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Marine current turbine platform with faired spar

Abstract

The present invention is a marine current turbine featuring a downstream rotor, a faired spar, a deckhouse at the waterline, and a ballasting and mooring arrangement to ensure the center of buoyancy is above the center of gravity to provide a stable platform and ample rotor torque reaction. The faired spar minimizes the wake deficit ingested by the rotor and reduces turbulence and drag on the turbine. The deckhouse provides buoyancy to react to gravitational forces and the downward tension component supplied by the mooring system during maximum platform and rotor drag conditions and reserve buoyancy if a portion of the platform becomes flooded. The mooring arrangement preferably forms a bridle to provide yaw stability.

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Background/Summary

BACKGROUND OF THE INVENTION

1 Field of Invention

(1) This invention relates to platform and mooring configurations and materials for marine current turbines.

2. Description of Related Art

(2) Hydrokinetic energy in tidal and riverine currents is an abundant renewable energy source and highly reliable, forecastable, and typically located near an electrical distribution grid. A marine current turbine, a.k.a., a hydrokinetic turbine (HKT), works much like a submerged windmill, driven by water rather than air. However, water current flows are more predictable than air flows in time and maximum velocity. Underwater rotors capture the dense flowing energy of a current. The tips of the rotor blades are positioned below the surface so they will not danger shipping or be vulnerable to storms.

(3) Significant technical and environmental barriers make current marine current turbine systems prohibitively expensive. An efficient platform supporting the turbine is required to minimize the cost of energy produced by the turbine, which depends on the platform's capital cost, efficiency in electricity production, and the cost to operate and maintain it. The turbine cost of energy is directly impacted by the costs of fabrication, transportation, installation and recovery, and accessibility to

perform maintenance.

(4) U.S. Pat. No. 7,541,688 to Mackie discloses a floating, semi-submerged, tethered marine current turbine utilizing surface piercing struts. Because the struts have a small waterplane, most of the turbine's buoyancy is provided by a submerged nacelle. The turbine's draft and trim are altered through solid ballast and filling/emptying ballast tanks using ballast pumps or compressed air.

(5) A marine current turbine attached to a floating platform is preferable and is moored via anchors in powerful tidal streams or river currents. However, conventional floating platforms are ill-equipped to handle wave-induced whole-body motions transmitted to the turbine and generator, reduce the turbine's efficiency, and increase the design loads on the fixed and rotating machinery, particularly the turbine blades. Conventional mooring systems are large and expensive because a floating platform attracts large forces from the waves.

(6) A need, therefore, exists for a floating platform to support a turbine rotor stably at an optimal depth to maximize energy extraction, enable operation in opposite tidal current directions, i.e., an ebb current or a flood current, every six hours, and operate reliably over long periods of unmanned operation. A need exists for a simple, robust, and inexpensive mooring system to restrain the floating platform.

SUMMARY OF THE INVENTION

(7) The present invention overcomes these and other deficiencies of the prior art by providing an accessible, cost-optimized marine current turbine comprising a downstream rotor, a powertrain, a nacelle, a faired spar, a deckhouse at the waterline, and a unique mooring arrangement. Active control surfaces provide stable operation and buoyancy and ballast configuration to ensure the center of buoyancy is above the center of gravity with sufficient separation to provide ample rotor torque reaction. The faired spar minimizes the wake deficit ingested by the rotor and reduces turbulence and drag on the turbine. The deckhouse provides sufficient buoyancy to react to gravitational forces and the downward component of the tension provided by the mooring system during maximum platform and rotor drag conditions. The deckhouse also provides reserve buoyancy if a portion of the platform becomes flooded. The mooring arrangement preferably forms a bridle to provide yaw stability in addition to reacting drag forces.

(8) In an embodiment of the invention, a turbine for converting current flow into electricity comprises: a floating spar platform comprising a nacelle at the bottom end, a faired spar at a midsection, and a deckhouse at the top end; and a rotor disposed at a downstream end of the nacelle. The faired spar comprises a teardrop body and a V-shaped tail. The faired spar may comprise a rotatable fairing. The turbine may further include a spreader disposed on the deckhouse or the nacelle, wherein the spreader comprises two connection points configured to attach to one or more mooring lines. The turbine may comprise a thruster configured to translate and yaw the turbine. The fairing may include a ballast tank. Flooding or evacuating the ballast tank causes the natural frequency of the turbine to vary. The vertical motion of the deckhouse subjected to wave conditions may be modified by flooding or evacuating the ballast tank. The deckhouse may comprise a rudder and an elevator. The deckhouse has a greater waterplane area and buoyancy volume than the faired spar.

(9) In another embodiment of the invention, a turbine for converting current flow into electricity comprises: a floating spar platform comprising a nacelle at the bottom end, a faired spar at a midsection, and a deckhouse at the top end; a nacelle attachment point and a spreader disposed on the floating spar platform, wherein the nacelle attachment point and the spreader comprise outer end connection points for attaching one or more mooring lines; a rotor comprising a plurality of blades operating within a rotor plane; and a thruster configured to drive the rotor in an intended direction between current flow changes. The turbine may further comprise a current flow direction sensor, wherein the current flow direction sensor activates the thruster in response to sensing a change in current flow direction. The rotor is configured to park horizontally to allow maximum bottom clearance during shallow tide or extreme wave conditions. The faired spar may comprise a

rotatable fairing. The deckhouse may include a rudder and an elevator.

(10) In yet another embodiment of the invention, a turbine comprises a floating spar platform, a turbine drivetrain attached to the floating spar platform, the turbine drivetrain comprising a main shaft on which a rotor is mounted, a spreader above the turbine drivetrain, and a thruster to drive the floating spar platform in a controlled direction to a downstream operating position. In the operation of the turbine drivetrain, the floating spar platform floats vertically with the turbine's center of gravity located below its center of buoyancy. The rotor may comprise variable pitch blades. The floating spar platform may comprise a deckhouse to access the turbine drivetrain. The floating spar platform comprises a faired spar with a teardrop body and a V-shaped tail.

(11) The present invention achieves stable, safe operation in all sea conditions with unprecedented cost-performance and a high turbine up-time. Renewable energy can be delivered to remote and local electrical grids. The invention operates autonomously, with remote supervisory control and a data acquisition computer providing data analysis and operator input to the onboard controller. The control system can prioritize maintaining the lowest energy cost, increasing component life, and maximum available energy.

(12) The foregoing and other features and advantages of the invention will be apparent from the following, a more detailed description of the invention's preferred embodiments, as shown in the accompanying drawings and the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) For a complete understanding of the present invention and its advantages, reference is now made to the ensuing descriptions taken in connection with the accompanying drawings briefly described as follows.

(2) FIG. 1A illustrates a marine current turbine system according to an embodiment of the invention.

(3) FIG. 1B illustrates a floating spar platform of the marine current turbine system of FIG. 1A.

(4) FIG. 1C illustrates a rear (upstream) view of the marine current turbine of FIG. 1A.

(5) FIG. 2A illustrates the marine current turbine of FIG. 1A with a single-anchor non-bridled mooring arrangement according to an embodiment of the invention.

(6) FIG. 2B illustrates the marine current turbine of FIG. 1A with a two-anchor catenary mooring arrangement according to an embodiment of the invention.

(7) FIG. 2C illustrates the marine current turbine of FIG. 1 with a lower yaw spreader according to an embodiment of the invention.

(8) FIG. 2D illustrates the marine current turbine of FIG. 1 with an upper yaw spreader according to an embodiment of the invention.

(9) FIG. 3 illustrates a marine current turbine with an active bridle, active ballast, and active control surface arrangements according to embodiments of the invention.

(10) FIGS. 4A-D show embodiments to control the floating spar platform's direction of drift and yaw.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

(11) Preferred embodiments of the present invention and their advantages may be understood by referring to FIGS. 1-4D, wherein like reference numerals refer to like elements. Although the present invention is described in the context of a marine environment, i.e., a marine turbine, the present invention may be deployed in any water environment with a flowing current, such as a freshwater river or lake.

(12) The invention advances floating platforms and mooring systems for a marine current turbine by reducing structural mass in favor of active controls to maintain the stable operation of a highly

unconstrained, energy-generating tidal turbine. The invention utilizes a minimum mass/volume surface-following deckhouse to support an optimized substructure carrying a rotor and powertrain to generate electricity. A faired structural spar provides personnel access to a nacelle for servicing the powertrain components and minimizes wake effects on the rotor while providing an active control surface for operational stability and ballast tanks within the faired profile. A two-bladed, independent pitch rotor is designed to be parked horizontally to enable a minimal parking depth and the ability to utilize the blades for controlling the direction of yaw during tidal changes.

(13) FIGS. 1A-C illustrate a marine current turbine system **100** according to an embodiment of the invention. FIG. 1A shows a perspective view of the marine current turbine **100**. The marine current turbine **100** comprises a downstream two-bladed rotor **110**, a hub **114**, a nacelle **116**, a faired spar **120**, a deckhouse **130**, and a mooring system **140**. The nacelle **116**, the faired spar **120**, and the deckhouse **130** collectively form a floating spar platform **170**. FIG. 1B shows a side view of the floating spar platform as it would float in a marine environment. FIG. 1C shows a rear view of the marine current turbine **100** in the marine environment.

(14) By placing the rotor **110** downstream, a direct load path is established from the rotor **110** to the anchor via a lower mooring line **142**. This puts the primary load-bearing structure, the nacelle **116**, in a pure tensile function, reducing the faired spar **120** structural member thickness and cost. The two-bladed rotor **110** serves several vital functions. Primarily, it enables a novel operating mode wherein rotor blades **112** can be parked horizontally, thereby significantly reducing the overall draft of the turbine. This is essential for deploying the largest rotor plane possible at a site with significant depth fluctuations during large slack tidal and wave events. The two-bladed rotor **110** also enables a large pitch bearing spread in a compact hub **114** as disclosed in commonly-owned U.S. patent application Ser. No. 17/688,772, entitled "Fixed and Pitching Blades, Spar Shaft, Bearings and Materials for Marine Current Turbine," filed Mar. 7, 2022, the entire disclosure of which is incorporated by reference herein. Independent blade pitch control is also made possible via actuators within the nacelle **116** utilizing concentric mechanical linkages within the main shaft. In an alternative embodiment of the invention, the rotor **110** may use one or three or more blades **112**.

(15) The faired spar **120** connects the nacelle **116** to the deckhouse **130**, where a large portion of the platform's **170** buoyancy resides. This arrangement ensures the center of buoyancy is above the center of gravity to provide a stable platform and ample rotor torque reaction. This arrangement also ensures that a portion of platform **170** is always at the sea surface for access. The faired spar **120** also provides access to the rotor's **110** drivetrain in the nacelle **116** from the deckhouse **130** for maintenance activities. Faired spar **120** width is kept to a minimum and embodies a streamlined profile, whereby the fairing shape surrounds a tubular spar at its leading edge, and its thickness distribution along the chord line becomes narrower as it approaches the tail to minimize the wake deficit ingested by the rotor **110** and reduce turbulence and drag on the turbine **100** by the current flow. In an embodiment of the invention, the faired spar **120** comprises a teardrop fairing body **122** characterized by sides that converge into a V-shaped tail **124**. An optional longitudinal flange may be included downstream from the V-shaped tail **124** to form a Y-shaped tail. In other embodiments, the faired spar **120** may be foil-shaped (as in airfoil or hydrofoil) with a low-drag profile. Its trailing edge may be sharp or blunt. Blunt trailing edges may be rounded or flat. More complex trailing edges may be applied to reduce noise, hydro-elastic singing, or shed vorticity. These complex shapes include serrations, flat-plate extension, asymmetric (rounded on one side, sharp corner on the other), and may be formed of a stiff or compliant material. The thickness to chord ratio can be 1:2 to 1:8. Preferably, the height of the spar **120** holds the rotor **110** at a depth that the blades **112** remain at least one meter below the sea surface.

(16) The deckhouse **130** provides ample buoyancy to react to gravitational forces and the downward force component of the tension provided by the mooring system **140** during maximum platform and rotor drag conditions and reserve buoyancy in the event a portion of the platform **100**

becomes flooded. The deckhouse **130** has a large waterplane area and buoyancy volume relative to the faired spar **120** to minimize platform height above water and variation in the draft induced by changing drag forces on the mooring system **140**. The deckhouse **130** also provides an access hatch and houses equipment that may require regular servicing or replacement, such as power electronics, electrical transformers, and controllers. The deckhouse **130** ensures that platform **170** follows the variations in water surface profile, including changes in sea state and tidal elevations, enabling the rotor's **110** submersion depth to be maintained relative to the surface. This surface-following capability allows the turbine **100** to operate in the highest current velocities near the surface due to the shear effects of the moving fluid. Consistent rotor **110** submersion depth reduces the potential for cavitation damage of the blade tips **112** as they traverse near the surface and reduces the impact of wave orbitals on the rotor **110**. The deckhouse **130** is surface-following because it has a greater waterplane area and buoyancy volume relative to the faired spar **120**.

(17) In another embodiment of the invention, the traditional use of steel to form marine structures is substituted for cementitious materials such as ordinary Portland cement (OPC), ultra-high performance concrete (UHPC), or geopolymer concrete (GPC) combined with reinforcing materials such as steel, carbon fiber, basalt fiber, glass fiber, and other suitable materials, the identification of which is apparent to one of ordinary skill in the art, in the form of woven mat, mini-rods, mini-bars, rebars, and dispersed fibers for fabrication of the floating spar platform **170**. The application of cementitious materials provides certain benefits such as reduced material cost relative to steel, reduced fabrication costs, and enhanced corrosion resistance in a marine environment.

(18) The mooring system **140** comprises two attachment points on the turbine **100**: one generally inline between the rotor center of effort **143** on the nacelle **116**, reacting primarily with the drag imposed by the rotor **110** and nacelle **116**, and an upstream anchor **210** (shown in FIG. 2A), and another attachment point **145** higher on the platform **170** than the first to react to the drag of the spar **120** and the deckhouse **130**. The upper mooring attachment point **145** may be above or below the waterline. Mooring lines **142** and **144** attach to these two points, **143** and **145**, respectively. Either upper or lower mooring lines **142** and **144** may be split and bridled laterally to provide additional yaw stability. In one embodiment, the bridled lines **142** and **144** are attached via a movable attachment point, windlass, winch, or similar system, the identification and implementation of which is apparent to one of ordinary skill in the art.

(19) In another embodiment of the invention, an electrical power and data umbilical **150** exits the turbine **100** from any location, preferably from the front of the nacelle **116** or deckhouse **130**, depending on if the transmission is to equipment located on the sea surface or seabed. If the transmission is to the seabed and a single anchor is utilized, the umbilical **150** should land close to the anchor **210**. Cable management hardware, floats, weights, or bend restrictors may be implemented on the umbilical **150** or mooring lines **142** and **144** to regulate their interaction.

(20) FIG. 2A illustrates the marine current turbine **100** with a single-anchor-non-bridled mooring arrangement **200** according to an embodiment of the invention. Here, an anchor **210** is coupled to mooring lines **142** and **144** and the umbilical **150**. FIG. 2B illustrates the marine current turbine **100** with a single-anchor-bridled mooring arrangement **250** according to an embodiment of the invention. Here, the anchor **210** is coupled to the umbilical **150** and an intermediate mooring line **146** that connects to mooring lines **142** and **144** at a bridled connection point **251**. In another embodiment of the invention, an additional intermediate mooring line **149** connects between the connecting point **251** and a second anchor **211** to provide a two-anchor mooring configuration.

(21) FIG. 2C illustrates the marine current turbine **100** with a lower yaw spreader **240**, providing lateral separation of the lower connection as two points **242A** and **242B** connecting to two mooring lines **142A** and **142B**, according to an embodiment of the invention. FIG. 2D illustrates the marine current turbine **100** with an upper yaw spreader **260**, providing lateral separation of the upper connection as two points **244A** and **244B** connecting to two mooring lines **144A** and **144B**.

according to an embodiment of the invention.

(22) FIG. 3 illustrates a marine current turbine **100** with a bridled, single-anchor mooring arrangement **340** according to an embodiment of the invention. The faired spar **120** comprises a rotatable upper spar fairing **320** to counteract the torque induced in the rotor **110** and a lower portion **330**. An optional elevator **350** is added to adjust the pitch of the faired spar **120**. In another embodiment, a rudder **355** connecting the elevator **350** to the deckhouse **130** may be actively rotated about its axis to cause a steering force on the rear section of the deckhouse to yaw the turbine **100**. In a preferred embodiment of the invention, the mooring arrangement **340** comprises winches **345** on the upper yaw spreader **260** to adjust the tension of the mooring lines **144** at points **244A** and **244B**.

(23) In another embodiment of the invention, one or more fixed ballast weights **310** are disposed on the nacelle **116** to provide a gravitational counterbalance to buoyancy induced in the faired spar **120** and the deckhouse **130**. Variable ballast tanks in the lower portion **330** of the spar fairing **120** provide a means of actively lowering or raising the center of gravity of the turbine **100** by introducing or removing saltwater **331**, which also increases or reduces the deckhouse's **130** draft.

(24) A central control system may monitor sensors indicating the turbine's **100** operating conditions and the state of its external environment and make operating decisions to activate control surfaces to cause a response from the turbine **100**. Controller programming may prioritize the operational health and safety of personnel onboard the turbine **100**, platform **170** stability, power generation capacity, and management of loading conditions that affect the turbine's **100** and mooring system's **340** longevity.

(25) FIGS. 4A-D show embodiments to control the platform's **170** direction of drift and yaw around the anchor point **210**, or the bridal connection point **251** in the case of a two-anchor mooring, during tidal current direction changes, to prevent accumulated twisting of the mooring lines **142** and **144** or **146** and the umbilical **150**. FIG. 4A shows one embodiment whereby horizontally parked rotor blades **112** are set to differing pitch positions to allow the surrounding current to impose a differential force on the rotor **110** causing the nacelle **116** and platform **170** to yaw in the desired direction. FIG. 4B shows another embodiment whereby the rotor blades **112** are parked vertically and pitched to an angular position causing the nacelle **116** and platform **170** to yaw in the desired direction. FIG. 4C shows another embodiment utilizing a marine thruster **440** positioned laterally on the downstream portion of the nacelle **116** to produce a lateral force on the nacelle **116** causing the nacelle **116** and platform **170** to yaw in the desired direction. FIG. 4D presents a further embodiment whereby the marine thruster **440** is positioned laterally and is submerged on the downstream portion of the deckhouse **130** to produce a lateral force on the deckhouse **130**, causing the deckhouse **130** and platform **170** to yaw in the desired direction. The turbine may further comprise a current flow direction sensor **442**, wherein the current flow direction sensor **442** activates the thruster **440** in response to sensing a change in current flow direction.

(26) Controlling the direction and arc of the turbine **100** and mooring lines can be commanded by the central controller to prevent mooring entanglement and twist and umbilical electrical cable twist as the turbine **100** is repositioned from one tidal flow direction to the other. One method is to implement a marine thruster **440** positioned in front or behind the platform's hydrodynamic yaw center to actively drive the platform in a direction to avoid random drift that could cause entanglement and cumulative twisting of the platform's electrical cable umbilical **150** and mooring lines **142**, **144** and **146**. Another method is an asymmetrical pitch of the blades **112** to provide more drag on one side of the platform than the other to achieve a controlled drift direction. A third method utilizes active mooring line tension control using winches **345** on spread mooring lines **144** to augment the rotor or platform hydrodynamic forces to reduce slack in the mooring line and create a controlled drift direction. A fourth method is to implement hydrodynamic control surfaces, such as the rudder **355**, to yaw the platform in the tidal flow in a prescribed direction.

- (27) Active or passive hydrodynamic control surfaces may be implemented to improve turbine stability and dynamics in yaw, heave, or roll. One control surface is represented by the faired spar **120**, which surrounds a tubular spar beam and reduces turbulence and hydrodynamic drag on the platform. Actively rotating the rotatable upper spar **320** causes an asymmetric lift force on one side, perpendicular to the flow, and can counter the torque induced by the rotor **110** and be utilized to prevent lateral roll of the platform **170** not otherwise overcome by buoyancy/ballast forces.
- (28) To avoid resonant heave behavior of the spar platform **170** driven by wave conditions, the variable ballast tanks may be used to tune the natural frequency of the spar by pumping ballast water **331** in or out of the variable ballast tanks in response to the average sea state. Adding ballast water **331** to the variable ballast tanks improves roll stability by lowering the center of gravity and causing the platform's first-order natural frequency to shift to a lower frequency. Conversely, pumping ballast water **331** out of the variable ballast tanks will increase the natural frequency. Avoiding alignment of wave frequency and the platform's natural frequency will reduce the heave excitation of the turbine **100**.
- (29) Platform **170** may be assembled from the principal components described: deckhouse **130**, spar **120**, and nacelle **116**. Bolted joints may be provided between these components or elsewhere to enable the turbine to be broken down into smaller parts for shipping, or the platform **170** may be joined by welding or other means of fastening, the identification and implementation of which are apparent to one of ordinary skill in the art.
- (30) The turbine **100** may be towed to or from the site in a vertical orientation using a tow bridle attached to the primary mooring points **143**, **145** with blades feathered.
- (31) The invention has been described herein using specific embodiments for illustration only. However, it will be readily apparent to one of ordinary skill in the art that the invention's principles can be embodied in other ways. Therefore, the invention should not be regarded as limited in scope to the specific embodiments disclosed herein; it should be fully commensurate in scope with the following claims.

Claims

1. A marine current turbine system for converting current flow into electricity comprising: a floating spar platform comprising a nacelle at a bottom end, a faired spar at a midsection, and a deckhouse at a top end, wherein the faired spar comprises a teardrop body and a V-shaped tail; means for mooring the floating spar platform to a bottom of a marine environment comprising a first mooring line coupled to the nacelle and a second mooring line coupled to the deckhouse, wherein the first mooring line and the second mooring line are disposed within a vertical plane; and a rotor disposed at a downstream end of the nacelle, wherein the deckhouse is configured to provide buoyancy and is at least partially submerged during operation of the rotor to convert current flow into electricity.
2. The marine current turbine system of claim 1, wherein the faired spar comprises a rotatable fairing.
3. The marine current turbine system of claim 1 further comprising a thruster configured to translate and yaw the turbine.
4. The marine current turbine system of claim 1, wherein the faired spar includes a ballast tank.
5. The marine current turbine system of claim 4, wherein flooding or evacuating the ballast tank, causes the turbine's natural frequency to vary.
6. The marine current turbine system of claim 4, wherein vertical motion of the deckhouse subjected to wave conditions is modified by flooding or evacuating the ballast tank.
7. The marine current turbine system of claim 1, wherein the deckhouse comprises a rudder and an elevator.
8. The marine current turbine system of claim 1, wherein the deckhouse comprises a greater

waterplane area and buoyancy volume relative to the faired spar.

9. A marine current turbine system for converting current flow into electricity comprising: a floating spar platform comprising a nacelle at a bottom end, a faired spar at a midsection, and a deckhouse at a top end; means for mooring the floating spar platform to a bottom of a marine environment comprising a nacelle attachment point and a spreader disposed on the deckhouse, wherein the nacelle attachment point and the spreader comprise outer end connection points for attaching one or more mooring lines; and a rotor comprising a plurality of blades operating within a rotor plane, wherein the nacelle attachment point and a horizontal center of the spreader are disposed within a vertical plane defined by a vertical axis of the floating spar platform and a rotation axis of the rotor, the deckhouse is configured to provide buoyancy and is at least partially submerged during operation of the rotor to convert current flow into electricity, and the faired spar and the deckhouse provide maintenance access to the rotor.

10. The marine current turbine system of claim 9 further comprising a thruster configured to drive the rotor in an intended direction between current flow changes and a current flow direction sensor, wherein the current flow direction sensor activates the thruster in response to sensing a change in current flow direction.

11. The marine current turbine system of claim 9, wherein the rotor is configured to park in a horizontal position to allow maximum bottom clearance during shallow tide or extreme wave conditions.

12. The marine current turbine system of claim 9, wherein the faired spar comprises a rotatable fairing.

13. The marine current turbine system of claim 9, wherein the deckhouse comprises a rudder and an elevator.

14. A marine current turbine system comprising: a floating spar platform including a deckhouse, a faired spar, and a nacelle, a turbine located at the nacelle of the floating spar platform, the turbine comprising a rotor, wherein the deckhouse is configured to provide buoyancy and is at least partially submerged during operation of the rotor to convert current flow into electricity, and means for mooring the floating spar platform to a bottom of a marine environment comprising a deckhouse attachment point and a spreader disposed on the nacelle, wherein the deckhouse attachment point and a horizontal center of the spreader are disposed within a vertical plane defined by a vertical axis of the floating spar platform and a rotation axis of the rotor.

15. The marine current turbine system of claim 14, wherein in operation of the turbine, the floating spar platform floats vertically with the marine current turbine system's center of gravity located below marine current turbine system's center of buoyancy.

16. The marine current turbine system of claim 14, wherein the rotor comprises variable pitch blades.

17. The marine current turbine system of claim 14, wherein the deckhouse is configured to provide access the turbine, provide buoyancy, and is at least partially submerged during operation of the rotor to convert current flow into electricity.

18. The marine current turbine system of claim 14, wherein the floating spar platform comprises the faired spar with a teardrop body and a V-shaped tail.

19. The marine current turbine system of claim 14 further comprising a thruster configured to drive the rotor in an intended direction between current flow changes and a current flow direction sensor, wherein the current flow direction sensor activates the thruster in response to sensing a change in current flow direction.
