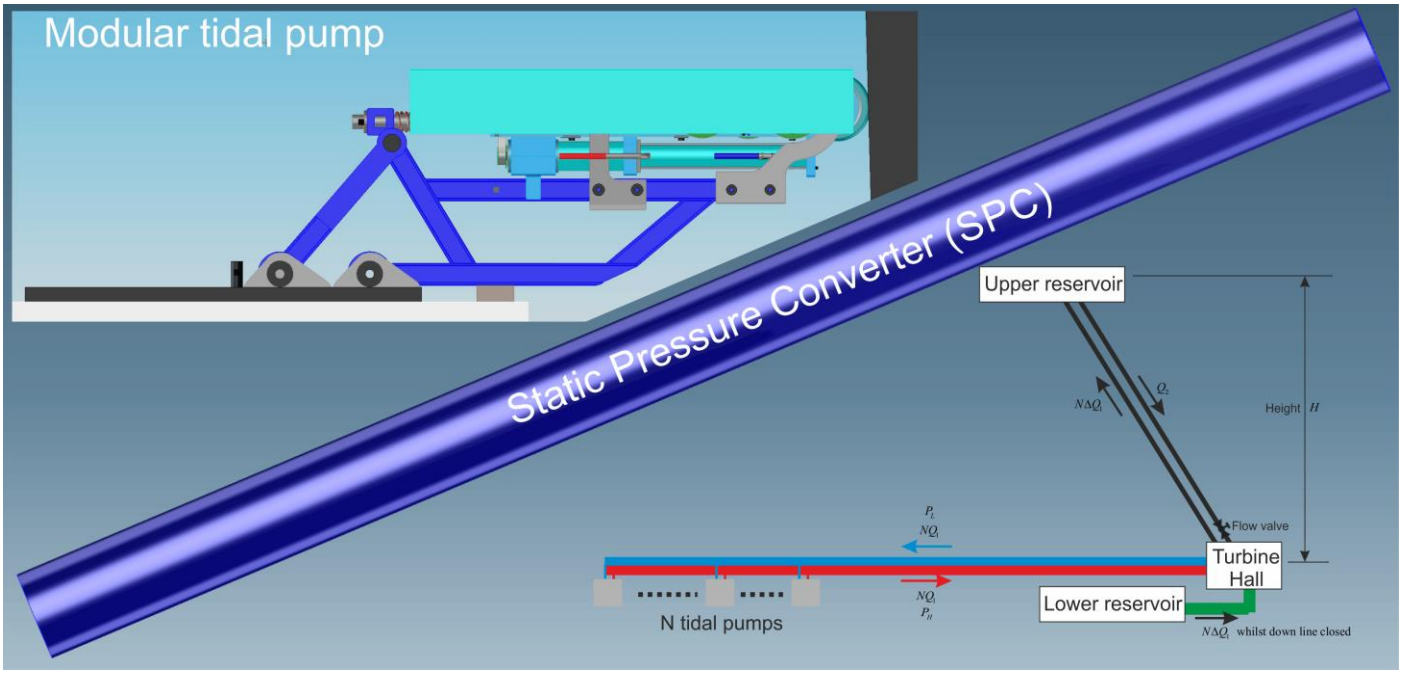
Organisation: SPC-Tidal

SPC Tidal Height Change Energy Proposal: SPC Characteristics

Document: 170322_3



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SPC characteristics

The SPC is the key element in the present proposal, the functioning of which is paramount to the TPGU's success. A test rig has been built that demonstrates the SPC in operation in an arrangement that simulates the one proposed for the TPGU. The flow diagram for this test rig is shown in Fig.A.1.

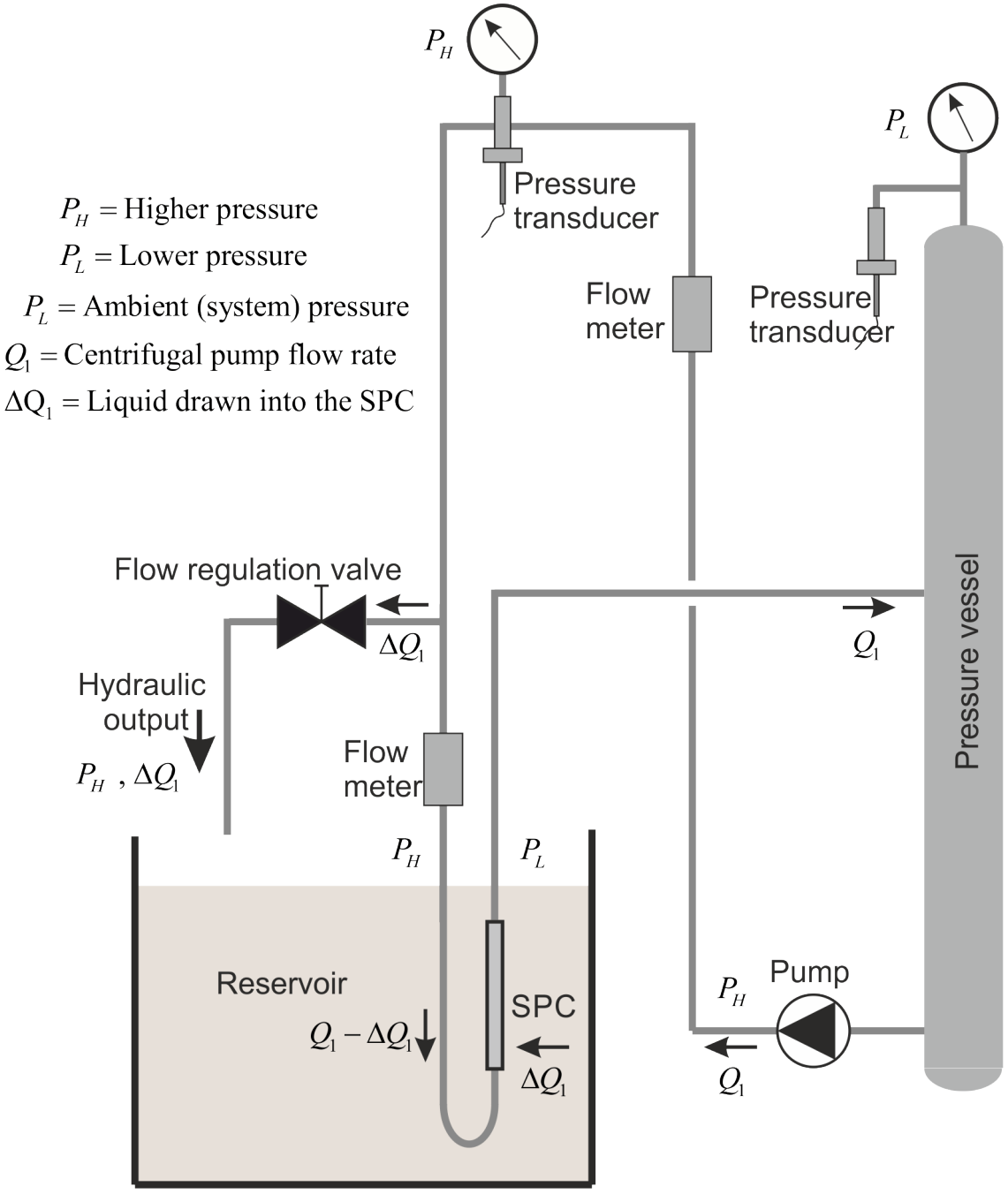

Fig.A.1: Flow diagram for the SPC demonstration test rig

The test rig pump is a low-powered centrifugal unit. This pump drives water through the SPC, as a result of which water is drawn from the reservoir via the SPC into the circuit, and the total quantity returned to the pressure vessel. The more water that is drawn from the reservoir, the higher the system pressure rises within the pressure vessel. The steady state system pressure within the pressure vessel is dictated by the setting on the flow regulation valve. The more it is opened, the lower the steady state pressure.

The hydraulic output, which in the case of the TPGU drives the turbine generator, is exhausted back into the reservoir. At steady state, the reservoir volume does not alter. The entire test rig circuit may be thought of in classical terms as a pump. The inlet is the SPC and the outlet the flow regulating valve. The reservoir water enters at

atmospheric pressure and the hydraulic output exits with a pressure equal to the sum of the system pressure and the centrifugal pump delivery pressure. The characteristics of this test rig pump are shown in Fig.A.2.

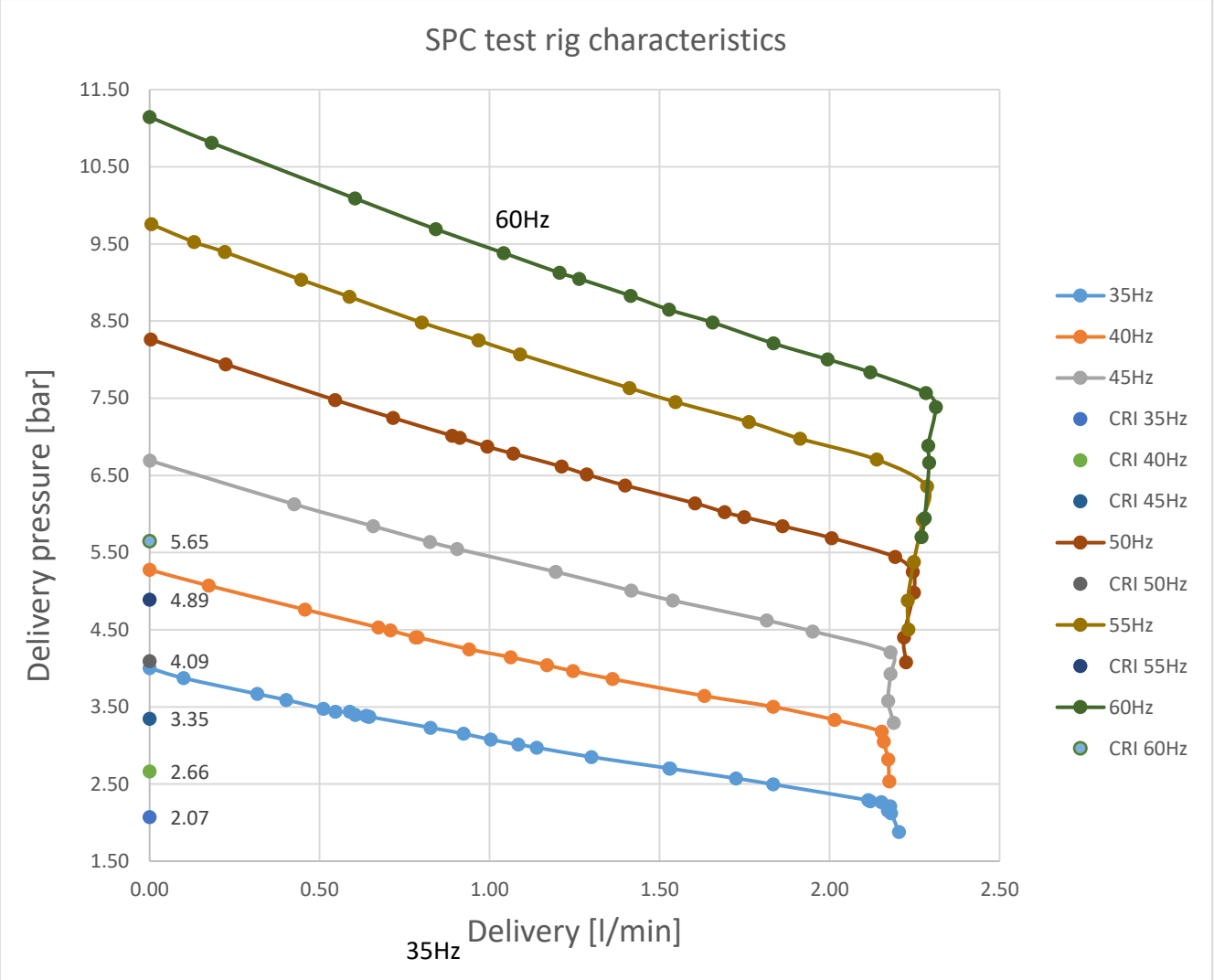

Fig.A.2: SPC demonstration test rig characteristics

The points have been recorded by means of a data acquisition logger. Each point is the mean of 1,000 readings, taken at a frequency of 100Hz over a period of 10secs. The pressure transducers are of the type Druck strain gauge, and the flow meters are inductive.

SPC hydraulic delivery power

The SPC hydraulic delivery power is dependent on both the system pressure and the flow rate driving the SPC. A pump with a fixed delivery pressure cannot increase the SPC driving flow rate. To achieve this flow rate increase, it is necessary to increase the system pressure. Consequently, the SPC effectively upgrades the pressure delivery of such a pump. The result of these phenomena is that an SPC permits the pressurisation of a closed or partially closed system.

In Fig.A.3, a graph is shown exhibiting the hydraulic delivery power as measured in the test rig for a specific SPC. The family of curves represent the results for the centrifugal pump run at a range of frequencies from 35 to 60Hz. Each frequency may be likened to the use of a specific power pump. The higher the frequency, the more powerful the pump.

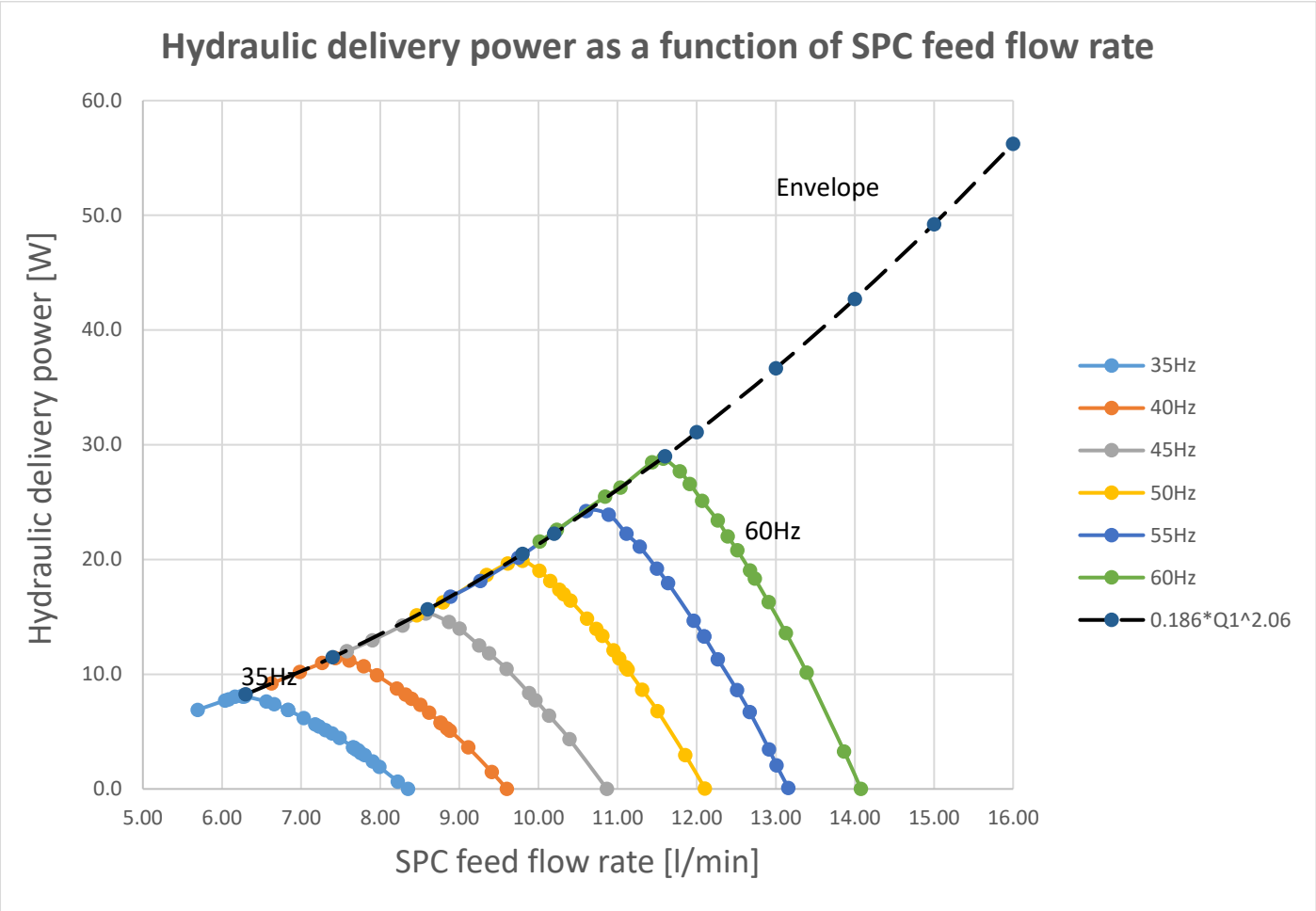

Fig.A.3: Hydraulic delivery power development for a given SPC and various pumps

The dashed line represents the theoretical envelope drawn on the experimental points. As clarification, taking the 60Hz results, the flow rate of 14 l/min corresponds to the maximum system pressure that can be attained with the given pump running at 60Hz. For this point, there is no output and so the hydraulic delivery power is zero. On opening the delivery valve, the system pressure drops, as does the SPC feed flow rate. However, a hydraulic stream now exits the flow regulation valve and so one has a non-zero delivery power.

It is apparent from the envelope that the hydraulic delivery power increases rapidly in terms of the centrifugal pump performance.

SPC hydraulic efficiency

Test rig measurements have been made comparing the hydraulic output with that of the centrifugal pump hydraulic power input. The resulting measurements are referred to as the SPC's hydraulic efficiency. These results are displayed in Fig.A.4. The maximum hydraulic efficiencies are coincident with the maxima displayed in Fig.A.3.

These results pertain to an SPC whose external dimensions are those of a cylinder 20mm in diameter and 300mm long. The smallest internal diameter is 2.5mm, and as such, the SPC could be made substantially slimmer. This SPC is one of a number of designs that the author has made himself and whose manufacturing precision is not optimal.

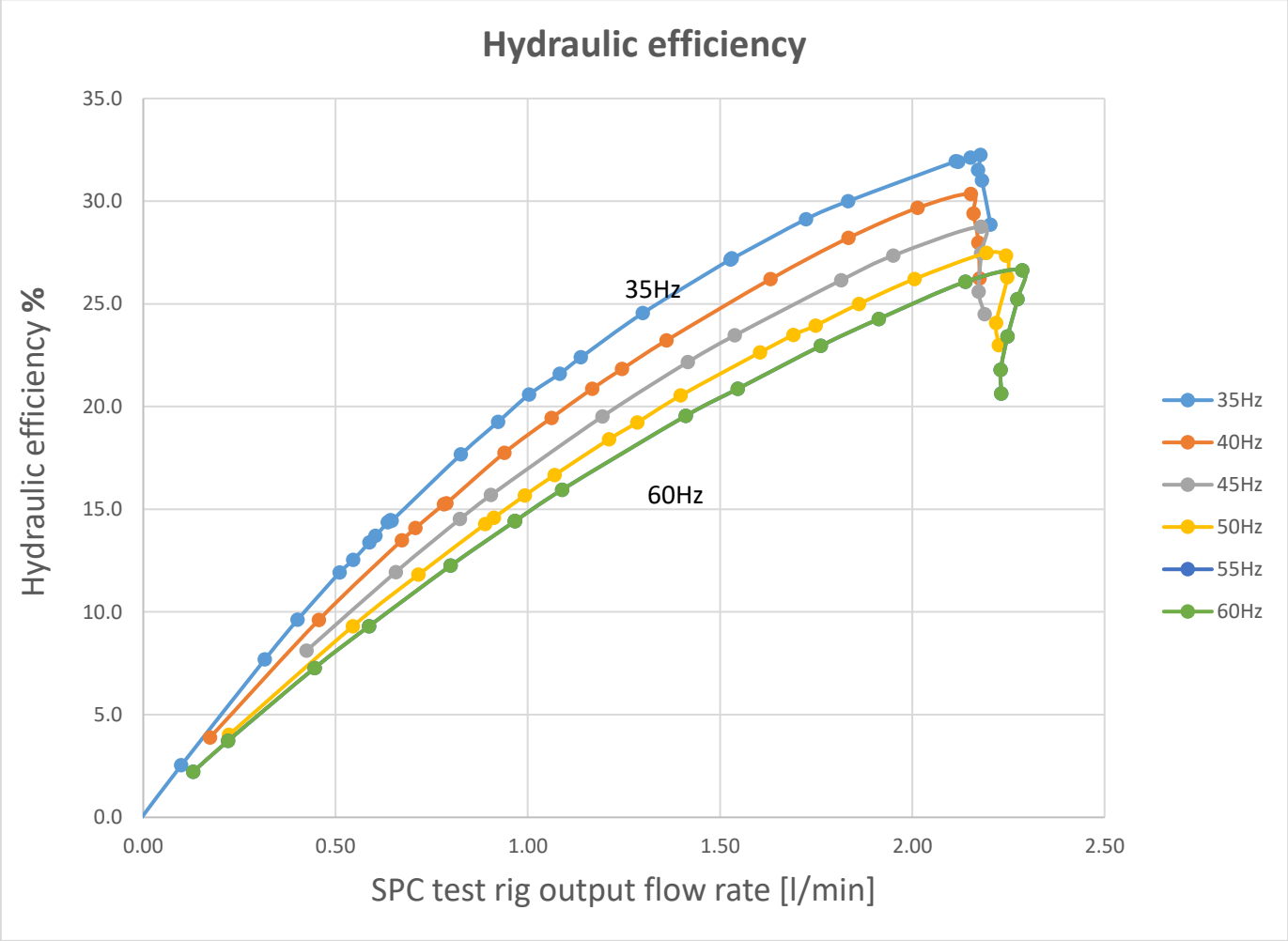

Fig.A.4: Hydraulic efficiency for a given SPC and various pumps

Document list

1. 170322_1: SPC Tidal Height Change Energy Proposal: Brief Description
2. 170322_2: SPC Tidal Height Change Energy Proposal: Concept
3. 170322_3: SPC Tidal Height Change Energy Proposal: SPC Characteristics