Attachment 2

to the Human Performance Group Chairman's Factual Report

DCA15MA019

Simulator Test Plan Notes

Simulator Test Plan SpaceShipTwo

Aircraft: SpaceShipTwo Simulator
Airport: Mojave, CA

Participants:	Simulator Operator:	Mike Masucci - Virgin Galactic
	Pilot/Left Seat:	Mark Stucky – Scaled Composites
	Copilot/Right Seat:	David Mackay – Virgin Galactic
	Observers:	David Lawrence - NTSB
		Katherine Wilson - NTSB
		David Gerlach - FAA
		Christy Helgeson - FAA
		Clint Nichols - Scaled Composites

The simulator test plan was run on November 4, 2014, from 1500 until 1635 in conjunction with the Operational Factors Group. Eight test runs were conducted to document the various timing from release of SpaceShipTwo from WhiteKnightTwo until 1.8 Mach. The simulator test plan and results were documented in the Operational Factor Group Chairman's Factual Report Attachment 10 "SS2 Simulator Test Plan."

The Human Performance Group made the following additional observations:

- If feather was not unlocked by 1.5 Mach, a CAS aural/visual alert "FEATHER LOCKS" would appear on the center MFD. Some pilots may feel embarrassed by triggering the CAS message because it indicated the pilot was not flying as perfect as he could be. CAS message will disappear once feathers are unlocked.
- Nz (similar to G) could pass through 1.4 around 0.8 Mach. However, Nz changes very quickly and a pilot's visual scan never dwelled on Nz during simulated runs. Not in same location on PFDs (Mach was located at top center, Nz was located at left and lower), but both white and same font size. No pictures of display taken in sim.
- Seats: cushions on back of seatback (in lieu of parachutes) and bottom of seat specific to each pilot. Varying thickness used to adjust pilot's view out window. Seat cushions easily changed out. Seat was not adjustable. Rudder pedals could be moved by maintenance action only (remove seat to access pedals) to make specific for pilot. Some pilots used rudder blocks on pedals themselves (brackets to fit width of pedal). Brake cylinders aft of pedals, so not much room to adjust. Accident crew used nominal seat cushions and no blocks on pedals on the day of the accident flight.
- "Eyebrow" lights (i.e., back up indicators) on left top side of instrument panel: NOT LOCKED amber light on top of OK TO LOCK green light below. Green light will only illuminate when the feather is in the down position. Simulator did not have actual lights installed; just labels.
- Primary flight displays (PFD):
    - KEAS on top left of display with Nz: under and Nx: under that (both in white).
    - Mach: top center of display with TAS: under (both in white). ADI info below this.
    - Altitude information on top right of display. Baro setting under that near center of display.

- Center console feather controls:
    - LT FEATHER/RT FEATHER: 2 handles pinned together. Handles with labels on each part of handles. Feather was actuated by pulling FEATHER handle out (away from instrument panel) to stop.
    - LT FEATHER LOCK/RT FEATHER LOCK: 2 handles pinned together. Handles with labels on each part of handles. To unlock feather, pilot would move handles right past detent and slide handles down to unlock position. FEATHER UNLOCK label could been seen when levers were in the up position and UP TO LOCK label could be seen when levers were in the down position. The Virgin Galactic chief pilot mentioned the levers had the detent since he instinctively moved them like thrust levers during a crosswind landing (same location as previous airline aircraft he had flown). He was not sure if this was in the simulator or in flight.
- Controls moved in specific sequence to operate feather locks. Feather could not be actuated while feather was in locked position due to relative position of handles.
- Simulator sessions would have been done with "day of" winds on last minute practice sessions. Most practice sessions were run with a standard atmosphere and minimal winds. As they got closer to flight day, they would start to inject more realistic expected day of winds and then once they had the actual forecast for day of winds, they would put them in the simulator. The ability to add the forecast winds was a major training aid that close to the flight.
- New trim information was added to both PFDs. Some pilots were not aware of trim additions until they saw it in the simulator prior to the accident flight.
- One pilot commented that he did not expect the bobble to be as pronounced as it was in actual powered flight and later found out the former chief aerodynamicist did not expect it either.
- Virgin Galactic planned to take control of SpaceShipTwo around mid-December 2014 and had some design changes planned.
- Pilots made comments during vertical and space flight to address/correct "1 axis at a time".
- Pilots train primarily in the simulator in civilian clothing, and rarely in the clothing worn during a test flight (flight suit, helmet, oxygen mask, gloves).
- Feather unlock handle has greater tension/force in the aircraft versus the simulator; motion is slight pull to right and down to unlock.
- In some glide flight simulator sessions, simulator run speed was increased (aircraft speed stayed the same) during descent to landing to avoid long times with minimum workload.