SYNCHRO-SYM Wind Turbine Electric Generator Systems

**Best Electric Machine (BEM)** is entering the Computer-Aided-Design (CAD) phase of developing a family of lightweight electric generator systems for large wind turbines that is based on its patented electric motor technology called **SYNCHRO-SYM**, which is a symmetrical wound-rotor “synchronous” doubly-fed electric motor system circuit and control architecture as only provided by the highly integrated Brushless Real Time Emulation Controller (BRTEC), starting with the SYNCHRO-SYM Wind Turbine 500 (or SSWT-500) lightweight electric generator product.

The SSWT-500 specification:

- Provides a componentized Wind Turbine Generator System with a superior operating performance specification that always includes the efficiency, weight, and dimensions of the essential electronic controller, which for SYNCHRO-SYM is the highly integrated BRTEC, frame, axle, and bearing assembly;
- Provides a componentized Wind Turbine Generator system without rare-earth permanent magnets (*such as neo permanent magnets*) and their associated issues of field assembly, cogging (*or torque ripple*), cost, reliability, safety, life expectancy, and pollution;
- Provides a compact, small diameter, stackable, low speed direct drive capability that is without the compounding complexity, loss, maintenance, reliability, and size issues of a gearbox;
- Provides a compact, low speed direct drive capability that can be field replaceable by a small internal nacelle crane, lengthwise stackable to 16 MW, small diameter and shippable by conventional means, starting with 500 KW or 1 MW standalone or componentized lengthwise increments;
- Provides failsafe operation until field replacement of any failed generator in the stack (*without the mitigating effects of permanent magnet torque ripple*).

The following table provides the SSWT-500 specification:

| SSWT-500 PERFORMANCE SPECIFICATIONS (compared to the GE Haliade-X Wind Turbine Generator) |
|-----------------------------------------------|-----------------------------------------------|
| **SYNCHRO-SYM** (Axial-Flux)                  | **GE Haliade-X** (Radial-Flux)               |
| Total Power                                   | 1-16 MW                                       | 12-14 MW                                    |
| Stackable Power Increments                    | 1 MW (Each SSWT-500 includes Dual BRTEC and Frame, Axle & Bearings) | Large, non-stackable self-contained unit. (Permanent Magnet Electric Machines must be fully assembled at the factory) |
| Speed                                         | 0-10 RPM (Higher RPM without overvoltage concerns) | 0-10 RPM                                   |
| Length (shippable Length)                     | 21 in (530 mm) (Includes the integrated BRTEC) | 9.8 ft? (3 M?) (Does not include the electronic controller) |

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| **Diameter** | **12 ft**  
(3.7 M)  
(Includes the integrated BRTEC) | **36 ft**  
(11 M)  
(Does not include the electronic controller) |
|-----------------|-----------------|-----------------|
| **Total System Efficiency**  
(Turbine Hub to AC/DC Power Grid) | > 91% @ 12' Dia.  
(Includes the integrated BRTEC) | ? |
| **Rotor or Stator Component Weight**  
(shippable weight) | 16,413 lbs. (2)  
(8,125 kgs)  
(Includes the integrated BRTEC) | ?  
(Permanent Magnet Electric Machines must be fully assembled at the factory and for safe transport) |
| **Total Increment Weight**  
(shippable weight) | 35,000 lbs. (3)  
(17,371 kgs)  
(Includes the integrated BRTEC) | ? |
| **Volume**  
\((\text{Dia./2})^2 \times \pi \times \text{Length}\) | 5.7 M³  
(Include the BRTEC) | 285 M³ (1)  
(Does not include the electronic controller) |
| **Total Stackable Units** | 16x  
(Frames, Bearings, and Axles provide structure strength) | ? |
| **Total Stackable Length**  
(16x) | 28 ft  
(8.54 M)  
(Includes the integrated BRTEC) | N.A.  
(Nacelle is 67.5ft/20.6M long) |
| **Stackable Volume** | 91 M³ (1)  
(Includes the integrated BRTEC) | 285 M³ (1)  
(Does not include the electronic controller and for 13 MW) |
| **Total Stackable Weight** | 280 tons (1)  
(254 tonnes)  
(Includes the integrated BRTEC) | 600 tons? (1), (4)  
(Nacelle total is 660 tons, including electronic controller, for 13 MW) |

(1) Consistent with the wound-rotor doubly-fed [synchronous] electric machine circuit and control architecture, as only possible by the enabling technology of brushless real time emulation control or **BRTEC**, SYNCHRO-SYM shows half the size, half cost, and half loss as all other electric machine systems, such as the RE-PM generator system.  
(2) 15 ton internal nacelle crane  
(3) 25 ton internal nacelle crane  
(4) 700 ton, 150 meter, external mobile crane