Contribution ID: **764** Type: **Poster**

Wed-Af-Po.01-06: S.M.A.R.T.: A bold design to achieve aneutronic fusion energy

Wednesday 2 July 2025 14:30 (2 hours)

S.M.A.R.T. promises to be the boldest design to generate aneutronic fusion energy, first as process heat, and then as electricity for the power grid. I propose to incorporate 27 novel features to enable the Toroidal-Field (TF) system–with its brittle ceramic HTS conductor–to survive the peak stresses–and strains–from the (J x B) Lorentz forces generated by a peak ambient field of more than 30 tesla. About half of these innovations will be unique: new, superior materials, improved geometries, etc. As a mechanical engineer and novel-materials advocate, I espouse the philosophy, "More progress is wrought through judicious exploitation of novel materials than is yielded through meticulous optimization of familiar materials." In particular, note that HTS is a ceramic and brittle. At a mere 0.4% strain, the current-density (CD) of HTS degrades by ˜10%; at 0.7% strain, the CD plummets by ˜50%! Thus, high tensile- and yield-strength properties are of little value; it is high modulus and/or meticulous rigid external support that are crucial. Except for brittle tungsten, no metal has adequate stiffness. Thus far, high-modulus carbon fiber, such as ". . . high tensile strength (3.76 - 5.53 GPa), high tensile ductility (8 - 13%) and high electrical conductivity (1.82 - 2.24) * 10**4 S / cm"� (https://www.nature.com/articles/ncomms4848) is one of the woefully few materials that possess adequate high modulus (˜400 GPa), tensile yield strength (>1.6 GPa), and elongation to fracture (˜10%). Someday soon, we hope that graphene, fullerenes, carbon nanotubes, and carbyne, etc. will supplant high-modulus carbon fiber. Ultra-pure aluminum, reinforced with graphene platelets, etc., may slash magneto-resistivity (>25); ice-powered "pistons"� may "torque"� the Toroidal Field (TF) coils to eliminate the vertical strain in the flimsy Inner Leg. Direct Energy Conversion (DEC) from the protons and alpha particles will be attempted; additional electricity will be extracted from the bremsstrahlung and/or synchrotron radiation. Several heating techniques will be evaluated for plasma ignition; if an Ohmic Heating (OH) system proves essential, it will be partitioned into two independent systems: the first, a high-voltage, low-eddy-current, twisted-cable, modest volt-second system to enable plasma ignition, the second, a low-voltage, high-CD, high volt-second system to greatly prolong the pulse length of the plasma current, perhaps even to steady state.

Author: WEGGEL, Carl (M.A.G.I.C., LLC)

Presenter: WEGGEL, Carl (M.A.G.I.C., LLC)

Session Classification: Wed-Af-Po.01 - Magnets for Stellerators and Other Configurations