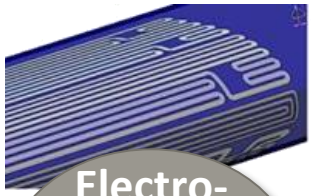
CfP10 Call - Clean Sky 2 Info Day in Toulouse

SYSTEMS ITD

Cleansky2 - SYSTEMS ITD
Overview of Technical Scope

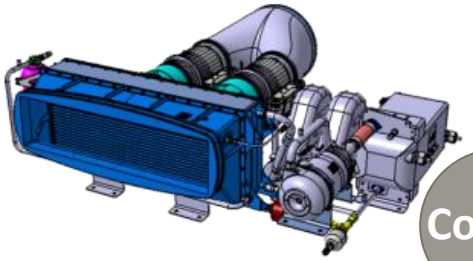
More Electric Aircraft



Electro-Thermal Ice Protection

Cabin & Cargo Systems

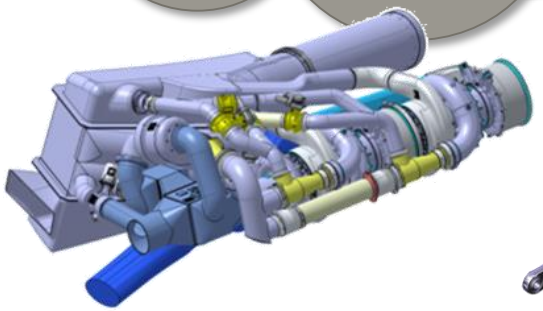
Enhanced Cockpit, Cabin & Cargo systems



Cooling

Air Quality

Electrical Air Conditioning



Innovative Electrical Wing

Electrical Power Generation & Distribution

Electrical Landing Gear

Cockpit & Avionics functions

Clean Sky
JOINT UNDERTAKING

CS2-SYS-ITD

Info – Day – CfP Wave 10

Identification Code	Title	Type of Action	Value (Funding in M€)	Topic Leader
JTI-CS2-2019-CfP10-SYS-01-15	Enhanced digital georeferenced data models for cockpit use	IA	1.00	Thales
JTI-CS2-2019-CfP10-SYS-01-16	Innovative processing for flight practices improvement	IA	0.60	Thales
JTI-CS2-2019-CfP10-SYS-01-17	New Efficient production methods for 94 GHz (W-band) waveguide antennas	IA	0.50	SAAB
JTI-CS2-2019-CfP10-SYS-01-18	Low-profile/drag electronically steerable antennas for In-Flight Connectivity	IA	1.40	Thales
JTI-CS2-2019-CfP10-SYS-01-19	VOC filtration device for Inerting System	IA	0.90	Zodiac Aerospace
JTI-CS2-2019-CfP10-SYS-01-20	Innovative high flow rate constant pressure valve for inert gas discharge from pressurized vessels	IA	0.70	Diehl Aviation
JTI-CS2-2019-CfP10-SYS-01-21	Grey Water Container with Reduced Biofilm Growth	IA	0.70	Diehl Aviation
JTI-CS2-2019-CfP10-SYS-02-58	Automatic Haptic System Test Bench for Active Inceptors	IA	0.70	Safran
JTI-CS2-2019-CfP10-SYS-02-59	Innovative DC/DC converter for HVDC power sources hybridization	IA	0.80	Airbus
JTI-CS2-2019-CfP10-SYS-02-60	Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics	IA	0.60	Liebherr
JTI-CS2-2019-CfP10-SYS-02-61	Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants	RIA	1.20	Liebherr
JTI-CS2-2019-CfP10-SYS-03-23	Electro-Mechanical Landing Gear system integration for Small Aircraft [SAT]	IA	0.60	Piaggio Aero
JTI-CS2-2019-CfP10-SYS-03-24	Power Semiconductor Device module using Silicon Carbide devices for a relatively high-frequency, circa 100kW aircraft motor drive applications	IA	0.62	University of Nottingham

JJTI-CS2-2019-CfP10-SYS-01-15

Enhanced digital georeferenced data models for cockpit use

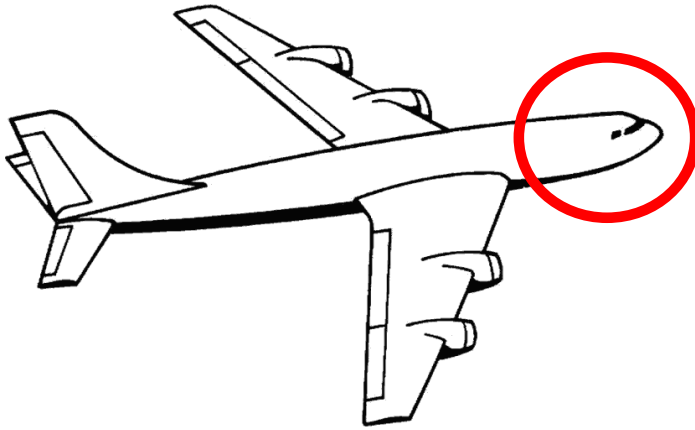
Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

T

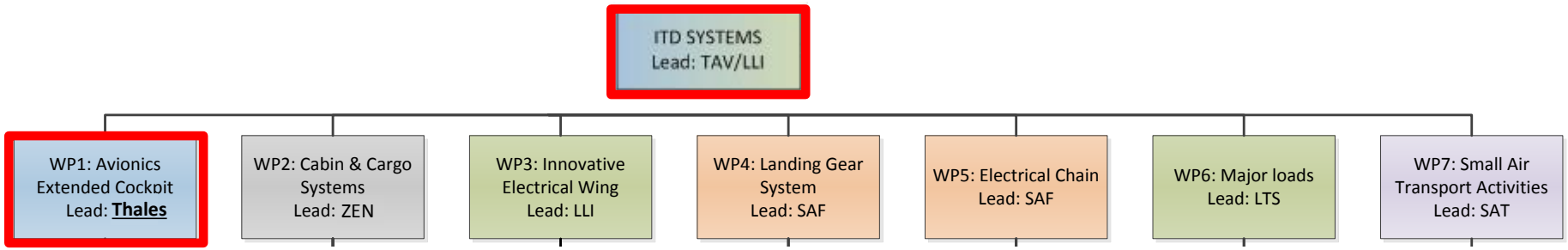
Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 1.3 **Extended Cockpit / FMS & Functions**		
Indicative Funding Topic Value (in k€):	1000		
Topic Leader:	Thales	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	24	**Indicative Start Date (at the earliest)[1]:**	> Q1 2020



Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-15	**Enhanced digital georeferenced data models for cockpit use**

Short description

This call is for partners to evaluate use of georeferenced data used in enhanced cockpit applications. Objectives of such applications are to contribute to crew workload reduction, enhance safety, and provide in-flight decision support. This initiates a step to Single Pilot Operations.
It is envisaged that there will need for high quality data (high resolution terrain, geographic and cultural representation, and obstacle representation).



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JOINT UNDERTAKING

Enhanced digital georeferenced data models for cockpit use

- **Final objective: Evaluate the sources & suitability of georeferenced data use in enhanced cockpit applications**
  - ➔ **Need for high quality data:** high resolution terrain, geographic and cultural representation, and obstacle representation
- **Target: step to Single Pilot Operations**
- **The Applicant should be able to offer:**
  - Survey of adequate data sources (including open sources)
  - Evaluation of the data characteristics against conditions of the mission types / use cases
  - Processing, tools transformations and overall architecture to generate datasets adapted to the use cases

Clean Sky
JOINT UNDERTAKING

Enhanced digital georeferenced data models for cockpit use

❑ Skills & Capabilities expected from the Applicant

- **Experienced in collection, analysis/processing of geomatic data**
  - ✓ Geomatics, Geographic Information Systems
  - ✓ Big data & validation techniques
- **To ensure a large coverage, a consortium of several geomatics providers and associated expertise is expected**

❑ Major milestones

- M1: month 3 ➔ Technical and Operational requirements
- M2 : month 7 ➔ Market analysis on geographic data providers, including open data
- M3 : month 15 ➔ Processing, tools , Algorithms definition
- M4: month 24 ➔ Application Prototyping

JTI-CS2-2019-CfP10-SYS-01-16

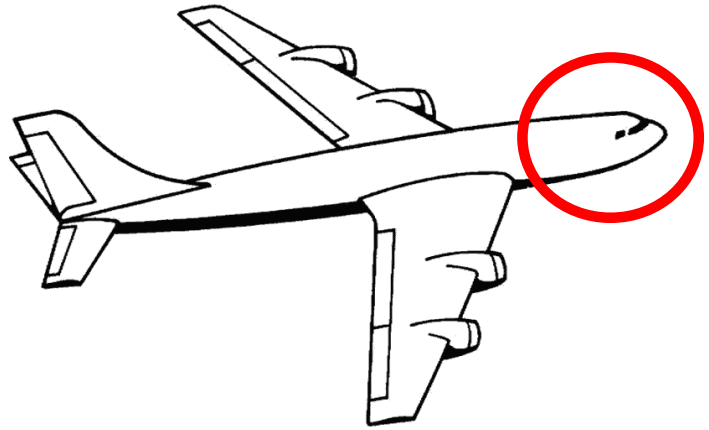
Innovative processing for flight practices improvement

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 1.3 **Extended Cockpit / FMS & Functions**		
Indicative Funding Topic Value (in k€):	600		
Topic Leader:	Thales	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	24	**Indicative Start Date (at the earliest)[3]:**	> Q1 2020

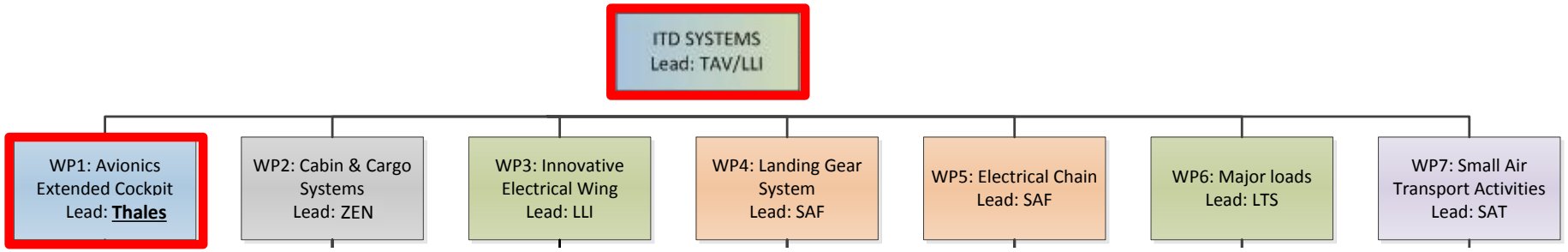


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-16	**Innovative processing for flight practices improvement**

Short description

Reduction of direct operating costs is a permanent must for airlines. Complementary to open world flight optimization applications connected to classical avionics FMS, the objective is to foster methods and tools for support services allowing mission optimization.

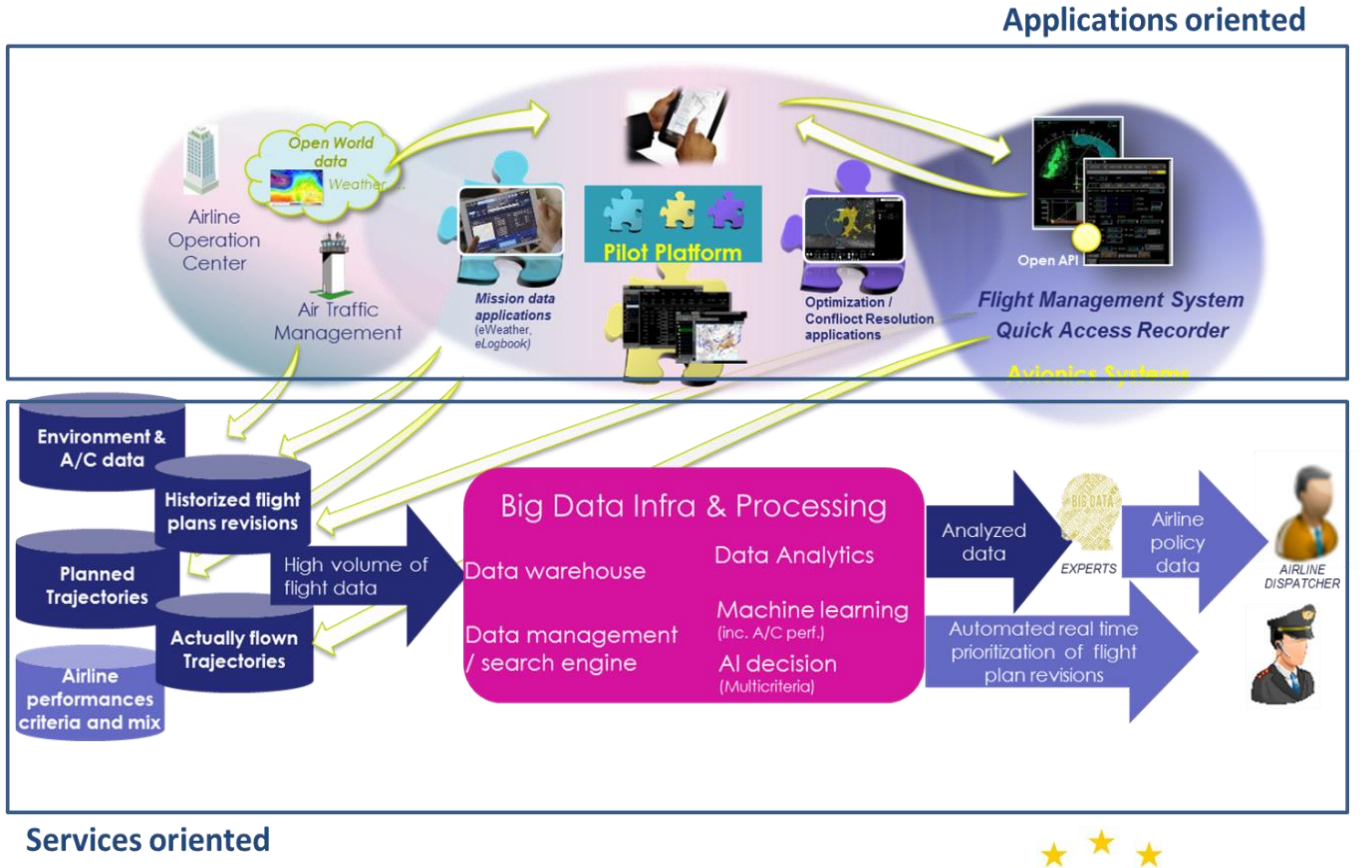
Links to the Clean Sky 2 Programme High-level Objectives[4]	
This topic is located in the demonstration area:	Cockpit and Avionics
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Advanced Long Advanced Short/Medium Range



Clean Sky
JOINT UNDERTAKING

Innovative processing for flight practices improvement

- **<u>Final objective</u>: foster big data methods and tools for support services allowing mission optimization**



- **<u>The Applicant should be able to offer</u>:**
  1- **Data engineering and big data analytics processing** to identify and propose mission optimization actions to pilots

  2- **Customized prototype software means suite** implementing the proposed solution

Clean Sky
JOINT UNDERTAKING

Innovative processing for flight practices improvement

❑ Skills & Capabilities expected from the Applicant

- **Experience and strong background on mathematical multi-criteria decision making modelling techniques is sought.**
- **Collaboration with airlines is encouraged**
  to collect flight policy data & to validate multi-criteria decision making model against experienced flight preferences
- **Data collection and processing:**
  Capability to collect and process flight policy data
- **Modeling technologies:**
  Prerequisite: Knowledge and background in the multicriteria decision making techniques
- **Trajectory computation and optimization:**
  Nice to have: Background in aircraft trajectory computation and optimization

❑ Major milestones

- M1: month 10 ➔ Prototype Development Readiness Review
- M2 : month 20 ➔ First release Results Review
- M3: month 24 ➔ Final acceptance

JTI-CS2-2019-CfP10-SYS-01-17

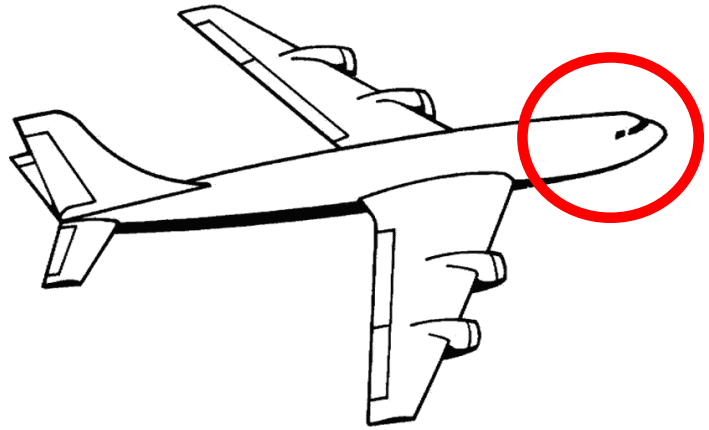
New Efficient production methods for 94 GHz (W-band) waveguide antennas

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

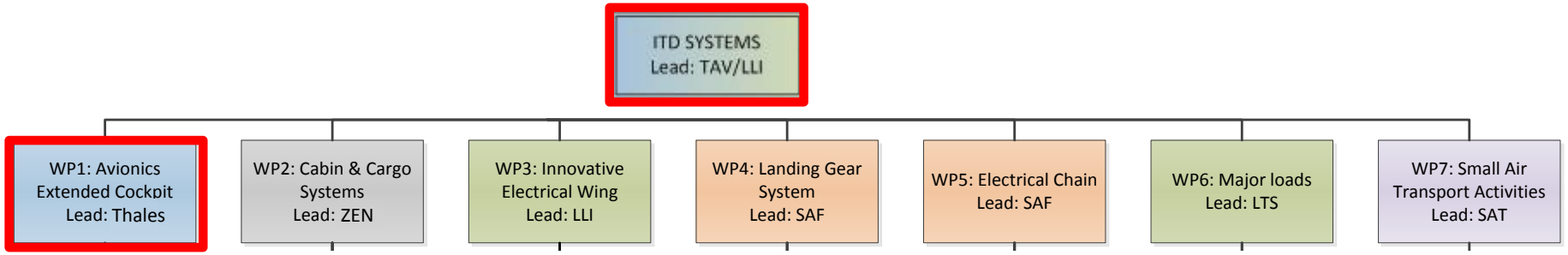
Clean Sky 2

Type of action (RIA/IA/CSA):		IA	
Programme Area:		SYS	
(CS2 JTP 2015) WP Ref.:		WP 1.3.5 **EVO & Awareness**	
Indicative Funding Topic Value (in k€):		500	
Topic Leader:	SAAB	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	20	**Indicative Start Date (at the earliest)[5]:**	> Q1 2020



Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-17	**New Efficient production methods for 94 GHz (W-band) waveguide antennas**
Short description	
Development of efficient and affordable production methods for high precision mm-wave waveguide antennas. A new method and solution is required to reach the performance, quality and cost targets to a TRL5 level which will enable future implementation of the next generation of radar sensor technology in EFVS operations.	

Links to the Clean Sky 2 Programme High-level Objectives[6]	
This topic is located in the demonstration area:	Avionics Extended cockpit
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Regional and Large passenger aircraft



Clean Sky
JOINT UNDERTAKING

New Efficient production methods for 94 GHz (W-band) waveguide antennas

Summary of

- Topic objective
- What the Applicant should be able to offer,
- Skills & capabilities expected from the Applicant,
- Major milestones.

JTI-CS2-2019-CfP10-SYS-01-18

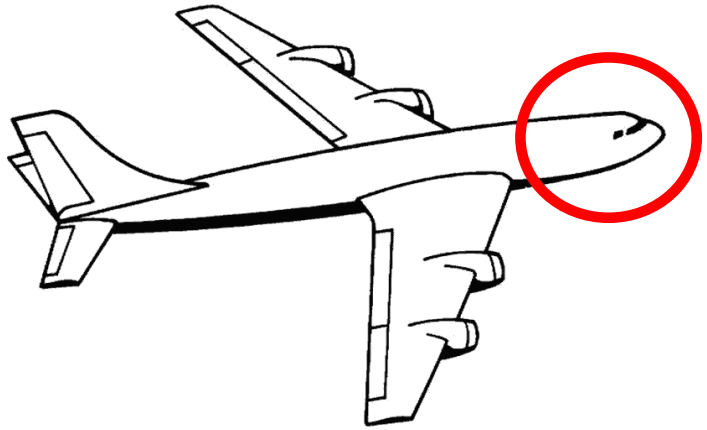
Low-profile/drag electronically steerable antennas for In-Flight Connectivity

Innovation Takes Off

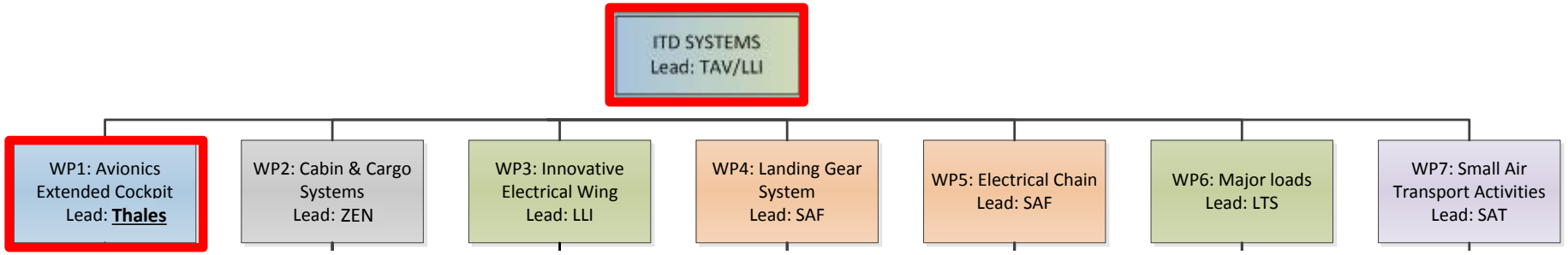
http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):		IA	
Programme Area:		SYS	
(CS2 JTP 2015) WP Ref.:		**WP1.4.4 Communication Platform**	
Indicative Funding Topic Value (in k€):		1400	
Topic Leader:	Thales	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	24	**Indicative Start Date (at the earliest)[7]:**	> Q1 2020



Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-18	**Low-profile/drag electronically steerable antennas for In-Flight Connectivity**
Short description	
The objective is to study and prototype the next generation of low-profile airborne antennas that will be used for In-Flight Connectivity in the horizon 2022-2025. Such project will have to demonstrate that the use of electronically steering can meet the stringent requirements of commercial aircraft connectivity, while bringing significant benefits such as reduced maintenance, low drag and weight.	



Low-profile/drag electronically steerable antennas for In-Flight Connectivity

- **Final objective: Demonstrate that the use of electronically steering can meet the stringent requirements of commercial aircraft connectivity, while bringing significant benefits such as reduced maintenance, low drag and weight**

  ➔ **Low-profile and highly efficient Electronically Steerable Antenna solutions for the next generation of In-Flight Connectivity services**

- **Target: Commercial aircraft - Horizon 2022-2025**

- **The Applicant should be able to offer:**

  - Study & demonstration of fully validated Electronically Steerable Antennas prototypes

    ➔ For instance: ground-based Ka-band Satcom solution to demonstrate over-the-air communications with a GEO and/or a MEO satellite

Clean Sky
JOINT UNDERTAKING

Low-profile/drag electronically steerable antennas for In-Flight Connectivity

❑ Skills & Capabilities expected from the Applicant

- ➢ **Antenna system design, development and qualification principles**
- ➢ **Electronically steerable antenna core technologies**
- ➢ **Satellite communication in Ka band,**
  including standards for Ku and Ka-band Satcom airborne terminals
- ➢ **Thermal management in RF designs**
- ➢ **Low drag radomes**

❑ Major milestones

- ➢ M1: month 8 ➔ Antenna System Requirement Review
- ➢ M2 : month 12 ➔ Technology Assessment Review
- ➢ M3: month 15 ➔ Antenna Prototype Design Review
- ➢ M4: month 20 ➔ Antenna Prototypes Test Review

Clean Sky
JOINT UNDERTAKING

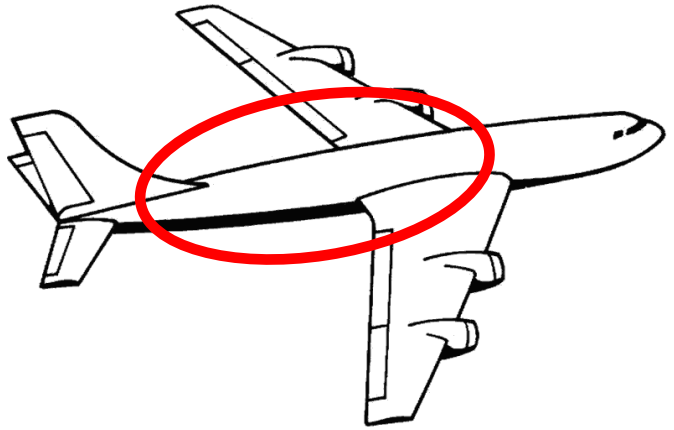
JTI-CS2-2019-CfP10-SYS-01-19

VOC filtration device for Inerting System

Innovation Takes Off

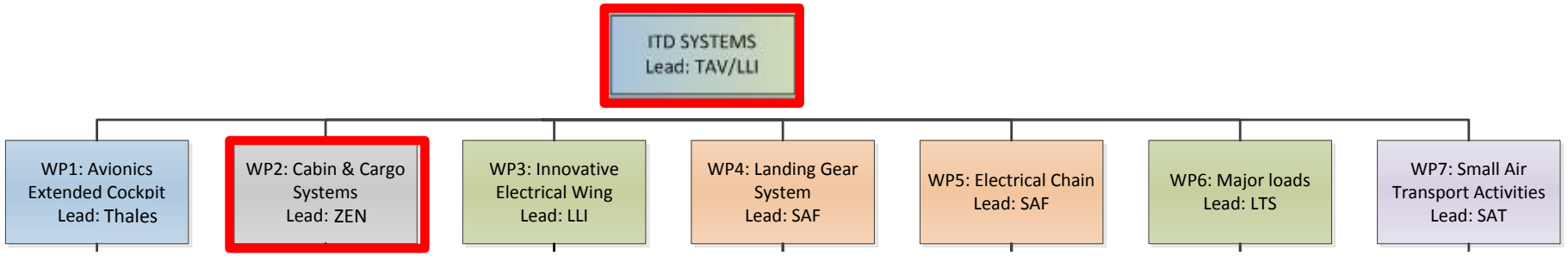
http://www.cleansky.eu/content/homepage/about-clean-sky-2

Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 2.3 **Cargo Applications**		
Indicative Funding Topic Value (in k€):	900		
Topic Leader:	Zodiac Aerospace	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	27	**Indicative Start Date (at the earliest)[9]:**	> Q1 2020



Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-19	**VOC Filtration device for inerting system**
Short description	
The aim of this topic is to increase the life duration and availability of an inerting system in protecting the separation membranes. The objective is to design and manufacture filtration devices to get rid of the volatile organic compounds present in the system feed air and harmful for the system.	

Links to the Clean Sky 2 Programme High-level Objectives[10]	
This topic is located in the demonstration area:	Innovative cabin passenger / taylored system
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Advanced long and short / medium range



VOC filtration device for Inerting System

Topic Leader : **SAFRAN**

Objectives:

- Improve bleed air filtration to **increase inerting system life duration and availability**
- Select the **most suitable technology** to stop **VOC** contained in the air
- Develop prototypes and **prove by tests their efficiency** in an aeronautical environment

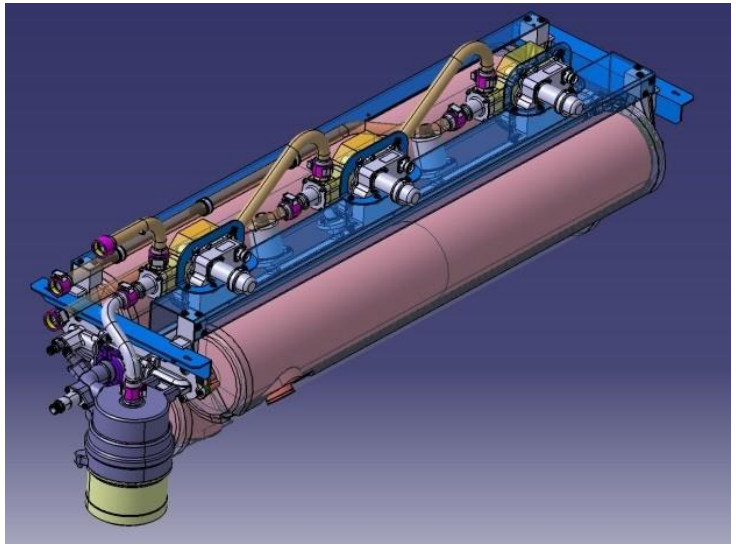
Link to systems ITD activities : cabin & cargo systems

- Innovative **Cabin & Cargo Technologies**
- This inerting system is integrated in a **cargo green fire-suppression system** which employs nitrogen, water-mist and oxygen depleted air instead of halon
- **Availability of the inerting system** (linked to the quality of the bleed air) is a major key for this essential system

Background information:

In-flight experience has proven the value of an efficient filtration chain when operating an inerting system.

Close cooperation with Topic Leader will be essential to define the VOC list, approve the filtration technology and validate its efficiency regarding the protection of the inerting system separation modules



JTI-CS2-2019-CfP10-SYS-01-20

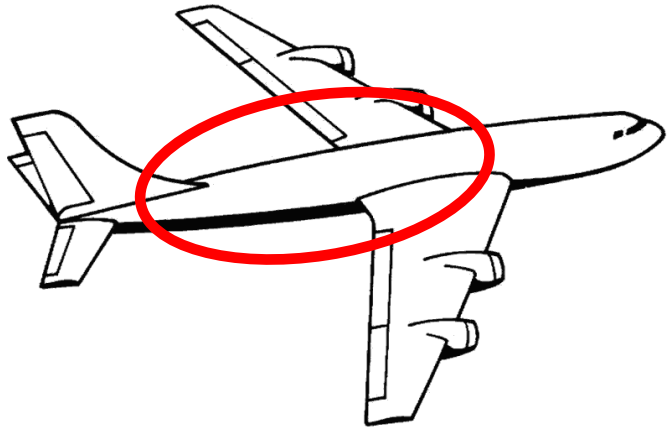
Innovative high flow rate constant pressure valve for inert gas discharge from pressurized vessels

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):		IA	
Programme Area:		SYS	
(CS2 JTP 2015) WP Ref.:		WP 2.3 **Cargo Applications**	
Indicative Funding Topic Value (in k€):		700	
Topic Leader:	Diehl Aviation	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	24	**Indicative Start Date (at the earliest)[11]:**	> Q1 2020

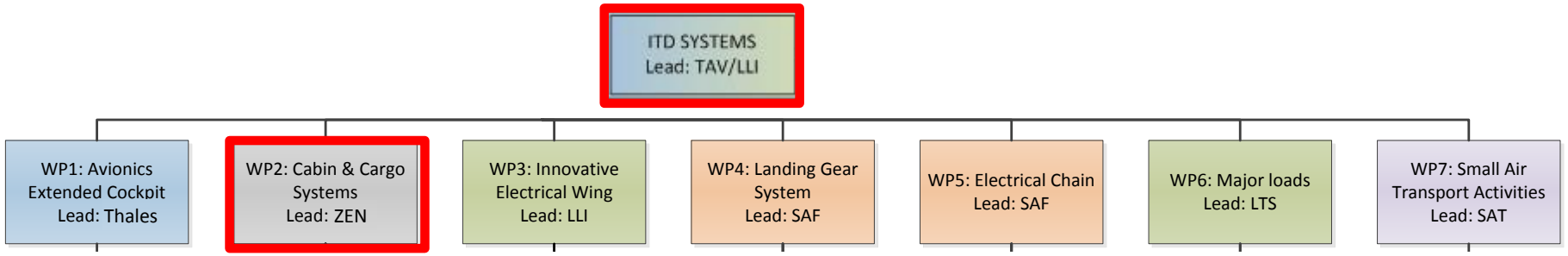


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-20	**Innovative high flow rate constant pressure valve for inert gas discharge from pressurized vessels**

Short description

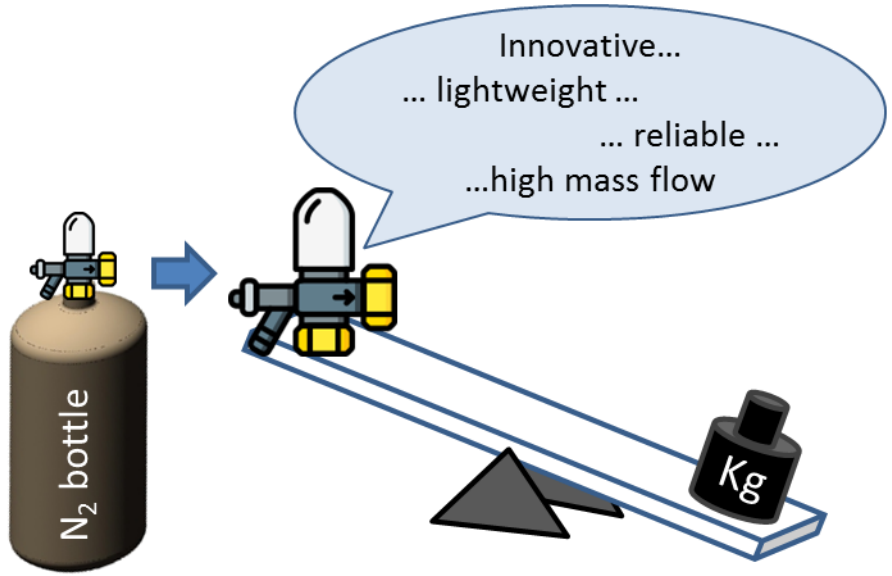
High pressure inert gas storage vessels are used for a novel water mist and inert gas based fire suppression system for aircraft cargo compartments, within WP2.3. Other than today's commonly used Halon based fire suppression systems, the mass flow rates and supply pressures for these systems are much higher, resulting in a series of challenging requirements which are not met by today's available system.hardware. The applicant shall develop an innovative high pressure and very high mass flow valve for inert gas, which is capable of providing a constant output pressure over a broad spectrum of input pressures. Any proposed solution shall meet the aviation specific requirements such as reliability, environmental requirements and lightweight design, in addition to the extreme performance requirements necessary for an inert gas fire suppression.

Links to the Clean Sky 2 Programme High-level Objectives[12]	
This topic is located in the demonstration area:	Cargo systems
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	SMR and LR aircraft



Innovative High Flow Rate Constant Pressure Valve for Inert Gas Discharge from Pressurized Vessels

- Topic Leader: Diehl Aviation
- Objectives:
  - Development of a **constant pressure valve** for **discharging nitrogen** from composite bottle(s) at high flow rates
  - Compliance of valve with **aerospace requirements** according to RTCA Do160

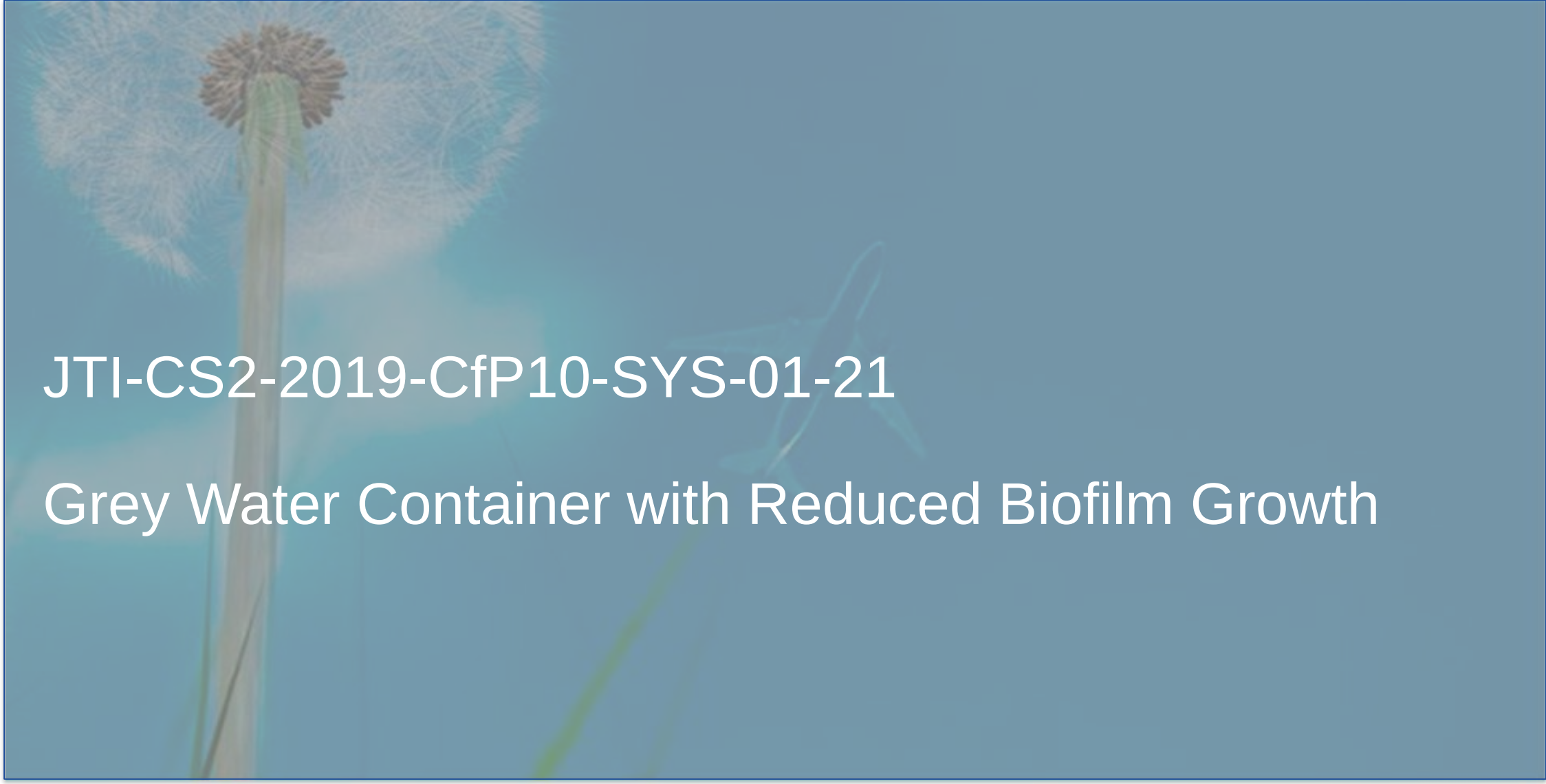


- Link to Demonstrator:
  - Innovative **Cabin & Cargo Technologies**
  - The valve/pressure reducer will be integrated into a **noval green fire-suppression system** which employs nitrogen, water-mist and oxygen depleted air instead of halon
  - **The valve** will significantly influence weight, reliability and service-life of the system
- Background information:

Close cooperation with Topic Leader for clarifying requirements, selecting and evaluating appropriate concepts:

  - High constant flow rate capabilities of approx. **160 g/s** at a constant output pressure
  - Ports for monitoring pressure, filling the tank and over pressure protection, etc.
  - Lightweight design, high reliability & safety requirements

Clean Sky
JOINT UNDERTAKING



JTI-CS2-2019-CfP10-SYS-01-21

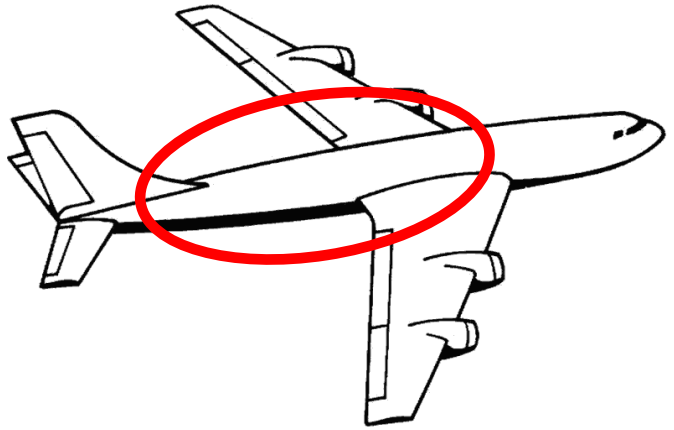
Grey Water Container with Reduced Biofilm Growth

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 2.3 **Cargo Applications**		
Indicative Funding Topic Value (in k€):	700		
Topic Leader:	Diehl Aviation	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	21	**Indicative Start Date (at the earliest)[15]:**	> Q1 2020

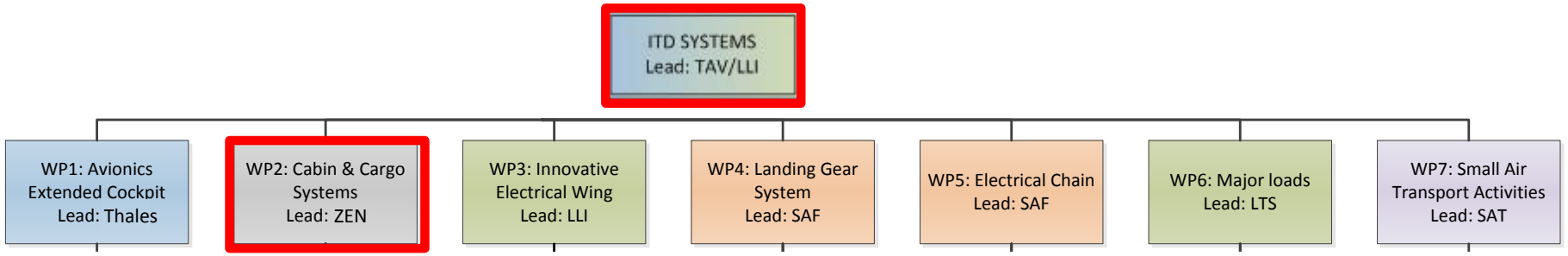


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-01-21	**Grey water container with reduced biofilm growth**

Short description

Objective of the CfP is the development of a grey water storage vessel made of plastic with long lasting reduced biofilm growth. Biofilm growth reduction is a key challenge for all components of the Grey Water Reuse System (GWRS) which are in contact with nutritious grey water. Inhibition of biofilm growth may be realized by different methods such as adding antimicrobial substances to the plastic compound, by surface coating or painting, by dirt repellent or very smooth surfaces. Scope of work is the identification of the most effective method and manufacturing of a grey water container, which employs the preferred biofilm inhibition method. Based on this container, it shall be demonstrated that besides biofilm growth reduction also aircraft specific requirements are fulfilled.

Links to the Clean Sky 2 Programme High-level Objectives[16]	
This topic is located in the demonstration area:	Equipment for cabin and cargo
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Cabin and Cargo systems



Clean Sky
JOINT UNDERTAKING

Grey Water Container with Reduced Biofilm Growth

- Topic Leader: Diehl Aviation
- Objectives:
  - Development of a **lightweight grey water container** with **cost-efficient manufacturing process**
  - **Enhancing service-life** and **reducing efforts for maintenance of the grey water container** by developing innovative methods, materials and coatings for the **prevention of biofilm growth**
  - Demonstrating **functional requirements** and compliance with **aerospace specific requirements** according to RTCA Do160
- Link to Demonstrator:
  - Innovative **Cabin & Cargo Technologies**
  - The container is an essential element of a grey water re use system for aircraft lavatories (toilet flushing).

Biofilm Growth due to nutritious grey water

- Background information:
  - Grey water is water that has been used for hand washing in lavatories. It may contain substances such as soap, dirt, drinks, food remainders, etc… .The grey water is re used for toilet flushing after storage in the described container.
  - Methods can comprise: **antimicrobial coatings, paintings, antimicrobial additives in plastic compounds, dirt repellent surfaces, very smooth surfaces** … **and other innovations!**
  - Close cooperation with Topic Leader for clarification of requirements, selection of appropriate materials and processes for manufacturing of the container.

Clean Sky
JOINT UNDERTAKING

JTI-CS2-2019-CfP10-SYS-02-58

Automatic Haptic System Test Bench for Active Inceptors

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

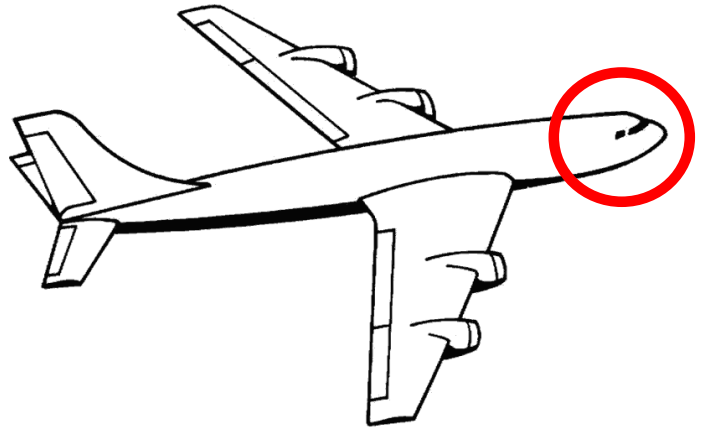
Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 3.2.5 **Smart Active Inceptors**		
Indicative Funding Topic Value (in k€):	700		
Topic Leader:	Safran	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	12	**Indicative Start Date (at the earliest)[17]:**	> Q1 2020

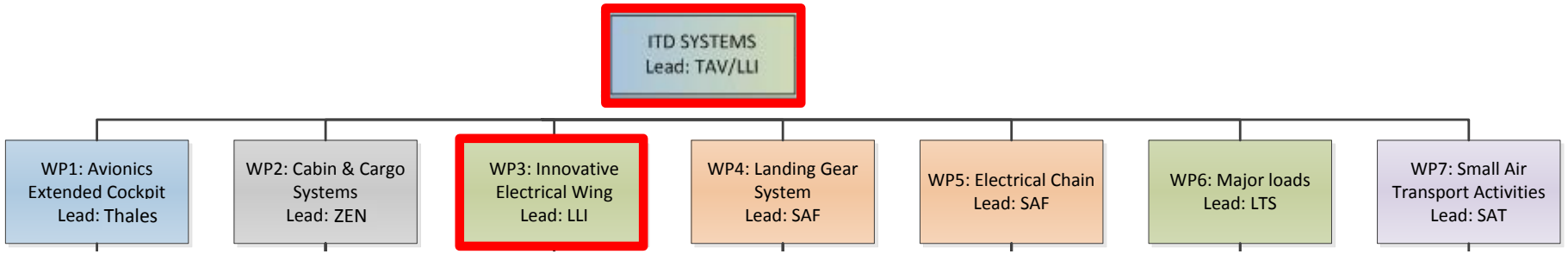
Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-02-58	**Automatic Haptic System Test Bench for Active Inceptors**

Short description

The new generation of active inceptor provides new functionalities and especially haptic behaviour to improve the flight experience and the crew coordination. It is therefore important to have means of test able to support these new and high level functionalities.
The goal of the project is to design and manufacture a new generation of system test bench, fully automatized/robotized, able to receive and to control a shipset of generic active inceptors developed in the frame of ITD SYS. The test bench must simulate the haptic behaviour of the pilots' hands and needs to be adaptive to the various configurations and combinations compatible with generic inceptor : fixed wings, rotary wings, cyclic and collective functions, throttle type,...).

Links to the Clean Sky 2 Programme High-level Objectives[18]	
This topic is located in the demonstration area:	Cockpit & Avionics
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Regional Multimission TP, 70 pax





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Automatic Haptic System Test Bench for Active Inceptors

Summary of

- Topic objective
- What the Applicant should be able to offer,
- Skills & capabilities expected from the Applicant,
- Major milestones.

JTI-CS2-2019-CfP10-SYS-02-59

Innovative DC/DC converter for HVDC power sources hybridization

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 6.4 **Major loads / Integrated demonstration & validation**		
Indicative Funding Topic Value (in k€):	800		
Topic Leader:	Airbus	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	24	**Indicative Start Date (at the earliest)[19]:**	> Q1 2020

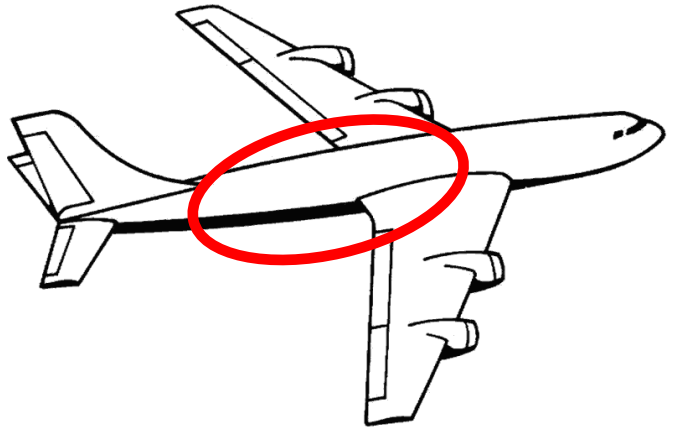
Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-02-59	**Innovative DC/DC converter for HVDC power sources hybridization**

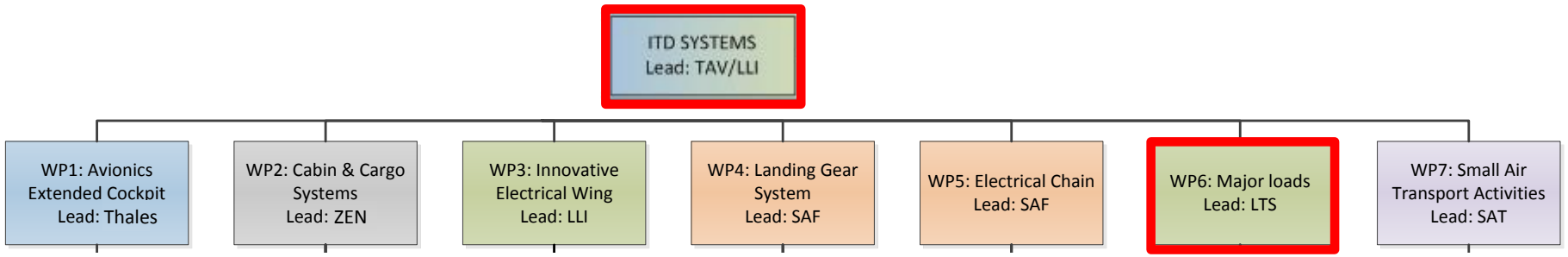
Short description

HVDC power network is the future power network for the more electrical aircraft and is an enabler for sources hybridization as new functions. The More Electrical Aircraft HVDC network sources hybridization function requires a dedicated HVDC DC/DC converter to manage the appropriate interface between the HVDC power sources, the distribution network, and the HVDC power storage. This innovative converter shall be designed, simulated, developed and integrated into Airbus HVDC network demonstrator. The expected innovations are:

- converter control laws allowing parallelization of different HVDC sources at demonstrator level
- demonstration of high power density and high efficiency based on:
  - disruptive topologies and switching control
  - introduction of new components technologies
  - innovative filtering topologies with new solutions investigating active and passive designs compliant with HVDC power quality

Links to the Clean Sky 2 Programme High-level Objectives[20]	
This topic is located in the demonstration area:	Electrical systems
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Advanced Long-range Ultra-advanced Long-range Advanced Short/Medium-range Ultra-advanced Short/Medium-range





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Innovative DC/DC converter for HVDC power sources hybridization

Summary of

- Topic objective
- What the Applicant should be able to offer,
- Skills & capabilities expected from the Applicant,
- Major milestones.

JTI-CS2-2019-CfP10-SYS-02-60

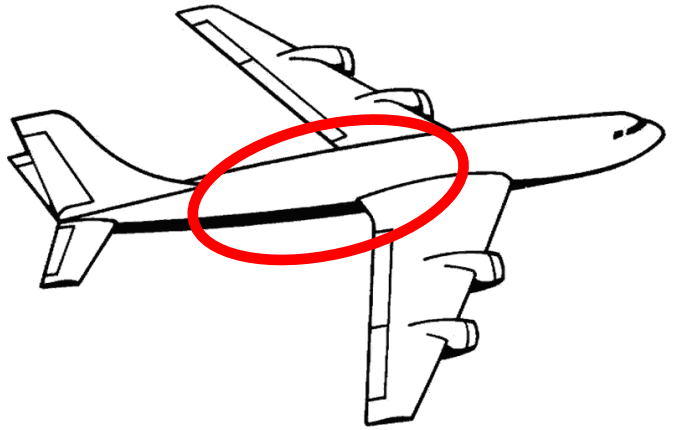
Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):	IA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 6.1 **Electrical air system & thermal management**		
Indicative Funding Topic Value (in k€):	600		
Topic Leader:	Liebherr	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	36	**Indicative Start Date (at the earliest)[21]:**	> Q1 2020

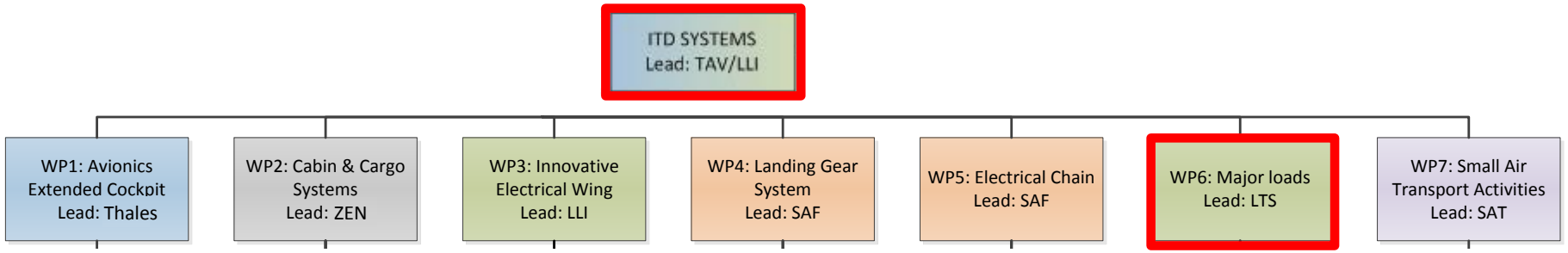


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-02-60	**Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics**

Short description

Following results from the MALET CfP, it underlines the major challenges of modelling Environmental Control System (ECS) and thermal management architectures. A first topic is related to modelling the ECS for covering the full usage envelop, including starting and on/off phases that constitute themselves a real challenge. More specifically, the heat exchanger performances modelling in presence of moist air and refrigerant is one of the major issue for ECS modelling. A second topic is related to the capability to accurately compute electrical losses for system application without compromising the overall computational cost. From detailed developed models in the project, the usage of data analytics technologies should enable to achieve the digital twin with expected accuracy and computational costs.

Links to the Clean Sky 2 Programme High-level Objectives[22]	
This topic is located in the demonstration area:	Electrical Systems
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Advanced Short/Medium-range



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Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics

Scope of work

Task 1 : System Thermo-fluid modelling

Due : T0+30 months

Task 1.1 :VCS - Heat Exchanger Modelling

- The model shall cover several operating modes :Switch-off mode / by-pass mode ; Reverse flow ; Hot / Cold side inversion
- The physical phenomenon involved in the required HX models are listed below :
  - Multi-phase heat exchange
  - Moist air effects
  - Physical heat exchange
  - Thermal inertia

Task 1.2 – VCS – System Modelling

- Validation of new Heat Exchanger model

Task 1.3 – VCS – HX & System Surrogate Modelling

- Derive both “static”(time independent) and “transient” (time dependant) surrogate models for :
  - Reducing the computational cost for similar accuracy,
  - Enhancing model accuracy versus real product

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Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics

Task 2 : System Electrical modelling
Due : T0+24 months

Task 2.1 – Electrical - Detailed Losses Modelling

- Derive models representative of actual electrical component from standard datasheets including an accurate evaluation of heat losses
- Build an actual component database from datasheets enabling engineers to use such components easily when modelling electrical models. The database shall be validated versus reference tools (plex) or test results (if available).

Task 2.2 – Electrical - Losses Surrogate Modelling

- Derive both “static” and “transient” surrogate models for reducing the computational cost for similar accuracy level
- The objective is to obfuscate the electrical characteristic time constant that is not compatible with whole system simulation but keeping the main system effects related to thermal losses or to specific electrical power transients

Task 3 : System Thermal-Electrical modelling
Due : T0+36 months

Task 3.1 – Simulation of integrated electrical and thermofluid models

- Demonstrate that all developed models (detailled and surrogate) could be combined to simulate the complete electro-thermo-fluid VCS system in an efficient and accurate way.

Important Remark : all the MODELICA libraries and models developed during the project shall be compatible with Dymola/MODELICA technology and delivered as license free source MODELICA code to the topic manager.

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Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics

Major Deliverables & Milestones

Deliverables

Ref. No.	Title - Description	Type*	Due Date
D1.1	VCS Heat Exchanger Library Report	R	T0+18
D1.2	VCS System Library Report	R	T0+24
D1.3	VCS Surrogate Modelling Method and Library Report	R	T0+30
D2.1	Electrical Libray Report	R	T0+12
D2.2	Electrical Library Database	D	T0+18
D2.3	Electrical Surrogate Modelling method and library Report	R	T0+24
D3.1	Integrated System Modelling & Simulation Validation Report	R	T0+36

*Type: R=Report, D=Data, HW=Hardware

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Toward a Digital Twin ECS and thermal management architecture models : Improvement of MODELICA libraries and usage of Deep Learning technics

Special skills, Capabilities, Certification expected from the Applicant(s)

- Skills
  - Thermo-fluid System modelling
    - Theoritical and Numerical background regarding phase changing physical phenomenon, evaporator and condenser heat exchangers
    - Theoritical and Numerical Vapour Cooling System modelling background for choosing adapted modelling technics,
    - Dymola/MODELICA background to produce expected models using this language,
  - Electrical System modelling
    - Theoretical and Numerical background regarding power electronics modelling in an efficient way,
    - Dymola/MODELICA background to produce expected models using this language,
  - Surrogate modelling
    - Data analytics background to derive deep learning models,
    - Software Development background to provide autonomous deep learning models for their integration within Dymola/MODELICA

- Capabilities
  - Data analytics framework / environment,
  - Dymola/MODELICA tool

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JTI-CS2-2019-CfP10-SYS-02-61

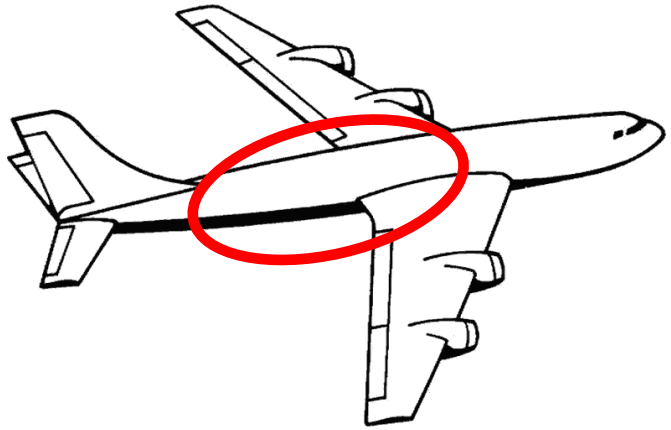
Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):	RIA		
Programme Area:	SYS		
(CS2 JTP 2015) WP Ref.:	WP 6.1 **Electrical air system & thermal management**		
Indicative Funding Topic Value (in k€):	1200		
Topic Leader:	Liebherr	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	36	**Indicative Start Date (at the earliest)[23]:**	> Q1 2020

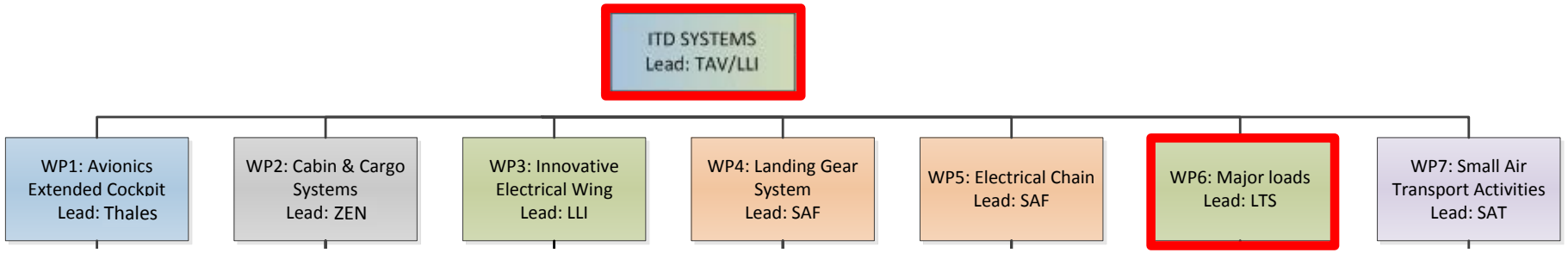


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-02-61	**Vapor Cycle System - Heat Exchanger performance 3D modeling with different new low GWP refrigerants**

Short description

The objective of this topic is to gain knowledge on physics involved inside two-phase heat exchangers and more explicitly in evaporators, and in particular to understand the impact on performance and pressure drop of the following parameters: gravity field, titer quantity and spacial distribution, mass flow rate of refrigerant, HX structure. Hence a multi-scale modeling approach is awaited in order to focus on various physical phenomenon induced in the heat exchanger. This numerical approach shall be validated by experimental developments led under a design of experiments.

Links to the Clean Sky 2 Programme High-level Objectives[24]	
This topic is located in the demonstration area:	Boundary Layer Ingestion
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Ultra-advanced Long-range Ultra-advanced Short/Medium-range



Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Scope of work

Task 1 : Bibliography of the recent (academic and industrial) research on VCS evaporators

Due : T0+12 months

- Bibliography focus: recent developments on VCS heat exchangers technologies (core and headers).
- Identification of driving parameters of a good design and also innovative tricks and technologies
- Fluids of interest : new HFO fluids, HFO mix, CO_2
- Milestones 1 (M1): Delivering the literature background for CFD two-phase calculation under specified conditions of mass flow, titer and accelerations

Task 2 : Implementation of CFD strategy for two-phase headers and exchanger core

Due : T0+12 months

- Best modelling method to be implemented to fit to H/X conditioning and specificities.

⇒ Methodology to be developed for calculations on two fluids:

- one adapted to high temperature
- one adapted to low temperature

⇒ Fluid selection to perform calculations and comparisons on an H/X higher power capacity (# 40 kW).

- Methodology shall include an approach on CO_2 if possible

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Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Task 3 : Set up of the optimization chain
Due : T0+18 months

- Optimization strategy to deliver the best way of building the best header under a certain amount of environmental constraints.
  - Establish a response mapping for common header geometries in the field of aeronautics applications under functioning for a single HFO;
  - Define the best original design for a header geometry meeting the requirement described by a specification for an application on the same fluid.

  ⇒ Use a Design of Experiment

Task 4 : Development of the test bench and methodology to validate CFD calculations (Measurement and observation)
Due : T0+30 months

- Test rig focused on evaporator + include rest of VCS loop (compressor, ai ventilation, valves…) to reproduce specific boundary conditions of exchanger.
- Air performance required:
  - [-10°C; 60°C] temperature range;
  - [0.010 kg/s; 0.500 kg/s] mass flow range;
  - [0 ; 10 kW] cold power range.
- Evaporator max volume: 250 x 400 x 400 mm^3 (volume for 10 kW)

Adaptations of existing test bench to be done but the project should also propose experimental methods susceptible to be exported to the Topic Manager facilities for further headers and core characterizations

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Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Task 5 : Experimental validation of the calculation methodology based on a conventional geometry and an optimized design

Due : T0+36 months

- Heat exchangers and headers will be delivered by Topic Manager to perform following tests to observe and validate calculation assumptions mainly in terms of flow patterns and phase distribution on :

- A conventional design header stressing attention on mal-distribution issues:
  - Validation configuration on LT HFO;
  - Validation configuration on HT HFO;

- An innovative design manufactured for the project that should improve distribution issues and validate the CFD approach.
  - Validation configuration on one single fluid.

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Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Major Deliverables & Milestones

Deliverables

Ref. No.	Title - Description	Type*	Due Date
D1	Bibliography of the recent (academic and industrial) research on VCS evaporators	R	T0+12
D2	Methodology and optimization chain for headers and core calculation	R	T0+18
D3	Portable measurement methodology to the Topic Manager	R	T0+24
D4	Final report describing ▪ Experimental results ▪ Calculation validation based on experimental results	R	T0+36

Milestones

Ref. No.	Title - Description	Type*	Due Date
M1	Pre-validation of CFD methodology based on literature background	R	T0+12
M2	Optimized design of an innovative “header+H/X” subassembly	R & D	T0+18
M3	Exportable experimental methodology freezing for Topic Manager	R	T0+24
M4	Final model validation based on experimental results	R	T0+36

*Type: R=Report, D=Data, HW=Hardware

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Vapor Cycle System - Heat Exchanger performance 3D modelization with different new low GWP refrigerants

Special skills, Capabilities, Certification expected from the Applicant(s)

Skills

- Thermodynamics applied to H/X
- H/X design
- CFD computations
- Experimental skills

Capabilities

- Computing facilities in order to be able to run two-phase flow thermo-fluidic calculation
- Testing facilities compatible with cores and headers subassemblies characterization with air (temperature range: -10°C/+60°C , air flow range: 0.01kg/s; 0.5kg/s, refrigerant flow range up to 80 g/s) and corresponding refrigerant pressure and temperature levels. Corresponding maximum cold power is approximately 10 kW.

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JTI-CS2-2019-CfP10-SYS-03-23

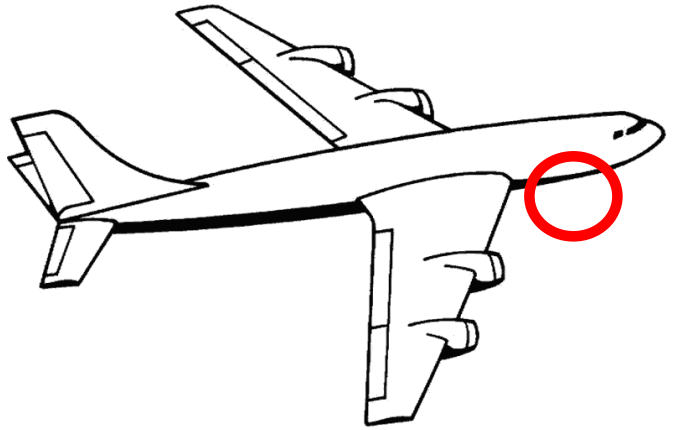
Electro-Mechanical Landing Gear system integration for Small Aircraft [SAT]

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

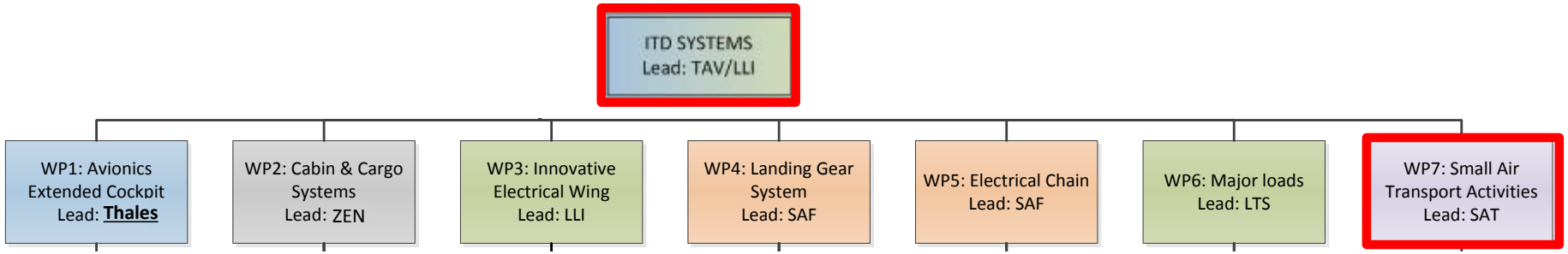
Clean Sky 2

Type of action (RIA/IA/CSA):		IA	
Programme Area:		SYS [SAT]	
(CS2 JTP 2015) WP Ref.:		WP 7.2 **More Electric Small Air Transport**	
Indicative Funding Topic Value (in k€):		600	
Topic Leader:	Piaggio Aero	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	36	**Indicative Start Date (at the earliest)[25]:**	> Q1 2020



Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-03-23	**Electro-Mechanical Landing Gear system integration for Small Aircraft**
Short description	
This topic aims at integration of electro-mechanical landing gear and brake system (which are being developed as part of other research projects for small aircraft) in an "aircraft zero" (iron-bird) integration and test environment, enabling its advancement from TRL3 / TRL4 to above TRL5.	

Links to the Clean Sky 2 Programme High-level Objectives[26]	
This topic is located in the demonstration area:	Electrical Systems
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	19-pax Commuter



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Electro-Mechanical Landing Gear system integration for Small Aircraft [SAT]

- **Final objective:** To test and characterize the integrated landing gear/brake/actuation system in a wide variety of conditions and be able to test full-scale runway/tire/brake/gear/structure interactions (to verify stability/performance)
  - ➔ **use modular design and cost-effective testing technology**
  - ➔ **reproduce representative landing gear characteristics, dynamic runway conditions and external loads/ environment**
  - ➔ **provide power supply and inputs to the electro-mechanical system under test, collect ouputs**
- **Target: Small Air Transport**
- **The Applicant should be able to offer**:
  - adaptation and interfacing of prototype electro-mechanical brake/LG actuation equipments (developed as part of other research projects and made available –or suitable representative dummy hardware), so to permit best integration,
  - **modular design** of test facilities, interfaces and loading system, so to ease subsystem integration and troubleshooting,
    - ➔ For instance: include automated test / data processing tools, which may be the basis for advanced system diagnostic and maintenance tools
  - the highest degree of **versatility** and **cost-effectiveness** of the proposed infrastructure.
    - ➔ For instance: validation test campaign (laboratory tests) including failure cases, endurance and reliability testing, …

Electro-Mechanical Landing Gear system integration for Small Aircraft [SAT]

❑ Skills & Capabilities expected from the Applicant

- **Previous experience in design/development of advanced test facilities in the field of aeronautical landing gear system technologies,** preferably direct experience in design, development/integration testing and qualification of such products;
- **Experience ad in the management of testing** and proficiency in typical tools/methodologies of data acquisition/post-processing, preferably for aerospace industry,
- ***Preferably: experience with landing gear testing and dynamic braking test rigs capable to deal with high temperature****, and/or experience in use of data for diagnostic and prognostic purposes;*
- **Proven experience in international R&T collaborative projects and/or industrial environment;**
- **Knowledge of electrical and mechanical component and system integration;**

❑ Major milestones

- M1: month 06 ➔ Preliminary Design Review of landing gear/brake/actuation system Integration & Test Facility (following Requirement Review in month 02)
- M2 : month 12 ➔ Critical Design Review of landing gear/brake/actuation system Integration & Test Facility
- M3: month 20 ➔ Validation of Integration & Test Facility manufacturing & interfacing (1st Test Readiness Review)
- M4: month 25 ➔ 1st Test (initial) Report approval/validation
- M5: month 36 ➔ Final Test Report approval/validation

JTI-CS2-2019-CfP10-SYS-03-24

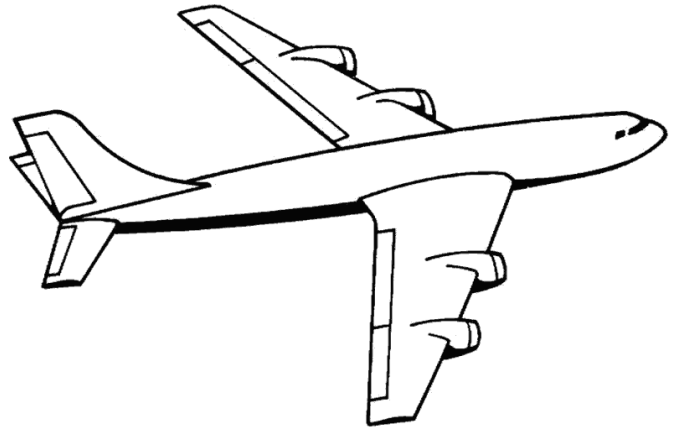
Power Semiconductor Device module using Silicon Carbide devices for a relatively high-frequency, circa 100kW aircraft motor drive applications

Innovation Takes Off

http://www.cleansky.eu/content/homepage/about-clean-sky-2

Clean Sky 2

Type of action (RIA/IA/CSA):		IA	
Programme Area:		SYS	
(CS2 JTP 2015) WP Ref.:		WP 100.1 **Power Electronics**	
Indicative Funding Topic Value (in k€):		620	
Topic Leader:	University of Nottingham	**Type of Agreement:**	Implementation Agreement
Duration of the action (in Months):	18	**Indicative Start Date (at the earliest)[27]:**	> Q1 2020

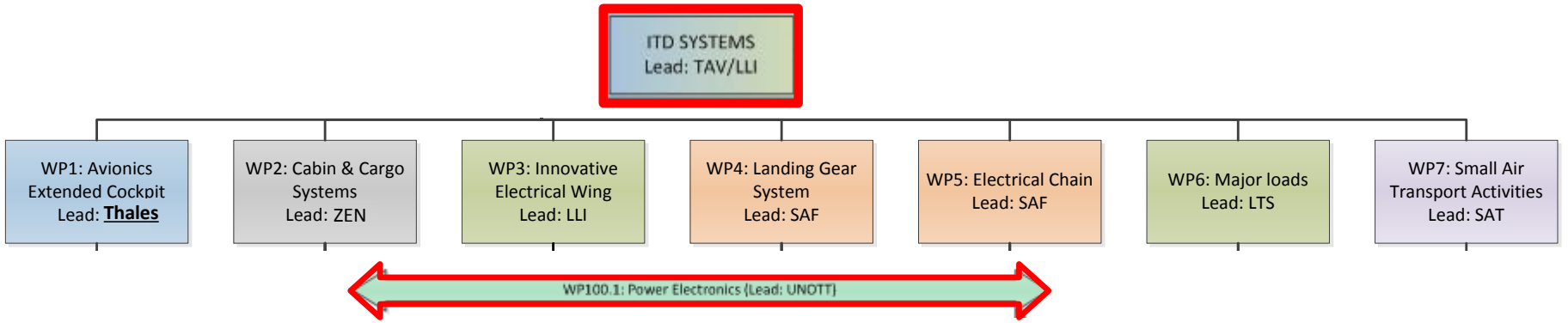


Topic Identification Code	**Title**
JTI-CS2-2019-CfP10-SYS-03-24	**Power Semiconductor Device module using Silicon Carbide devices for a relatively high-frequency, 100kW aircraft motor drive applications**

Short description

This CfP will result in a programme of work for the development of a SiC power electronic device module for a 100kW multi-level power converter. The design will enable the minimization of the power converter's weight and volume as well as enabling the functionality, requiring innovation and technology adoption for manufacturability.

Links to the Clean Sky 2 Programme High-level Objectives[28]	
This topic is located in the demonstration area:	Boundary Layer Ingestion
The outcome of the project will mainly contribute to the following conceptual aircraft/air transport type as presented in the scene setter:	Ultra-advanced Long-range Ultra-advanced Short/Medium-range



Power Semiconductor Device module using Silicon Carbide devices for a relatively high-frequency, circa 100kW aircraft motor drive applications

- Topic Leader:
  - Institute of Aerospace Technology, University of Nottingham, UK
- Objectives:
  - Development of a power electronic device module using Silicon Carbide power devices for a 100kW multi-level power converter.
  - The design will enable the minimization of the power converter's weight and volume
- Applicant Requirements
  - Wiliness for innovation and technology adoption to enable the manufacturability of power modules for Silicon Carbide power devices in demanding applications
  - Facilities and ability to realise power electronic converter modules for production and evaluate manufacturability

Parameter	Value
Operating Temperature	50°C (max)
DC Link Voltage	540V (nominal)
Converter Power	100kW
Device Switching Frequency	15kHz
Device Voltage	650V (max)
Device Current	250A (max)
Storage Temperature	-55°C to 100°C
Cooling	Forced air
Effieciency	>97.5%
AC Input Voltage	230V (nominal)

Deliverables			
No.	Title - Description		Due
1	Completed, tested SiC power electronic device modules and associated gate drive		M12
2	Technical report on the manufacturability and calculated reliability of the power electronic module		M18

Milestones			
No.	Title - Description		Due
1	Design of the power electronic module and integrated gate drive circuit – design review		M8
2	Test results and evaluation of the performance of the power module within the target applciation		M16

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Any questions?

Info-Call-CFP-2019-01@cleansky.eu*

Last deadline to submit your questions:
5th July 2018, 17:00 (Brussels time)

*Note: email address only active as from 07/05/2019 (Official Call Opening date via the Participant Portal)


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