DOCUMENT REVIEW

Version	Date	Description of evolution	Modifications
1.0		First edition	-

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1. Publishable s ummary

State of the art ±Background

There is increasing concern about the adverse environmental effects of aircraft engine noise which has resulted in the need to identify methods for reducing or shielding noise for aircraft in flight. A number of research programmes have been undertaken to develop novel empennage configurations for a business jet and this LOSPA project will provide a new wind tunnel model to be used in a future wind tunnel test campaign to investigate the effectiveness of new aircraft geometry in promoting noise reduction; specifically a novel empennage design and laminar flow wing configuration.

The empennage will comprise a ‘U-tail’ design, in which the horizontal tailplanes act as physical shields to reduce the noise detected on the ground arising from the rear fuselage mounted engines. Removable vertical tailplanes will be developed to reduce the noise emanating laterally from the aircraft.

The key areas of progressive development of this model include the introduction of Turbine Power Simulators into the rear fuselage mounted nacelles to simulate the engine effects, adaption of the empennage design to produce a non ‘U-tail’ configuration, plus the introduction of steady and unsteady pressure measurement sensors into the nacelles and empennage components to measure both the aerodynamic and acoustic characteristics of the new design.

The new model design will be of modular construction such that testing can be performed in a variety of model configurations including testing with vertical tailplanes removed and powerplant removed. From this progressive approach, the aerodynamic and acoustic characteristics of this novel design will be fully-investigated to ascertain its effectiveness in achieving the perceived reduction in engine noise and the improvement in wing performance and low speed handling qualities.

The result of this work will promote the development of future aircraft designs with enhanced environmental characteristics (lower noise levels and improved efficiency of operation).

This Periodic Report relates to the entire project from 1 Nov 2011 until 31 Dec 2014

Objectives

The objectives within the framework of this overall project are:-

- Design and manufacture of the rear tail Empennage and Nacelles, including a Stress Report and Inspection Report where appropriate
- The Empennage would incorporate a ‘U-tail’ arrangement of HTP and VTP, and the Nacelles would be fully instrumented for integration of TPS units supplied externally
- Design and manufacture of a set of high aspect ratio wings which will have removable leading edges and trailing edge flaps
- These items would be designed to interface with the remainder of the model which would be provided by a partner independent of this CfP
- Complete the final assembly of all new hardware to the supplied fuselage, and deliver to the DNW test facility in preparation for aerodynamic and acoustic testing

Environmental benefits

The overall aim of this programme of work is to provide a wind tunnel model which facilitates an efficient, productive wind tunnel test campaign and the acquisition of valuable acoustic and aerodynamic data to permit the novel aircraft design to be evaluated

This will provide an experimental data set which can be used to obtain a thorough understanding of the complex flow field around the LOSPA model nacelles and empennage, and the handling/performance of the novel aircraft design.

The wind tunnel model and measurement techniques developed during this programme of work will be available for use in future experimental investigations.

This information will be utilised in the design of future aircraft in order to reduce the noise levels detected on the ground, emanating from aircraft engines. This will assist in reducing the problem of environmental impact and provide the community with a better living environment.

The improved aerodynamic performance of future aircraft will also result in a reduction of noise generation which will produce significant benefits to the local environment.

Description of work

The LOSPA project is structured in to four main Work Packages (WPs):-

- WP1 - is dedicated to the design and manufacture of the LOSPA model Empennage and Nacelles.
- WP2 - involves the design and manufacture of the LOSPA model Wing assemblies, which would be undertaken by consortium member Future Advance Manufacture (FAM)
- WP3 - is the final assembly of all new hardware to the supplied Fuselage, and the inspection and validation of the finished model.
- WP4 - is to carry out the technical and financial management of the work programme.

Progress

WP1 – Design and Manufacture of Empennage and Nacelles – Lead Participant ARA

The geometry of the model (1:5 scale) was provided in CATIA v5 format by the CfP Leader at commencement of the project.

The main model support system, main balance and air feed systems for the TPS nacelles are existing items at the proposed test facility (DNW).

The model was designed to be modular, both to satisfy the requirement for a variety of empennage configurations, and also to facilitate future upgrade of model components without the need to replace significant component parts.

The HTP trim function and elevators were designed such that deflections could be controlled by appropriate motorisation, the actuators for which were supplied by NLR. One hand of VTP / HTP contained pressure taps, and 3-component strain gauge balances were also included, although calibration was performed by DNW.

In-process and final inspection of model hardware was conducted on ARA’s Hexagon Metrology CMM.

In order to permit testing of the horizontal tail alone (in isolation from the vertical tail components), appropriate fairings / off blocks were also produced for the unoccupied joint features. The interface between the rear fuselage and the Centre Fuselage components (to be supplied by INCAS) was controlled at the design stage to ensure smooth, contiguous airswept profiles on final assembly

Interfacing with the centre fuselage (designed by INCAS) was achieved by the design and manufacture of an appropriate adaptor plate which was used at both manufacturing companies to ensure the subsequent smooth and accurate assembly of both these major sub-assemblies

ARA worked closely with the CfP Leader to ensure that the nacelle design provided the necessary features for the selected TPS unit, including the design of the exhaust components to provide satisfactory mass flow characteristics. The nacelles would be rear fuselage mounted, hence all air supplies, instrumentation wiring, tubing and bearing oil supplies (if required) would be routed through the pylons into the fuselage. The nacelle cladding design incorporates appropriate sealing features to avoid internal leak paths, and non-metallic materials were used in the region of the primary duct to minimise the risk of icing.

For thrust accounting purposes the nacelle incorporated a high level of internal instrumentation in the inlet, downstream of the fan and turbine, and in the TPS supply line. Duct instrumentation was mounted on a number of rakes to enable local flow features and distortion levels to be evaluated.

In addition, a large array of Kulite® unsteady pressure transducers were installed in the nacelle inlet and exhaust nozzles for the proposed acoustic evaluation.

The final CAD model has been provided to the customer, together with a Stress Report and Inspection Report. An Assembly Guide was also supplied to assist in pre-test rigging and configuration change at the wind tunnel test facility

As confirmed at CDR and Model Approval stages (see Ref 8), the Work Package was therefore successfully achieved in line with the agreed re-schedule

WP2 – Design and Manufacture of Wingset – Lead Participant FAM

This work package involved the design and manufacture of a set of low sweep, high aspect ratio wings with removable Krueger-type leading edge extensions, double slotted trailing edge flaps and winglets.

The wing design aimed to permit rapid, repeatable model configuration changes, specifically for both the cruise wing and the high-lift configurations, including a variety of slat, flap and airbrake deflections achieved via manual model changes.

One hand of wing incorporated a total of 240 pressure taps, and aileron deployment was designed to be controlled by appropriate motorisation, the actuators for which were supplied by NLR.

A 3-component strain gauge balance functionality was also incorporated into one of the Krueger slat brackets

For in-process Quality Control and final inspection, simultaneous 5-axis scanning of components was possible using a 2.3 metre CMM equipped with Renishaw REVO head and MODUS (CATIA V5 compliant) software. Inspection reports detailed the compliance of final surfaces in comparison to the nominal CAD data, displayed in sectional scans, together with detail of the final assembled geometry.

As confirmed at CDR and Model Approval stages (see Ref 8), the Work Package was therefore successfully achieved in line with the agreed re-schedule

WP3 – Final Model Assembly – Lead Participant ARA

Prior to shipment of the Model to DNW for the customer's test campaign, most of the major sub-assemblies (including those produced outside the scope of this CleanSky programme) were transported to ARA for final confirmation of assembly and approval by the customer.

Because of the overall size of the model, the wing however was approved by the customer during a meeting at FAM (see Ref 8), including interfaces with the undercarriage and the centre fuselage via the wing mounting shims.

Some sealing tests were able to be performed on the nacelle while still at ARA, but ultimately as planned, the full functional test had to be undertaken at DNW during test preparation.

ARA provided staff to DNW during various phases of nacelle sealing and overall model assembly, but due to issues during the nacelle leak testing and because of the potential additional unplanned activity extending beyond the available budget, some necessary operations had to be arranged between the customer and DNW.

Upon completion of testing during mid 2015, the relevant parts of the Model will be returned to ARA for storage.

WP4 – Project Management – Lead Participant ARA

Technical management and financial administration has been maintained by ARA throughout the duration of this programme, but during the whole project there have been several enforced changes due to movement and re-allocation of personnel.

The ARA Financial contact at the outset was Mr Ian Potter but during mid 2012, Mr Rob Daly has taken over the Financial and Project Co-ordinator roles, with my assistance for the latter functionality in replacement of Mr Paul Hammond.

A personnel change also occurred during the same timeframe at FAM, where Mr Craig Peterson replaced Mr Mike Sullivan as the main contact.

Additionally, there were several factors early in the programme that resulted in a significantly late start, which together with manufacturing at ARA (and elsewhere) taking longer than expected and thus causing further delays, it was necessary to apply for an extension to the overall programme.

Ultimately it was agreed this timeframe would increase to 38 months, and the resultant impact upon the various work packages was recorded (see Section 2.1).

LOSPA contact details

Project Officer: Helmut Schwarze

helmut.schwarze@cleansky.eu

Topic Manager: Olivier Colin

Dassault Aviation, Aircraft & Stores Engineering Technical Directorate

92552 Saint-Cloud, France

+33 (0) 147 113894

olivier.colin@dassault-aviation.com

Project Co-ordinator: Robert Daly

ARA Manton Lane, Bedford

MK41 7PF

+44 (0) 1234 321686

rdaly@ara.co.uk

Task Manager: Peter Spi ers

ARA Manton Lane, Bedford

MK41 7PF

+44 (0) 1234 321690

pspiers@ara.co.uk

Consortium: Craig Peterson

Future Advanced Manufacturing

Herrick Way, Staverton

GL51 6TQ Cheltenham

+44 (0)1452 712597

craig.peterson@futuream.com

2. Core of the report for the period

2.1. LOSPA Project objectives

The revised timing for objectives of the overall project are summarised in the following:-

	Project Quarters	1	2	3	4	5	6	7	8	9	10	11	12	13
WP1	Design and Manufacture of the Empennage and Nacelles	M1.1Project Launch ♦ M1.2 Deliverables to ARA ♦												
T1.1	Design and stress analysis of the Empennage	M1.3 Preliminary Design Review ♦												
T1.2	Manufacture of the Empennage													
T1.3	Design and stress analysis of the Nacelles				M1.4 Critical Design Review ♦									
T1.4	Manufacture of the Nacelles							M1.5 Release Stress Report ♦						
T1.5	Integration of the Nacelles and Empennage													
WP2	Design and Manufacture of the Wing Assemblies													
T2.1	Design and Stress Analysis of the Wing Components													
T2.2	Manufacture of the Wing Components													
T2.3	Integration and Inspection of the Wing Components													
WP3	Final model Assembly/Integration											Completion of Manufacture M1.6 ♦		
T3.1	Assembly of Wings, Empennage, Nacelles to LOSPA model. Validation											Model Buy-off M1.7 ♦		
WP4	Project Coordination and Management													
T4.1	Technical management													
T4.2	Financial / administrative management													
T4.3	Exploitation and Dissemination													

WP	LOSPA General Achievements in the Period 1 Nov 2011 until 31 Dec 2014
WP1.	Completion of the detailed Design (see Ref 9) Release and Approval of final Stress Report Completion of Model manufacture Release and Approval of final Inspection Report Release and Approval of Assembly Guides Model Approval by customer, and delivery to WT facility
WP2.	Completion of the detailed Design (see Ref 9) Completion of Model wing manufacture Release and Approval of final Inspection Report Model Wing Approval by customer, and delivery to WT facility
WP3.	Completion of assembly, integration and interface validation Model Assembly Approval by customer, and delivery to WT facility
WP4.	See section 2.3.1

2.2. Work progress and achievements during the period

2.2.1. Work progress vs. project objectives

WP	Task	Achievements in the Period 1 Nov 2011 until 31 Dec 2014
WP1	T1.1	Deliverables presented to Topic Leader:- • Final Stress Report • Inspection Report • CAD design for Model • Completed Model, delivered to DNW ready for Testing • Assembly Guides • Minutes of Meetings, see References • Powerpoint presentations, see References
	T1.2	Completed

	T1.3	Completed
	T1.4	Completed
	T1.5	Completed
WP2	T2.1	Deliverables presented to Topic Leader:- • Final Stress Report • Inspection Report • CAD design for Wing • Completed Wing, delivered to DNW ready for Testing
	T2.2	Completed
	T2.3	Completed
WP3	T3.1	Completed
WP4	T4.1	On going, see section 2.3
	T4.2	On going, see section 2.3
	T4.3	On going, see section 2.3

Problems encountered

For a combination of reasons, including late specification changes and grant re-negotiation, late delivery of CAD and slippage of resource availability at ARA / FAM, the original start date from the IA of 1 Nov 2011 was not achieved

Although there were several false starts, the consortium did not launch this programme until early Sept 2012 which was 10 months late

Also throughout the programme it became apparent both during design and also manufacture, that the consortium and also other parties such as INCAS (outside of this CleanSky activity, but manufacturing the fuselage, nose, straight through nacelles, alternative VTP / HTP tail, and under-carriage) were struggling to achieve the very significant workloads within the revised timeframes

This culminated in a request to extend the overall duration of the project to 38 months, taking completion therefore out to the end of December 2014

Although there were some subsequent issues after model delivery, entailing repeated efforts to effectively seal the nacelles (ARA provided a level of support, but ultimately this problem was resolved between Dassault Aviation and DNW), the revised programme for initial aerodynamic testing to start in December 2014 was achieved

Further planned testing of the acoustic performance of the model is scheduled for late Q1 2015, and Dassault Aviation have reported good model behaviour so far during the aerodynamic tests

Problem description	Corrective action	Result
For several reasons at the outset and during the design and manufacturing phases, initial programme timing was not going to be achieved	A request for an increase to the overall project time frame was agreed.	The model was then delivered to DNW according to the revised schedule All Deliverables were achieved and initial testing was commenced to the revised schedule

2.3. Project management during the period

2.3.1. Consortium management tasks and achievements

The following meetings or key events have occurred during this Period:-

Meeting	Date	Location	Purpose / Justification / Outcomes	Attendees
Launch	01/09/2012		This was 10 months late in comparison to the start date shown in the IA	
PDR	13/11/2012	Bedford	Preliminary Design Review (see Ref 2)	Dassault Aviation DNW ONERA INCAS, FAM, ARA
Design Review	22/01/2013	Bedford	Design Review I (see Ref 3)	Dassault Aviation DNW ARA
Design Review	13/02/2013	Bedford	Design Review II (see Ref 4)	Dassault Aviation DNW ONERA FAM, ARA
CDR	31/05/2013	DNW	Critical Design Review (see Ref 5)	Dassault Aviation DNW ONERA INCAS, FAM, ARA

Manufacturing Review	26/09/2013	Bedford	Manufacturing Review I (see Ref 6)	FAM ARA
Manufacturing Review	07/02/2014	Bedford	Manufacturing Review II (see Ref 7)	FAM ARA
Model Approval	18/09/2014	ARA, FAM	Empennage, Nacelles & Wings (see Ref 8)	Dassault Aviation FAM, ARA
Delivery	31/09/2014	DNW	Delivery and preparation in DNW	Dassault Aviation DNW ONERA ARA

2.3.2. Problems encountered

No problem was encountered at project management level other than the technical issues, which are discussed in section 2.2.1

2.3.3. Changes in the consortium

The ARA Financial contact at the outset was Mr Ian Potter but during mid 2012, Mr Rob Daly has taken over the Financial and Project Co-ordinator roles, with my assistance for the latter functionality in replacement of Mr Paul Hammond.

A personnel change also occurred during the same timeframe at FAM, where Mr Craig Peterson replaced Mr Mike Sullivan as the main contact.

Participant	Previous Focals	Current Focals	Date
ARA, Bedford	Ian Potter Paul Hammond	Rob Daly Peter Spiers	May 2012
FAM, Cheltenham	Mike Sullivan	Craig Peterson	May 2013

2.3.4. List of meetings

See section 2.2.1

2.3.5. Project planning and status

WP1, WP2, WP3 and WP4 are all complete pending the release of final Reports

3. Deliverables and milestones tables

The following table presents the status of all the deliverables of the LOSPA project.

Del. no.	Title	WP no.	Short Description	Due date	Status
D1	Model Design	1, 2 and 3	a) Complete CAD database (CATIA v5 format) for the LOSPA model b) Model Stress Report compliant with the test facility requirements	T0+21	Submitted to Customer See Note 1
D2	Model Manufacturing	1, 2 and 3	a) Delivery of complete LOSPA model equipped with acoustic and pressure sensors. b). Model Inspection Report. c). Assembly Guides d). Calibration reports for any balanced components	T0+34	Complete

Note 1 : As per the agreement with CleanSky, the CAD Model has only been supplied to the Customer
Note 2 : Scheduled dat es have been revised to reflect the agreed extension

The following table shows the status of all the milestones of the LOSPA project.

Milestone number	Milestone name	Work package(s) involved	Expected date (months)	Means of verification	Status
M1.1	Launch Meeting	WP1, WP2	T0	Minutes of meeting, definition of actions.	Complete
M1.2	Supply of all required deliverables to ARA	WP1, WP2	T0	Required deliverables are provided to ARA. ARA acknowledgement of receipt.	Complete
M1.3	Preliminary Design Review (P.D.R.) hosted by ARA	WP1, WP2	T0+12	ARA presentation of initial design status for review and approval. Minutes of P.D.R. acknowledging agreed design status and actions.	Complete
M1.4	Critical Design Review (C.D.R.) hosted by ARA	WP1, WP2	T0+19	ARA presentation of final design status and stress reporting for review and approval. Minutes of C.D.R. approving design status and actions.	Complete
M1.5	Release of Stress Report to designated test facility	WP1, WP2	T0+30	ARA Stress Report formally issued to test facility for advance review	Complete
M1.6	Completion of model manufacture.	WP1, WP2	T0+33	Production of Inspection Report	Complete
M1.7	Model Buy-off at ARA facility	WP1, WP2	T0+37	Minutes of Meeting	Complete

Note 1: Scheduled dates have been revi sed to reflect the agreed extension

4. Explanation of the use of the resources

4.1. Effort allocation per work package

The following table summarises Effort Allocation for the LOSPA project during this Period.

WP#	Work performed	ARA	FAM	Effort (man-month)
1.1	Design and stress analysis of the Empennage	5	0	5
1.2	Manufacture of the Empennage	21	0	21
1.3	Design and stress analysis of the Nacelles	7	0	7
1.4	Manufacture of the Nacelles	24	0	24
1.5	Integration / inspection of the Empennage and Nacelles	2	0	2
2.1	Design and stress analysis of the Wing & Components	0	7	7
2.2	Manufacture of the Wing & Components	0	26	26
2.3	Integration / inspection of the Wing & Components	0	1	1
3.1	Final assembly and validation	3.9	0	3.9
4.1	Programme Technical Management	4	0	4
4.2	Programme Financial & Administrative Management	4	0	4
4.3	Exploitation & dissemination	0.1	0	0.1
TOTAL		71.0	34	105

This is very close to the original overall budget

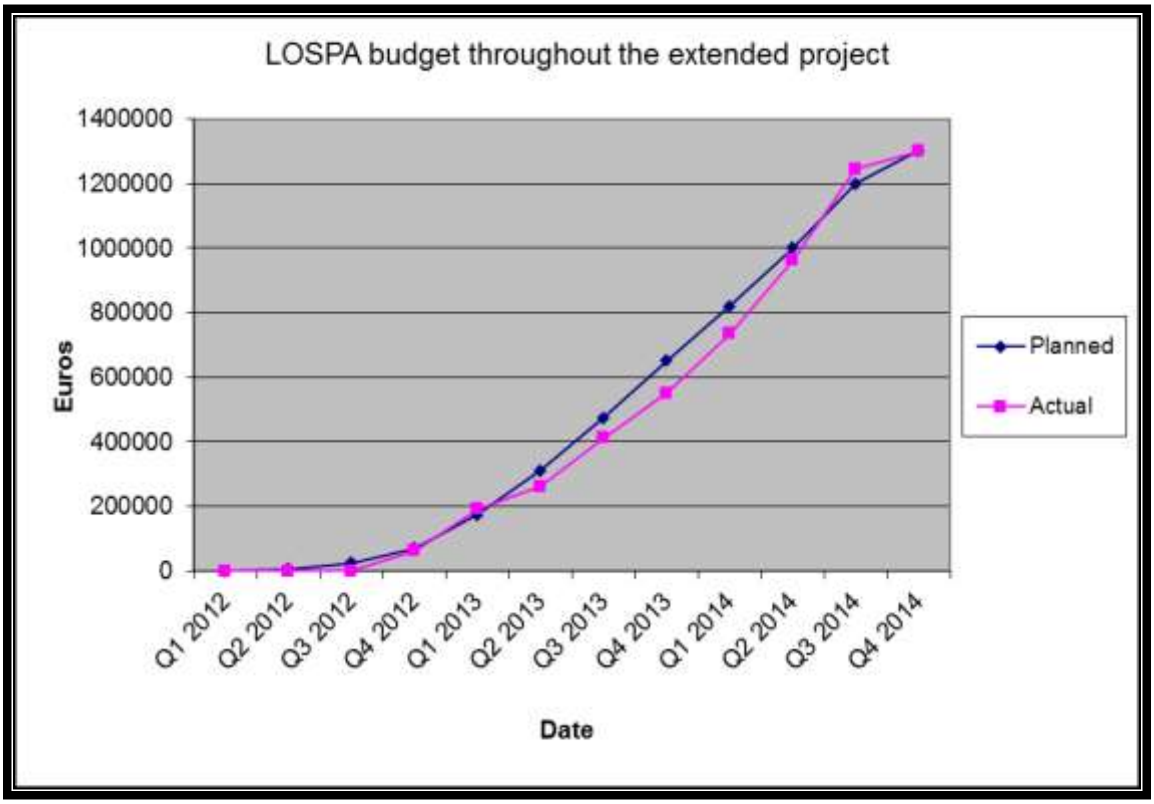
4.2. Cost sheets per partner

Form C documents have been submitted for the period, as per the following table:-

Participant	Form C submittal		Value (Euros)
	Loaded on portal	Hard copies posted	
ARA	Tbc	tbc	tbc
FAM	tbc	tbc	Tbc

4.3. Project budget

This graphic presents the final actual budget profile for the full, extended project duration compared with the equivalent planned budget declared by the consortium.



The final expenditure is almost the same as the original budget

Acronyms

ARA	Aircraft Research Association Ltd.
CDR	Critical Design Review
CFD	Computational Fluid Dynamics
KOM	Kick Off Meeting
PDR	Preliminary Design Review
PM	Progress Meeting
FAM	Future Advanced Manufacture
WP	Work Package
HTP	Horizontal Tail Plane
VTP	Vertical Tail Plane
ASM	Assembly
IA	Implementation Agreement

References

[Ref 1] Picture of model at Model Approval meeting

[Ref 2] Preliminary Design Review (PDR)

[Ref 3] Design Review I

[Ref 4] Design Review II

[Ref 5] Critical Design Review (CDR)

[Ref 6] Manufacturing Review I

[Ref 7] Manufacturing Review II

[Ref 8] Model Approval

(Ref 9) Deliverables

Ref 1 Picture of model at Model Approval meeting

Starboard wing

Port wing

Empennage / Nacelle Asm (with alternative central VTP attached solely to confirm interfacing)

Ref 2 Minutes of Preliminary Design Review

LOSPA PDR Meeting Bedford – 12 & 13th November2012

SFWA WP224 : LOSPA Model PDR

Attendees:

Gabriel Petit	Dassault Aviation
Bertrand Vache	Dassault Aviation
Floriane Rey	Dassault Aviation
Marc Stojanowski	Dassault Aviation
Eric Germain	Dassault Aviation
Sinus Hegen	DNW
Bert Padding	DNW
Iwan Philipsen	DNW
Jean-Luc Hantrais -Gervois	ONERA
Daniel-Ciprian Mi ncu	ONERA
Victor Pricop	INCAS
Ionut Brinza	INCAS
Mike Sullivan	FAM
Mark Tovey	FAM
Dave King	ARA
Paul Hammond	ARA
Luke Roberts	ARA
Rob Porter	ARA
Peter Spiers	ARA

Objectives

To conduct a PDR design review of the current status for the LOSPA programme

Model presentation

TPS Integration

DA confirmed that the port nacelle will no longer incorporate thrust reversal

Because of minor differences in the TPS interface sizes, ARA currently propose 2 different nacelles – DA to confirm 0.1mm aft facing step is acceptable or provide alternative intake geometry to suit actual dimensions of TPS units (compared with design)
Action: DA

ARA to supply and fit 40 Kulites radially at inlet plus the 20 longitudinal units further aft (confirmed not at 6 o'clock position). Backing pressure tubes will need bending or shortening. ONERA to install rear radial ring of 40 units plus 10 on an extended LE support strut around the bifurcator Action: ARA to supply bifurcator LE support geometry to ONERA and place orders for 60 Kulites

DNW will provide the 2D intake for calibration Action: DNW

Primary duct rake has 4 arms and currently mounted on core cone – ARA to connect core cone to TPS with rake not attached Action: AR A

Outer flow rake has 6 arms, but thermocouples to be removed and mounted separately at same radius but between arms. ONERA require (for acoustic test only) rear rake aft of Kulites, therefore either 2 positions required or investigate whether the instrumented nacelle could have 2 different sets of relevant components (one with rakes for thrust monitoring and without Kulites, and the other with Kulites for acoustics and no rake in the outer flow)

Action: DNW to propose layout A RA to study most appropriate option

Wing design

FAM to proceed with the principle of a central cavity and covers for pressure tubing rather than trying to take these along the LE/TE interfaces (although cavity will need to split at the root) Action : FAM

Aileron motorisation to be investigated

Action: FAM to provide CAD to DNW who will integrate relevant envelope. DA to confirm no sealing required

Further investigation of flap & slat bracket movement required (separately up/down and forward/aft) Action : FAM

FAM confirmed 7000 series aluminium alloy for the wing and Ramax for the brackets – final stress report not required until few weeks before testing

Action: DA to send FAM the latest wing shim fixing and FAM to send DA model of wing ti p interface

Confirmed single o/b station for pressure plotting on the port wing, and 2 i/b stations on the starboard

The mid-wing slat will be split in two (for manufacturing) and then fixed together. The first half of the mid-wing slat will also be split to enable a part of the slat to be fixed to an instrumented bracket for slat loading (both parts could also be fixed together during non-loading test polars Action: FAM

Front fuselage

Fuselage section made up from 4 quadrants with 5mm covers (al alloy). Nose (2 halves) can be accessed in landing gear bay and after removal of nose tip.

Central cover to be split to ease handling Action: DA

Instrumentation plate within the front fuselage to be designed by DNW. CAD file to be sent to DNW Act ion: DA, DNW

There is a possibility of a smaller air bridge from DNW. Detail of this and instrumentation layout (inclinometer) to be provided Action: DNW

There are 2 wing sweep angles required, utilising different wing root shims and body fairings (possibly STL). Relevant slack must be accommodated to allow wing detachment
Action: DA

Landing gear wheels likely to be foam to prevent damage

Suggest recess of body fairings into wing to alleviate potential feather edges

Action: DA

Aft fuselage

Spaceframe principle agreed with relevant covers (butt joints agreed) – ARA to consider steel frame rather than al alloy. 6mm clearance gap required around sting Latest sting geometry to be confirmed. Aft fuselage will be required to enable rear mounted capacity
Action: ARA, DNW

DNW to propose pipe layout and disconnects to ARA Action: DNW

ARA to provide central VTP interface with aft fuselage to DA. Pylon to aft fuselage interface also to be provided to DA Action: ARA

Gap sealing at root of HTP when rotated is not required – ARA to introduce raised section on fuselage with a planar interface with the HTP root. Both HTPs to be joined during assembly, with manual setting on one side only Action: ARA

Motorisation to be quickly assessed for HTP and elevators

Action: FAM to provide CAD to DNW who will integrate relevant envelopes. DA to confirm no sealing required for elevator

DA to send proposed strain gauge scheme and confirm specification for control surface hinge lines, loads and deflection angles Action: DA

No Kulites required on either HTP (since no thrust reversal). Staggering of pp locations at LE (at same chord) permissible to facilitate installation

Action: ARA

General

Finalise conceptual design of all parts Action: All parties

Test matrix to be supplied to ARA Action: DA

Component interface and sub assembly approval planned at ARA. The final Model Assembly and Buy Off is to be conducted at DNW with ARA support

Timeline planning document to be prepared by DA. All parties to provide Microsoft Project timing plan for consolidation Action: All parties

The customer confirmed that the PDR had been satisfactorily completed

Ref 3 Minutes of Design Review I

LOSPA Review Me eting

22 Jan 2013

Attendees:

Dassault	DNW	ARA
Gabriel Petit	Bert Padding	Dave King
Anthony Souilliart	Iwan Philipsen	Luke Roberts
		Peter Spiers

ARA presented their current status – all relevant CAD data now to be made available directly to partners

Topic	Action	Owner
The rear core duct rake design (option 2) was approved. The front fan duct rake and it's impact on 2 alternative ducts (rather than 1 with removable rakes) still to be evaluated	DNW to assess need for additional rake further aft	DNW
Assembly sequence for nacelle generally agreed, but some potential sealing issues still to be resolved	ARA to incorporate sealant grooves where possible to avoid blow out	ARA
Leakage testing can be performed without the external cladding	ARA to perform this test, with DNW in attendance	ARA / DNW
Air supply interface detail into strut to be supplied	DNW to provide	DNW
Spaceframe and cladding for rear fuselage agreed, and internal clearance envelope maintained	Nacelle loading might necessitate additional cross brace	ARA
VTP/HTP layout agreed, but elevator motorisation would require alternate longer lever (no issue) and alternate housing (possible issue)	ARA to supply geometry and loads. DNW to investigate options	ARA / DNW
ARA to provide all relevant CAD data to DA and DNW	DNW to advise method for transfer to their FTP site	DNW
DA request instrumented nacelle to be available mid July	DA to provide 'global' timing plan so all partners understand inter-dependencies	DA
WebEx review next week Tues 29 Jan starting at 10.00 UK time	CAD data available before to aid any partner without a visual link during WebEx (with colour coding to identify sealing faces)	ARA

Ref 4 Minutes of Design Review II

LOSPA Model design review	12/02/2013	Lieu / Place : ARA - Bedford
Affaire suivie par	G. PETIT	

DIFFUSION / *Distribution*: Participants / *Attendees*

Nom / *Name*	Société / *Company*
Gabriel PETIT	DASSAULT-AVIATION
Floriane REY	
Bertrand PLANTIN	
Anthony SOUILLIART	
Peter SPIERS	ARA
Rob PORTER	
Dave KING	
Craig PETERSON	FUTURE ADVANCED MANUFACTURE LTD
Mike SULLIVAN	
Marc TOVEY	
Bert PADDING	DNW
Henri VOS	
Daniel CIPRIAN	ONERA
Eric MANOHA	

DIFFUSION / *Distribution*: Non présents

Nom / *Name*	Société / *Company*
Zdenek JOHAN	DASSAULT-AVIATION
Pascal BARIANT	
Eric GERMAIN	
Jean LE GALL	
Marc STOJANOWSKI	
Michel SGARBOZZA	
Philippe ROSTAND	

5. Goal of the meeting

This meeting was devoted to the design of the LOPSA model. May objectives were:

- Overview and consolidation of the planning
- Overview of the design status of all sub-parts of the model
- Preparation of CDR

6. Talks

6.1. Organization

Anthony SOUILLIART from Dassault-Aviation design office is replacing Bertrand Vache as head designer for the model. He is therefore the point of contact for all design and manufacturing issues.

6.2. Planning

Several critical items are listed below:

- ONERA will check the period of availability of their Kulite LQ-125 for the instrumented nacelle nozzle.
- FAM asks for an increased duration of instrumentation slot for the wing. At least 20 working days have to be added to the planning.
- DNW cannot book a slot for the aerodynamic tests after the beginning of November

Due to the different items above and considering that the planning is very risky at his stage, it is decided to postpone the final delivery of the model by 2 months. It is theref ore stated that the aerodynamic part of the tests cannot occurred in 2013 but in the beginning of 2014, just after the acoustic upgrade of DNW -LLF.

Dassault will propose an updated planning as soon as possible. It is therefore asked not to increase more than necessary the design phase to achieve at least:

- A final delivery of the model by end 2013
- A delivery of the instrumented nacelle that enable calibration tests by 2013.

6.3. Design status

6.3.1. Fuselage

Design of the fuselage is going on. A meeting with INCAS have occurred the week before this review to consolidate the manufacturing strategy and enable the final design phase of the fuselage. Some items are nevertheless necessary:

- Balance fixing and interface from DNW.
- Instrumentation plate rough design. It is stated that the final design and manufacturing of this part could occurred later, even in preparation phase, but space allocation and fixing have to be checked before

the end of the design phase. For that DNW have to finalize the instrumentation layout on the fuselage (aft and front).

For the instrumentation coming from the wing, it is stated that it will exit from the front part of the wing before the wing shim. Plastic tubing will come from the wing to enable wing sweep changing and quick connectors will be integrated in the belly- firing just at the exit of the wing to enable efficient configuration changes.

During the discussions, it is also stated that the maximum weight of the model should be around 1500kg (without balance).

Pre-check-tests:

- Cubic nozzle test: a calibrated nozzle is fixed under the fuselage with 4 M10 screws. Dassault will therefore integrate this requirement in its design. The test is realized without wind and the front fuselage is removed to enable the connection between each airline bridge to the nozzle.
- Pressure check: no requirement for the model.
- Load check: a calibrated load is put on the tip of the wing to record the balance response. Some accurate location part is needed (aileron pin or screw for example).

Instrumentation in the fuselage:

The following items have to be integrated in the fuselage, either in front or aft location:

- Scanivalves: the one needed for wing instrumentation will be located in the front fuselage. The ones for the HTPs will be integrated in the aft fuselage
- Engine monitoring system will be put in the aft fuselage in the neighborough of the pylons
- Oil decoupling system is located just behind the strut in the aft fuselage
- ONERA will check the need of amplification system for the Kulites

6.3.2. Aft fuselage

The aft fuselage is made with assembly of different straight parts welded together. At interface plate, a final machining will be done to achieve the specified tolerances. Major part of the aft fuselage is steel-made. The justification will be obtain by a load test of the fuselage.

The interface plate seems to be too thin (22mm):

- ARA will investigate this issue
- ARA will provide a round hole for air supply into the strut
- Dassault will advise the potential change of the fixing location on interface plate

The external shape is obtained by panels assembly. It is asked that threaded holes will be integrated in the different panels to ease the mounting and dismounting. It is also asked for dowels for assembly repeatability and fitting under loads.

Dassault will provide the tolerances at interface plate and ARA will travel these figures to the different others interface plates (pylons, VTP, HTP, …).

6.3.3. Instrumented nacelle

Major issue for this parts are:

- Avoid any leakage after assembly
- Integrate the Kulites and rakes

Sealing strategy have been explained. DNW asks for O-Ring with no end when possible. It is asked by DNW that specific leakage tests (1bar pressure test) have to be realized after Kulite integration on each separate part (Air inlet and nozzles) before delivery to DNW. ARA will provide ONERA some specific parts to close the nozzle for leakage test. A global leakage test will be done later after assembly.

The leakage test could cause issue with current ARA rubber sleeve Kulite installation. ARA will revisit its integration process.

Last Kulite integration in the bifurcation proposed by ARA is validated by Dassault (response from Kulite is 33kHz high-pass filter far from 12KHz requirement)

The number of Counter pressure pour the instrumented TPS has been stated:

- Air Inlet: 4 Counter Pressure (one for 10 Kulites)
- Nozzle (azimuthal): 7 Counter pressure defined as (from top to bottom:
  - One for the 2 first at the bifurcation (on each side)
  - One for the three following transducers (on each side)
  - One for the 10th following transducers (on each side)
  - One for the 20th remaining
- Bifurator: 1 is sufficient. The CP tube must act as the Kulite as Pitot tube, therefore , the tube must have a 0.5mm ring have to be integrated in front of the pressure tube:

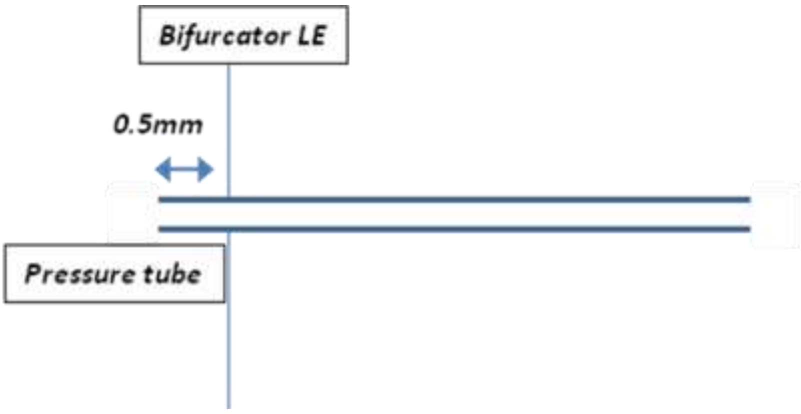


Illustration of bifurcator LE integration

- X-wise line: 2 CP (one for 10 Kulite)

Therefore, the sum is 14 Counter Pressure tubes. To buffer the unsteady fluctuations and to have at the transducer side a real steady pressure:

- Either a 0.5m tube (minimum) have to be integrated between the CP exhaust location and the transducers
- Either using special device proposed by Kulite to enable a low-pass filter. It could be added to any order for around 300Eu per device.

DNW advise to use separate alimentation for each transducers.

WARNING: LQ-125 and XCQ-062 have two different counter-pressure tube diameter (seems to be 0.75mm for LQ-125 and 0.4mm for XCQ-062 newly ordered)

ONERA request a slightly larger and tapered entrance for the 40 radial transducers installation to allow feeding in from inside.

ONERA requests that the transducers must be as flush as possible with minimal recess. Rotational spacing and angle between air inlet and nozzle azimuthal array must be the same.

2 nozzle parts will be manufactured for Instrumented TPS. One with Kulites and one with thrust-bookkeeping rakes in secondary duct. Both bifurcators (on each side) LE will present an offset to integrate Kulite transducers.

Rakes needed for Thrust bookkeeping will be removed for acoustic tests (Air inlet and secondary duct in nozzle). Nevetheless, it is stated that for a good TPS monitoring is needed at least:

- Rake in primary duct
- Two rake legs in the secondary duct behind the last X-wise line transducer

The rakes layout are agreed.

6.3.4. Shielding empennage

Quick connectors will be integrated in the HTP for VTP pressure taps disconnecting when removing the VTP. (same for strain gauge)

The two HTP sides will be attached together using a plate. This plate could be attached to a motorization system supplied by DNW. Concerning the layout of the motorization system, it seems that space allocation is limited in the aft fuselage (length of the level arm). Some solutions could be proposed to improve the situation:

- Increase the space inside the aft fuselage to obtain at least 70mm (100mm would be perfect) between the lower side of the fuselage to the trim axis.
- Inclined motorization integration

The aft fuselage CAD file will be delivered to DNW for layout studies.

There is no layout problem for the elevator motorization. A bigger engine could even be integrated to ease the level arm part design.

Dassault will provide DNW with the load estimate document for the model.

Dassault also restrict the trim angle range of the HTP. Maximum deflection is now -6° (compared to -12° before). Formal communication will be done to ARA by Dassault to confirm this requirement.

It is asked for the rudder deflection to have two hinges and one bracket. No angular sector is needed, the control of angle will be done during the inspection.

Clean covers for HTP off runs are confirmed. Level plate for HTP trim angle check is also needed.

6.3.5. Classical Tail:

The interface is available in the CAD file of ARA. It is a proposition that could be easily changed in case of Dassault requirements due to the loads of the VTP.

Dassault will integrate the needed pocket in the VTP for HTP motorization layout study. (same for elevators)

For all layout studies, DNW will ask NLR for subcontracting.

6.3.6. Wing

FAM asked for a decrease of psi probes on the upper part of the Wing. Dassault agree and will sent an updated requirement.

Hinge line of the Kruger is needed

Kruger X and Z setting have to be checked by Dassault. The requirements have to be updated.

Some discrepancies appear on the aileron that have to be fixed as soon as possible:

- Shape of the leading edge doesn't enable the full range of the aileron (+20° / -30°). Positive deflection are downstream and positive deflection are upstream.
- The hinge line is located at the middle of the width of the aileron, it doesn't permit the integration of the level-arm for motorization. A slight movement upstream of the hinge line (5 or 7mm) would correct this situation

Dassault will therefore upgrade the aileron geometry.

Different setting options have been presented for the flaps. The final definition should take into account:

- To have quick configuration changes, no flap roof dismounting is accepted for flap setting changing
- FAM propose that flap setting changing could be done using a cavity at the root of the bracket with plate to make discrete setting values. This is preferred by Dassault.
- To lock the X movement of the brackets some screws have to be added in X axis to tighten the bracket and the setting plates. U shaped plates are interesting for quick changing.
- A deformation computation of the flaps under loads will be presented to check the slot evolution and the flap bracket justification.

7. Miscellaneous

As DNW, ONERA, NLR or INCAS are not parties of LOSPA Implementation Agreement, the CAD files and other data or information needed to accomplish the relevant SFWA WP224 studies are provided by Dassault under the sub-license right defined in the section 9.3 of the Implementation Agreement.

All partners are asked to send the current design status in Catia V5 format to Dassault to make a first gather of all parts and check the interfaces. After this model assemble by Dassault, it will be broadcast to other partners their own need.

Ref 5 Minutes of Critical Design Review

DGT/DTIAE/AERAP
RÉDACTEUR / WRITTEN BY : G.PETIT

DIFFUSION / *Distribution*: **Participants /** *Attendees*

Nom / *Name*	Société / *Company*
Gabriel PETIT	DASSAULT-AVIATION
Bertrand PLANTIN	DASSAULT-AVIATION
Anthony SOUILLIART	DASSAULT-AVIATION
Floriane REY	DASSAULT-AVIATION
Eric GERMAIN	DASSAULT-AVIATION
Craig PETERSON	FAM
Mark TORVEY	FAM
Jonathan THULBON	FAM
Iwan PHILIPSEN	DNW
Hans VREMAN	DNW
Henri VOS	DNW
Peter SPIERS	ARA
David KING	ARA
Leonard COSTIAN	INCAS
Andreea BOBONEA	INCAS
Daniel-Ciprian MINCU	ONERA
Jean-Luc HANTRAIS-GERVOIS	ONERA

DIFFUSION / *Distribution*: **Non présents**

Nom / *Name*	Société / *Company*
Zdenek JOHAN	DASSAULT-AVIATION
Pascal BARIANT	DASSAULT-AVIATION
Jean LE GALL	DASSAULT-AVIATION
Philippe ROSTAND	DASSAULT-AVIATION
Michel SGARBOZZA	DASSAULT-AVIATION
Marc STOJANOWSKI	DASSAULT-AVIATION
Michel MALLET	DASSAULT-AVIATION
Jean-Claude COURTY	DASSAULT-AVIATION
Victor PRICOP	INCAS

1. Objectives

This meeting held in DNW Flevoland facility was the Critical Design Review of the LOSPA Model designed and manufactured for acoustics and aerodynamic tests expected to begin in Q1 2014. The discussions have therefore the aim to make a clear status of :

- Model design and preliminary Stress Analysis
- Appropriateness of model design and instrumentation for its use in DNW-LLF Test Section
- Final model delivery planning

2. High Level remarks

2.1 General remarks

In the following text section, it is reminded several general remarks that are relevant for all parts of the model and all partners:

- Maximum weight of the parts to be handled manually by an operator alone in the test section is 20kg. The heavier parts will have to present at least one leverage point (three preferred for important sized parts)
- Threaded hole in aluminum must be equipped with Helicoil or steel inserts to avoid any peening of the thread
- All partners responsible of design parts shall deliver together with the model assembly and dis-assembly drawing. A global and described part list will also be part of this furniture.
- All manufactured parts have to be marked and easily identifiable.
- Motorization study will begin by early June and end by mid July. The priority list is below:

o Ailerons
o HTP Trim
o Elevators

2.2 Planning

An updated planning will be deliver together with this minutes.
Based on the discussions and due to CDR final date (late May in regards of early April as expected before) :

- ARA own planning is shifted by two months
- INCAS planning is shifted by two months
- Out of Meeting: ONERA ask for a delivery of the nozzle to equip with their Kulite raw by beginning of August. ARA is OK with this query.
- Due to an early rough machining of wing parts, FAM is able to deliver it directly to DNW by late December
- Delivery of the nacelles for assembly, sealing and calibration tests is therefore possible by October
- Delivery of the rest of the model is therefore expected by end of December for a final assembly and preparation for January 2014.

3. Design Review

3.1 Front Fuselage

As the raw material is already ordered and paid by INCAS, the nose cone will be RAMAX2. Weight of this part is therefore 21kg instead of 7kg if made of aluminum.
The instrumentation plate has been presented by DNW. It will be manufacture and fix in the front fuselage during the preparation. Some improvements and fixing points for this plate integration have been asked by DNW:

- Access to front fuselage under the wind shield: no access door could be design at this stage
- Threaded holes to fix the instrumentation plate (integrated in last send design)
- Fixation of inclinometer on fuselage main part (integrated in last send design)

The table below remind the expected number of pressure probe to be recorded for the different test entry:

		Configuration	Wing	HTP	VTP	Nacelle		Total
						Counter Pressure	Rake nozzle	
Aerodynamic	Full Model	U-Tail	182	60	30	4	92	368
		+Shapped Tail	182	54	0	4	92	332
		No HTP	182	-	-	4	92	278
Aeroacoustics	TPS Alone		-	-	-	14	18	32
	Model with one TPS	U-Tail	182	60	30	14	18	304
		U-Tail without VTP	182	60	-	14	18	274
		+shapped Tail	-	54		14	18	86
		No Wing	-	60	30	14	18	122
		No HTP/VTP	182		-	14	18	214
	Airframe noise	U-Tail	182	60	30	-	-	272
		+shapped Tail	182	54	0	-	-	236

To ease handling in wind tunnel section, a three point leverage threaded hole will be D&M on the assembled front fuselage.
To enable an efficient model preparation, it is asked to checked that the front fuselage could be closed at the very end of the model assembly. That will maximize the time of instrumentation integration & test for DNW
.
3.2 Central fuselage

The balance (mounted on its sting) will be pushed inside the central fuselage once the air and oil tubing are still in place. A clash appears in the current design that will be change in next iteration (supplied in the post-meeting CAD file update).
Undercarriage (including doors) have to be STL metallic parts (no plastic). Special care is to be put on stress analysis of the doors fixing screws in side slip angle conditions.
Some threaded holes have to be integrated on lower part of central fuselage (with belly fairing removed) for cubic nozzle test. Information are to be send by DNW.
Quick connectors are required at wing root for pressure probes in order to enable a quick configuration change when modifying the wing sweep angle.
Covers are needed on the belly fairing for the no wing acoustic run.
3.3 Wing

The entire wing design have been updated and converted in Catia V5 format. All major parts have been studied in term of Stress Analysis both in term of constraints and deformation. It is nevertheless asked that:
 A 20% load increase is to be taken into account for dynamic loads on all parts. Safety factors are to be checked with these figures. Some are currently without margin and could therefore become insufficient with a load increase.
 The right and left hand side wing bending under loads has to be checked in order to avoid too much differences between both wings. (Out of meeting: update of both wing bending have been checked and supply by FAM. Deflection figures between right and left wing are negligible with current design which is therefore approved).

All pressure probes are located on the same wing side which is the better solution. All the pressure holes are to be realized normal to local surface. The leading edge probes are therefore to be redesign under this constraint. To enable the integration of a lot of probes in the very beginning of the wing, FAM can put the probes staggered but at a maximum distance of 3mm (model scale) right and left from the reference Y section.
All covers have to be drilled with threaded holes in order to make a quick opening of these cavities for configuration changes.
Angular sector have to be provided together with the model to check the aileron deflection during preparation. A leveling plate is also necessary for the wing to check the wing global setting at root during preparation. A specification could be send by Dassault for these two items.
For leverage issues, 3 threaded holes are needed (in cavities with covers) on the upper side of the wing.
To avoid any clash between flap and belly fairing in case of increased sweep configuration, it is asked that the inboard flap will be cut in two parts (fixed together with keys for example in case of reference sweep case). The cutting plane is located 35mm inboard of the first flap bracket.
There was a misunderstanding for flap roof and spoiler configurations. When extended, there is a gap under the spoilers and there is no flap roof under it. The “Clean” flap roof have therefore to be cut in span to enable the changing in spoiler deflection angle for lift dumping configuration.
Filled threaded holes are preferable when the material thickness is sufficient.
It is asked to put a groove and a rubber seal between the leading edge and wing-box.
It is asked to study the integration of brushes to limit the leakage between the aileron and the wing-box.
Quick and easy access disconnection system have to be integrated for flap to have efficient flap setting changing.

3.4 HTP/VTP

3.4.1 U-Tail

Angular sector are needed to check elevator deflection during model preparation.
Leveling plate is also needed to check Trim angle of the HTP during model preparation.
To enable the integration of a lot of probes in the very beginning of the wing, FAM can put the probes staggered but at a maximum distance of 3mm (model scale) right and left from the reference Y section.
Sealing is requested between HTP and VTP/HTP tip.
To enable the rotation of the HTP the horizontal part is divided in a fixed part (dme -4° which is the reference trim angle) and a movable part. This fixed part have to be dismountable for no HTP/VTP runs and covers are therefore needed "flush" to the aft fuselage to close it.

3.4.2 + Shaped Tail

Leading edge parts designed and manufactured to ease the pressure probes drilling are to be welded to the HTP during manufacturing.
The recess for the trim changing rotating system have to be changed accordingly with INCAS query to ease its manufacturing.
Trim pinion have to be designed in different parts to enable an easy manufacturing.
For leverage issues, 3 threaded holes are needed on the complete HTP/VTP assembly.
The connection/disconnection of pressure probes and the integration of connectors in the HTP/VTP are to be checked to enable a quick configuration change when HTP is removed.

3.5 Aft Fuselage

Stress Analysis logic have to be explicated for final model justification.
DNW asks for a modification of pylon root interface to be sure that this interface is normal to air tubing.

3.6 TPS Nacelles

Assembly process have been presented to check any leakage potential issues. Only one interface appears problematic (YZ plane in the pylon) but no other assembly solution seems possible. Special care is to be observe when mounting these parts together (fitting, sealing).
After the leakage tests of the TPS, very limited assembly/disassembly of the different parts are possible. The Inlet and outer shelf design are therefore to be updated to limit the leakage potential issues when replacing the 2D inlet (for calibration) with the final 3D ones. Out of meeting: a modification of the design have been presented and approved by DNW and Dassault. The external shelf is now in two part and only non-sealing parts are needed to be removed for inlet fixing (except inlet itself of course but treated with a simple and efficient O-Ring). This solution also cure the sealing problem at the trailing edge of the nacelle.
The thickness of the trailing edge of the nacelle is sufficient to avoid deformation under pressure internal loads (8mm is ok) Leakage tests are made with a internal over-pressure of 1 bar, and the final acceptance of the all assembled TPS is leakage rate less than 0.2b/min.

Kulite integration is ok except for the two just next to the bifurcator LE in the nozzle row. The remaining thickness between the rubber seal and the Kulite cavity is too thin. It is therefore proposed that the installation of the neighboring transducers are the same.
It is asked that counter pressure could be recorded during test. Tubing are therefore to travel outside from the TPS to the Instrumentation plate.
For the TF Nacelle, the interface has to be checked between Dassault and ARA once the modification of pylon root will be realized.

Ref 6 Minutes from Manufacturing Review I

ARA	FAM Review	Sheet 1 of 1

Date	26 Sept 2013
Location	Room 41 ARA
Chairman	P Spiers
Attendees	Craig Peterson FAM
Apologies	
Project Number	RBC00701
Project Title	LOSPA & Embraer review

Agenda

1.	Review of possible FAM support for LOSPA and potentially Embraer

Minutes

1.	FAM have capacity to support LOSPA manufacture if required – this would be done via transfer within CleanSky rather than as sub-contract
2.	FAM prefer that pp installation on LOSPA wing should be undertaken by ARA (this will mean that there is no longer a need for further transfer of CleanSky budget from ARA to FAM)
3.	FAM can provide early, the Kruger slat bracket for ARA installation of gauging, and also wing control surfaces for pp installation if required
4.	FAM can still undertake machining of LOSPA welded tail frame if required
5.	Capacity available for manufacture of two wing sets from potential Embraer programme – Craig would prefer both clean wing sets rather than one with pp
6.	FAM would also like to offer immediate design support as well as manufacturing, if required for Embraer (FAM now have 6 designers)
7.	Craig confirmed that there is still ARA owned Ramax material at FAM

Actions

Minute Item No.	Action	Owner	Target / Completion Date
1	Decision required to start RFQ process for LOSPA parts	K Williams	31/10/13
1	Possible retrospective activity required, since one previous component for LOSPA was sub-contracted to FAM	A Mason	31/10/13
2	Notify relevant personnel of this change	P Spiers	15/101/3
3	Plan for design, purchase and fitting of gauging	R Porter	31/11/13
4	PO to be raised if agreed	K Williams	4/101/3
5 & 6	Sub-contract decisions to be agreed	K Williams	11/10/13
7	FAM to supply inventory list	FAM	15/101/13

Signed............ Dated ....27 Sep 2013

Ref 7 Minutes from Manufacturing Review II

	LOSPA Manufacturing Review	Sheet 1 of 1

Date	Friday 7 Feb 2014
Location	ARA Bedford
Chairman	
Attendees	Craig Peterson FAM Peter Spiers ARA
Apologies	
Project Number	RBC00701
Project Title	LOSPA

Agenda

1.	Review manufacturing status at both companies, with reference to the LOSPA programme
2.	Agree action plan

Minutes

1.	FAM are currently scheduling final delivery to DNW by the end of June
2.	ARA, under our present plan, would be at least a further 2 months (although some staged deliveries would be achieved ahead of this final delivery)
3.	FAM will shortly have 3 fitters (3rd will be Toby ex-Airbus, who has instrumentation experience also)
4.	Consequently it was agreed that FAM would take back the pp installation of the starboard wing
5.	ARA still to undertake strain gauge installation of one Kruger slat bracket
6.	FAM have further capacity to assist ARA with hand finishing / final assembly and also with some component manufacture (EDM only, not CNC)

Actions

Minute Item No.	Action	Owner	Target / Completion Date
4	ARA to transfer agreed budget to FAM to cover pp installation	A Mason	28/2/14
5	FAM to provide design asap and confirm part availability for ARA planning of gauging – ARA to re-assess budget for this activity	FAM / P Spiers	14/3/14
6	ARA to prepare relevant RFQ for FAM assistance	P Spiers	13/2/14
6	When determined, the revised timing will be relayed to Dassault	P Spiers	28/2/14

Signed……… Dated …… 7 Feb 2014

Ref 8 Minutes of Model Approval Meetings

DGT/DTIAE/AERAC
RÉDACTEUR / WRITTEN BY : O.COLIN / E.GERMAIN

Affaire suivie par O. COLIN

DIFFUSION / *Distribution***: Participants /** *Attendees*

Nom / *Name*	Société / *Company*
Craig PETERSON	Future AM
Peter SPIERS	ARA
Floriane REY	DGT/DTIAE
Olivier COLIN	DGT/DTIAE
Anthony SOUILLIART	DGT/DTIAE

DIFFUSION / *Distribution***: Non présents**

Nom / *Name*	Société / *Company*
Jean LE GALL	DGT/DTIAE
Marc STOJANOWSKI	DGT/DTIAE
Philippe ROSTAND	DPR/PFF

COPIE(S) : dont (A)bsents / *with (M)issing*

Nom / *Name*	Société / *Company*

OBJET :		Minutes of Buy-off meeting – LOSPA Model for PLAAT Tests (DNW-LLF)	
Date :	17&18/09/2014	**Lieu /** *Place* **:**	**FAM – Cheltenham, UK** **ARA – Bedford, UK**

1. Visit at FAM facility and Wings buyoff (17/09/14)

Attendees: Craig Peterson (Future AM)
Peter Spiers (ARA)
Floriane Rey, Olivier Colin, Anthony Souilliart, Eric Germain (Dassault Aviation)

Deliverables
OK with the FAM pressure taps labels. The table and drawing for the correspondence of taps and ports on disconnects have to be sent to DA (paper drawings already provided).
FAM will provide Dassault with exploded drawings, stress report, table of pressure taps connection on disconnects (including FAM label).
Wing shim, wing box and all wing elements will be sent to DNW (transport to be managed by FAM).
The main landing gears (manufactured by INCAS) were presented on the wing and fitted. They will be sent back to ARA and will be shipped to DNW by ARA together with the rest of the model.
Geometrical inspections have been made, reports were sent to Dassault. FAM will advise the way to correct the local mismatch of flap position (about 0.15 mm from nominal) measured on a single section by the adjunction of an appropriate permanent spacer between bracket and wing box.

Wings review
FAM prepared the starboard wing mounted with flaps 20° (nominal position), airbrakes on and clean leading edge, the port wing mounted with flaps 40° (nominal position), no airbrake and Krüger slats. Both main landing gears were mounted. Plastic pressure tubes were visible on the starboard wing (with FAM labels and disconnects).

Assembly of the wing shim on wing root still has to be checked. DA sent the CAD of the wing shim to FAM during the meeting (17/09) to indicate the right positioning of this piece. If necessary, the diameter of dowels and dowel holes can be increased if installation appears to be problematic (details of corrective action to be agreed between DA and FAM).
Elements of interface between ailerons and their motorization have to be manufactured by FAM next week (7 pieces for each side). CAD files for manufacturing are available at FAM (sent by DNW in July 2013). Shipment of all FAM model parts will be organized as soon as aileron motorization interfaces are manufactured.
All other elements have been manufactured and fitted.
DA wishes to have a small chamfer on starboard wing lower side leading edge most inboard element, in order to allow routing of the Krüger strain gauge cables towards fuselage, without having to open covers (large amount of screws, can lead to long configuration change).

Miscellaneous
FAM support during model build-up at DNW has to be defined by DA – probably a few days at DNW needed at the beginning of model rigging activities (to be discussed with DNW).
FAM has to estimate a model replacement value for the insurance (hardware and manufacturing costs) in case of damage during model build-up and testing at DNW.
FAM will define the total mass and centre of gravity of each wing (clean configuration).
Transport of FAM model parts to DNW is of FAM responsibility.

2. Visit at ARA and aft fuselage / U -tail buyoff (18/09/14).

Attendees: Peter Spiers (ARA)
Floriane Rey, Olivier Colin, Anthony Souilliart, Eric Germain (Dassault Aviation)

Inspection
Model inspection documents sent so far by ARA to DA show no deviation of the geometry beyond tolerances, DA therefore considers the corresponding pieces fully acceptable.
Nevertheless, model inspection of ARA manufactured parts is not completed yet (DA inspection requirements are not fulfilled so far). In terms of planning, a complete inspection will require more time than actually available if the model has to be delivered at DNW by beginning of October (assumed target date for DNW). ARA proposes to perform a complete model inspection after the tests at DNW, however DA requests a partial inspection prior to shipment, consisting in the inspection of the most outboard sections of HTP / VTP parts. This seems to be a fair compromise (partial inspection possible without further delay of model shipment). Provided these controls show that tolerances are respected on the outboard sections, risks of having geometrical mismatches on the inboard sections are small.
In addition, ARA will measure the distances between elevator trailing edge corner and HTP (inboard and outboard) for each elevator setting available, and compare the measurements with theoretical values (to be provided by DA). The same exercise will be done on the vertical part of the U-tail (rudder)
.
Model interfaces
INCAS parts could be installed without problem on the ARA rear fuselage. This represents three interfaces :
- Central /aft fuselage
- Aft fuselage / standard VTP (cross-shaped)
- Aft fuselage / through flow nacelles (port and starboard).

Fitting (surface hand-finishing) between these pieces was successfully performed. The central and aft fuselage were fitted in the vertical position, ARA therefore stresses the necessity of controlling the joint in the horizontal position (weight of model parts might modify the position of each fuselage part with respect to the other).
A modification of the nacelle pylons (manufactured by INCAS) was made by ARA in agreement with DA, to match the nacelle position with the theoretical model. DA agrees on the final result.

Deliverables
ARA will produce an assembly notice for TPS nacelle.
ARA will provide DA with stress reports.
Drawings are available in pdf format, DA asks ARA to produce a few paper versions with “top level” elements (exploded view with most important elements). ARA will provide DA with a list of all elements and description of their location (“where used” list, already available).

ARA will provide Dassault with the mass and CG location of their parts.

Instrumented TPS
A leakage problem was detected by ARA on ONERA instrumented nacelle. ONERA plans to fix the problem during a 3-days stay at DNW (from 29/09 to 1/10). ARA has sent the sealing plates together with the nacelles, they can be used if necessary. ARA proposes to give assistance to ONERA during this action, however DA understanding is that ONERA plans to handle this on their own (confirmed by ONERA on 22/09/14).

Model review
The aft fuselage was presented fully assembled, with U-tail together with the standard VTP.

Manufacturing of a few elements needed for the interface between DNW motorization and motorized elements still needs to be completed (not a planning issue). All other elements have been manufactured and fitted.
ARA is requested to connect plastic tubes to metallic pressure tubes, together with pressure disconnects. ARA proposes to perform this work prior to shipment (information from DNW required) or directly at DNW during model preparation phase, in order to install the right length of plastic tubes in agreement with DNW (knowing that U-shaped HTP will be disassembled during test campaigns).

Post-meeting note: DNW expressed its preference for delivery of a U-HTP equipped with plastic tubes in order to ease installation of remote controls.
ARA will provide DA with a table listing the address of each pressure port on the connectors and labeling of each tube.
ARA is asked to put filler material on the permanent screws (i.e. HTP covers on port side, where there is no pressure ports).
DA forwarded DNW request to ARA for a reference mark for the U-shape HTP 0° setting. A leveling plate exists to define the zero angle position during preparation phase (with bubble level).

General planning
A general planning needs to be agreed with DNW (expected model delivery date, various sequences and milestones). ARA people are ready to give support during preparation phase for TPS integration, TPS calibration and model mounting. A proposal was made to organize a telecom or webex during the 30/09 meeting planned at DNW with DA for test preparation, in order to elaborate a detailed planning and arrange ARA assistance.
DA to make a more detail planning of the preparation phase of the tests to organize the needs in terms of support from ARA (and FAM). We talked about a maximum of 2 ARA people during 2 weeks.
ARA has to check what is it possible for DA to take in charge in the LOSPA project.

Strain gauges calibration
Calibration of the Krüger slat bracket (starboard) and U-HTP strain gauges was discussed with ARA.
Strain gauges have been installed on the U-tail (2 bridges) and on one port and one starboard Krüger slat bracket by ARA. No cabling has been installed yet. Dassault was assuming that calibration of the strain gauges would be done by DNW, however this point has never been discussed in the past or mentioned in LOSPA documentation. Since DNW recently informed Dassault that they do not calibrate client balances, but only check the calibration, Dassault asked ARA to consider cabling the strain gauges and performing strain gauges calibration on U-tail and starboard Krüger bracket (no need to have port bracket calibrated as well) within the next days or weeks at ARA. This has to be discussed and planed internally at ARA, we should know within the next few days the impact this action should have on ARA model parts delivery. DA will provide ARA with calibration process and methodology to be followed by ARA.
Calibration of the strain gauges at ARA would have an impact on final model delivery date. The decision to proceed will be made once we know the impact of the calibration activities (on both planning and financial aspects).
Post-meeting note: Dassault finally decides to release ARA from this request and tries to find a solution for performing calibration during preparation time.

Miscellaneous
ARA has to estimate model replacement value for insurance (hardware and manufacturing costs) in case of damage during model build-up and testing at DNW. The question of model and tunnel insurance will be discussed with DNW during test preparation meeting.
Transport of ARA and INCAS model parts to DNW is of ARA responsibility.

3. List of actions

Item	Company	Due date
1. Finish manufacturing of motorization interface elements, send to DNW	FAM, ARA	CW40
2. Create a chamfer on wing LE root element for strain gauges cable routing	FAM	CW39
3. Delivery of wings and wing shims to DNW	FAM	01/10/14
4. Delivery of fuselage & tails to DNW	ARA	ASAP
5. Delivery of drawings, stress reports	FAM, ARA	CW 40
6. Delivery of inspection reports	FAM	CW 40
Finalize partial inspection, send report	ARA	ASAP
7. Wing pressure taps: delivery of drawings, pressure plotting identification table and leak test results.	FAM	CW 40
8. Provide requirements for strain gauges calibration, Estimate budget and planning for calibration of U-HTP and stbd slat bracket strain gauges	Dassault ARA	Action cancelled by Dassault (23/09)
9. ARA to return slat bracket to FAM	ARA	ASAP
10. FAM to return landing gears to ARA	FAM	ASAP
11. Provide a drawing of each wing in the clean configuration outlining the CG location and mass	FAM	CW41
12. Provide a drawing of aft fuselage with U-shaped HTP outlining the CG location and mass	ARA	CW41
13. Prepare assembly notice for Nacelles/TPS	ARA	mid-October
14. Supply a shim set to correct flap offset	FAM	CW40
15. Define model rigging support requirements from ARA and FAM teams	Dassault	CW41
16. Get information from DNW on the length of pressure tubes to install on U-HTP	Dassault	ASAP
17. Estimate model parts value for insurance	FAM ARA INCAS	Done ASAP Done
18. Dassault to involve ARA to elaborate preparation planning (TSP integration and Model assembly) meeting)	Dassault	CW40 (during 30/09
19. Confirm a suitable date for a final meeting with the entire LOSPA team & European Commission at DNW following full model assembly	Dassault	CW43

Ref 9 Deliverables

Deliverables presented to Topic Leader and approved:-

- Final Stress Report
- Inspection Report
- CAD design for Model
- Completed Model, delivered to DNW ready for Testing
- Assembly Guides