System Design and Manufacturability of Concrete Spheres for Undersea Pumped Hydro Energy or Hydrocarbon Storage

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Offshore wind and energy storage have both gained considerable attention in recent years as increased wind capacity is installed, less attractive/economical space remains for onshore wind, and power-plant ramping, transmission cable capacity constraints and other integration issues make wind power integration with the existing power grid more costly as wind penetration increases. In order for offshore wind to maintain a stead supply to the power grid without increasing these integration issues and costs, some form of large-scale energy storage is required.

For water depths greater than 50m, floating wind turbines are expected to be more economical than wind turbines mounted on pilings or stands. The greater water depths in which floating wind turbines are located provide an opportunity for a unique energy storage concept that takes advantage of the hydrostatic pressure at ocean depths to create a robust pumped storage device. Coupling this energy storage system, either with a floating wind farm or as a storage-only power plant, provides a far more consistent and predictable power plant that could ultimately lessen the cost of large-scale wind integration, consistently reduce fossil fuel use, and reduce greenhouse gas (GHG) emissions by load-leveling onshore generation.

The US Department of the Navy's goal for renewable energy supply to shore facilities is 50% by 2020; implementing large-scale energy storage will increase the reliability of renewable energy supply and reduce the risk of power loss caused by natural disasters. Various scenarios evaluated offshore major US Naval bases including San Diego and Hawaii show promise for the technical and economic feasibility of this undersea energy storage concept, with cost-per-kilowatt-hour competitive with current energy storage technologies.

The same type of device structure can be used for undersea hydrocarbon storage during periods of hurricane/tropical storm shut-in's at oil wellheads, maintaining wellhead production without risking personnel or environmental safety due to storm evacuations at the rigs on the ocean surface.

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