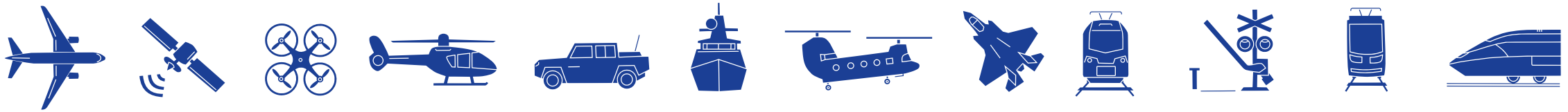
ADSE
CONSULTING AND ENGINEERING

The stakes of Battery & Electrification certification

NAG meeting

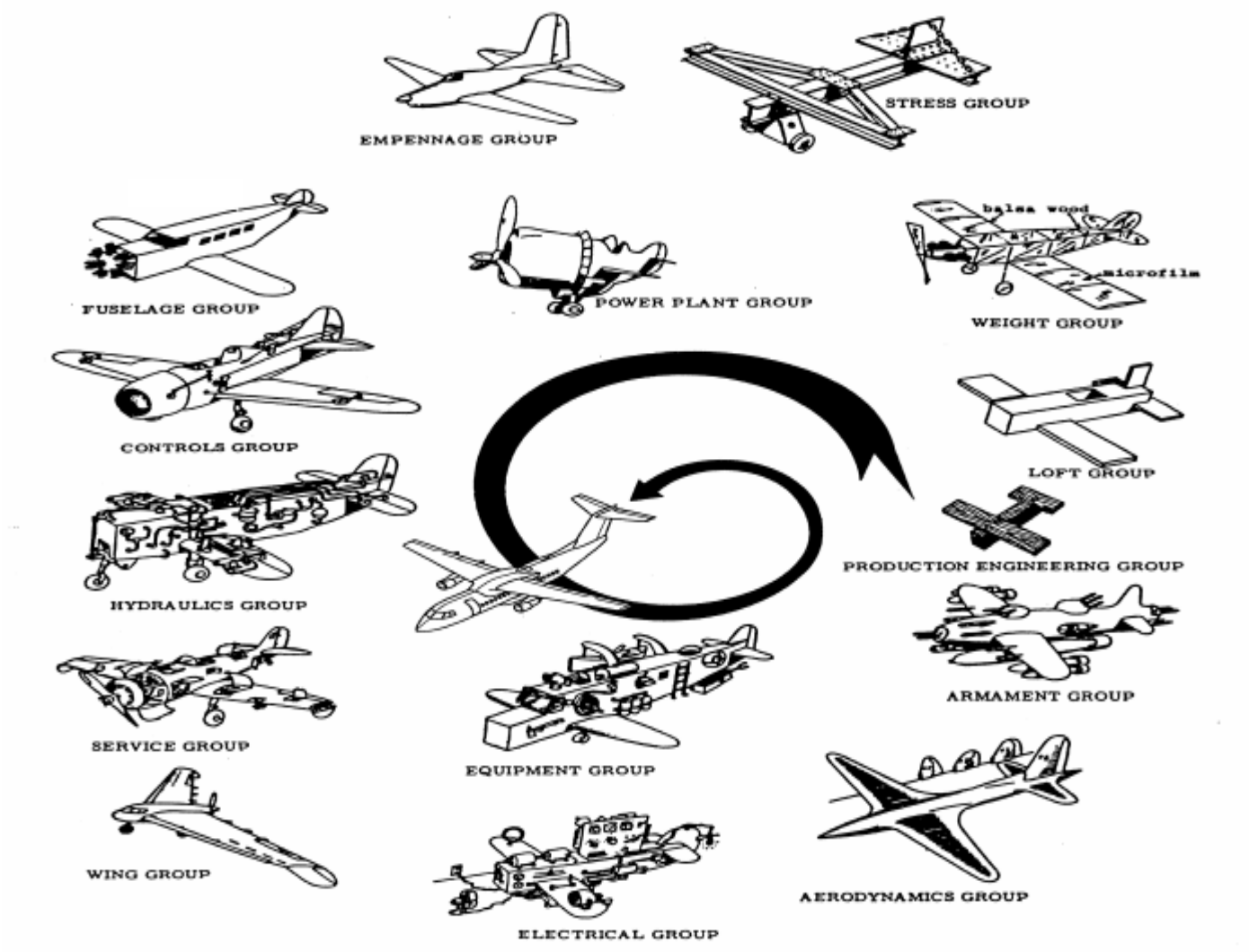
6 April 2022

Eric van der Veen

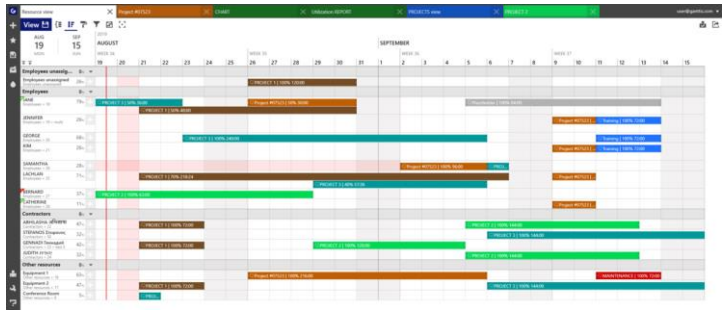


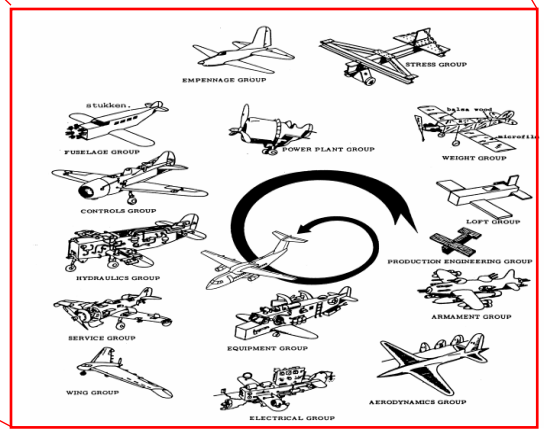
www.adse.eu

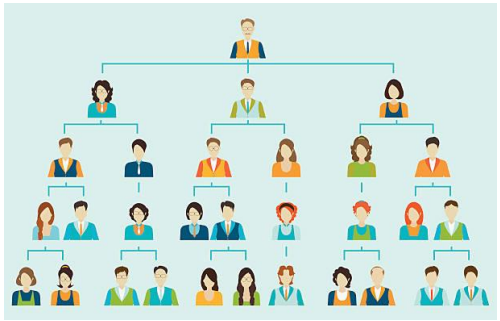
Aircraft engineering – in search of an optimised compromise



Aircraft development – harmonizing conflicting stakeholder needs








European Aviation Safety Agency

APPROVAL CERTIFICATE

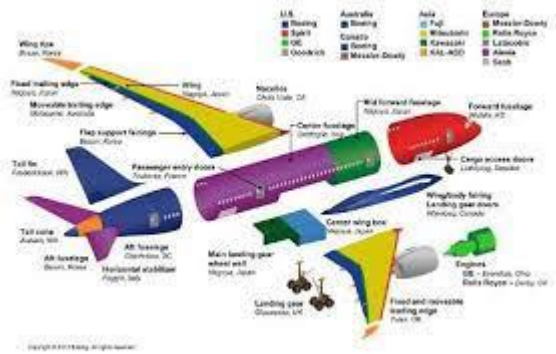
EASA.21J.481

Pursuant to Regulations (EC) 216/2008 and (EC) 1702/2003 and subject to the conditions specified below, the Agency hereby certifies

Aircraft Development and Systems Engineering (Adse) B.V.
Scorpius 90
2132LR Hoofddorp
The Netherlands

as a DESIGN ORGANISATION

approved according to Part 21, Section A, Subpart J



The dreamliner battery – ‘only’ 3x the previous performance

- A parked Boeing 787, Lithium-ion cobalt oxide (support) battery overheated & caught fire in 2013
- In 2007 FAA had approved 787 battery with 9 SC’s (Special Conditions)
- Produced uncontained thermal runaway and spread of fire

- Full grounding of worldwide B787 fleet
- Cost to Boeing estimated $125M ***per month***

- Cause of shortcut has not been determined.
- Two fire events in 52.000 flight hours (instead of 1:10.000.000)
- Shortcomings identified at GS Yuasa, Boeing and FAA.

- Remedied (<u>not</u>: solved) by 84 kg enclosure to battery

- More recent types (LiFePo4, LiMn2O4) may be less susceptible, but at expense of performance

Lesson: little room to manoeuvre, major programme risks

Certification challenges specific to Aerospace electrification

- State of charge
- State of health
- Power management
- Software compliance
- EMI/EMC at high voltage
- Thermal management
- Charge & replacement safety, handling, storage
- Fire & smoke, toxicity, emergency evacuation
- Crash & impact
- Lightning
- EWIS

Etc.

Progress ongoing…

- Programme of the 2019 tri-annual Aircraft Fire and Cabin safety conference

Tuesday, October 29, 2019

	Ocean Ballroom A	Ocean Ballroom B	Superstar Theater	Horizon Ballroom
	Powerplant I Chair: Robert Ochs, Ph.D. FAA Technical Center	Cabin Safety I: Egress Chair: Rick DeWeese FAA CAMI	Fire Research I: Advanced Materials Chair: Alexander B. Morgan, Ph.D. University of Dayton Research Institute	Battery I Chair: Thomas Maloney FAA Technical Center
8:00 AM	SAE AS6826 Powerplant Fire Test Standard and FAA AC20-135 Update (John Ostic)	[1] Evaluation of Egress from Side-Facing Seating with Deployed Inflatable Safety Equipment (David Weed)	Deoxybenzoin-containing Polymers: Combining Tailored Polymer Architecture with Non-halogenated Materials (Todd Emrick, Ph.D.)	Detecting Hidden Fires on Aircraft Using Thermal Imaging Cameras (Simon Hind)
8:30 AM	[SAE A-22] Development of AS6826/3: Fire Test Pass-Fail Criteria/Development of AIRxxxx: Assessment of Fire Test Results (Daniel Laborie)	Inflatable Emergency Egress II: Evaluation of Individual Inflatable Aviation Life Preserver Retention Characteristics (Melissa Beben)	Effects of Thermal Conductivity on Flame Spread over Carbon-fiber Composites (Haiqing Guo, Ph.D.)	[2] Fire Mitigation Strategies for Aircraft (Bob Brown)
9:00 AM	[SAE A-22] Development of AS6826/4: Powerplant Fire Test Boundary Conditions (Gregg Wozniak)	[3] Aircraft Seat Dimensions: Evaluation of the Effects of Seat Pitch and Width on Transport Category Airplane Egress (David Weed)	Heat Release Testing of Fabrics: Sample Back Side Insulation and Fiber Type Effects (Alexander Morgan, Ph.D.)	Hazards Associated with Personal Electronic Devices Placed in Checked Luggage (Steven Summer)
	BREAK	BREAK	BREAK	BREAK
10:00 AM	An Air Framer's Pursuit of AC 20-135 Testing (Gregory Roberts)	Evaluation of Serious Games for Passenger Education (Melissa Beben)	The Effect of Phosphorus on Flame Retardancy of Plastics (Haiqing Guo, Ph.D.)	[4] Practical Considerations for Fighting a Lithium Battery Fire in the Aircraft Cabin (Steven Summer)
10:30 AM	Concerns with Baseline Fire Barrier Recommendations of FAA AC 20-135 (Gregory Roberts)	WiWaves: Civil Aerospace Medical Institute Wind and Wave Water Survival Research Facility, Project Description, Outlook and Timeline (David Weed)	Phosphorus Hydrazides - New Potential Flame Retardants for Epoxy-Based Materials (Alexander Morgan, Ph.D.)	[5] Developing the 1st Edition of the Standard for Safety for Battery Fire Containment Products, UL 5800 - Harmonized Standard for the U.S. & Canada (Alexandra Klieger, Susan Malohn)
11:00 AM	Comparative Review of Kerosene Burners via an Assessment of the Post-test Material Allowables of Composite Panels (Tom Mallon)		[6] Small Scale Fire Test for Component Substitutions in Aircraft Materials (Natallia Safronava)	Lithium Ion Battery Thermal Runaway Propagation Mitigation with Carbon Fiber Thermal Runaway Shield (TRS) (Michel Mo)
	Powerplant II Chair: Robert Ochs, Ph.D. FAA Technical Center	Cabin Safety II: Operations and Design Chair: David Weed FAA Technical Center	Fire Research II: Characterization Chair: Richard E. Lyon, Ph.D. FAA Technical Center	Battery II Chair: Thomas Maloney FAA Technical Center
1:30 PM	Sonic Burner Compared to Carlin® for Propulsion Grade Fire Testing - How Equivalency can be Maintained? (Mary Kelly, Ph.D.)	[7] Rationale for New Brace Position Guidance (Rick DeWeese)	Recent Developments in Microscale Combustion Calorimetry (Richard Walters, Ph.D.)	Training Enhancements in Response to Lithium Battery Fires (Scott Schwartz, H.G. Bombardi)
2:00 PM	Available Burners for Propulsion Grade Fire Testing - A Review (Tom Mallon)	[8] Rethinking Complacency (Peter Zografos)	Automated Characterization of Pyrolysis Kinetics and Heats of Combustion of Flammable Materials (Morgan Bruns)	Flight Deck and Cabin Risk Reduction Informational Videos (Richard Hill)
2:30 PM	The BTU Heat Transfer Device: Adapting a Standard Tool in Aircraft Fire Testing to Small Scale Experiments (Tanja Pelzmann)	[9] Design for Cabin Safety (Cesar Alberto Silva)	Future State: How the MCC is Changing How Industry Characterizes Heat Release Properties (John Harris, Ph.D.)	ICAO's Overall Plan for the Safe Carriage of Lithium Batteries by Air (Lynn McGuigan)
	BREAK	BREAK	BREAK	BREAK
3:30 PM	Research on Flame Characteristics of the Oil Burner (Fei Xie, Ph.D.)	Fast and Furious-Development pf Evacuation Commands (Peter Zografos)	[10] Using Microscale Combustion Calorimetry as a Predictor for Radiant Panel Behavior of Insulating Microfiber Blankets (Fredrick Vance, Ph.D.)	A New Hazard-Based Classification System for Shipping Lithium Batteries as Dangerous Goods: Background and Update (George Kerchner)
4:00 PM	Temperature Rise Study on Fluid in Tube Subjected to Oil Burner (Long Chen, Ph.D.)	[11] Prevention of Inadvertent Slide Deployments (Kai Bredemeier)	Measuring Toxic Potency of Smoke Over a Range of Fire Stages Using Milligram Samples (Louise Speitel)	FAA Dangerous Goods Program: Incidents and Undeclared (Michael Givens)
4:30 PM	Considerations for Hydrogen Fuel Cells in Airborne Applications (Robert Ochs, Ph.D.)		Determining the Effect of Fire Barriers on the Combustion Behavior of Cored Composite	[12] Prospects for Safer Batteries for Transportation (Aron Newman, Ph.D.)

Guidelines for success

- Keep it simple
- Focus on the essence, one change at a time
- Concurrent Design & Certification
- Embrace the authorities, jointly develop knowledge and regulations
- Embrace the supplier establishment
- Embrace industry working groups (ASTM, Eurocae, SAE,…)

Contact details

For 20 years, we make it work

EXPERTS | **IMPROVEMENTS** | **SOLUTIONS** | **INNOVATIONS**

Visit us at:
www.adse.eu

Telephone: 0031 (0) 23 554 2255
E-mail: info@adse.eu

Address: Planeetbaan 4
2132 HZ Hoofddorp
The Netherlands