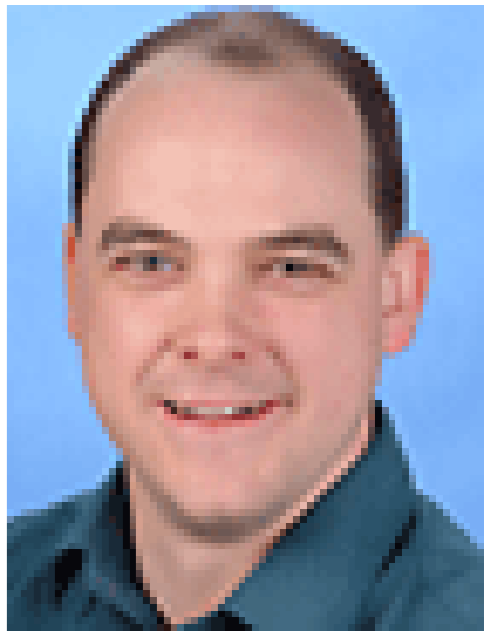


Enhancing Aerospace Efficiency Through Integrated Electrical Power

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Introduction

This Royal Society Industry Fellowship has supported research to increase the efficiency of aircraft through the use of more-electric technology. A number of important goals have been reached, increasing the understanding of the implications of imposing larger electrical loads on gas turbine engines. The objectives of this Fellowship are:

- 1- Multi-shaft engine emulation using electric drives and accurate incorporation of generator load and mechanical coupling
- 2- Modelling of electric load operating scenarios and characteristics
- 3- Electrical energy management strategies for improved platform efficiency

Intelligent Electrical Power Network Evaluation Facility

IEPNEF is a hardware test and research lab to simulate an aircraft electrical system. Power is distributed around a high-voltage DC bus to a number of power electronics-based load emulators, which replicate the behaviour of real aircraft loads such as actuators, environmental control systems, fuel and oil pumps, and avionics. The system is operated from a central control room, allowing IEPNEF to replicate real operating characteristics and allow extended investigations over any chosen flight or operating regime.

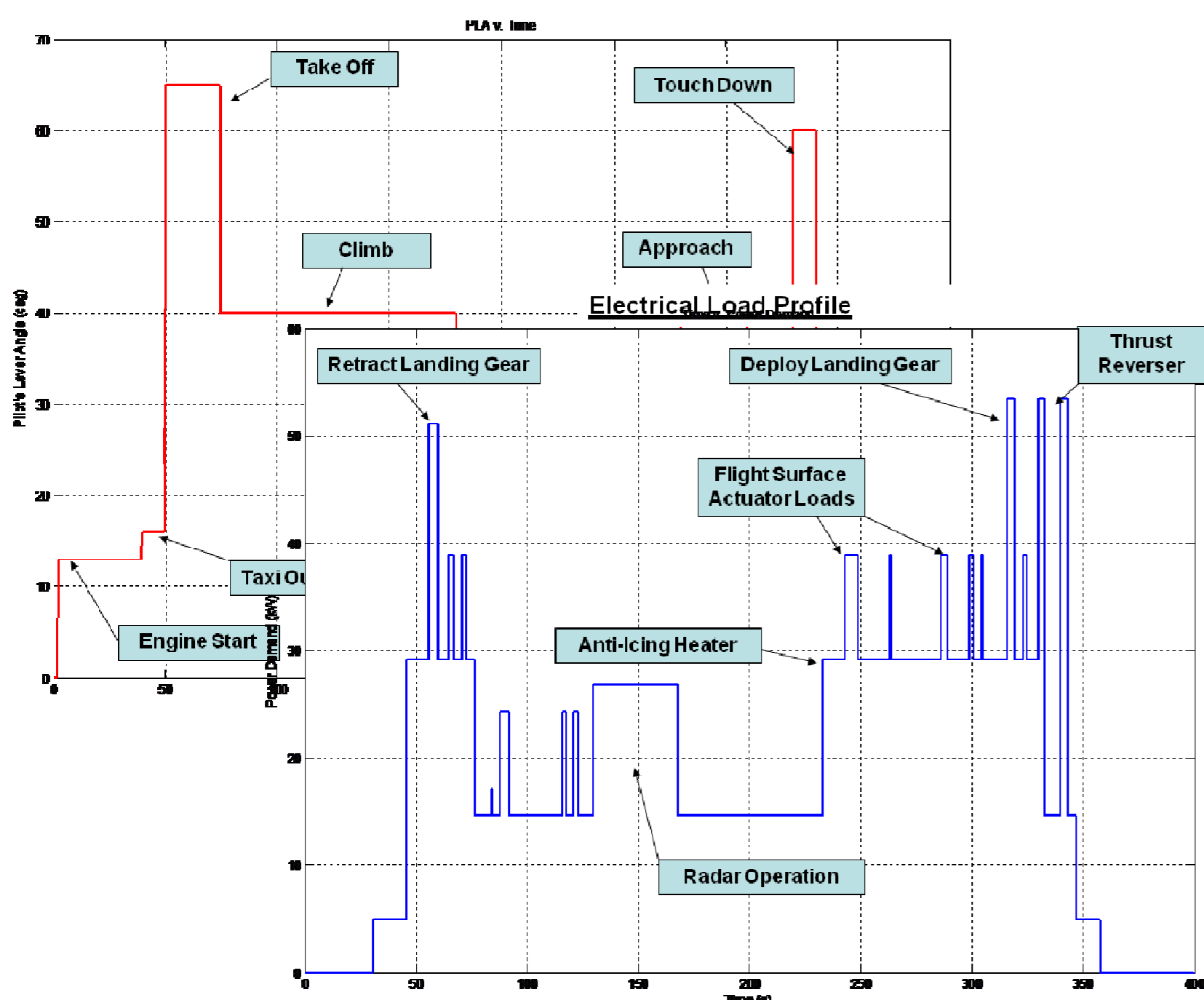


Fig. 2: Electrical Loads During Flight Cycle

IEPNEF System Diagram

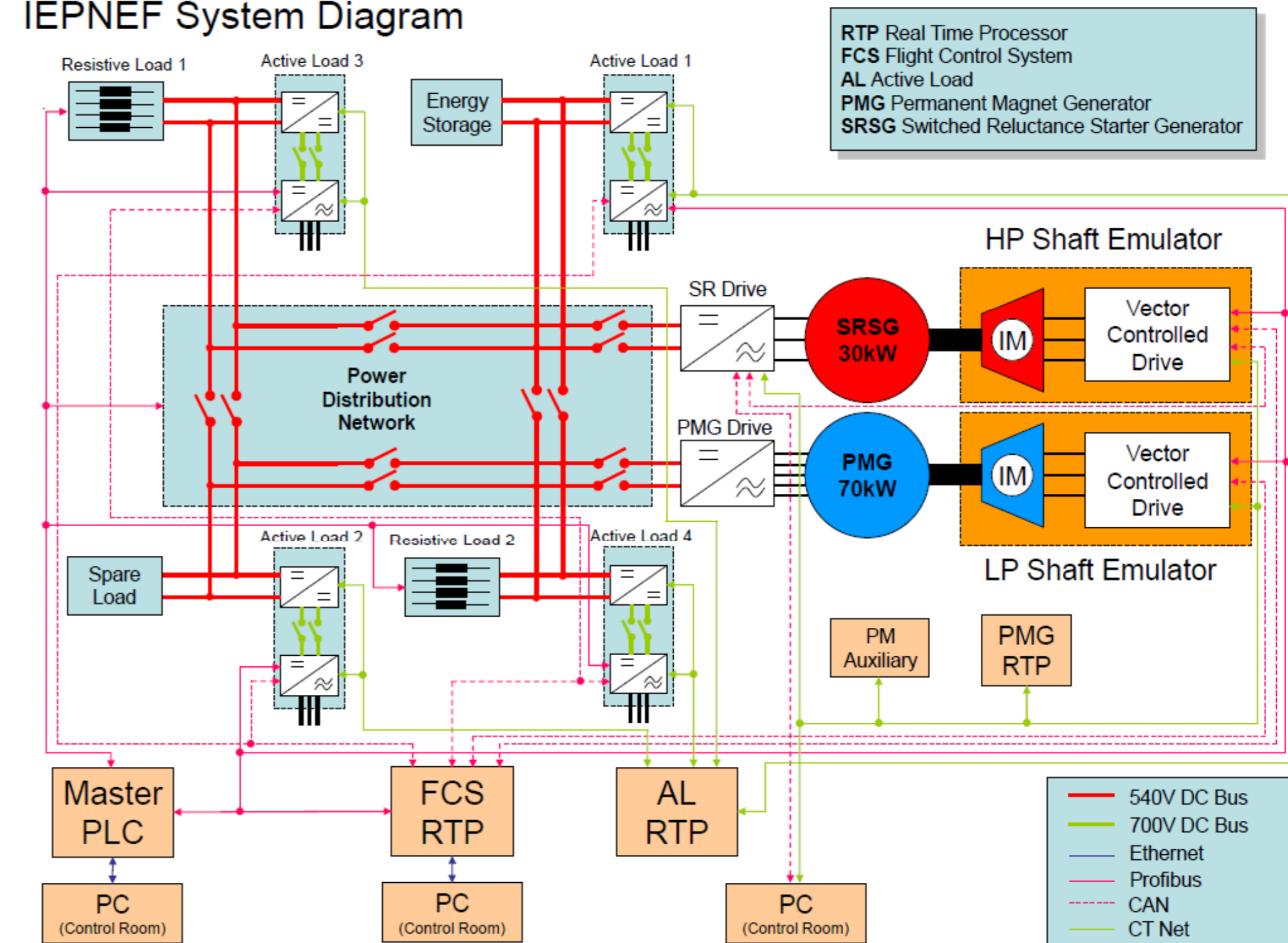


Fig. 1: IEPNEF

Load Emulation and System Optimisation

The dynamic model of an Adour engine has been incorporated into IEPNEF's real-time controller, with torque and speed feedback from the physical plant. A mission sequence was constructed to include the operation of typical electrical loads at defined points in the mission. Electrical models of more sophisticated loads have been analysed and implemented. System efficiency is now under investigation, with a focus on the potential benefits of electrical storage as a means of buffering an engine against sudden, large changes in electrical load.

My Industry Fellowship...

has enabled me to apply my understanding of large electrical power networks and energy systems to the aerospace environment. Simultaneously, it has greatly increased my knowledge of aircraft systems and of new, advanced, power-dense electrical machines and converters that are not yet found in large power systems. The Royal Society's training in entrepreneurship, innovation and media communications will prove invaluable in my further career development.