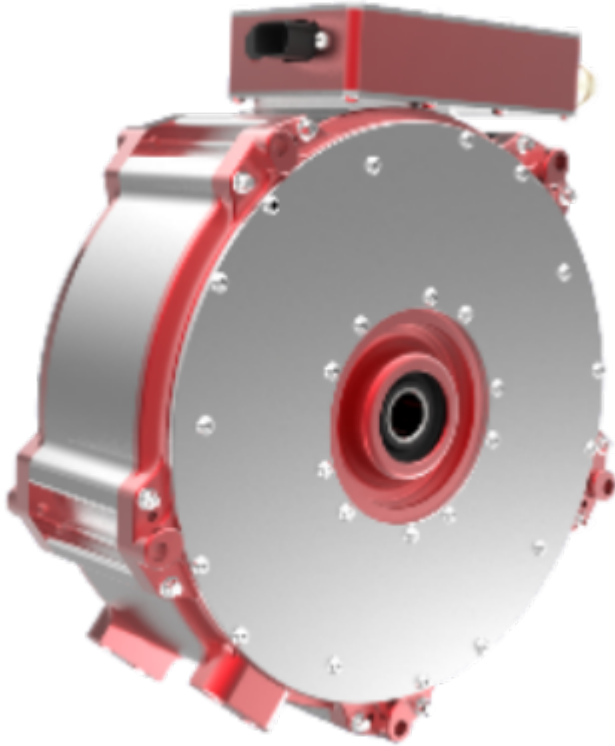


# **SIXTY YEARS OF SYNCHRO-SYM STUDY**



## **SYNCHRO-SYM Technologies**

**– SIXTY YEARS OF APPLIED  
SYNCHRO-SYM STUDY –**

***Our Mission:***

***Innovate For Our Clean, Efficient,  
and Sustainable Energy Future!***

## **SIXTY YEARS OF APPLIED SYNCHRO-SYM STUDY**

The following bibliography (with clarifying comments enclosed in { }) references over 60 years of selected academic studies, research, and publications, which confirm the exceptional performance attributes and implementation challenges surrounding the brushless symmetric multiphase doubly-fed “synchronous” electric motor or generator system (EMS) with the unique, *optimal electromagnetic symmetry* of directly-excited multiphase (or active) winding sets symmetrically placed on the rotor and stator assemblies, respectively, which inherently maintains the same electric motor package footprint of materials, cost, and loss, *but only with the practical enabling invention of a brushless real time emulation controller (BRTEC)* to eliminate the multiphase brush-slip-ring assembly and its known instability issues of “synchronous” operation, such as by random line or shaft perturbations, from sub-synchronous to super-synchronous speeds, including at (or about) synchronous speed:

\* [DOUBLE CONTINUOUS POWER DENSITY and EIGHT TIMES PEAK TORQUE DENSITY] “The double-armature machine {similarly known as the symmetric synchronous doubly-fed electric motor as only provided by SYNCHRO-SYM} has many merits...**continuous power rating is double**...in addition...**a maximum pull-out torque of...eight times nominal frame size** torque rating.” [See page

95, 1<sup>st</sup> column, paragraph 3] [1]

\* [LOWER COST] “...the power electronic converter {of SYNCHRO-SYM} only has to handle a fraction of the **total power...losses in the power electronic converter can be reduced...the cost...becomes lower.**” [See page 227, 1<sup>st</sup> column, paragraph 1] [2]

\* [“SYNCHRONOUS DOUBLY-FED”] “...the **doubly-fed synchronous electric machine** {of SYNCHRO-SYM}...which allows full advantage...from the possibility of delivering energy to both the rotor and stator...create unstable operation...the desirable steady-state features of this machine are not available...” [See page 653, 1<sup>st</sup> column, paragraph 1] [3]

\* [SENSORLESS & AUTOMATIC EMULATION CONTROL] “The operation of an **ideal control circuit would be independent of the amplitude and frequency of the input signal.**” [See page 656 3<sup>rd</sup> column paragraph 1] [3]

\* [REAL TIME CONTROL] “The **controller requires too many measurements and off-line computations... {unlike BRTEC of SYNCHRO-SYM, the field-oriented controller (FOC) is not brushless, uniformly bidirectional, instantaneous, sensorless, automatic, which quickly leads to instability}**” [See page 1651, 1<sup>st</sup> column, paragraph 3] [4]

\* [INSTABILITY WITHOUT REAL TIME CONTROL] “The **problem of inherent instability...uncontrollable torque angle is an old one ... the problem of accelerating the machine and synchronizing it to the power system has continued.**” [See page 526, Column 2, Paragraph 2] [5]

\* [REAL TIME CONTROL] “Since realization of such a **control which requires...zero time is almost impossible...**” [See page 803 paragraph 6] [6]

\* [UNRIVALED PEAK POWER ] “*...peak-power capability of this machine when acting as a motor is greater than that of any comparable form of machine.*” [See Abstract] [7]

\* [LOWER COST] “*The power converters rating...is substantially lower than the machine rating...*” [See page 787 column 1, paragraph 1] [8]

\* [LOWER SIZE] “*The higher cost of the machine (due to the slip rings of the Doubly-fed machine) is compensated by a reduction in the sizing of the power converters {of the Doubly-Fed Machine}.*” [See page 414, column 2, paragraph 3] [9]

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The [classic theoretical study for all EMSs begins with the symmetric multiphase doubly-fed “synchronous” electric motor or generator system \(S-EMS\)](#) and becomes the foundational study for *all other electric machine systems* of today by *deoptimizing its electromagnetic symmetry* of an active rotor and active stator with the non-optimal electromagnetic asymmetry of a “passive rotor” with permanent magnets, reluctance saliencies, DC field windings, or slip-induction windings, which is the Asymmetric EMS (**A-EMS**). The S-EMS with an active rotor *provides* twice the constant-torque speed range with a given torque, voltage, and frequency of excitation as the A-EMS with a passive rotor (*i.e., 7200 RPM at 60Hz with one pole-pair versus 3600 RPM for all others*). In effect, the “active rotor” contributes additional working power and torque to the electromechanical energy conversion process while consuming *half* the loss, cost, and size of the EMS along with the universally essential active stator delivering the primary torque and working power production of the EMS, which is tantamount to **double the power density and octuple the peak torque at half the cost and half the loss per unit of power rating** with the same packaging and design rating of the A-EMS with a passive rotor that cannot contribute any working power

or torque to the electromechanical energy conversion process along with the universally essential active stator but still consumes the same half of the A-EMS loss, cost, and size.

With the formidable challenges of inventing a practical BRTEC with the limited technology of the time, followed by the timely discovery of a practical rare-earth permanent magnets or RE-PM (circa 1980s) that would effectively eliminate the cost, size, loss, and provisioning of electric motor magnetizing MMF, research on the pinnacle of electric motor systems, which is the S-EMS, was abandoned and left to obscurity in favor of the RE-PM A-EMS (*until the patented invention of SYNCHRO-SYM with the only practical BRTEC*). By blatantly disregarding the environmental impact, human exploitation, and geopolitical consequences of mining and manufacturing RE-PMs, [a global adversary seeking world dominance \(the CCP\) has stealthy become the major producer, supplier, and influencer of the RE-PM A-EMS](#) and as a result, the RE-PM EMS is at least propelling the electric transportation revolution.

Without the basic classical theoretical study of electric machine systems, today's so-called EMS experts are actually practitioners of integrating the global adversary's manipulated supply chain of readily available RE-PM A-EMS components. Why else do so-called EMS experts anecdotally consider the RE-PM EMS to be the highest performing EMS available in oblivious defiance of the bibliography of researched facts of their colleagues? Why else is the cost, size, and loss of magnetizing MMF ironically being retrofitted into the RE-PM A-EMS to gain the coveted benefit of field weakening, which was already more reliably, efficiently, and cost effectively provided by another comparably optimized A-EMS, the Induction A-EMS, which is being replaced by the RE-PM EMS to originally eliminate magnetizing MMF? Why else would so-called electric machine experts foolishly confuse the S-EMS, as only provided by SYNCHRO-SYM, with the antiquated

multiphase slip-ring assembly wound-rotor doubly-fed *induction* EMS or the so-called brushless doubly-fed *induction* EMS, which like the RE-PM A-EMS, is an inferior performance/price A-EMS but without the manipulated but readily available supply chain of components?

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## References

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