Vertical Flight Society
Transcend Air and the Vy 400R: VTOL for VIP Transport

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Question & Answer Session

MODERATOR  
Harry Nahatis  
President, East New England Chapter of VFS

SPEAKER  
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QUESTION

Why are you showing the aircraft with skids rather than wheels? Wouldn’t there be an performance advantage to do a rolling takeoff?

ANSWER

• We have chosen to focus on out-competing conventional helicopters. We will likely offer small caster wheels on the R model to facilitate taxiing at airports, but we have no plans to certify rolling takeoffs or landings. We judge the additional certification cost and risks not to be worth the capability for our target customers and missions.

QUESTION

What are your current design challenges to design and build a full-scale plane?

ANSWER

• We are ready to embark on a detailed design for our full-scale manned prototypes as soon as that phase is funded. We believe at this point that we have addressed all the major design challenges that we can, short of building and flying at full scale.

QUESTION

Could you comment on Vy 400's hover performance vs. competitive conventional helicopters for the missions anticipated in your markets?

ANSWER

• It hovers out of ground effect (HOGE) at 100F at 5,000' MSL (HH). Hover duration is only limited by fuel on board, so could be up to approximately 2 hours. In simulation, it hovers nicely at altitudes in excess of 10,000'.

QUESTION

What engine options are you considering for the Vy 400?

ANSWER

• Currently certified turboshafts.

QUESTION

Is it planned to have a pressurized cabin?

ANSWER
- Yes, to 8,000’ cabin altitude, same as airliners, vs a max certified ceiling of 20,000’.

**QUESTION**

What technologies and techniques are you using to achieve the dramatic price difference from the AW609?

**ANSWER**

- Several! First, we use propellers, not rotors, and constant speed propellers are approximately 10 times less mechanically complex than rotor heads and rotor blades. Plus, with the 609, they have to achieve and certify safety versus all the NxN interactions of those complex systems, which takes it from 10x to 20x or perhaps 100x the required testing.
- Second, single engine, so no cross-shafting with complicated clutches for failover, and no need to write flight control system software to manage all of the interacting fault conditions safely. Again, no need to test all those NxN failure conditions.
- Third, we do not tilt the engine, so no need for special cooling and lubrication to support that. Fourth, no wheels, no brakes, no controls for same. Fifth, single pilot, so no second set of inceptors and displays with redundancy and testing costs as above.
- Smaller structure, half as many engines, much simpler drive train, fewer systems, simpler systems, dramatically simpler FCS requirements - it all boils down to the Vy being a much simpler design.

**QUESTION**

To what extent are you participating in the efforts to mature and demonstrate electric actuators with the bandwidth, fault tolerance and jam-proof operation required for flight-safety-critical rotor control?

**ANSWER**

- We aren’t, since we are not using rotors, the Vy 400 being a tiltwing with propellers. However, we have identified off-the-shelf actuators from several major aerospace OEMs that will meet our requirements for our flight control surfaces and propeller pitch.

**QUESTION**

How safe is a parachute at low altitudes?

**ANSWER**

- At very low altitudes, it offers no value, and we rely on meeting and exceeding Part 27 (light helicopter) crashworthiness standards, including 30 g seats, fuel tank bladders, etc.
- At altitudes above several hundred feet, it will bring the aircraft down at a speed that will protect the occupants from harm.
• In between, the Vy 400 will have a height-velocity curve (H-V) like any single engine helicopter, or many loaded twin helicopters. The H-V curve will delineate the required forward speed before gaining altitude to enable either (a) an autorotation that will result in a good outcome, or (b) a parachute deployment that will slow and orient the aircraft so that its frangible structure (like car crumple zones) can be relied upon to protect the occupants. We are fortunate to be working on (b) with BRS.

QUESTION

What impact will the COVID-19 pandemic have on your business case?

ANSWER

• It may improve the attractiveness of the R aircraft for private use. To the extent it ends up making regular plane tickets more expensive due to reduced load factors, it will make even more routes cheaper door-to-door for people flying the Vy on our airline.
• In the near term, the uncertainty is hitting our aerospace partners and slowing our progress somewhat, but we are structured to handle that OK.

QUESTION

What is the proposed disc loading?

ANSWER

• 18.5 lbs/sqft

QUESTION

Given your prior co-founders experience in EVTOL, why not EVTOL?

ANSWER

• Batteries can’t power the mission yet. Hybrid doesn’t help since we use more power in cruise than hover.

QUESTION

How are you addressing the issues encountered by the experimental tiltwings of the 60s (such as the CL-84)?

ANSWER

• So far, via through reading of historical documents on the CL-84 and other tiltwing programs; consultation with experts from NASA, Bell, Boeing, PiAC, and elsewhere; detailed numerical analyses; full-scale simulated flight test; and 1:5 scale flight test. We have found that individually activated flight control surfaces managed by a fly-by-wire FCS
have let us develop good flight qualities through identifying and managing regimes with non-linear dynamics.

QUESTION

Can you say something about timescales?

ANSWER

• At the beginning of 2020, pre-COVID-19, we expected entry into service in 2025. Not clear if that is still achievable, will revise as needed when the global A&D market settles down.

QUESTION

Multiple electric aircraft designs have placed propulsion systems at the wingtips. What considerations are given to asymmetrical yaw in the event of a single engine failure? Does distributed electric propulsion minimize this concern?

ANSWER

• A benefit of our single engine and mechanical drive train design is that particular failure mode is impossible. The props are geared together and must turn at the same speed, or else the driveshafts are designed to shear, un-powering the props.

QUESTION

What is driving the 1800shp? Rate of Climb, fast cruise speed?

ANSWER

• Fast cruise speed and transition dynamics, though we love the rate of climb benefit.

QUESTION

Where is engine exhaust flow path?

ANSWER

• Out above the empennage.

QUESTION

Will it contain any Icing Protection Systems? Certified for flight into known icing (FIKI) conditions?

ANSWER

• Yes, we will use icing protection on the engine intake and electric anti-icing for FIKI in
airplane mode. We do not currently intend to certify the Vy 400 for FIKI in helicopter mode.

QUESTION

Does it use a conventional swashplate cyclic control?

ANSWER

• No cyclic, they are propellers with collective only. We can use wing tilt dynamically to control pitch in the event of a tailfan failure in hover, but much lower cycles per second are needed than for a rotor cyclic control.

QUESTION

What is the Wh/kg tipping point to make it viable for you?

ANSWER

• We need viable battery tech that can deliver pack-level energy density of above 1,000 Wh/kg (including cells, pack structure, cooling system, shielding, and safety systems).

QUESTION

Is this going to be an aluminum design?

ANSWER

• Not determined yet. There appear to be no compelling weight or performance benefits to either aluminum or carbon fiber at this scale, so secondary concerns will determine the choice as part of the certification detailed design effort. That said, we like the maintainability of aluminum, and the fact that existing fire codes and fire safety systems already accommodate it.

QUESTION

BETA have quite publicly denounced the complexity of tilt rotors and tilt wings in favor of lift+cruise, citing the propeller pitch adjustment as one of the primary issues. Do you find that changing propeller pitch is a source of great complexity for you and how have you decided on tilt wing?

ANSWER

• We respect the BETA team, and they are certainly right that lift+cruise is dead simple. However, it results in higher weight and drag, and that is unacceptable for our high-speed mission. Fortunately, we have been successful managing transition dynamics through coordinated propeller pitch and other control surface movements. That learning is some of our key intellectual property.
QUESTION

I am a consultant in Zero Emission Aviation projects, from Avignon (France). One of the major limitations for operations in urban environment for helicopters and small turboprops is getting from environmental criteria, especially noise. How is Vy 400 going with dB figures, especially comparing with helicopter noise performance? Don't you think it should push quickly for electric propulsion, coping also with zero emission projects.

ANSWER

• Firstly, limiting noise is certainly an important design goal. Having flown 15 electric VTOL aircraft, we can state with authority that electric does not automatically equal quiet. Aircraft are not cars, yet many people seem to believe that because electric cars are very quiet at slow speeds, electric VTOL aircraft will be quiet at full power in a hover.

• How noisy a design is emerges from a complex set of system tradeoffs, while how annoying that noise is comes from a larger socio-economic context. Noise that benefits the hearer is much less bothersome, which is why our airline's low fares for all travelers will enhance acceptance of the noise remaining after we have taken all the design and operational steps we can to reduce it.

• Our main propellers have a design tip speed of about Mach .5, which is considered "quiet." Our tailfan is being diligently, and iteratively, refined to minimize noise while delivering the required thrust. The turbine noise will be reduced somewhat via several techniques, some obvious and some proprietary.

• One advantage of our dual propeller design vs conventional helicopters is it does not have the low frequency "whop-whop" BVI component that comes from slower-turning rotor blades. That low frequency is transmitted well by building structures and is thus infeasible to soundproof against. The higher frequencies produced by the Vy can be mitigated in nearby buildings when and where necessary with standard sound deadening techniques.

• Secondly, sustainability is certainly our goal, measured rigorously from the system level on a full lifecycle, fully comparable basis. One of the key environmental benefits of the Vy is enabling a significant increase in air transportation capacity without building more runways. Not taking land or sea, and not producing and pouring miles of concrete, turn out to be significant environmental beneficences. In the near term, offering a sufficiently superior service that fills a Vy flight with people who would otherwise have driven personal gasoline powered cars actually lowers direct CO2 emissions. And the use of sustainable alternative jet fuels will also significantly reduce emissions.

• In the longer term, the Vy will benefit from the same battery breakthroughs the eVTOL players are counting on when we convert existing aircraft to electric.

• Address Additional Questions To: peter@transcend.aero