Team 13/34 – Portable Hydroelectric Generator

Operation Manual

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1. Executive Summary

This operation manual entails the use of two different environmental variants of a portable hydroelectric generator. The device intends to power common electronic devices such as smart phones, laptops, etc. The output of the device intends to produce a minimum 12V and 2.2A but will not exceed 110V or 18A. The electrical system is modular and is intended for use with both the river and ocean variant designs for the portable hydroelectric generator. The electrical housing used for the ocean variant model intends to also be employed on the river variant model. Each device will have to be tethered via rope, chain, or bungee in various fashion depending on the given scenario of use.

The river variant which employs the use of an undershot waterwheel will be suspended by an aluminum frame and supported by flotation in the water from boat fenders. The waterwheel will be connected to the power transmission system comprised of a bike chain and sprocket. The power transmission system will drive the alternator that allows current to flow in the electrical system. Energy can then be delivered on shore via extension cable to power applicable electronics.

The ocean variant design employs the use of a helical turbine mounted underneath the base of a hollow cylindrical housing used to hold the electrical components of the system. The alternator will be mounted to the bottom of the electrical housing. The shaft of the alternator will be protruding out the bottom of the electrical housing and made water proof by use of a shaft seal. The charge controller will also be mounted inside the electrical housing and an output extension cord will be sealed out the side of the housing. The electrical housing is sealed by use of o-ring, lid combination as well as being bolted down. The helical turbine will be directly coupled to the alternator by use of the threaded alternator shaft and set screw on the threads to ensure it does not come loose under operation.

2. Components

Components relate to the various parts that comprise our two separate prototype models. The first model is the river variant and the second model is an ocean variant, portable hydroelectric generator.

a. River Variant

The river variant consists of three primary components: water wheel, power transmission, and the frame.

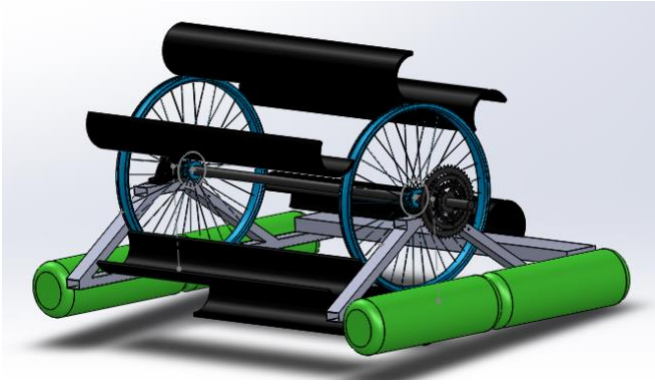

Figure 1 – Isometric view of river variant.

b. Ocean Variant

The ocean variant consists of two primary components: electrical housing and a helical turbine.

Figure 2 – Model of ocean variant, depicting electrical housing and helical turbine.

Each variant employed will be tethered by use of rope, chain, bungee, etc to secure the device in flowing water source.

c. Modular Electrical System

For simplicity, since the turbine can be dismounted from the electrical housing of the ocean variant, it will be utilized with the river variant also. The river variant will

connect its turbine drivetrain to the electrical housing of the ocean variant. The electrical system consists of three primary components: DC alternator, charge controller and a DC-to-AC converter. The electrical system begins with the WindBlue Power DC-540 permanent magnet alternator.

Figure 3 – WindBlue Power DC-540 Permanent Magnet Alternator.

The charge controller limits the voltage to be in-line with the input requirements of the DC-to-AC converter.

Figure 4 - Charge controller.

The final component in the electrical system is the DC-to-AC converter, which will provide usable power to a 3-prong 110V AC port as well as two USB ports.

Figure 5 – DC-to-AC converter.

3. Setup

The general deployment strategy for both the river and ocean variant first require the selection of a suitable water source whose flow rate is significant enough to provide the power desired. Once a deployment location has been selected, the individual execution strategies for each device are described within the following subsections.

a. River Variant

1. Screw gear coupler to electrical module. Use wing-nut fasteners to attach to bar clamp tensioner at rear of river module. Hand tighten wing nuts. Ensure tensioner clamp is in most closed position by pressing short lever and manually compressing.
2. Place drive chain over sprockets attached to both the paddle wheel and electrical module. Tension chain by compressing handle to open clamp.
3. Inflate all floats to recommended pressure (on floats). recommended pressure (on floats).

b. Ocean Variant

1. Depending on the location, utilize the anchoring connections to situate the device so that it remains stable.
2. Bring extension cable from attached device to land for connection to DC-to-AC converter.
3. Connect DC-to-AC converter to extension cable and begin to attach devices for electrical utilization.

4. Operation

a. River Variant

1. Manually place complete module into moving water source (rivers, streams…) so that the paddle wheel rotates freely. Ensure to keep electrical output module out of the river.
2. Secure module to at least two stationary points on opposite sides of the water source (i.e. riverbank) by attaching desired line (rope, chain, cable, ratchet straps…) to any opposite points on the frame and the stationary objects. The electrical cable can be wrapped around the securing lines.
3. Begin to use electrical power immediately.

a. Ocean Variant

1. Manually place device into flowing water source, ideally a channel, between bridges, or significantly flowing sources of water. Ensure rotation of helical turbine, freely in flowing water source.
2. Tether the device from two points along the sides of the electrical housing.
3. Anchor the device along its center axis just below the helical turbine to ensure up right flotation.
4. Connect device to electrical system on shore to utilize generated power.

5. Troubleshooting

1. River Variant

1. The device is tilted to a side: Tighten existing securing lines. Replace or add additional lines if necessary.

2. Not-enough power is being output: Ensure integrity of output cable and module; replace if necessary. Move to faster source of water. Increase sprocket size on paddlewheel.
3. Objects keep jamming the paddles: Remove objects manually, and ensure no damage has been done. Secure rigid object (stick, metal fencing…) to front of module to prevent inflow of foreign objects.
4. Module won't float when being placed in river: Use tensioned securing lines to provide any additional buoyancy needed by securing to stationary positions above their anchor points on the module. Alter line tension to raise or lower module into water.

2. Ocean Variant

1. Ensure anchoring on the center axis of the device to ensure from the helical turbine being moved to the surface of the water and rotating the device.
2. Not-enough power is being output: Ensure integrity of output cable and module; replace if necessary. Move to faster source of water.
3. If helical turbine is damaged, detach the turbine from the alternator and replace and continue with use.

6. References

[1] "WindBlue Power - The Best Wind Generator Parts and PMA Permanent Magnet Alternators on the Web." Wind Blue Power, www.windbluepower.com/.