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Aviation in Europe – Innovating for Growth

The 7th European Aeronautics Days



L O N D O N



20 – 23 OCTOBER 2015

Smart Electrical Power Distribution Centre

Enhancing Electrical Test Bench Evaluation of
More Electrical Aircraft Technologies

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Presenter: Jean BESTER

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European Community's Seventh Framework Programme (FP7/2007-2013)
for the Clean Sky Joint Technology Initiative under
grant agreement n° SP1-JTI-CS-2010-05-287098



Collaborations

Three partners are involved in the management, conception and construction of the
SEPDC

- **ESIEE-Amiens** (Amiens, France): Project management & simulation
- **Hazemeyer** (Saint-Quentin, France): Electrical systems design and manufacturing
- **Triphase** (Heverlee, Belgium): Power electronics, instrumentation and control design

SAFRAN Labinal Power Systems (formerly Hispano-Suiza) is the Topic manager
They are a member of the **Eco-Design for Systems**
as under **Clean Sky 1** together with

**Agusta Westland, Alenia Aermacchi, Dassault Aviation,
Eurocopter, Fraunhofer, Liebherr, Safran, Thales**

COPPER Bird®

Characterization & Optimization of Power Plant & Equipment Rig

- Constructed under the Power Optimised Aircraft (POA) programme (2002 till 2006).
- Used for the validation of new technologies as developed for More Electrical Aircraft
- Brought up-to-date to meet the requirements of Clean Sky
- Substantial upgrade made to its Electrical Power Distribution Center



Characterisation & Optimisation of Power Plant & Equipment Rig



SEPDC Objectives

Smart Electrical Power Distribution Centre

Design and manufacturing of a power distribution system for testing and validation of embedded devices (power sources, loads) for use on future More Electric Aircraft to ensure performance and dependability.

Controlled power distribution with programmable protection devices between sources, loads and busbars.

Introduce a high level of reconfigurability to the COPPER Bird® in order to easily allow changing of its configuration between architectures for Generic Architecture, Green Regional Aircraft, Green Rotorcraft and Dysfunctional Tests.



SEPDC Main Functions

Controlled power distribution with programmable protection devices between sources, loads and busbars.

- Has two main components: **Central Cabinet** which houses the **Racks**
- Function of **Central Cabinet**
 - House Racks
 - House bus bars
 - House real-time target
- Function of **Racks**
 - Control: the control of individual contactors and the ability to program different sequences
 - Protection: Fast detection of over currents
 - Visualization: visualization of the current, voltage RMS values and temperature
 - Allows the interconnection of DC bus bars in a highly configurable manner
- Real-time target to capture the measurements and control the Racks



Specifications and General Description

Main principle

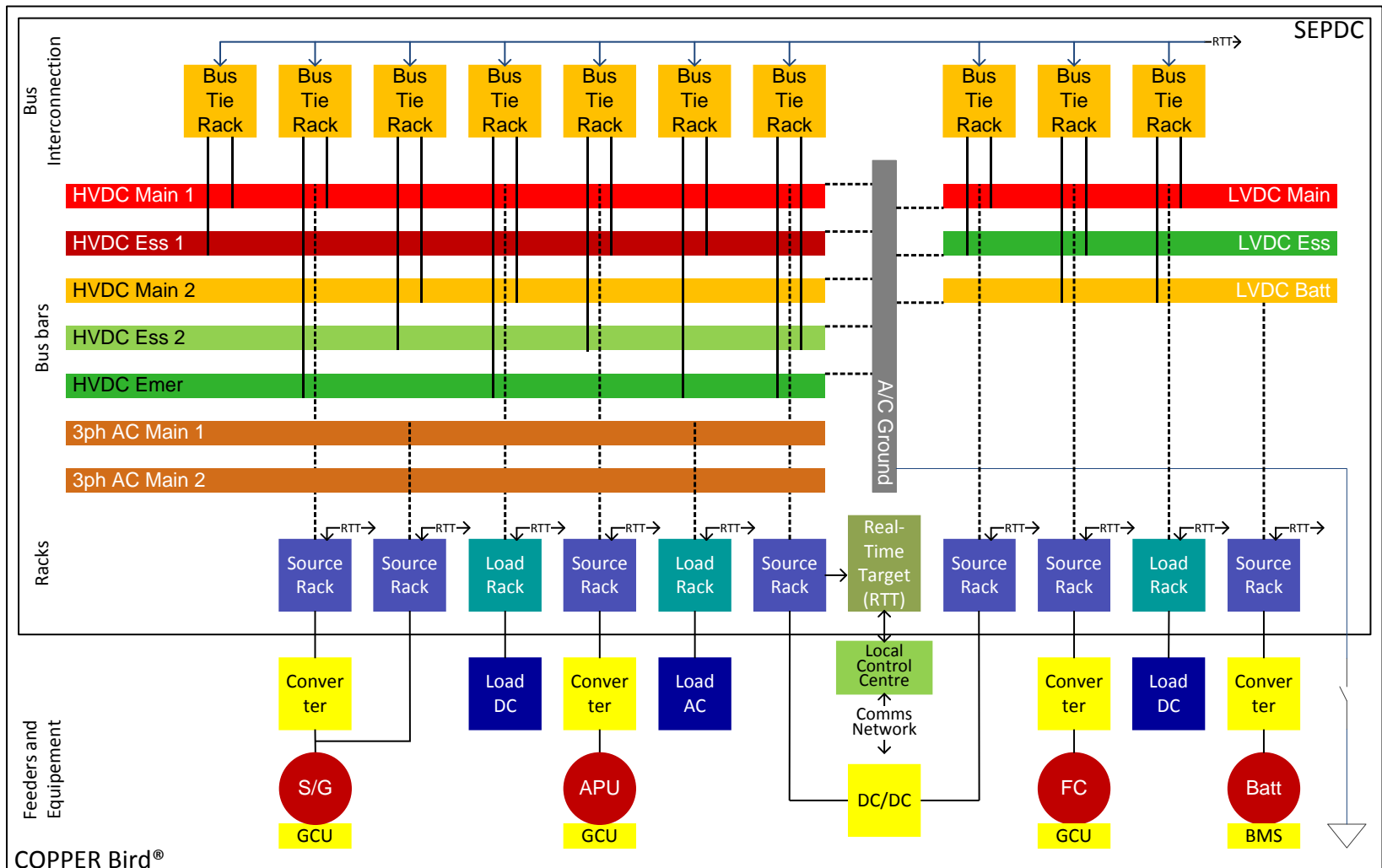
- 2 DC loops : 1 HV (5 bus bars) + 1 LV (3 bus bars)
- 2 AC bus bars

Main characteristics

- Racks:
 - 30 instrumented Racks (availability to go up to 60 rack)
 - 3 types of Rack: Source, Load and Interconnection
- Voltage:
 - HVDC : $270V_{DC}$ and ability to go up to $540V_{DC}$ HVDC
 - LVDC : $28V_{DC}$
 - AC : 2 x 3-phase $115V_{AC}$ with the ability to go up to 2 x 3-phase $230V_{ac}$
- Current:
 - DC : up to 400A /Rack continuous
 - AC : up to 350A /Rack continuous
 - Each bus bar up to 1000A

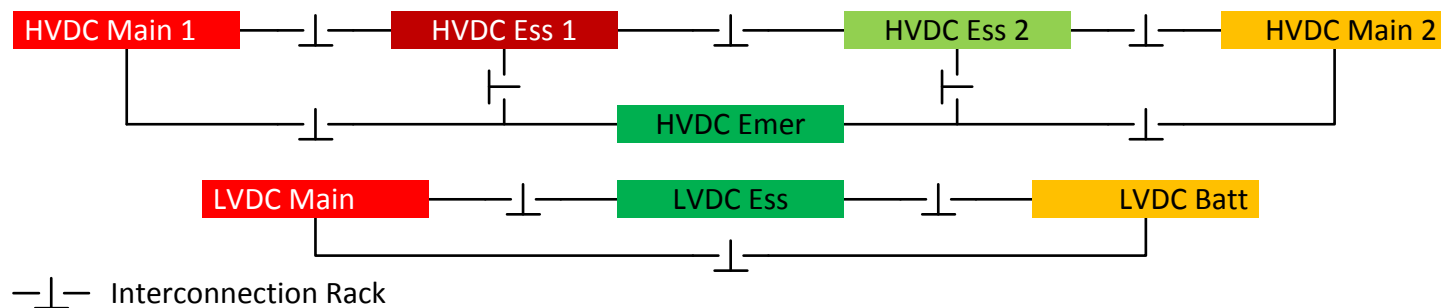
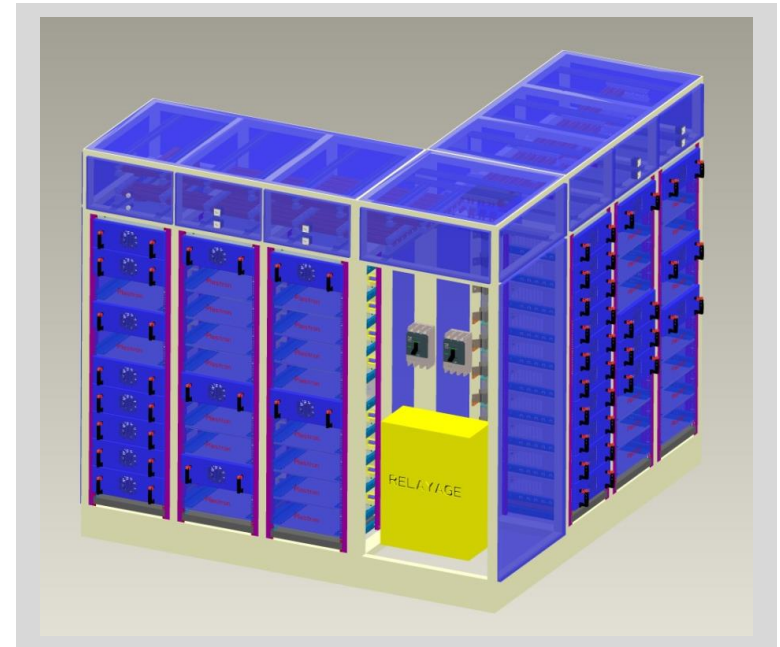


COPPER Bird® and SEPDC



The Central Cabinet

- Houses all the busbars
 - High Voltage DC $270V_{DC}$
 - Low Voltage DC $28V_{DC}$
 - AC $115V_{AC}$ or $230V_{AC}$
 - $0/+28V_{DC}$, $0/+270V_{DC}$, $0/+540V_{DC}$, $\pm 135V_{DC}$, $\pm 270V_{DC}$, $115/230V_{AC}$
 - Maximum rating of $1000V$, $1000A_{RMS}$
- Houses the Triphase real-time target
- Houses protection circuitry for industrial power ($230V_{AC}$)
- Has 60 Rack positions



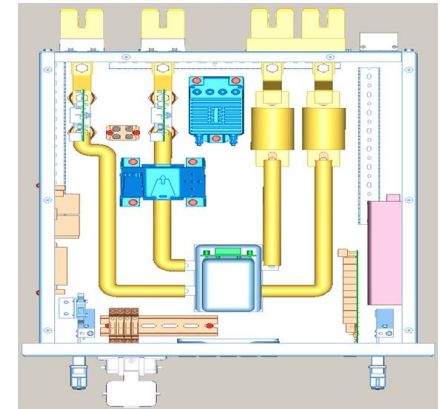
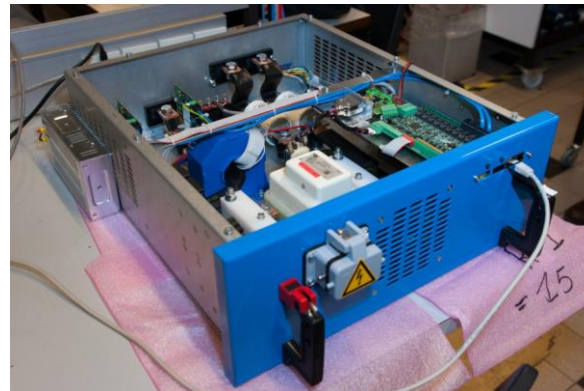
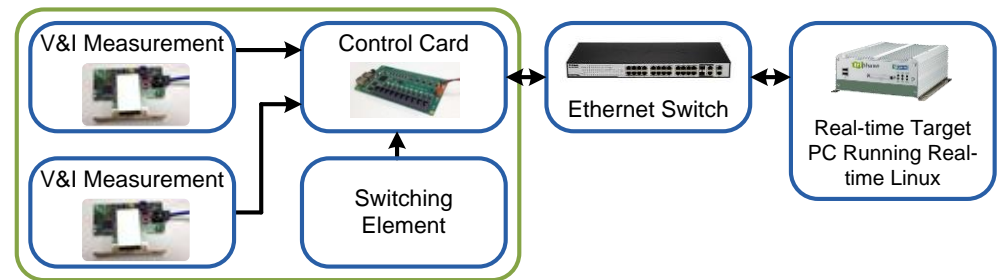
The Rack - The Instrumentation

- Main switching element
 - Able to house any type, currently aerospace contactors and solid state power controllers (SSPCs)
- Current and voltage sensors as requested by airframers
- Voltage and current sensors by Triphase
 - Current measurement: $400A_{\text{rms}}$ continuous, $\pm 450A_{\text{peak}}$ (Range 1) and $\pm 4500A_{\text{peak}}$ for 50ms (Range 2)
 - Voltage measurement: $\pm 1000V_{\text{peak}}$
 - Accuracy as % of full range: 0.25% for voltage, 0.25% (Range 1) and 0.5% (Range 2) for current, $\pm 0.5A$ for differential current
 - Resolution and sample rate: 16 bits at 51.2kHz
- Controller card
 - Conditioning of measurements with temperature compensation
 - Communication with real-time system
 - Executes software programmable fuse
 - Interfaces with and controls the main switching element
 - Automatic offset cancellation (very high offset accuracy) and gain calibration



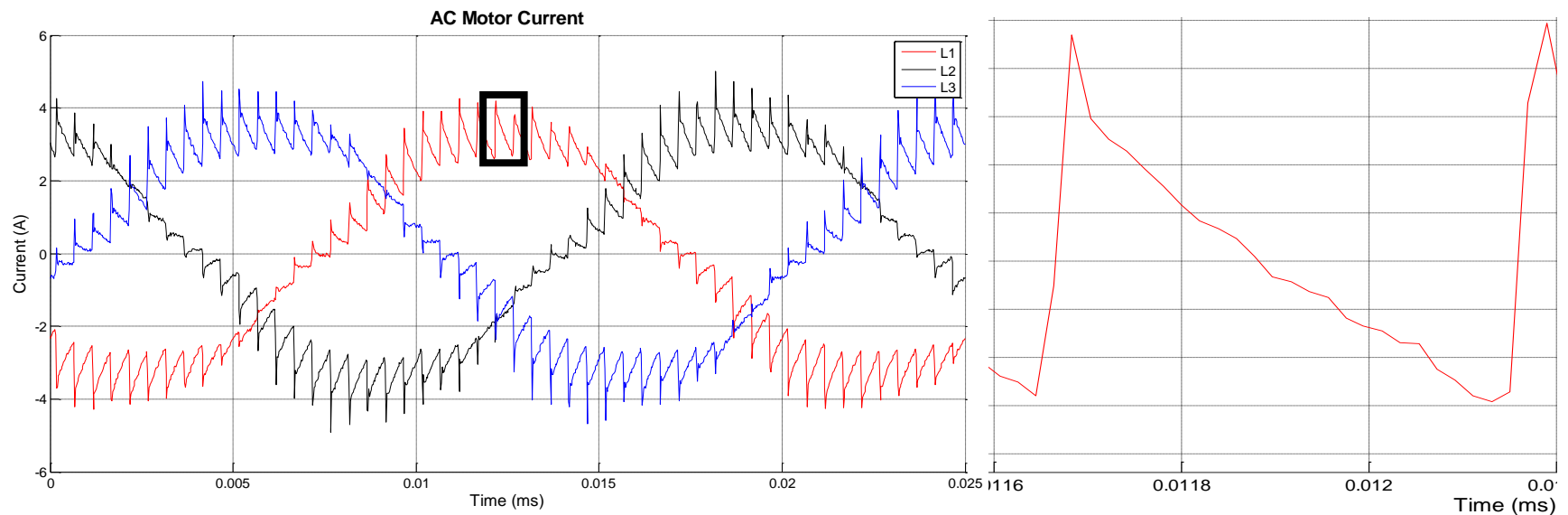
Inside the Racks

- Control
 - Large scale data processing and real-time control
- Protection
 - Overcurrent
 - Overload
 - Overvoltage
 - Undervoltage
 - Voltage unbalance
 - Differential current
 - Programmable fuse
- Instrumentation
 - Voltage measurements
 - Current measurements
 - Residual current measurements



Rack Measurements

- Rack snapshot capability
- 2 seconds at 51.2kHz



Measurement snapshot showing the input current of a 50Hz synchronous motor as being powered by a VSD with a 1kHz switching frequency



Thank You for Your Time and Attention



SEPDC www.sepdc-fp7.eu

 hazemeyer

 triphase

ESIEE
AMIENS


Clean Sky