, and noting that a lot of the German families were having difficulty with low wages and with economic conditions among the average public not at the best, we gave away all of the three children's winter clothing and some of our own, because, knowing we were going to be down in Mississippi, we wouldn't need them for a cold winter.

Well, when we got back to New York we were greeted by Lucius Clay, who had succeeded me in the Chief's Office in the Rivers and Harbors Section, and a Mr. Stout was with him. They greeted us as we got off the transport, and then congratulated us on my new assignment up at Passamaquoddy. He said, "You don't know about Passamaquoddy? Why, that's President Roosevelt's pet project. " President Roosevelt had a summer home up in Campobello Island, and his next door neighbor was Dexter P. Cooper. Dexter P. Cooper had been living for years on the Passamaquoddy Tidal Power Project plan. He was always proposing it, and he had been getting funding from General Electric, Westinghouse, and the turbine manufacturers, and he was presenting a glowing picture of the potential in development of Passamaquoddy and had sold it to Franklin D. So Franklin D. directed the Corps of Engineers to build the project. I guess they figured that with the special research and so on I had done, coupled with my prior service on rivers and harbors work and other activities, maybe I was the one to go up to handle the engineering.

So we were sent up to Eastport, Maine, and I was put in charge of engineering the project. I might say that was the principal phase of the Passamaquoddy project. We did have Roy Lord on operations, and we built barracks and so on and quarters for the personnel as it was planned to be a rather long-term construction project. Phil Fleming was the district engineer. Phil was a wonderful guy, but he didn't know anything about hydraulics or power development or turbines or such. He was the administrative and executive head. So the complete engineering was my function.

I gathered up a number of well-qualified individuals for my division. At that time there was a depression in the engineering field and we were able to get some well-qualified engineers such as from Stone and Webster and organizations of that type. So I got an excellent group of hydraulic, mechanical, and electrical engineers, and we proceeded on with the design.

We were restricted just to Cobscook Bay, limiting us to a single basin project. It's absolutely economically infeasible to develop economic hydrotidal power from a single basin project. You build a dam to enclose this interior bay, with massive gates to open at high tide in order to bring the level of the interior bay up to high tide, and as it recedes, you close the gates. Then as the tide drops to about 5 1/2 feet below pool level you open up the powerhouse and generate power during the falling tide until the tide again rises to where you have only about a 5 1/2-foot head difference, and then you shut off the power. You then have to wait until the tide gets up to inner pool level when you open the gates and try to refill the pool [to replace] the water that you have used in power development, doing that in successive cycles.

That means intermittent power. It also doesn't mean that you get the peak power at a fixed time of day, because it conforms with the tidal cycle, which is on a lunar day rather than a normal solar day, so that means that you get maximum power at either the night or the morning or the afternoon. So because of that, for firm power you have to develop an auxiliary source of power. So we planned for a pumped storage project in the vicinity. When developing tidal power, we would be sending some power down to the pumped storage project, pumping water up to this high-head reservoir. When the tidal powerhouse would shut down, we would regenerate the power from the pumped storage power facility. But that meant duplication of structures and equipment, power losses, and so on.

Incidentally, we were also using salt water. With salt water you suffer from corrosion and from galvanic action. If, as you must, you have copper and steel, you are going to have the damaging effect of galvanic action.

Concrete structures would also be subject to alternate exposure to freezing at low tide and higher salt water pressure at high tide. So we were confronted with many, many problems. Now, if they ever are going to develop the Passamaquoddy Tidal Power Project, it should be an international project. We should have Canada come into this with Passamaquoddy Bay and the United States with its Cobscook Bay, and the powerhouse between them. With two pools, the high pool would be filled to high tide level. The lower pool would have its gates opened near low tide to bring it down to low tide level and then closed. In that way you would have continuous power and something approaching economic feasibility without an expensive auxiliary power source.

But you must keep in mind that these are low-head projects. If you have a low-head hydro plant, it means that for hydraulic efficiency you have massive turbines, massive generators, moving at relatively slow speed. And when they are massive, that means more steel, more copper, more concrete to support it, and much higher expense per unit, per kilowatt unit of capacity, in addition to the problems of galvanic action and corrosion with salt water. In connection with our research we set up both a hydraulic laboratory and a soils mechanics laboratory. We also had experiments conducted at Worcester Polytechnic Institute as to how you would build a dam in flowing water with swift tidal currents and great depths–making cofferdams impossible-and with poor foundations. We would have to place massive boulders in the face of swift tidal currents coming in and out. So it would have been a very, very difficult project. In fact, I presented a paper on that to the Permanent International Association of Navigation Congresses [PIANC] about the problems in connection with construction of a rock-fill dam in a flowing stream.

We also set up a laboratory testing combinations of metals-copper and others—and the corrective means to control galvanic action and corrosion, both in salt water and salt water atmosphere. We also set up a special concrete laboratory to test different types of cements, because the concrete structures were going to be subject to not only salt water but to intermittent wetting and drying and to extreme freezing conditions. I later submitted a paper to the American Concrete Institute on these studies.

So there were many, many technical problems that we covered and I reported on in my report. We reported that although it was feasible from an engineering and construction viewpoint, its cost ran out of sight. At that time energy costs were much lower than they are now. But also, we indicated that there were other potential normal hydroelectric power development possibilities in the state of Maine which should, in preference, be developed first, even though one of the primary purposes at that time was to relieve unemployment. That is what was happening there at Passamaquoddy because the labor that we used on all the construction work was WPA [Works Progress Administration] labor [that] was engaged primarily to relieve unemployment in that area.

Incidentally, those are some of the things not mentioned in this book you gave me, *Army Engineers in New England*, where there is quite a long discussion on Passamaquoddy, but these are some of the things not mentioned that quite possibly could have been brought in.

Q: In this project you had provisions, as you have mentioned, for pumped storage. This is used now quite frequently, but was it a relatively new technique for hydroelectric power generation in the 1930s?

A: It was a very new technique. They had had a few of them in Europe, but now it is used frequently in many, many areas. It is possible and advantageous for a large steam power generating station to operate 24 hours around the clock, producing power at high efficiency. However, the power loads that they are selling, that are used by industry and by households, occur intermittently. You run at peak hours where there are large demands for power, and then the power demand will lower and you will have long periods where the power demand for the total system is low.

What they can do is to build power plants large enough to hit the peak capacity load throughout the system, but that would be uneconomical. It is also uneconomical for a steam power station to generate power for so many hours near the peak loads and then shut down until required to build it up again. It is much more economical and efficient to run that steam power, a basic power plant, at full load, just steadily around the clock. But that generates excess power during the low power need period. Therefore it is desirable to store that excess for use during peak load periods. And the way they store it, instead of by storage batteries, is to provide a large reservoir site up at a high elevation with a penstock, motors, and pumps and pump the water up into reservoir storage, and then when you have increased load, you can call on that reserve, send it down to regenerate power at the power station, and in that way equalize your load production to the varying load requirements.

Q: Apparently this is not very well understood by the general public, as witnessed by the cancellation to the Dickey-Lincoln project, which was going to be in combination with another Passamaquoddy-type power project.

A: Yes, it is too bad, particularly now, with increased costs for power generation. Many of our power stations are dependent on fuel oil, and there is strong objection to additional steam-coal powered plants unless they can get the type of coal which is relatively free of smoke pollution. That is more expensive and more difficult to get, particularly in certain regions where it requires long shipment distances to get the best type of coal. But considering all of those factors, in any place where there is a potential for pumped storage development and where you have major power stations with varying power loads throughout the system, one of the more economical methods of handling that increased demand is through the use of a pumped storage facility.

Q: You were an active participant in this project, and it is obvious from your comments that you did not think the project as then outlined was economically feasible. Would you agree that the political forces prevailed upon Roosevelt to let the project die in 1936?

A: Yes. I mean, here we had a report indicating what the heavy and uneconomical costs were. There were opponents as well as proponents to this development. The power interests in New England were not interested in having the federal government coming into the power generation field, particularly in a new area. As far as I was concerned, I would have opposed it if the government tried to sell such power direct to customers in the market area. I would favor selling this power to existing power companies to use in their distribution system, which is what we did later on in the Philippines when I built the Caliraya Project near Manila.

The attitude among Filipinos was that the government should not only generate the power but also sell it directly to the public. I strongly opposed that and said that we should generate the power at low cost because of tax-exempt government financing, especially with the hydropower costs high in capital cost but very low in maintenance and operation. If you can get government money at low interest, as compared to the high interest rates that private industry would have to pay, you can generate the power at a lower cost. But the best way to sell the power, rather than through duplicate and competing distribution facilities, is to utilize existing private utilities, selling the power in bulk to them at a rate that ensures a profit to you, and you control by regulation the rates that they sell in their system. That certainly is a more effective and better way to handle such power.

Q: That would be quite similar to the way that they do it out at Bonneville now, where they sell it to the Bonneville Power Administration. Do you believe that the Corps of Engineers gained any positive results from the Passamaquoddy project?

A: Oh, I think not. I mean, in world literature they are cognizant of it, and there have been studies made and so on. But as far as Maine is concerned, and the area up there, they are all disappointed that the government did not proceed to relieve unemployment there and to provide this power source and stimulate further industry up there.

But it is interesting, though, that just before any national election for the President or the Congress and Senate, you will see those who are about to run for office get a little resolution through the Rivers and Harbors Committee of the House or Commerce Committee of the Senate calling for a review of the project that we submitted, which is very easy to get. They then send it down to the Chief of Engineers, and we have to go in and review the project and so on, and the congressman hopes the review, which is destined to be adverse, is going to take longer than the time until election. But anyway, he has done his duty. He is trying to get this thing for his constituents, and that "damn" Corps of Engineers doesn't come up and give a recommendation for approval of the project for something that is economically unfeasible.

As I say, if you ever want to get back into the Passamaquoddy and its development, you have to go the international route and have Canada and the United States join in a two-basin project, which might, depending on studies, approach feasibility.

Q: Were there any technical achievements that were made under your direction in the studies of salt water effects, corrosion, concrete research?

A: Yes. As I say, we had extensive investigations in our concrete laboratory. Incidentally, Mr. Wurpel was our civilian engineer on our concrete lab studies. We tested different combinations of various types of cement and mixtures and so on, and came out with a rather extensive report. In fact, I gave a paper on it to the American Concrete Institute. (See Appendix E.) We came out with a recommendation as to the type of cement that we felt could best resist the many forces that concrete would be subject to up there—salt water, intermittent wetting and drying daily, getting wet under high hydraulic pressure and then drying out as the tide recedes. And then you have freezing weather, which is very harsh particularly on alternately wetting and drying concrete. We also, as I say, had problems with galvanic action. We were going to have copper and steel and other metals subject to salt water air as well as being immersed in salt water, or intermittently with the rising and falling tides. We made rather extensive studies with different types of metals, developing different measures to protect the metal, including use of zinc in connection with varying amounts of copper and steel. We set up quite a laboratory there. And those studies continued for quite some time, I know, after Passamaquoddy was terminated.

As I believe I stated previously, we also made extensive hydraulic laboratory studies down at Worcester Polytechnic as to the problems we'd have in building this dam under the swift flow of water in and out during construction of the dam. It would be impossible to build a cofferdam in these great depths and swift currents. You had to build it by dropping major size rocks and boulders to form the structure of the dam. With the swift tidal currents, you had to determine the sizes of rock that would resist being washed out. The upper layers of such structures would have to be placed during the limited slack water periods near changes of tide and at low tide for the uppermost protective layers.

We also had a relatively low head development, so we made extensive studies of different types of turbines and also the tailraces for maximum hydraulic efficiency. We had excellent studies of those, also conducted down at the Worcester Polytechnic, under Professor C. T. Allen, who was head of the laboratory at that time. Those, I think, were additional dividends in connection with our research. It was done in connection with the design of this quite different project.

Q: Yesterday you spoke of Sam Sturgis' part in Passamaquoddy. What about Roy Lord and his role as the chief of the Operations Division?

A: Royal was chief of operations. If the project had proceeded, and we were going into construction, and if he were still going to remain as chief of that, his would have been a rather major responsibility. But during the survey phase the principal thing we were doing was in engineering; the development of plans, specifications, cost estimates, and so on for it. As chief of operations, his function then was solely to supervise the construction of the quarters that we required for the personnel. We had to provide a rather sizable village community to take care of the personnel that we had and which we would require during the construction phase. That was principally the function that Lord had at that time, supervision of that construction. Oh, we did fill in two small railroad bridges where we were going to enclose the pool, and we did provide some rock-fill around those, and the Operations Division supervised that.

Q: What about Roy Lord, as a person?

A: Roy was a very positive person. He was held in very high regard by Phil Fleming as he later on went with Phil Fleming, I think, when Phil had the Public Works Administration. But Roy was a bit brash and direct. Roy wasn't too popular among a lot of the Corps. Later on his principal role was when he served in Europe, I think, as deputy or assistant to General Lee [Lieutenant General John C. H. Lee] in connection with the Services of Supply [European Theater of Operations, US Army, ETOUSA]. I have heard stones about his actions and service over there, but it's best to get those views directly.

Boston Engineer District

Q: When the Passamaquoddy project was shut down in 1936, you were transferred to the Flood Control Division of the Boston Engineer District. Did you have any choice in this assignment?