3 POINT AIRLINER LANDINGS

SETP Flight Safety Workshop Oct 22

Tim Butler

Nova Systems

Scope

- Conducting Flight Test Remotely
- Managing Unusual Conditions
- Understanding the requirements
- Managing Change
- Dealing with Safety Challenges
- What Nova took away from this experience

WheelTug Case Study

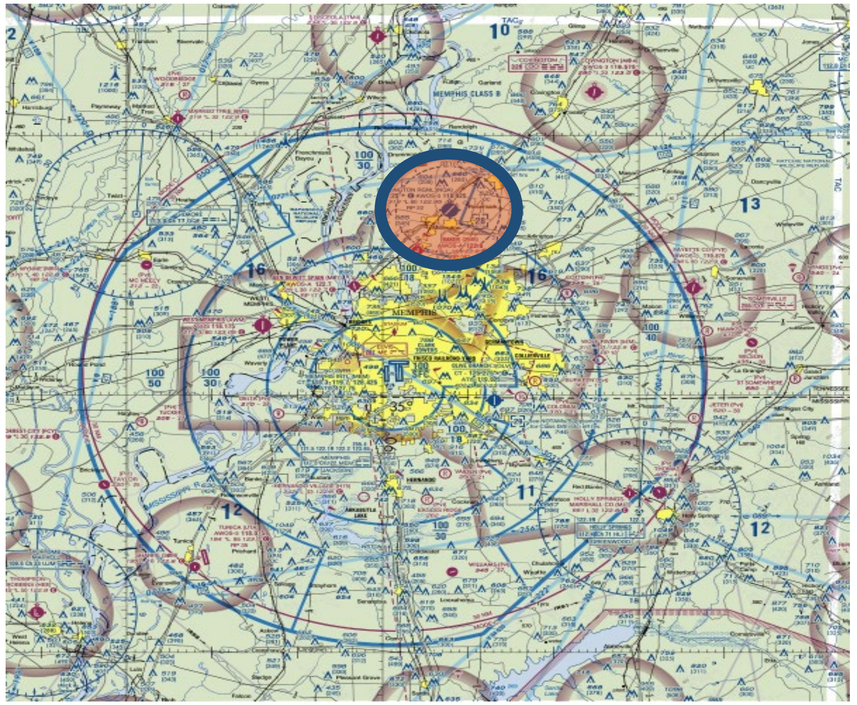
- WheelTug are developing an electric drive nosewheel
- Launch Aircraft - Boeing 737-800 (FAA STC)
- No data available from Boeing
- Baseline data required for the detailed design
- Aircraft used was from AlbaStar and Spanish Registered (EASA)
- High profile public demonstration booked for 15th Sep 2020 at Memphis Intl, USA
- Test due to take place in Aug 2020

WheelTug DRIVING AEROSPACE

Nova Systems

The Background

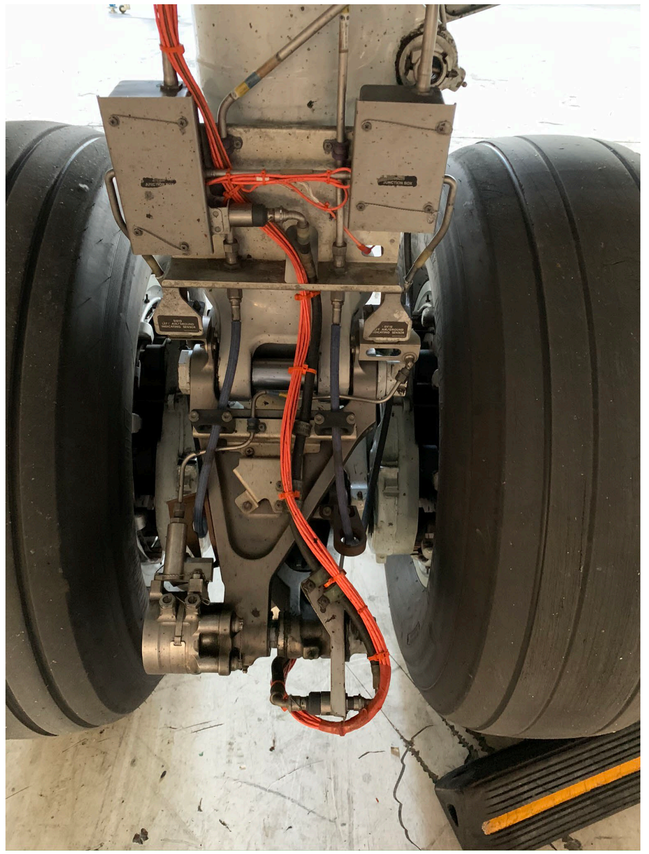
- Test plan at mature phase and US test organisation on contract
- Aircraft based at Millington Airfield north of Memphis, USA
- Realisation late that EASA Part 21 Sub P required for Permit to Fly
- Nova Systems contacted to provide PtF
- USA entry banned by Covid Restrictions



Landing Test Points

Required Test Points

- **Landings at varying descent rates**
  - **Low**
  - **Medium**
  - **High**



6.3.1 Flight Tests: Landing

The following conditions apply to all landing tests:

1. initiated from a stabilised approach on the runway centreline with:
   - Constant forward speed and constant rate of descent;
   - Zero lateral speed;
2. The aircraft should be flown maintaining a constant heading with zero angle of bank and sideslip;
3. Landing configuration: flaps set appropriately by pilot.

Landing Test Points

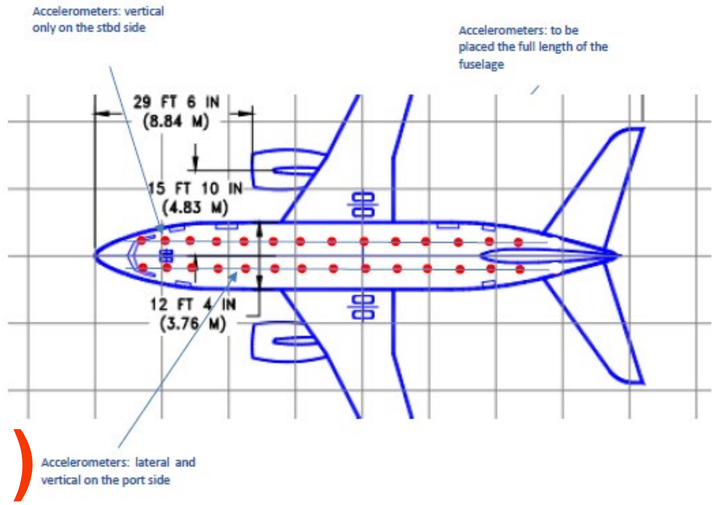
Required Test Points

- **2 Point Landings (mainwheels only)**
  - Agreed were achievable

- **3 Point Landings (main and nosewheel simultaneously)**
  - Cause for concern
  - Nosewheel first landing likely to lead to damage or collapse

Braking Tests

Required Test Points

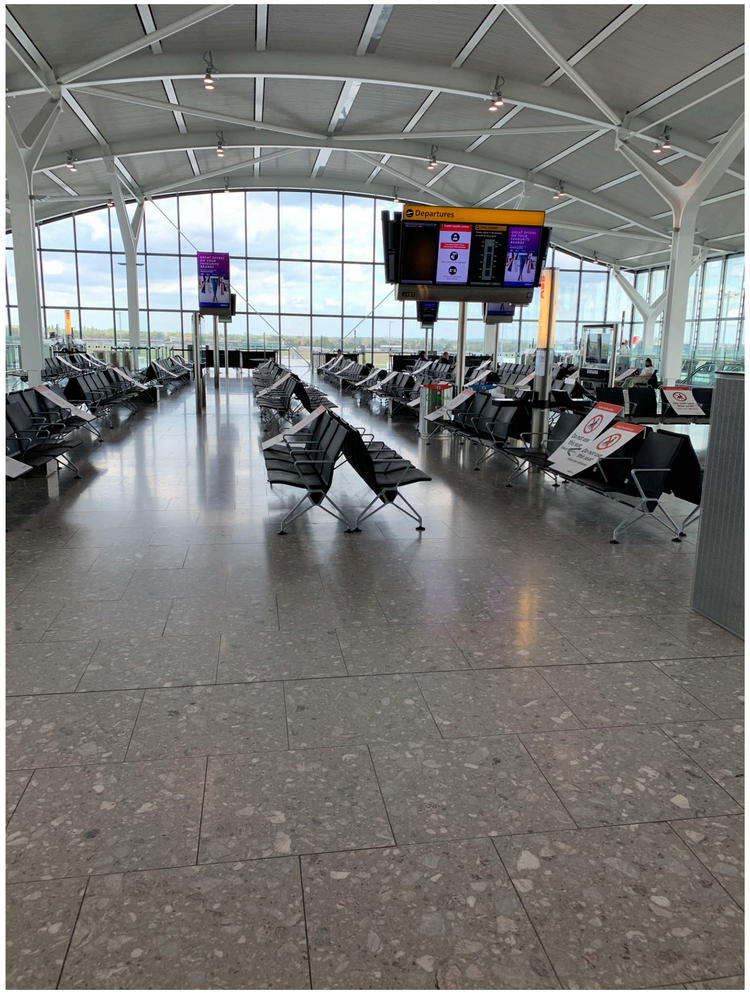


- **Ground Braking**
- **Required constant speeds (0.6 and 0.8 V1)**
- **Simultaneous pulse application of maximum wheelbrakes**
- **Multiple applications per run requested**
  - Considered possible but risks needed to be assessed
  - Could not use pulse of park brake as no antiskid provided

Safety Challenges - 1

Could the test be conducted?

- Entry to USA (Crew Visa with exemption required)
- Crew and test team already identified but EASA Cat 2 TP required to be PIC
- Timeline constraint - Nova on contract from end of July for an August test campaign
- Review of test points led to extensive safety and practicality discussions



The Initial Plan

- **Discussion with DO about reality of test requirements**
  - Unlikely to achieve all due environmental conditions
  - 3 point landing concerning
  - Ground braking adds additional risk
  - Agreed a 0.4 sec difference between main and nose touchdown
- **Discussion with the US TP due to fly the test as he had conducted similar tests previously**
- **Test plan revised and risk assessment updated**

3 Point Airliner Landings

Not Breaking the Nose Gear

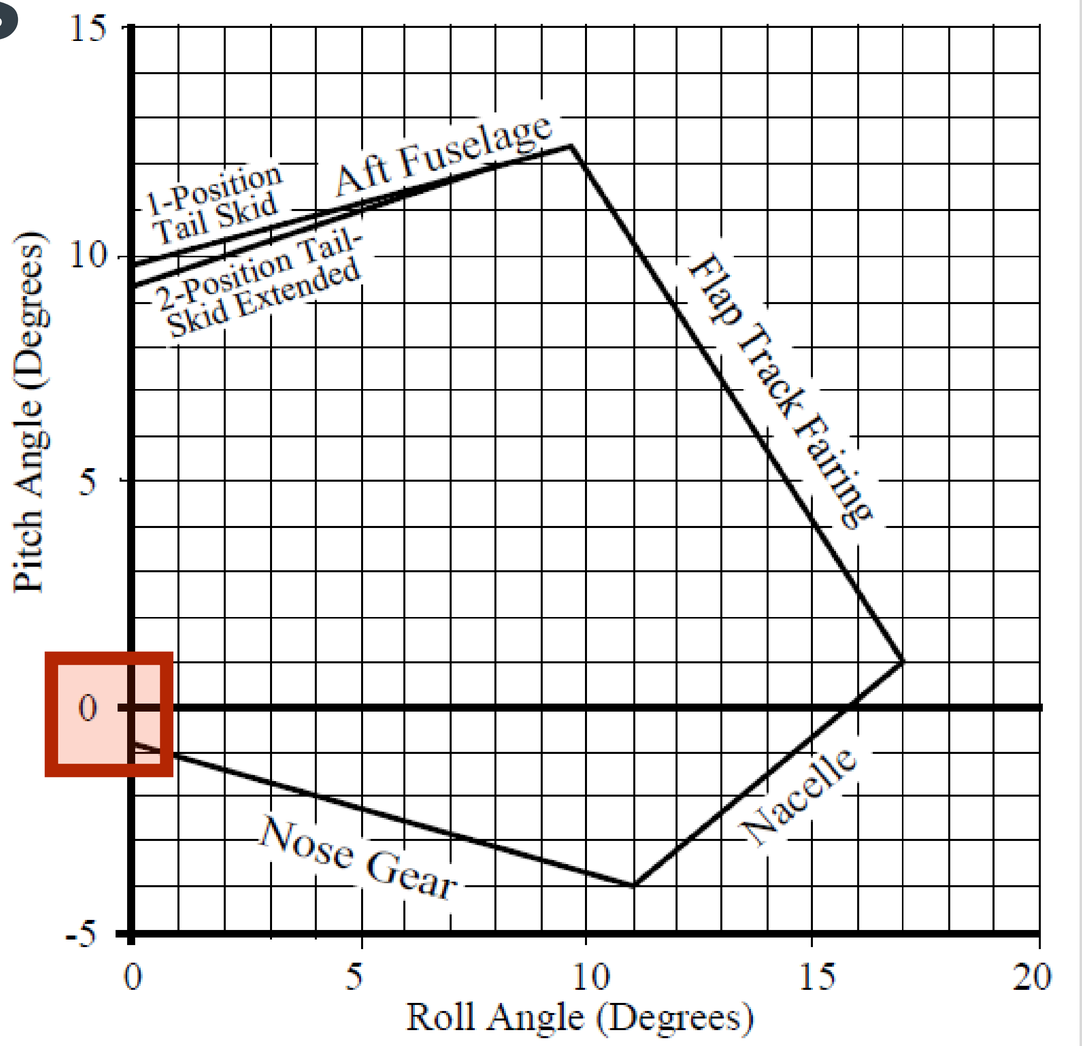
- **Test requirement to land on all 3 landing gear simultaneously with;**
  - Constant forward speed, rate of descent and zero lateral speed
  - 3 descent rates required

Final Approach (1500 FT)
Gear Down, %N1 for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG) 40	50	60	70	80
FLAPS 15 (V_{REF} 15 + 10)	PITCH ATT	2.0	2.5	2.5	2.5	2.5
	%N1	43	47	51	55	58
FLAPS 30 (V_{REF} 30 + 10)	PITCH ATT	0.5	1.0	1.0	1.0	1.0
	%N1	47	52	57	60	64
FLAPS 40 (V_{REF} 40 + 10)	PITCH ATT	-0.5	0.0	0.0	0.0	0.0
	%N1	53	58	63	67	70

3 Point Airliner Landings

Aircraft Geometry



3 Point Airliner Landings

Proposed technique

- **Technique proposed by the US TP had worked before**
- **Approach with Flap 40 and ~ 0 Deg body angle**
- **Flare to keep ~10 feet and maintain back pressure on yoke**
- **Idle thrust and maintain attitude**
- **Release back pressure to ‘drop’ aircraft and de-rotate to achieve 3 point touchdown**
  - Designers agreed to accept up to 0.4 sec deviation
- **Adjust ‘flare and maintain’ height to achieve different touchdown rates of descent**

Safety Challenges - 2

Changes and Discussions

- Call with experienced US Test Pilots advised 3 point landing ‘crazy!’
- Flights delayed to late August due to extensive FTI fit and delays in equipment transport due to Covid
- Original US Pilot no longer available
- Change of plan and I was promoted to PF
- Memphis Demonstration date could not change and was WheelTug priority

Initial Plan Updated

Delay in Aircraft Readiness

- Original training plan extended to include FFS simulator
- Test techniques trialed in FFS with discussions with experienced B737 TRE
- Nova CTP (Dave Best) attended FFS to make independent assessment of technique
- Test Programme and Risk Assessment reviewed with crew change and updated

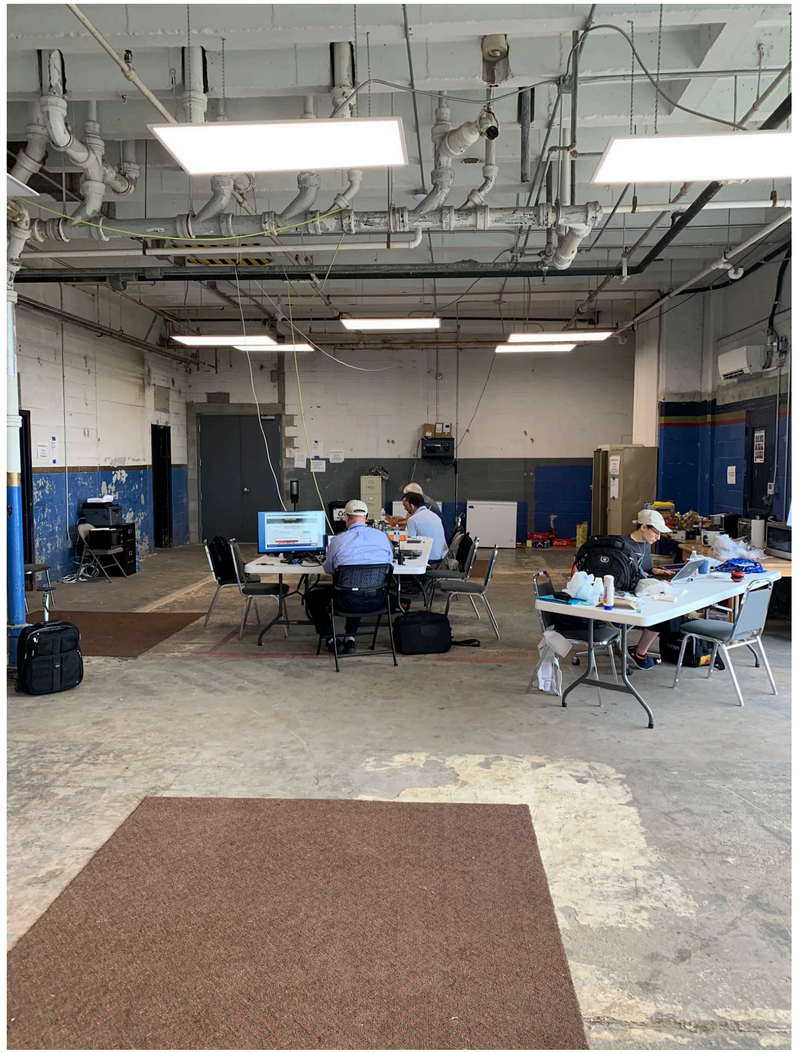
USA Arrival and Test Campaign

Travel in the height of a Pandemic!

- **US visa collected day before flight (1 September)**
- **Arrived in the USA on Wednesday Evening (2 September)**
- **Aircraft had to have FTI removed on following Monday 7 September**
- **FAA Special Flight Authorization not issued**
- **No flight planning had been conducted or discussed**
  - Millington runway only 8000ft
- **No flight planning support available**
- **Weekend was US national holiday (Labor Day)**

USA Arrival and Test Campaign

The Glamour of Flight Test



Safety Challenges - 3

Is it Safe?

- **No pre flight local area planning completed**
  - Workload
- **FAA SFA issued at 1600L on Friday before holiday weekend**
  - Time pressure and fatigue
- **Crew had never met (but had spoken by phone)**
  - CRM
- **Aircraft FTI still being fitted on Friday**
  - Time pressure and stress on FTE

Safety Challenges - 3

Is it Safe?

- **Only Nova employee on site was the Test Pilot**
  - Workload and Stress
- **US MRO had to be talked through EASA requirements**
  - Workload
- **Support from UK required round the clock working**
  - UK Workload

Test Execution

A Plan Comes Together

- **US DER Test Pilot arrived to assist on Friday**
  - Provided sanity check of plan and sounding board
- **Memphis Airport use organized by phone (11,000ft Rwy)**
  - Team very helpful and Low traffic due to pandemic
- **VFR Flight Planning in the USA not complicated**
  - www.1800wxbrief.com

Test Execution

A Plan Comes Together

- **Test campaign consisted of 3 flights**
  - Total of 7 hours
- **Weather throughout was excellent with light winds**
  - Allowed for stable approaches
- **All test points flown, but not all data gathered**
  - Data analysis overnight to determine next flights plan

Was it Safe?

Yes, with reservations

- Extensive UK planning and FFS training confirmed viability
- Support from Nova that NO! was an option
- Safety was maintained but test data was compromised
- Arrival of DER Test Pilot alleviated a lot of stress
- UK team support at all times of day or night invaluable
- US Test Team were highly professional and accepting of change
- Acceptance of ‘non type rated’ TP by Albastar crew

Was it Safe?

How much do you need to check?

AIRCRAFT RESCUE AND FIRE FIGHTING SERVICES

The Aircraft Rescue and Firefighting Department meets all the requirements of FAA Part 139 Index E, although it is published as an FAA Index A airport. The department has two 3,000 gallon ARFF vehicles and two 1,000 gallon vehicles. It is staffed 24 hours a day, seven days a week with personnel fully trained in FAA regulations and first responder procedures.

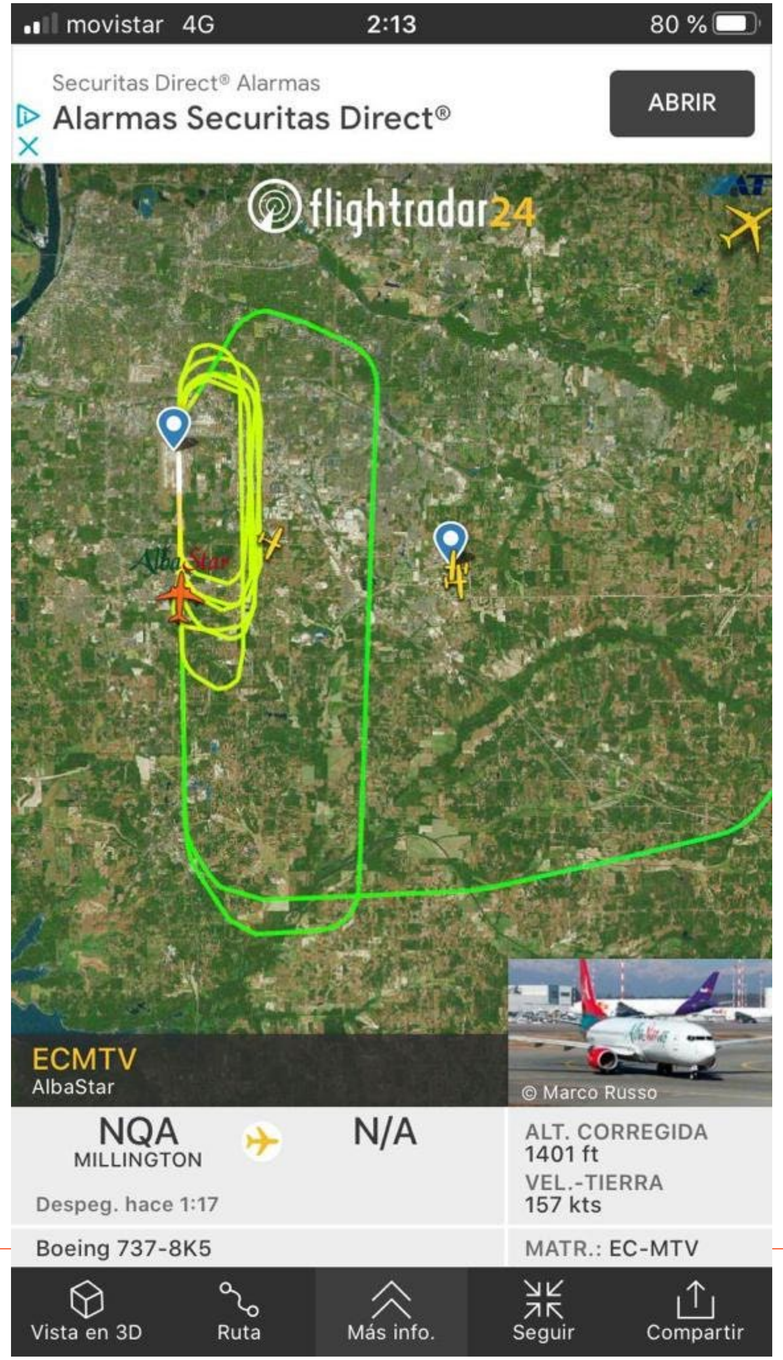
It is staffed 24 hours a day, seven days a week

Nova Lessons learned

- **We will always send 2 test personnel for test conduct**
- **Communication is key**
  - Without talking to AlbaStar, the original TP or other test crews we would not have information to make decisions
- **Relationship building is key**
  - Treating all parties with respect will overcome many obstacles
- **Don’t try and achieve everything when time is limited**
  - Flights were demanding and performance drop off noted after 3 hours of testing

Nova Lessons learned

- **You are always being watched!**



Questions?