The RAeS International General Aviation Design Competition 2019

There is no doubt that the green agenda is now well and truly in the public psyche, grown from a fringe interest only a few years ago to become probably the key issue on the scientific and political spectrums.

Undoubtedly there are those of us who feel uneasy about its increasing prominence in our everyday lives, but even the most ardent, banner-waving Luddites among us are coming to concede that we cannot continue the hedonistic waste of the Earth's resources with little or no consideration for future generations. The move is on to clean up our act, and environmentally generated electric power is our future, not only for industrial and domestic energy, but also to power our transportation systems.

The automotive industry is now fully on board with electric and hybrid power, and while the current crop of vehicles have a long way to go to reach the practicality of a modern petrol or diesel powered machine, they are significantly more advanced that the offerings of a decade ago. Progress happens because a commercial or political need is recognised, and that process is now certainly underway. It is also a truism that racing improves the breed, and work in Formula One and Formula E is intrinsically linked with advancement in the cars we will ultimately drive on the road.

Progress in aviation has been slower, but it is certainly ramping up. AERO has had an electric aircraft feature for several years at Friedrichshafen, and last year that had grown into a hall of its own. British interest has been slow to get going but with Roger Targett's Electroflight now under the wing of Rolls-Royce a three motor, 750kW 300+mph record breaking project named ACCEL, UK involvement is now truly underway.

Above The exciting new 300mph ACCEL. RAeS electric racer entry configurations may well be very much more unconventional

WORDS: Brian Hope

LAA is also pushing ahead with this new technology and in league with Nottingham University and F1 aircraft racing's AIR Race E organisation, is involved in the development of an electrical power pack to replace the Continental engines of F1 racers.

And another string to the F1 racing bow is the Design Competition being organised by the Royal Aeronautical Society for complete F1 Electric Racers. Once again AIR RAC E and the LAA are involved. Following the announcement of the competition in November, the Rules for the competition have now been announced.

The concept...

The objective is to design an electric air racer that demonstrates what is possible using the coming revolution in electric power.

ROYAL AERONAUTICAL SOCIETY AIRRACE LAA Light Aircraft Association

The winner will be the design with the shortest time around a course in a simulator. Air Race E (*airracee.com*) plans to bring electric power to Formula 1 pylon air racing in 2020.

The competition is intended to be as inclusive as possible, and entries from overseas as well as the UK are encouraged. Entrants will need some design knowledge, but do not have to be professional engineers.

Whether students, enthusiasts or professionals, you can enter as an individual or a team, and entrants are at liberty to form a consortium with other interested parties where specific skills and knowledge are required to fulfil the design exercise.

Entries will be assessed using the following criteria:

■ A competent design, with reasonable estimates of all parameters, especially mass and aerodynamic drag

■ The time taken to complete a defined course using a flight simulator.

Both of these elements must be submitted for the entry to be valid.

The entries will be judged by a team of professional aeronautical engineers from the RAeS and the LAA. The winners will be announced at the RAeS GA Group's Light Aircraft Design Conference on 18 November 2019.

Entries should include:

1. The entry form with your details and those of your team.
2. A description of the main features and innovations in your design.
3. A three-view, general arrangement drawing.
4. A rendered image of the design, for use in publications about the competition.
5. A report on your design, including estimates of aerodynamics; flight envelope; loadings; strength; weight; stability; control and performance.
6. An aircraft model folder (.acf aircraft file, .png paint files, folders for aerofoils, cockpit, objects). Replay file (.rep) for your timed run through the course.

The prize will go to the design that has the best time around a defined course in the simulator, subject to verification of the design. The judges reserve the right to modify your data if they believe that your assumptions and/or calculations are optimistic. In such cases, you may be required to re-submit your flight in the simulator.

Design constraints

■ Weight of the aircraft must be at least 227 kg ready-to-fly, but less pilot. Pilot weight is 80kg and is up to 1800mm tall and up to 500mm across the shoulders. The pilot sits upright or in a reclined position – not in a prone position.

■ Motors are limited to a total of 125kW maximum continuous power. There may be any number of motors, located in any position on the aircraft.

■ Propellers must be fixed pitch, but can include contra-rotating propellers on each shaft.

■ The total lifting surface area must be at least 6.132 square metres. This can include a lifting canard surface.

■ Ailerons must be 100 per cent dynamically balanced, or 100 per cent statically balanced with counterweight outboard of the spanwise centre of gravity of the aileron.

■ The main landing gear must be fixed. Nose and tail wheels and tail skids may be retracted in flight.

■ Main wheel brakes are required.

■ Tyres must be at least 11.4 x 5 size.

■ Wheel fairings (if used) must be at least 165mm at the inner and outer axle point line to nominal fairing lines on each side.

■ When seated in the cockpit with crash helmet, seatbelt and shoulder harness on, the pilot must be able to scan a field of vision measured from a datum plane parallel to the aircraft longitudinal axis of at least:

- 5° down over the nose.
- 25° true down over the leading edge of the wing for conventional, non-canard aircraft. Canard aircraft must be designed to achieve maximum forward and down visibility for turns and racing formation manoeuvres.
- 45° vertically upwards.
- 270° horizontally.

■ Substantial protection for the pilot other than the fin must be provided either fore or aft of the pilot cockpit. The structure must not obstruct forward visibility.

■ The minimum vertical outside dimension at the cockpit is 762mm. Any protrusions, fairings or additions to the fuselage or canopy mould lines will be discounted.

■ You should use the following values unless you have reasonable proof that you can do better with 2020 technology:

- Batteries pack installed mass = kWh stored × 3.33 kg/kWh
- Mass of motors = maximum continuous power kW × .20 kg/kW
- Power train losses from battery to propeller = 30 per cent

■ The batteries should contain enough energy for the defined race plus 30 per cent.

■ The aircraft structure must be capable of a limit load of +6/-4g at speeds from Va to Vne.

■ The aircraft must have a positive static margin above the minimum flight speed, and good handling at low speeds and at the stall.

Simulation

Your entry must include a flight model of your design in the form of an X-plane .acf file. You must also include files that define your aerofoil sections as .afl files. You may also include graphic files (.png) to improve the cosmetic appearance of your instrument panel and external surface. It's also possible to add in 3D object files to make it look even better.

Your simulator model should include data defining the motors and batteries. We shall review the energy used during your timed run to assess battery size.

Simulators such as X-plane are quite easy to learn and are available for a modest price (for personal use). Such simulators calculate the dynamic behaviour of your aircraft in real time from first principles. But this will depend upon the 2D aerofoil data, masses, body profile drag and other values that you input. You must provide evidence to support data that you use in your model.

The course will be published as X-plane format scenery files and you are expected to record a flight around this course, and to include your flight record with your entry.

Your time will be recorded using the latest version of X-plane on general release on 1 August 2019. ■

● Full details of the competition, which contains a bibliography for further guidance, and how to enter should be available shortly from the Royal Aeronautical Society at *https://tinyurl.com/y7ycxfge* or search online for RAeS Design Competition.