FLY RANCH
LAGI PROPOSAL 2020

DERVISH

With its undulating curves and twisting column of intersecting, lattice-like blades reaching towards the sky, Dervish evokes the structure of DNA, the sun-seeking flow of plant growth, and the spiraling patterns of rising heat, flame and vapor in the desert. As a striking visual icon and alluring destination in the landscape, Dervish boldly expresses the regenerative power of nature and the role of human ingenuity in stewarding its resources.

Dervish is a modular kinetic sculpture that generates electricity by harvesting wind energy. Functioning as a Vertical Axis Wind Turbine (VAWT), the sculpture consists of a series of stacking turbines, each containing its own dedicated magnetic alternator and internal gearing to translate wind-generated spinning motion into electrical current to be stored in a bank of batteries or used directly to power lighting on site or connected to a localized grid.

The sculpture's turbine is the primary design innovation, both aesthetically and functionally. Consisting of a double course of concave, semi-helical blades arranged at alternating, complementary angles, as the turbines rotate, the blades and their shadows create complex optical effects, like Moire patterns and other illusions, at times appearing to be spinning in reverse. The double course of blades are strategically arranged to optimize wind turbulence by capturing its prevailing outflow; increasing the surface area of wind exposure by harvesting turbulence without adding undo weight reduces drag and increases efficiency.

BENEFIT TO COMMUNITY

The final design, prototyping and manufacture of Dervish could provide broadly beneficial opportunities to the residents of Gerlach and Northern Washoe County, particularly for the Paiute Nation. We would work collaboratively with Nevada's State Office of Energy and WindExchange.Energy.Gov to identify enterprise zones in the region and related funding to manufacture the turbines. We would also work with Nevada's Wind for School's program to bring our project to public K-12 schools. The local manufacture and distribution of Dervish wind turbines, realized at optimal production scale, would provide micro-economic development, valuable educational opportunities and energy savings for Washoe County and Nevada residents, increasing Nevada's visibility as a leader in confronting the challenges of climate change.

SPECIFICATIONS

To optimize performance and ease of prototyping and manufacture, Dervish's turbines are made from water-jet cut T6061 aluminum, a recyclable material with high strength to weight ratio. To reduce waste, cost and energy consumption in production, components are designed to nest efficiently on standard flat sheets of 1/16" aluminum that are then formed into complex contours with a hydraulic press. The DIY press could be made using 5 axis, CNC cut molds, and standard automotive jacks. Each of the turbine's concave, helical blades is riveted to two individual end plates, allowing for easy transport, site assembly, repair and modification. Alternately, the turbine blades could be made from carbon fiber-reinforced bioresins, a more costly and technically challenging but lighter weight consideration. Overall height is 25.5'; each turbine is approx. 42" h with varying widths up to 48" at the top.

Dervish's modular construction, ease of transportation and site assembly increase the sculpture's scalability in manufacture, use, and potential impact. Indeed, one of the primary advantages of Vertical Axis Wind Turbines is their capacity to cluster in relatively tight spaces where wind is optimal. Arranged in clusters, VAWTs create their own updrafts, increasing the efficient capture of wind energy when at its peak, up to 10x greater than Horizontal Axis Wind Turbines by land area covered. The turbines are constructed around 6" D aluminum poles, which slip together into a telescoping, vertical stack. The fully assembled pole is held in tension/compression with an internal cable/turnbuckle system, allowing for rigidity while maintaining flexibility. Each turbine spins freely around the pole by use of two low resistance slew rings mounted to either end plate.

The stack of turbines mounts to a base consisting of an 8' high x 8" D aluminum pole rising from a 6' D x 10" thick cast permeable concrete slab (to lessen the impact of resource-depleting concrete, structural footings for the slab could be realized by removable, stainless steel helical anchors). The 8" D pole is supported by a tiered support base consisted of welded aluminum substrate with Glass Fiber Reinforced Concrete (GFRC) surface that invites engagement, creating a convivial hub. Offering a dramatic view up through the center of the sculpture, the circular base offers seating, stores batteries, and contains interpretive text and graphics that explain the unique attributes of the artwork.

OUTPUTS + INPUTS

Dervish exemplifies many of the advantages of the Darrieus, or lift-type VAWT. The turbines rotate at lower speeds so are safer and quieter, as well as better functioning in variable or extreme winds. Their relatively low cost of manufacture, transportability and ease of installation make them more scalable for both large and small-scale operations. A single turbine should produce about 60 watts of electricity at an average wind speed of 10 mph, so a stack of four would produce closer to 240 watts. A single turbine operating at this speed would charge a 12V car battery in less than 5 hours; a stack of four in about an hour at the same wind velocity. Higher wind speeds would produce significantly more power. The alternating spin directions of the stacked turbines reduces vibration, torque and wind load on the support structure, increasing the efficiency and durability of the system.

ENVIRONMENTAL IMPACT

Envisioning a future where beauty and sustainability converge, Derivsh combats climate change and greenhouse gas emissions by generating clean energy from the wind. The system is designed to be low-maintenance and low-impact, with simple, highly durable components. This type of turbine has been proven to be harmless to birds in flight and other wildlife. Construction on site will be carefully planned to limit environmental impact on the land, with any waste material removed; the artwork has a relatively small footprint and will be sited in collaboration with LAGI. Battery technology is evolving rapidly; we will utilize batteries with the least environmental impact, following best practices in sustainable energy systems to mitigate environmental impact when batteries need to be replaced. Creative collaboration with a battery company such as Tesla could afford the opportunity to utilize more costly technology within the prototype budget. The majority of materials used in Dervish are recyclable.

CONCEPTUAL COST ESTIMATE

Dervish would be easy to prototype. Startup costs would include tooling, specifically making molds to form blades, purchasing and cutting materials to our specifications, purchasing all hardware, alternators, gearing and electrical components, and finishing of component parts prior to assembly. To purchase one fully assembled on site Dervish VAWT would cost between 90-120K if managed by the design team, who would also serve as the fabricator, shipper and installer. This conceptual estimate would not include site work, including engineering, formwork and pouring a concrete pad and related footings as required. The estimate also does not include rental of boom lift or crane to install the stacked turbines. Maintenance of the finished product would be minimal. The turbine blades are easily replaced if damaged, as are the alternators and internal gearing. The slew rings will require periodic maintenance (at the estimated scale of 5-10 years) as a function of their load and estimated lifespan of bearings and/or plastic slip rings, TBD. (NOTE: The slew rings will be custom designed and made by Igus Inc to our requirements; we have worked with this company, an international leader in industrial technology application on previous exterior public commissions to create custom components.)

ON-SITE PROTOTYPE DEVELOPMENT

Component parts would be made in the vicinity of the design team and turbines assembled in the design team's studio workshop before being transported to the site. We would coordinate with local contractors to pour the footing and base on site and supervise installation and assembly. Thanks to our extensive experience installing similar types of large-scale, permanent civic art nationwide, we are skilled at identifying and securing trusted local partners to work with. While we have established relationships with specialized engineers and fabricators , we would embrace opportunities to work with the Fly Ranch team, local fabricators and local community stakeholders.