§ 5.6 (d)(2) – Project Location, Facilities, and Operations

For this document, the actual wording under 18 CFR § 5.6 will appear ahead of the corresponding section in bold and italicized print.

(2) Project location, facilities, and operations.
The potential applicant must include in the pre-application document:

§ 5.6 (d)(2)(i): Name and Business

(i) The exact name and business address, and telephone number of each person authorized to act as agent for the applicant;

The contact person for Half-Moon Cove is Dr. Normand Laberge / 46 Place Cove Road / Trescott, Maine 04652 / 207-733-5513 or 207-263-6471 (cell) / nlaberge@maineline.net. Leslie Bowman is also an authorized point of contact at: 72 Leighton Street / Bangor, Maine 04401 / 207-263-4554 / lbowman@maineline.net.

§ 5.6 (d)(2)(ii): Project Maps

(ii) Detailed maps showing lands and waters within the project boundary by township, range, and section, as well as by state, county, river, river mile, and closest town, and also showing the specific location of any Federal and tribal lands, and the location of proposed project facilities, including roads, transmission lines, and any other appurtenant facilities;

The proposed site of the dam for the Half-Moon Cove project appears in Figure HMC-01. The actual location of the proposed dam is at the lower, center section of the image in line with two roads which end on the Eastport and Perry side, respectively.

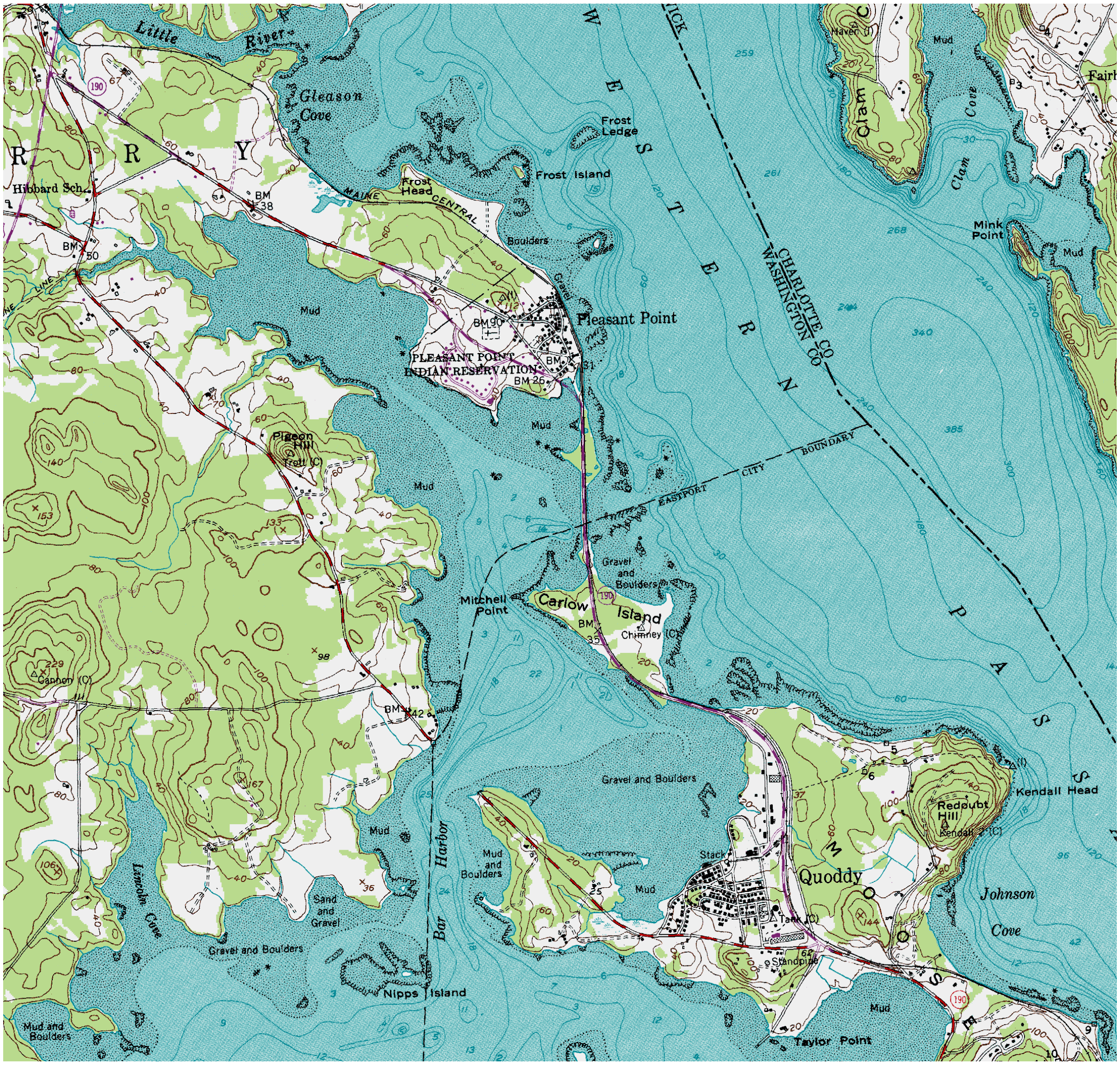

FIGURE HMC-01 – PROJECT SITE IN CENTER OF IMAGE
[ENTRANCE = 1200 FEET]

In this illustration, the high tide and low tide levels are depicted by different color tones. Tidal waters only enter from Cobscook Bay [bottom] and not from Passamaquoddy Bay. Since the high tide level will not be raised above or lowered below its present elevation, the main effect on water level will appear at the low tide mark which will be raised by 2-3 feet depending on the presence of neap or spring tide conditions. In terms of other basin features, the following information is provided for review:

PROJECT FEATURE	DESCRIPTION	COMMENTS
PROJECT BOUNDARY	880 ACRES AT MEAN HIGH TIDE; 250 ACRES AT MEAN LOW TIDE	HIGH TIDE LEVEL UNAFFECTED BY PROPOSED MODE OF OPERATION
BORDERING COMMUNITIES [WASHINGTON COUNTY, MAINE]	PERRY, EASTPORT, AND PASSAMAQUODDY PLEASANT POINT RESERVATION	PLEASE REFER TO FIGURE HMC-01 FOR LOCATION AND BOUNDARIES
DAM LOCATION	BETWEEN PERRY AND EASTPORT AT ENTRANCE TO HALF-MOON COVE	FORMER LOCATION OF TOLL BRIDGE CONNECTING EASTPORT AND PERRY
RIVER LENGTH MILE	N/A	TIDAL BASIN WITH INCONSEQUENTIAL STREAM FLOW AT NORTHERN END OF HALF-MOON COVE
TRIBAL LANDS	PLEASANT POINT RESERVATION	BORDERING NORTHEASTERN SEGMENT OF HALF-MOON COVE
FEDERAL LANDS	N / A	NEAREST FEDERAL PROPERTY UNAFFECTED BY PROPOSAL
APPURTENANT FACILITIES	TRANSMISSION LINE ABOVE ENTRANCE AND ROAD LEADING TO SITE AT BOTH ENDS	POSSIBLE INSTALLATION OF FILLING / EMPTYING GATES BETWEEN CARLOW ISLAND AND PLEASANT POINT RESERVATION

In Washington County, a community within fifty (50) miles from the proposed dam location with a population greater than 5000 residents does not exist. The nearest federal facility (non-Tribal), Moosehorn Wildlife Refuge, is more than twenty (20) miles from the proposed dam site and will not be impacted by the proposal.

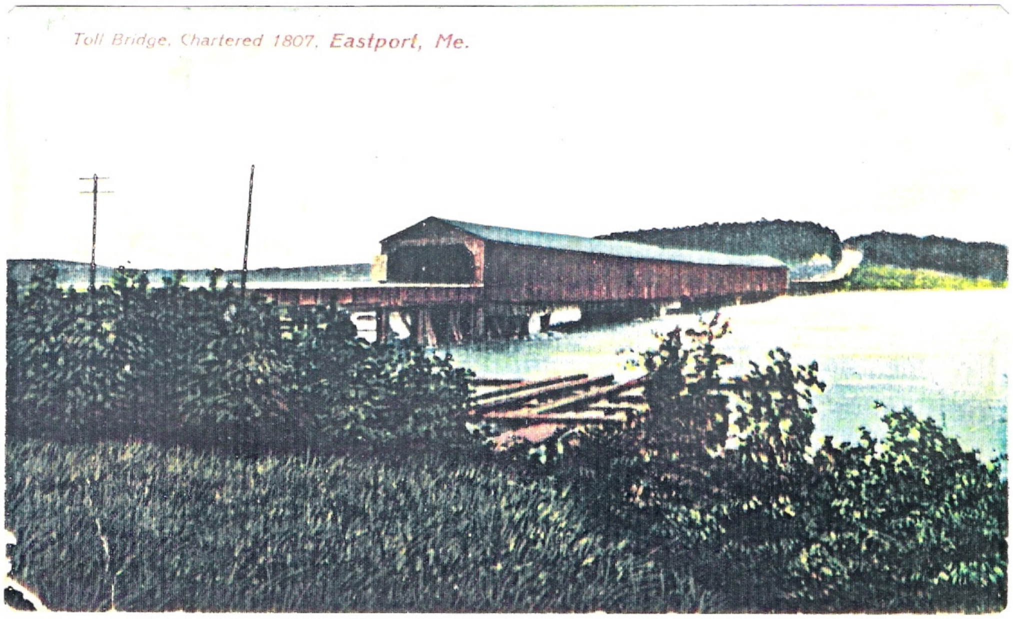

FIGURE HMC-02 – PHOTOGRAPH OF FORMER TOLL BRIDGE
AT PROPOSED DAM SITE (CIRCA 1950)

As a historical note and to document site conditions, Figure HMC-02 presents a view of the project site when a bridge connected Perry to Eastport (Moose Island). The distance across the two points of land is approximately 1200 feet with a maximum depth of approximately forty-five (45) feet at mean low tide. A cross section of the project is depicted below (Figure HMC-03) which includes proposed location of turbine bays and filling / emptying gates:

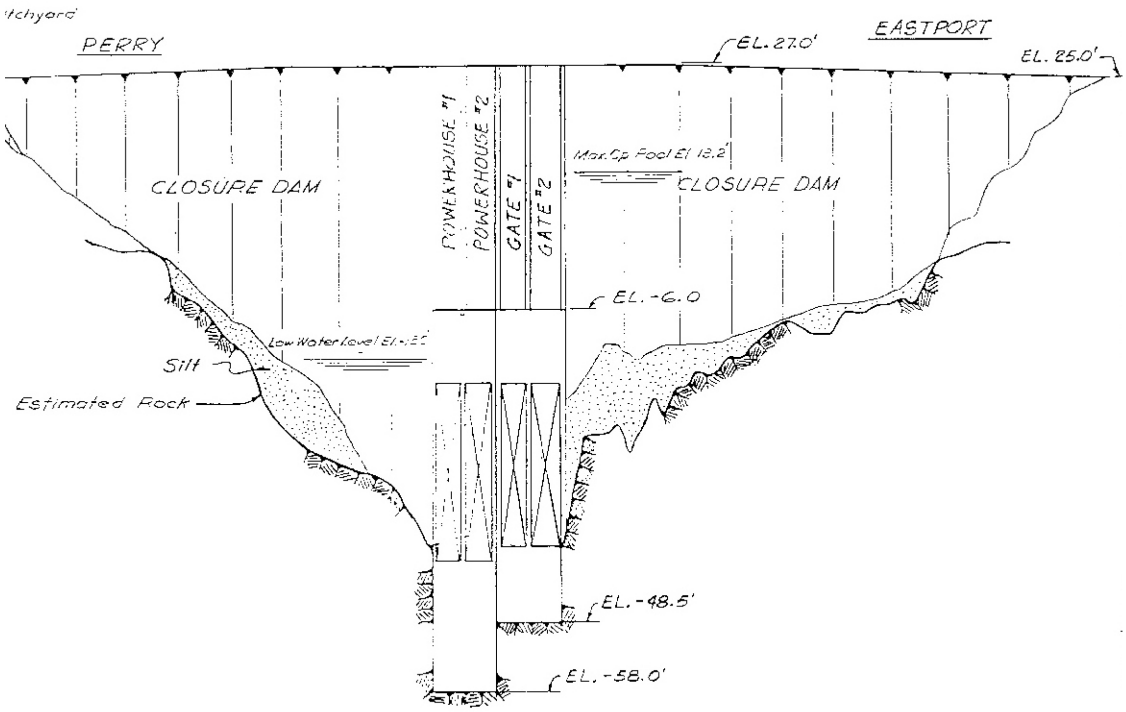

FIGURE HMC-03 – CROSS SECTION AT PROPOSED DAM LOCATION [NOT TO SCALE]

For a tidal barrage, an impoundment over normal high water will not be created as part of project plans. Depending on the time duration of energy generation, the average level of low water will be increased above normal levels due to the need to retain tidal waters to create potential energy within the impoundment. Once constructed, the operation of the project will not change unless sea water level increases substantially over the next several decades. The possibility of installing filling / emptying gates within the northernmost causeway will allow for tidal exchange with Passamaquoddy Bay. This aspect of the project is still under consideration.

§ 5.6(d)(2)(iii): Existing and Proposed Project Facilities:

(iii) A detailed description of all existing and proposed project facilities and components, including:

Half-Moon Cove includes the construction of a dam, or barrage, for harnessing the energy associated with the availability of an average tidal range of approximately eighteen (18) feet. A tidal dam derives its energy by retaining water within an impoundment to establish a difference in elevation (i.e., hydraulic head) between the basin and the receding sea level. With reversible turbines, energy is also generated by closing off the impoundment and allowing a head to develop between the incoming tide and the drawn-down basin.

For a tidal project with a barrage, the impoundment will still have a rise and fall of water which will be reduced depending on how power is generated during the tide cycle. A main challenge in formulating plans is to minimize this reduction in the naturally occurring rise-and-fall of tidal waters in order to mitigate environmental impacts while not drastically affecting the energy production potential of the site. For a tidal barrage, the most obvious measure of environmental impact refers to the reduction of the tidal range within Half-Moon Cove. Figure HMC-04 illustrates the normal method of producing power from a single-way, high pool system.

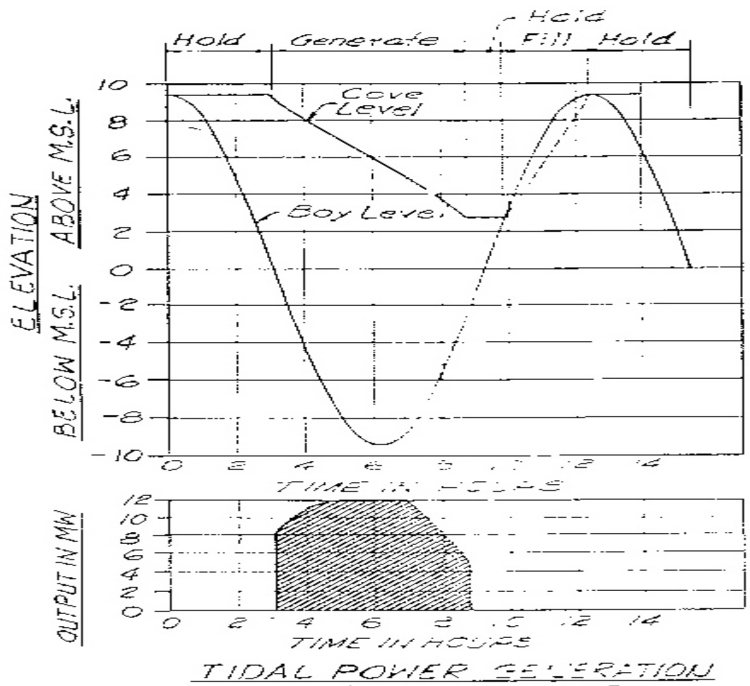

FIGURE HMC-04 – HIGH POOL GENERATION

This illustration refers to a tidal range of approximately eighteen (18) feet and depicts the output of the plant for approximately six (6) hours during a normal tidal cycle as a function of time. Power generation does not start until a hydraulic head of approximately ten (10) feet is available at the barrage which translates into approximately eight (8) megawatts (MWs) of turbine output. Production occurs until the presence of a five (5) foot head which equates to an output level of approximately five (5) MWs. Maximum power potential of around twelve (12) MWs is available when discharge occurs under a 13-14 foot head. This mode of operation represents an effective way of generating electricity by trying to maximize the hydraulic head for the turbine selected for the site. In order to develop a smooth slope for the basin level, gates are needed to empty and fill the tidal basin during various phases of the production mode. The energy derivable per tide cycle is directly proportional to the product of: [1] turbine discharge; [2] hydraulic head; and [3] production time. Based on the unit's physical dimensions, manufacturers design turbines by specifying performance (i.e., power, discharge) characteristics as a function of head. For a tidal application, turbines have relatively large diameters and rotate at relatively slow speeds. For Figure HMC-04, approximately 54,000 kilowatt-hours of electricity would be generated under this mode of operation and the tidal range within the basin would be reduced from 18 feet down to around 7 feet. This reduction in tidal range represents the most easily discernible impact on the environment for the following reasons:

1. A percentage of existing intertidal zone would be transformed into submerged land which reduces the surface area available for shellfish harvesting and other marine-related activities;
2. Water temperatures would increase during the summer due to a greater retention of tidal water and would, conversely, decrease during the winter months due to a substantially larger surface area during the tidal cycle;
3. Access to the tidal basin would be reduced due to the placement of a barrage with an accompanying increase in the velocity profile at the power plant and downstream from the filling / emptying gates; and,
4. Other physio-chemical parameters (e.g., salinity) might be altered due to the modified discharge pattern for the impoundment.

Other effects associated with this mode of operation have been noted by other researchers; however, the four (4) impacts described above are considered the major areas of concern and are directly related to the reduction in the tidal range within the impoundment.

A different mode of operation is also possible by formulating a discharge pattern based on making the elevation versus time relationship have a steeper slope. In this case, production would start earlier by triggering operation to the presence of a five (5) foot hydraulic head and by allowing a greater draw-down of the tidal basin through the use of a turbine with a greater diameter and with an increase in the filling / emptying capacity within the barrage structure. As a way to further improve the environmental acceptability of the project, the proposed mode of operation is based on using reversible turbines to generate electricity with both the incoming and out-going tide. The introduction of pumping capacity through the use of reversible turbines or installation of commercial pumps increases the attractiveness of a tidal barrage mode of development by being able to empty and fill Half-Moon Cove to more closely simulate natural conditions. In Figure HMC-05, a schematic representation of this mode of development is illustrated for a two-way tidal power plant. The key elements of Figure HMC-05 are summarized below:

- Figure HMC-05 illustrates water level of basin (Half-Moon Cove) as a function of time starting at low tide and progressing for two cycles of approximately twelve hours and 25 minutes
- Actual time of production is depicted by cross-hatched areas for three distinct time periods
- Low pool operation occurs shortly after low tide and electricity is generated as tidal waters flood into Half-Moon Cove through power plant turbines under available hydraulic head conditions (i.e., elevation difference between incoming tide of Cobscook Bay and impoundment)

- Low pool operation ceases shortly before high tide which triggers sluicing and pumping operations to raise the level of the impoundment to the maximum possible elevation
- High pool operation (i.e., generation between impoundment and receding Cobscook Bay level) occurs approximately 1-2 hours after high tide which represents the availability of a sufficient hydraulic head to power turbines located in the power plant and below lowest low tide levels
- High pool production ceases shortly after low tide
- Low pool production once again occurs shortly after low tide in a repeating and completely natural cycle
- Schematic diagrams at the top of Figure 5 illustrate how turbines operated during power production and pumping cycles
- Under neap tide conditions, pumps also have the capability to increase the level of impoundment waters above normal high tide elevations in order to increase production in the next cycle of operation

The LaRance tidal power project in France included the installation of reversible turbines during the construction period of the 1960s. Improvements and competition in the development of hydroelectric turbo-generator systems has increased the efficiency and availability of units suitable for installation at Half-Moon Cove. Research and development into hydro-kinetic devices has also developed technology which will be applied to the proposed barrage at Half-Moon Cove.

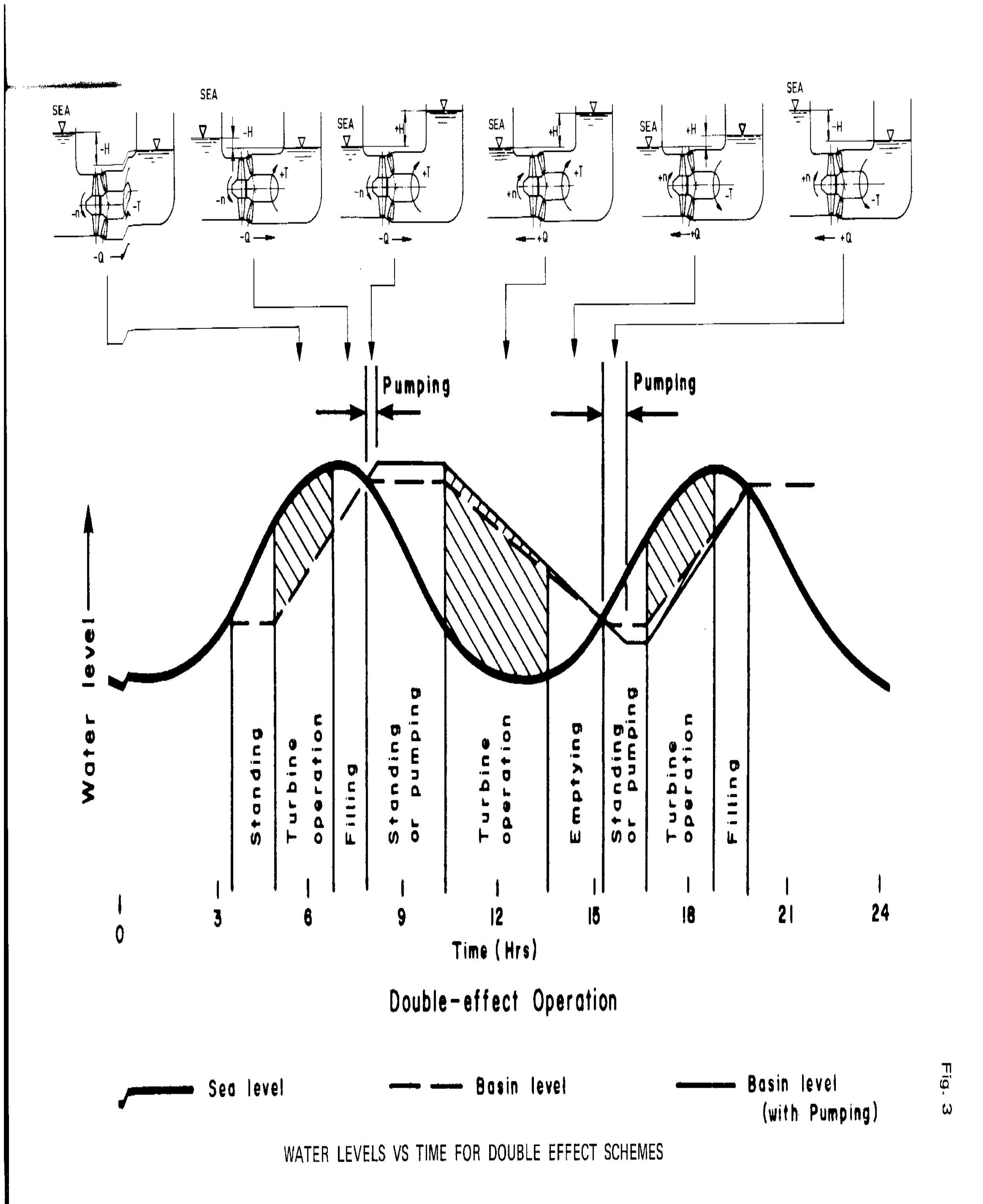

FIGURE HMC-05 – TWO-WAY MODE OF OPERATION

In this case, production time might extend for up to 8-9 hours of the tide cycle within a natural period of approximately 12 hours and 25 minutes. The tidal range reduction within the impoundment would be limited to 10-15 percent of the normal rise-and-fall of the tides. For an eighteen (18) foot tide, this reduction is approximately 2-3 feet at the lower end of the tidal spectrum. Reversible turbines were installed at LaRance Tidal Power Plant in France but were not initially used for low pool operation, but have now being utilized during the past decade. These bulb turbines were used in reverse to increase the elevation of the basin to increase potential energy in a manner which could be used at Half-Moon Cove. Figure HMC-05 shows the advantage of pumping shortly after high pool production to lower the level of the basin and shortly after low pool production to increase the level of the basin before the onset of the next cycle of production. An external source of power is needed to operate the turbines in reverse or to power commercial pumps. In various studies, the energy potential derived from pumping to fill / empty the basins has been documented as a cost effective measure. In this case, the ability to reduce the impacts associated with an altered tidal regime within the basin after high pool production is an important mitigating factor in being able to obtain regulatory approval for the project.

§ 5.6 (d)(2)(iii)(A): Physical Description of Dam and Other Structures:

(A) The physical composition, dimensions, and general configuration of any dams, spillways, penstocks, canals, powerhouses, tailraces, and other structures proposed to be included as part of the project or connected directly to it;

A cross section view of the proposed dam appears in Figure HMC-03 for a rockfill structure. The possibility also exists to consider a different mode of construction as depicted in Figure HMC-06 which would reduce construction time and costs.

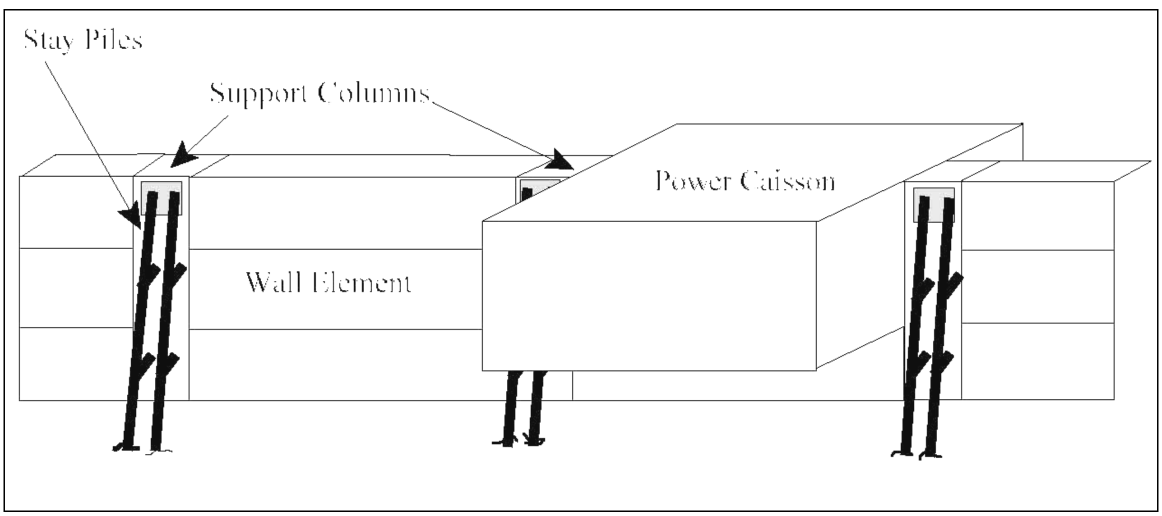

FIGURE HMC-06 - MAJOR STRUCTURAL COMPONENTS FOR PILE SUPPORTED / MODULAR BARRIER CONSTRUCTION

For the rockfill dam, the amount of material estimated for the structure which would span 1200 feet and have an elevation of +27.0’ (MSL) is summarized below:

DESCRIPTION	QUANTITY (CUBIC YARD)
CORE	18000
FILTER	24500
ROCKFILL	90000
ARMOR STONE	2300
COMPACTED GRAVEL	3670
CLOSURE WALL CONCRETE	1500

The project will not have a spillway, penstock, canals, above water tailraces, any other structure typical for a normal hydro-electric facility. For the modular barrier design, the dam will have the same elevation and will span the same length.

The powerhouse will be incorporated into the dam and will be constructed of concrete with an estimated total quantity of approximately 100,000 cubic yards of concrete. A schematic diagram for the proposed power house is depicted in Figure HMC-07 for a bulb type turbine design.

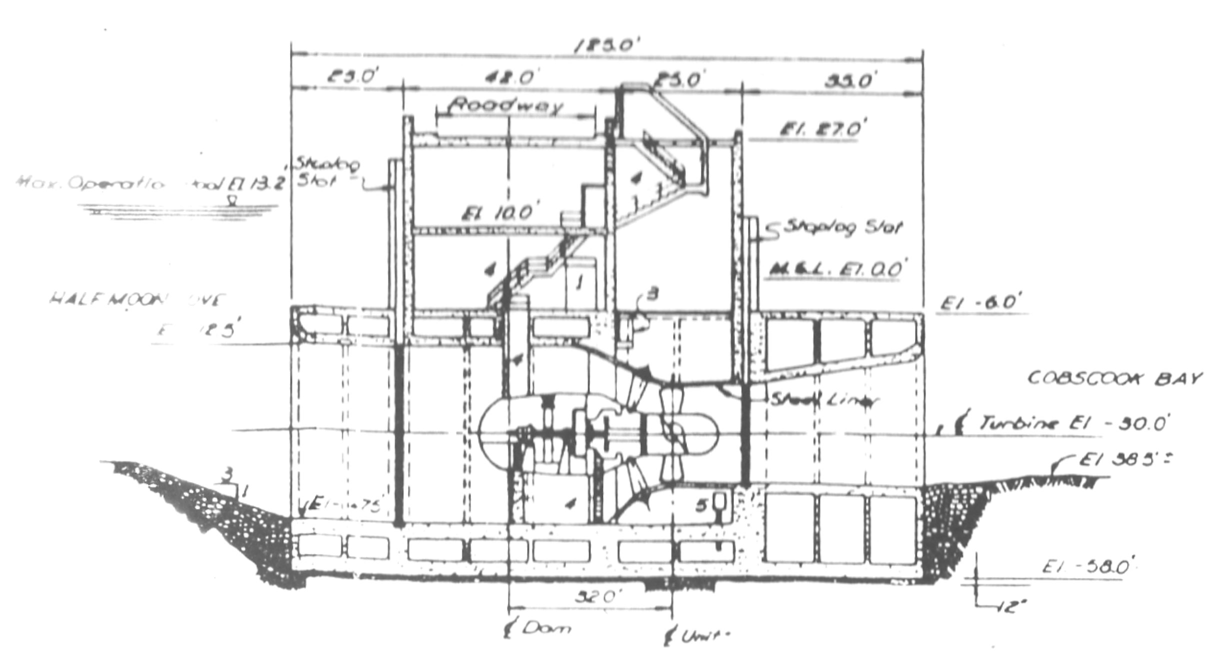

FIGURE HMC-07 – TYPICAL CROSS-SECTION WITH BULB TURBINE

§ 5.6 (D)(2)(iii)(B): Water Surface Area

(B) The normal maximum water surface area and normal maximum water surface elevation (mean sea level), gross storage capacity of any impoundments;

For Half-Moon Cove, the tidal range varies twice from approximately 12 feet to 26 feet during a lunar cycle of twenty-eight days. For a spring tide, production would be greater than an average tide due to an increase in hydraulic head and discharge values with accompanying improvements in turbine efficiency for both high pool and low pool operation. Conversely, neap tide conditions would result in less production than available with higher tidal ranges due a reduction in the average hydraulic head and discharge values. During the lunar cycle, the reduction in tidal range within the impoundment would still equate to around 10-15 percent of the natural tidal range and would occur at the low end of the spectrum since measures will be taken to ensure that the basin is filled to normal high tide conditions. This impact needs to be evaluated in terms of the actual elevation of the tidal basin as outlined below as referenced to mean sea level:

TIDAL RANGE [FT]	LOW TIDE ELEV. * [FT]	HIGH TIDE ELEV * [FT]
12	-6.0	+6.0
19	-9.5	+9.5
26	-13.0	+13.0

* *at mean sea level*

The only area of the intertidal zone which will be permanently transformed to submerged land will be limited to the elevation from -10.5’ to -13.0’ which translates into approximately one hundred and forty (140) acres for Half-Moon Cove which has a surface area of approximately 850 acres at high tide and an intertidal area of around 600 acres. The environmental impacts to the intertidal zone of Half-Moon Cove need to be measured in this lower layer of the water column which will be affected less than an estimated ten (10) percent of the time due to the periodic nature of the tides.

In order to appreciate the cyclical period of tidal ranges during a representative period, Figure HMC-08 provides an illustration of this behavior for a typical one month period during a calendar year.

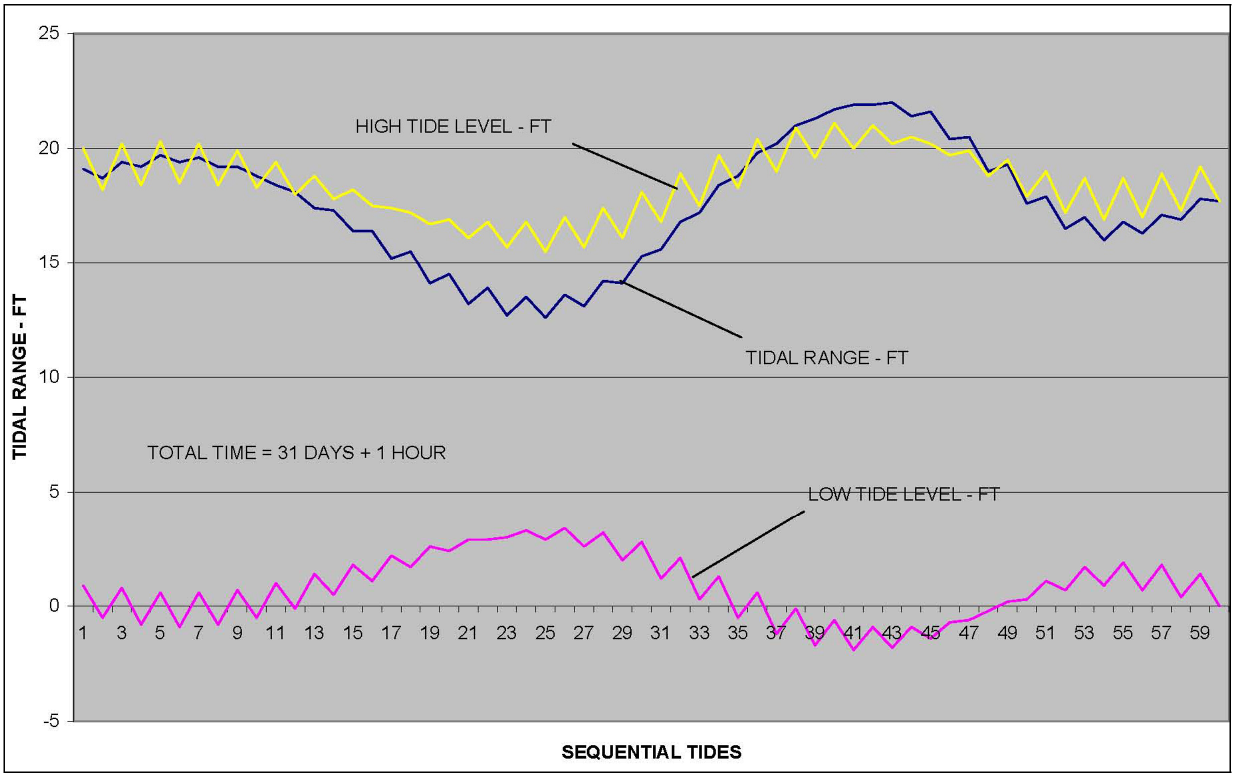

FIGURE HMC-08: TIDAL RANGE VARIATION DURING TYPICAL MONTH

Since an impoundment will not be created in the same sense of a typical hydro-electric dam, the impoundment for this proposal refers to the amount of tidal water retained within the basin during a normal production cycle. In this case, the volume of water is equal to an average area of approximately 140 acres with a height of 2-3 feet depending on existing tidal conditions. For this project, tidal waters are being detained instead of being impounded and the net impoundment area will be created at the low end of the tidal spectrum.

In order to provide an estimate on the volume of tidal water contained within Half-Moon Cove, the following tabulation lists some pertinent quantities in reference to the impact of an increase in 2-3 feet in the level of low tide:

TIDE HEIGHT [FT]	WATER VOL [ACRE-FT]	% OF TOTAL EXCHANGE
19.0	11600	100.0
14.0	7865	59.8
9.5	5000	35.1
3.0	2000	9.3
0.0	920	0.0

For this calculation, a three foot increase in the low tide level for a nineteen foot tide represents only 9.3% of the volume of tidal water which would naturally flood from and ebb into Half-Moon Cove. As reference, a three foot tide represents approximately 15.7% of the vertical distance for a nineteen foot tide. This relationship exists because the volume of tidal waters at the low end of the spectrum is much less than a comparable height at the high end of the spectrum.

Plans for Half-Moon Cove include the possibility of installing filling / emptying gates along the eastern perimeter between Pleasant Point and Carlow Island. These gates would assist in the control of the impoundment level during power production, but would also enhance the ecological quality of Half-Moon Cove by allowing tidal exchange from Passamaquoddy Bay which was cut off in the 1930s with the construction of two dams on both sides of Carlow Island. A time difference in the occurrence of high tide (i.e., approximately 20-30 minutes) at Carlow Island on the Passamaquoddy Bay side and the entrance to Half-Moon Cove might also provide some logistical advantages for the engineering optimization of operations. For this possible feature of the project, the objective with filling / emptying gates on the Passamaquoddy Bay side is presented in terms of both technical and environmental measures.

§ 5.6 (d)(2)(iii)(C): Turbine Specifications

(C) The number, type, and minimum and maximum hydraulic capacity and installed (rated) capacity of any proposed turbines or generators to be included as part of the project;

A specific turbine unit has not been selected at this time. A decision on turbine specifications will be made to optimize production for the final mode of operation decided for the project. The turbines will be reversible and will operate under a minimum head of four (4) feet with a design value of approximately ten (10) feet. Two units with a total capacity of sixteen (16) megawatts are envisioned for the project.. The approximate size of the units would range from 20-25 feet in diameter with a rotational speed of around 70 rpm and will depend on the project's final formulation. Figure HMC-07 illustrates a typical bulb unit at a tidal power facility (e.g., 10 MW units at LaRance).

§ 5.6 (d)(2)(iii)(D): Transmission Characteristics:

(D) The number, length, voltage, and interconnections of any primary transmission lines proposed to be included as part of the project, including a single-line diagram showing the transfer of electricity from the project to the transmission grid or point of use; and

The final destination of electricity generated from Half-Moon Cove has not been determined since a number of options require assessment before entering in a purchase power agreements. The transmission lines above the entrance to Half-Moon Cove are owned and maintained by Bangor Hydroelectric Company. For the purpose of this PAD, specifications will be provided for integration with Bangor Hydroelectric Company in order to characterize the practicality of this arrangement.

Presently, the Eastport area is served by a single 34.5 kV line from Pembroke. This line is conducted with #4 copper and is routed along the road passing the proposed tidal power site. This conductor is too small to carry the output of the proposed project; therefore, it is proposed to install a new 34.5 kV line from Pembroke to Half-Moon Cove, a distance of 7.1 miles using 266.8 kc mil ACSR. In order to maintain system voltage, Tidewalker proposes to install a 10 MVAR static compensator to control voltages while operating generators at a unity power factor. Figure HMC-09 below depicts the transmission system during the winter peak-base system of 1979-80 which has not changed dramatically during the past several decades in this undeveloped section of Maine:

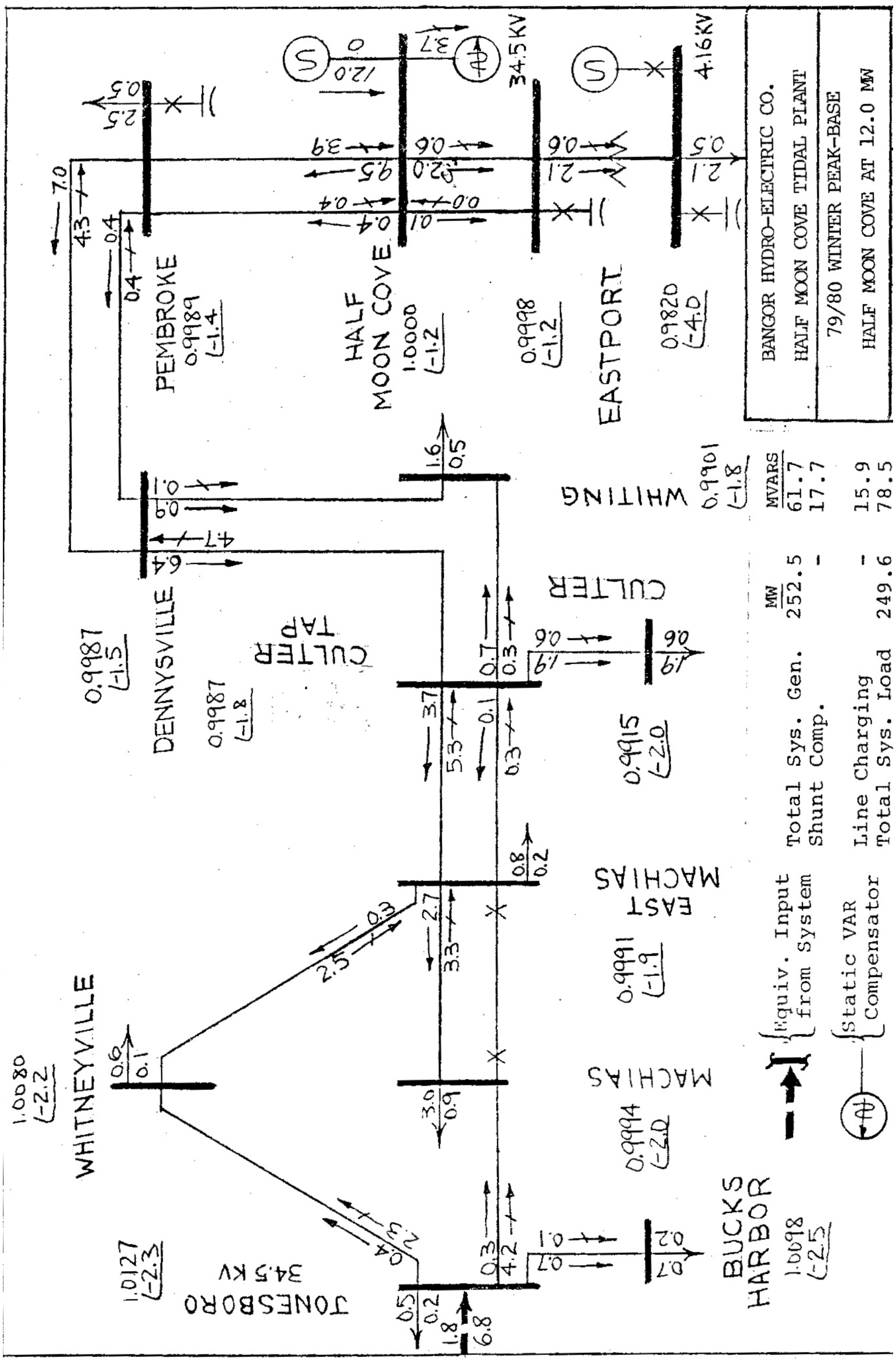

FIGURE HMC-09 – SINGLE DIAGRAM OF BANGOR HYDROELECTRIC

§ 5.6 (d)(2)(iii)(E): Plant Capacity / Output

(E) An estimate of the dependable capacity, average annual, and average monthly energy production in kilowatt hours (or mechanical equivalent);

Due to the basic nature of tidal power development, production schedule will be predictable; however, electrical generation will not occur around high and low tides when tidal waters are being retained to allow for the establishment of a hydraulic head. Since the production schedule is highly predictable, an attempt will be made to obtain a statistical credit for dependable power by considering value as a function of time during a complete twenty-eight day tidal cycle. During any two week period, both neap and spring tide conditions will have to be factored into the production schedule.

The proposed sixteen (16) megawatt plant with at least one reversible unit will produce approximately 60-70 million kilowatt-hour of electricity during a typical year. On a monthly basis, the plant will generate 5.00 – 5.83 million kilowatt-hours per month. With two units, periodic maintenance requirements will be scheduled during neap tide conditions and during short periods coinciding with the occurrence of high and low tide.

§ 5.6 (d)(2)(iv): Proposed Operation of the Project:

(iv) A description of the current (if applicable) and proposed operation of the project, including any daily or seasonal ramping rates, flushing flows, reservoir operations, and flood control operations.

Figure HMC-05 illustrates the proposed operation of the project which will be modified slightly to accommodate neap and spring tide conditions. A fourteen day operation cycle will essentially characterize the method for generating electricity at the proposed site. There is a slight variation in average tidal range on a monthly basis, but the difference in terms of characteristic water flow is less than 10% during a calendar year.

Daily and seasonal ramping rates will not apply to this project due to the predictable and constant nature of tidal flow.

Since tidal water will be allowed to flow in both directions while increasing the mean low water level by only 2-3 feet, a need does not exist to flush the area near the dam or to plan for maintenance exercises associated with sedimentation within the “impoundment”.

The control of impoundment level is an important component for optimizing energy production at this facility. The objective is to set the tidal range loss at 2-3 feet at the low end of the spectrum for all tidal conditions by the use of emptying / filling gates at the dam and, possibly, at the causeway between Pleasant Point and Carlow Island as described in this section.

Due to the intrinsic nature of tidal power operation, flood control will not translate into a water control mechanism. The run-off from heavy rain fall around Half-Moon Cove represents a minor contributing factor (< 1% of tidal water volume at neap tide conditions) to the amount of water passing through the entrance to Half-Moon Cove. The project will be designed to handle any expected rise in sea water level due to global warming and might provide some relief to property owners within Half-Moon Cove due to the ability to control high tide level without drastically affecting production schedules.

§ 5.6 (d)(2)(v): For Existing Licensed Project: License Terms

N/A – Unlicensed Facility

§ 5.6 (d)(2)(vi): Existing Licensed Project: New Proposed Facilities:

N/A – Unlicensed Facility