

Goals/Requirements

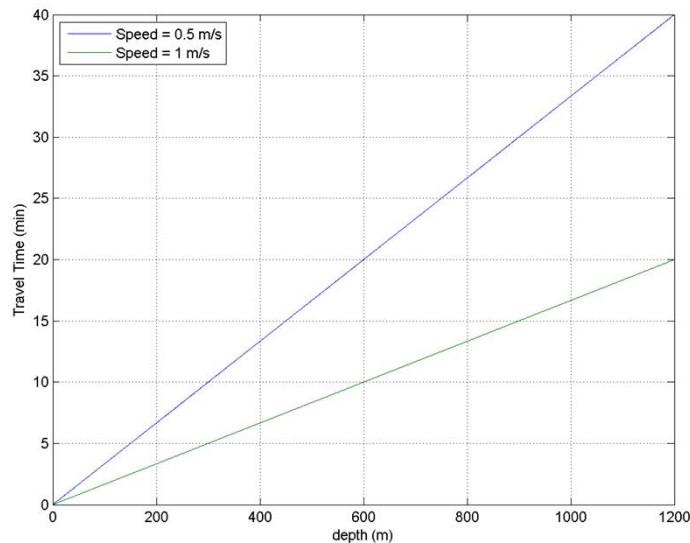
- Sampler system that can filter >1000 Liters of seawater across a 100 micron filter in less than 20 minutes.
- Minimum contamination...
- ROV Independent. Operable from the Paragon or similar sized vessel.
- 800m depth rating.
- One sample per cast, perhaps expandable to more.
- Multiple samples per trip.
- Measured sample volume and depth to 1% accuracy.

Contamination

- Minimizing contamination of the samples is a very important requirement, but hard to quantify.
- Sources of contamination:
 - Bits of the sampler shedding into the filter, directly or recirculated out the exhaust.
 - Contaminants adhering to the sampler and subsequently shedding onto the filter. i.e. Dock, ship or storage contamination.
 - Pre and Post cast contamination of the filter during handling.
- Two Approaches
 - Minimize contamination.
 - Make the system easy to clean.

Approach

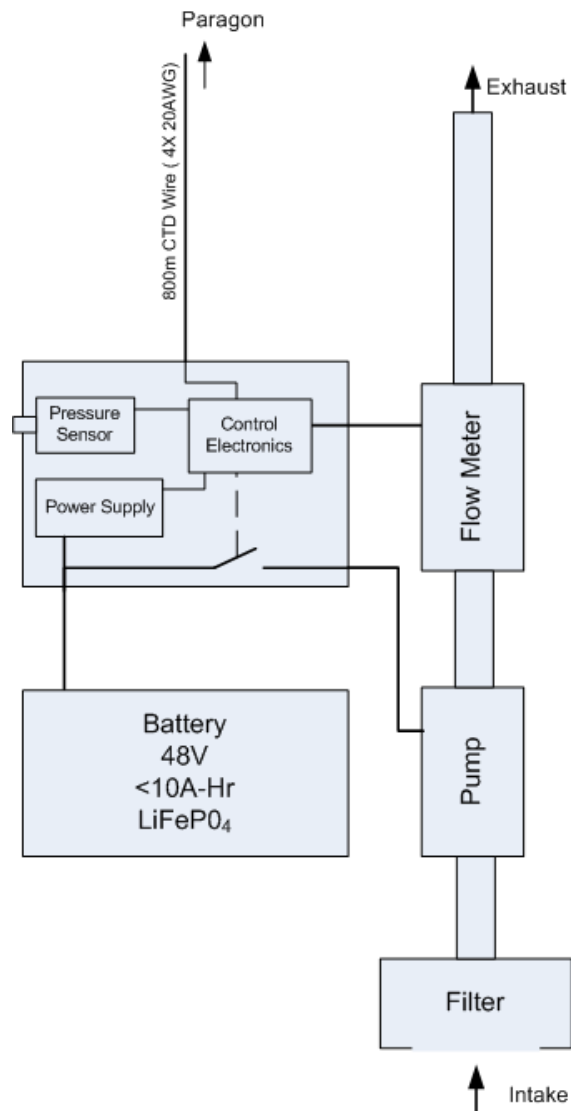
- Develop a battery operated system with replaceable sample cartridges and battery packs as needed.
- Approximate size/weight of existing paragon CTD Rosettes
- Control/Monitoring over CTD wire conductors
- Battery powered, swappable packs for multiple samples.
Would need to charge on paragon, details TBD
- Swappable sealed filter components
- As cleanable as possible, details TBD.



~40" Tall
32" Diameter ->



Block Diagram



Paragon Winch/Wire

4 Conductors, 20 AWG – 800m length – Break Strength = 2400lbs

33 Ohms/km: $I @48V/500W = 10.4A \rightarrow X$
 $I @400V/500W = 1.25A \rightarrow$ Voltage Drop = 66V
 $\rightarrow$ Power Loss = 82W

Control/Monitoring

Pressure Sensor Accuracy: .1% Full Scale (1m)

Flow Meter Accuracy: 1%

Start/Stop Commands, Monitoring of Flow Rate and Motor Current

Battery/Pump Sizing

Rate: 100 Liters/min

Volume: >1000 Liters. (i.e 10->30 minutes)

Battery swappable at sea.

Filter Cartridge

Ideally this could be sealed before and after use, loaded with clean water in lab, and not opened until back in the lab after the sample is taken. Pressure compensation issues...

Swappable at sea.

Motor/Pump

Flow Sensor

Controller

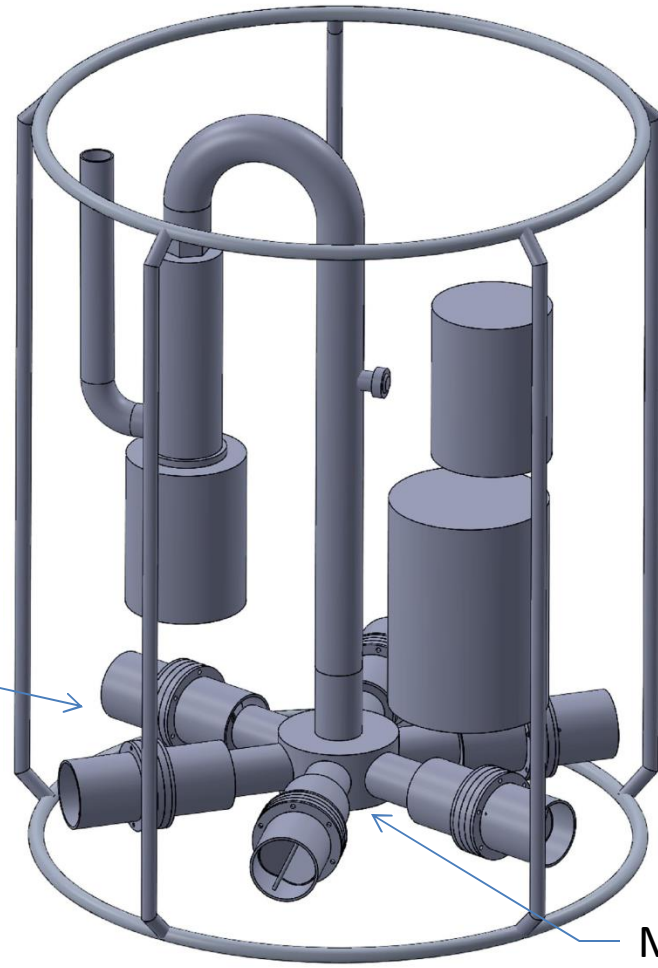
Batteries

Filter

Manifold

Single Sampler Version

Multiple Sampler Version

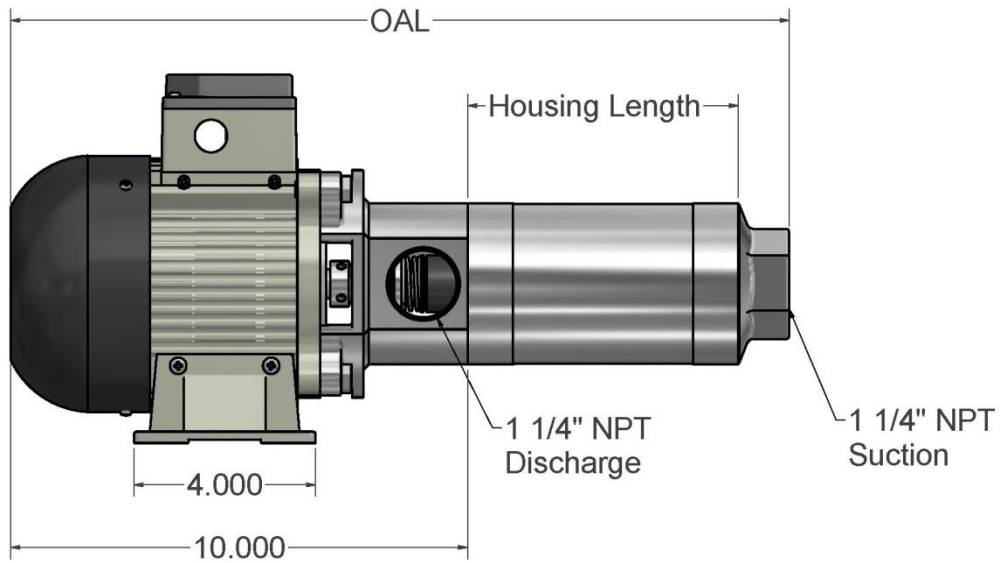


Flow Sensor

- Signet paddlewheel sensor was modified for use at depth and tested in March ROV dives.
- Digital interface that was integrated to dsPic board during March ROV dives.
- ~1% Accuracy
- Flow-rate range in 2" Pipe:
 - 17.633 Pulses/Liter
 - 15->1000 Liters/Min
- Requires 15 ID's (30") of straight pipe upstream, and 5 ID's (10") downstream.



Pump

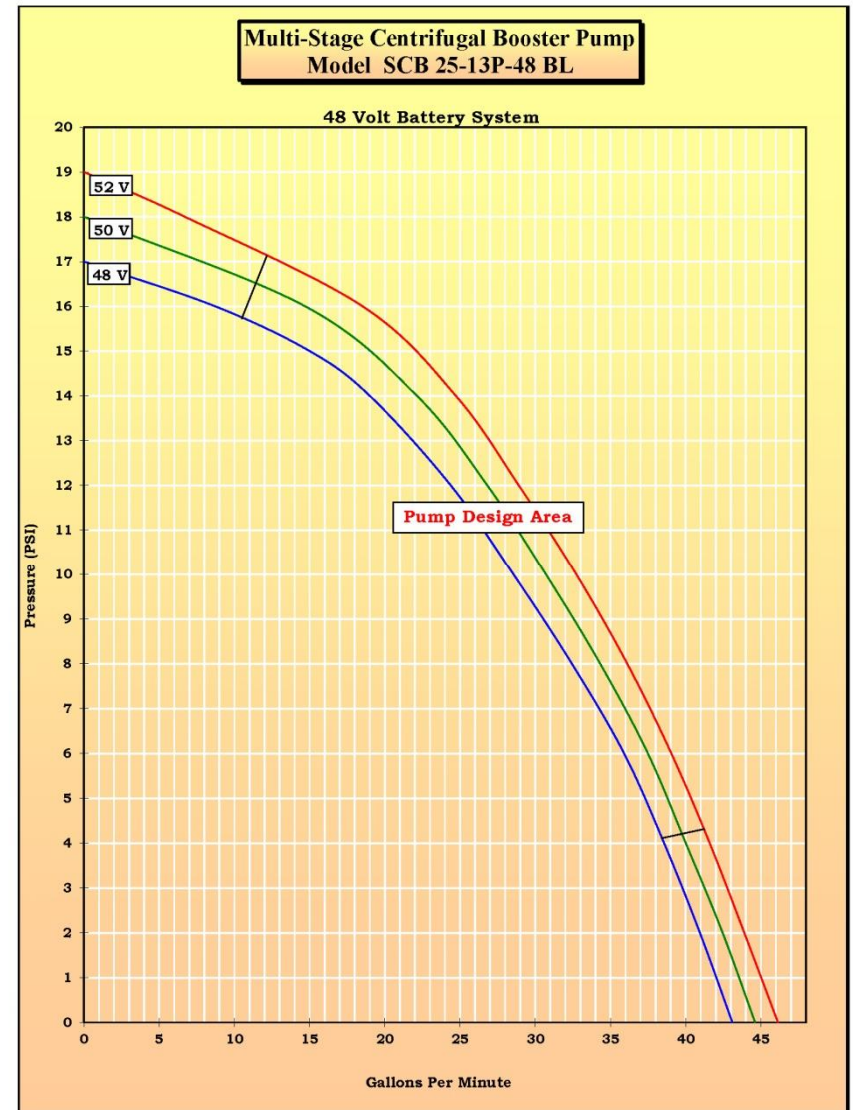


Multi-Stage Centrifugal Booster Pump **Model SCB 25-13P-48 BL**

48 Volt Battery System

1 Stage

PSI	TDH Feet	TDH Meters	Motor Voltage	Motor Amps	U.S. GPM	LPM	Motor Watts	System Efficiency
0	0	0.0	48	8.2	43.1	163.1	396	0%
2	5	1.4	48	8.2	40.9	155.0	394	9%
4	9	2.8	48	8.1	38.6	145.9	390	17%
6	14	4.2	48	8.0	35.9	135.9	382	25%
8	18	5.6	48	7.8	32.4	122.7	372	30%
10	23	7.0	48	7.5	28.5	108.0	360	34%
12	28	8.5	48	7.3	24.4	92.3	350	36%
14	32	9.9	48	6.8	19.0	71.9	325	36%
15	35	10.6	48	6.3	15.0	56.8	300	33%
16	37	11.3	48	5.8	8.7	33.0	279	22%
17	39	12.0	48	4.9	0.0	0.0	234	0%



Energy Requirements

Pressure Drop

- Main contributors are the filter, and any check-valves or other restrictions in flow path. 2" Piping over a few feet is negligible.
- Testing required.

Electrical Power Requirements (example)

- 100 LPM @ 10psi draws ~360W
- $2000\text{L}/100\text{LPM} = 20 \text{ minutes} = .33\text{Hrs}$
- Energy Requirement = $120\text{W-Hrs} = 2.5\text{A-Hrs @ } 48\text{V}$

Batteries

Requirements

- 200 W-Hrs + Margin
- Light enough in housing to be managed and swapped aboard Paragon
- Safely rechargeable on board the Paragon within the cast time.



LiFePO4 Examples

- 51V, 6.6AHr -> 7.6lbs - 330W-Hr (x3)
8.5"X4.2"X4.2" (~11"Long by 6" ID Housing, ~18lbs)
Total Weight = ~26 lbs
- 51V, 13.2AHr -> 15.3lbs - 660W-Hr (x5)
10.5"X6.0"X5.5" (~14"Long by 8.25" ID Housing, ~36lbs)
Total Weight = ~51 lbs

Control Electronics

- Re-use dsPic board design from wave-energy system.
- RS-485 or CAN for communications
- Laptop based user interface on Paragon

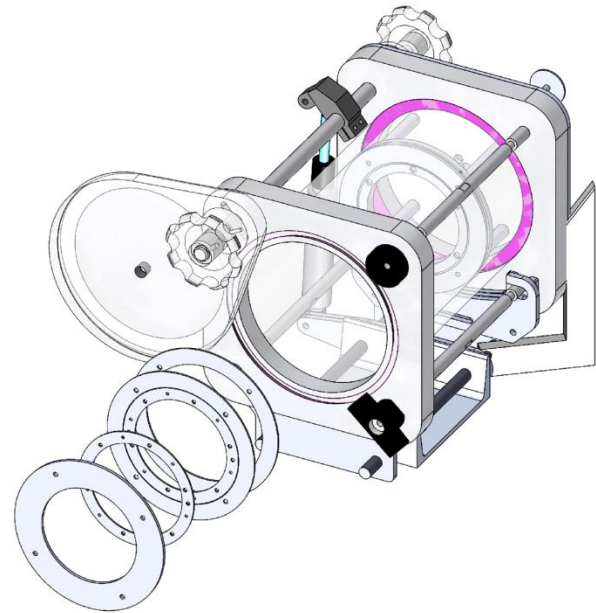
Alternatively

- Use SBE19+ as controller to gain CTD context. Would still need above electronics or similar to monitor flow sensor (digital signal...).

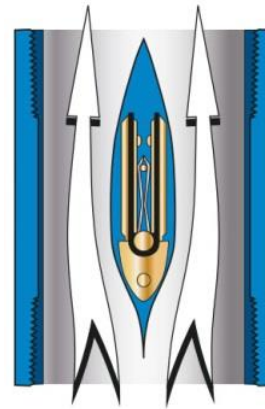
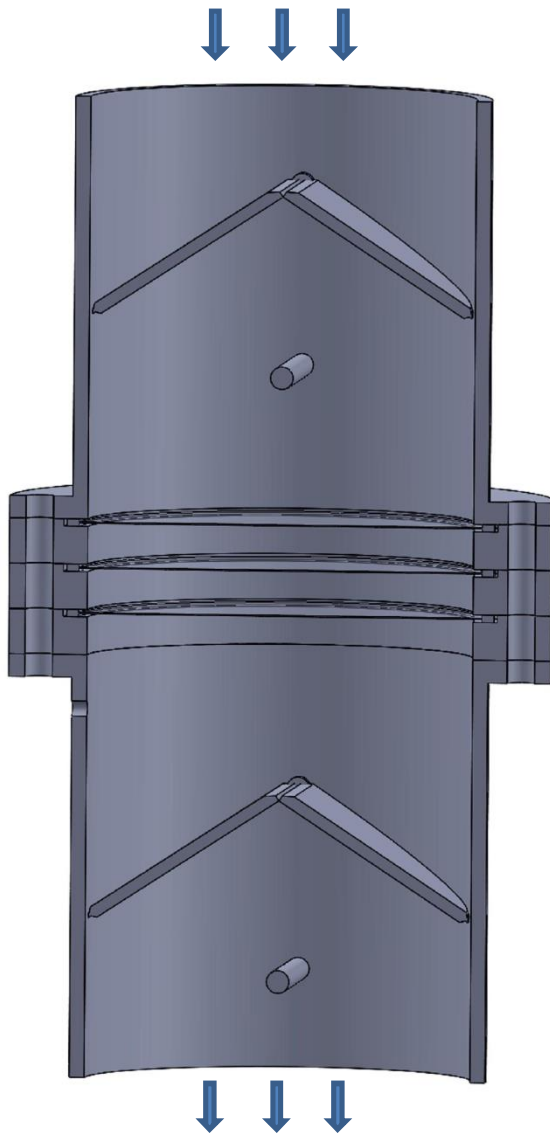
Filter Housing – Design TBD

Requirements

- 100 micron filter, 3-5” diameter. Size Fractionation...
- Sealed before and after use to minimize contamination
- Pressure compensated so there is no water exchange during cast
- Minimum inflow restriction
- Multiple instances, exchangeable on board the Paragon between casts
- Imaging requirements?



Filter Housing – Concept Design



[illegible]