SAE INTERNATIONAL

AEROSPACE INFORMATION REPORT

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Architecture Examples for Electrified Propulsion Aircraft

RATIONALE

The electrification of aircraft propulsion is an emerging area which holds much promise for realizing an air transport revolution and enabling new mobility options. These technologies have the potential for carbon footprint reduction, noise reduction, improved performance, new aerodynamic efficiencies, and better utilization of energy infrastructure. The application of electric power for aircraft propulsion can take a variety of forms, ranging from partial electric to all electric. The introduction of electric drive systems to drive propulsors, along with the variety of available methods to generate electricity and store energy, offers an increased design freedom for next-generation aircraft and aircraft architectures. This newfound design freedom exposes a need within the aviation industry to establish a common design language for electrified propulsion. The purpose of this document is to describe potential electrified propulsion architectures to ensure that, while the industry innovates in this area, they can share common architectural definitions. This common architectural language will simplify the industry-wide efforts to assess functional and safety requirements for these emerging technologies.

FOREWORD

Electrified propulsion offers potential benefits by introducing electrical systems to augment or replace traditional propulsion methods. This SAE Aerospace Information Report (AIR) provides information about six potential electrified propulsion architectures. It is intended for use as a launching point for current and future works of the SAE E-40 committee, providing common nomenclature for several potential architectures. This material is informational in nature; it is not mandatory. Due to continual technological advancements and the evolving nature of standards and specifications, it is acknowledged that this material cannot present all potential electrified propulsion architectures.

This document has been developed in coordination with ARP8676. Readers of this document may find ARP8676 a useful reference, as it provides definitions for terminology commonly used in the field of electrified propulsion. As electrified propulsion is an emerging technology, it is expected that both of these documents will be updated periodically.

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1. SCOPE

The application of electric power for aircraft propulsion can take a variety of forms, ranging from partial electric to full electric. The introduction of electric engines to drive propulsors, along with the variety of available methods to generate electricity and store energy offers great degree of new design freedom for next-generation aircraft and aircraft architectures. This newfound design freedom exposes a need within the aviation industry to establish a common design language for electrified propulsion. While this need for a common design language is recognized, the intent of this document is to encourage innovation, providing reference architectures as a launching point for future work in this area. This document will describe potential electrified propulsion architectures and provide examples. While providing these example architectures this document will develop common definitions for the elements of the architectures by defining:

1. The elements of electrified propulsion architectures, including any dedicated power generation and distribution systems as well as energy storage elements.

2. The interfaces to/from the electrified propulsion system.

3. The interfaces within the electrified propulsion system.

4. Electrical energy management and storage architecture of an electrified propulsion system.

While capturing these architectures and elements, this document will serve as a reference point for future works of SAE and provide aerospace industry guidance.

It is recognized that the high power density associated with electrified propulsion will require an advanced thermal management system (TMS). It is expected that, in practice, there will be a great degree of implementation-specific variation in TMS solutions for the elements of an electrified propulsion system. Although thermal management is an intrinsic requirement applicable to most, if not all, elements of an electrified propulsion system, TMS is outside the scope of this document, which is intended to describe six example electrified propulsion architectures.

1.1 Introduction

As an emerging field, electrified propulsion will take a variety of forms. It is recognized that innovation will continue in this area and, as such, this document is not intended to present all possible electrified propulsion architectures and variations. This document describes six potential electrified propulsion architectures and provides examples. This document details the elements of each presented architecture.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. Nothing in this document supersedes applicable laws and regulations.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP8676 Nomenclature and Definitions for Electrified Propulsion Aircraft

2.1.2 Other Publications

Bowman, C.L. and Felder, J.L., “Turbo- and Hybrid-Electrified Aircraft Propulsion Concepts for Commercial Transport,” NASA Glenn Research Center, Cleveland, OH, 44135, USA; and Ty V. Marien, NASA Langley Research Center, Hampton, VA, 23681, USA.