Federal Aviation Administration

Memorandum

Date: February 6, 2020

To: Michael Drew, Manager, Delta CMO-27

From: Shane Pengelly, Principal Operations Inspector, Delta CMO-27

Subject: Delta Flight 89 Fuel Jettison - UPDATE

Purpose/Goal: The purpose of this Briefing Paper is to inform CMO Management of the preliminary facts concerning the compressor stall which lead to an engine failure and subsequent fuel jettison on Delta Flight 89 from Los Angeles to Shanghai, China.

February 6, 2020 UPDATE:
This document is being amended to provide the investigative results pertaining to this event. (Reference "Investigative Results" section on page four (4) of this document)

Overview: After departure from LAX the crew experienced a compressor stall which lead to an engine failure at around 8,000' and a subsequent return to LAX. During the return, the crew jettisoned fuel. Fuel jettison began over an unpopulated area and at an altitude that allowed for fuel to atomize. During the return to LAX, the flight overflew a populated area and descended to an altitude that did not allow for the fuel to fully atomize.

Background: **Preliminary Details (Subject to Change)**

- Flight information:
  - Flight date 01-14-2020
  - Flight 89 (LAX – PVG / ZSPD)
  - Aircraft: Boeing B-777-232ER, Ship Number 7004, N863DA
  - Flight Crew Compliment: Four Pilots
  - Passengers on Board: 149
  - Souls on Board: 167
  - Flight Time, Take Off to Touch Down: 28 minutes
  - Out 1915Z, Off 1932Z, On 2000Z, In 2011Z
- During initial climb out at approximately 8000' AGL, crew observed 4.5-5.0 engine vibrations and audible surging on the right engine.
- Captain (CA) was pilot flying

- CA performed memory items, First Officer (FO) read the appropriate Quick Reference Handbook "ENG LIM / SURGE / STALL" procedure.
- Right engine was retarded to idle and engine surging ceased
- Engine was operated at idle for the rest of the flight
- The Air Traffic Safety Report confirms that the CA did declare an emergency with ATC
- Preliminary review of ATC recordings shows that the Crew declined holding to dump fuel
    - ATC asked, do you need to hold to dump fuel
    - Crew responded "negative, we need to return to LAX, to 25R"
- Crew initiated fuel jettison procedures while at approximately 8000' and continued down to approximately 2500' AGL
    - The timeline and reasoning behind this is still under investigation, however information provided below relates to how Delta pilots are trained for this type of situation
- Preliminary report states approximately 85,000 lbs of fuel was dumped
- Aircraft landed LAX on runway 25R full length.
- Runway 25R is 12,923' long and is the longest runway
- Landed approximately 65,000 lbs over maximum landing weight
- Ship 7004 Maximum Takeoff Weight 656,000 lbs. Maximum Landing Weight 460,00
- Aircraft Fire Rescue (ARFF) met aircraft to inspect brakes and engine
- Brake temperatures were no factor, aircraft taxied to the gate with ARFF escort
- Operations Specification B029 entitled Drift down or Fuel Dumping for CFR Terrain Clearance Requirements amendment 10 was signed 10-29-2018 and includes the B-777-200.
    - This Ops Spec does authorize the B777 for fuel dumping by referencing the associated procedures to follow which are housed in the Quick Reference Handbook.
    - In this specific case, the minimum safe altitude for the flight to return to the airport was 7700 feet which may have contributed to the flight crew decision to dump fuel.
- Boeing B-777 Quick Reference Handbook (QRH), "ENG LIM / SURGE / STALL" procedure does not require fuel dumping
    - QRH does require a review of the Operations Data Manual for abnormal Configuration Actual Landing Distances and Approach Speeds Table – this would have been reviewed to ensure the excess fuel weight would not have an abnormal effect on landing
    - At 600,000+ lbs landing weight, the ODM would require under 6,000' of runway – this aircraft landed at approximately 525,000 lbs
        - It should be noted that this performance figure would require the aircraft to utilize maximum braking, and maximum reverse on the only functional engine
        - Maximum braking during an overweight landing increases the risk of brake failure and fire.
        - Maximum reverse thrust on only one engine, increases aircraft yaw and decreases controllability.
- FAA Approved Delta Flight Operations Manual (FOM) (Proprietary Information) states:
    - [redacted]

- [redacted]
- [redacted]

Key Attendees/Individuals of Interest: N/A

Political Considerations/ Other Dynamics:

- Major media attention to include videos of the flight dumping fuel.
- News reports and interviews of kids and bystanders on the ground.
- YouTube videos to include ATC communications
  - https://www.youtube.com/watch?v=mIA90evz8gs&feature=youtu.be
- Dumping occurred over a populated area, to include Park Avenue Elementary School.
- According to FlightRadar, news is reporting the flight passed over the elementary school at 2,300' at 11:53AM local time.
- News reports17 children and 9 adults were treated for minor injuries of skin irritation. None were hospitalized.
- Schools reporting being affected
  - Park Avenue Elementary
  - Tweedy Elementary
  - San Gabriel Elementary
  - Graham Elementary
  - Jordan High School
  - 93rd Street Elementary

Crew Considerations

- Preliminary report shows crew concerns with California coast ridgeline
- Recordings of Air Traffic audio capture the FO stating that they experienced a second engine stall increasing the factors involved with this event
- Single engine holding, in order to jettison fuel, is per Captains discretion
- Crew was coordinating with ATC, Dispatch, and Cabin personnel during this emergency
- Weather was VFR

- Winds 250/7, 7sm visibility, scattered clouds at 2,100 AGL, broken ceiling at 18,000', Temp/Dew point 15/09, Altimeter 30.13

CMO Response:

- The crew involved has been grounded by Delta pending completion of the investigation
- The crew members involved have submitted Aviation Safety Action Program Reports and are cooperating fully with the investigation
- The CMO will work jointly with Delta to determine the human factors and other potential causes related to this matter and address them accordingly

Attachments N/A

Investigative Results

- Delta's FAA Approved Fuel Jettison Procedure, in the QRH, directly aligns with the manufactures Approved QRH
- Delta's FAA Approved Flight Crew Training Manual section 8.4.84, which addresses Fuel Jettison, directly aligns with the manufactures Flight Crew Training Manual
- Aircraft was approaching 7,500' when the flight crew felt yawing during the #2 engine compressor stalls, and then power rolled back to idle
- The condition of the aircraft during the engine failure was considered critical due to the relatively low altitude and airspeed when the emergency occurred
- Crew worked to restore power to the engine, but was unsuccessful
- The Captain determined the safest course of action was to turn toward the airport, using the shortest route which kept them over land, and minimized flight over high terrain.
    - Changing course in order to fly over water would have required the aircraft to cross over high terrain a second time, on only one engine, and was a longer return route to LAX
- While returning to LAX, crew duties which consumed their focus included:
    - Stabilizing aircraft, maintaining control and navigating back to LAX
    - Accomplishing QRH "ENG LIM / SURGE / STALL" checklist
    - Determining time till landing
    - Referencing Operations Data Manual (ODM) in order to determine a safe landing weight and distance
    - Reporting to ATC multiple times, regarding weather, souls on board, fuel state, and crew requested approach and runway. As they were handed off to different controllers, they had to restate the emergency and all the information again
    - Programing of the FMS to change the destination, route, approach, runway, and performance information
    - Multiple communications with flight attendants and passengers, which included the emergency briefing for the flight attendants
    - Preparing the aircraft for arrival by briefing the expected approach, setting speed bugs, flap settings, and brake settings for the predetermined weight.
- The crew started fuel jettison at approximately 8,000' in an effort to minimize effects of an overweight landing. Delta trains its crews that 4,000' was recommended as the minimum

altitude for fuel jettison; however, this is based on crew discretion depending on the emergency being experienced. Interviews revealed that the crew was unaware that their fuel was not atomizing prior to reaching the ground and continued to jettison in accordance with their initial plan in an effort to minimize the risk associated with an overweight landing.
    - This is important because flap settings, speeds, and runway distance are all predicated on the aircrafts actual landing weight and airport density altitude.
    - Not reaching the desired landing weight would have required the aircraft to utilize Maximum braking, and maximum reverse on the only functional engine, thereby raising potential risk to landing
    - Landing at a weight other than what is known and planned for could result in a tail strike, aircraft damage, runway overrun, or loss of control during landing.
    - An overweight landing could also result in brake failure or fire
        - Note: All of the above were avoided in this event
- The crew stated that they declined holding for fuel jettison to minimize flight time during this emergency.
    - The crew declined ATC's offer to hold, but investigation revealed that they were under the impression ATC knew that they intended to jettison fuel while returning to the airport due to the urgency of the situation.
        - Their reply of "No we don't want to hold and dump fuel" assumed that ATC knew they would jettison on return to the airport to save time
- The crew jettisoned fuel to an altitude of approximately 2,500'
- Crew workload was high at altitudes below 4,000' due to ATC directed maneuvering, aircraft configuration changes, and aligning with the instrument landing system.
- Aircraft landed safely on runway 25R at LAX
- Subsequent to landing, Delta maintenance personnel found significant turbine damage in the engine and it was replaced. Engine investigation continues with Rolls Royce

Investigation revealed that fuel jettison occurring below 4000' was attributed to the crews focus on getting the aircraft to the desired landing weight in time for landing, as well as handling the multitude of other tasks ongoing while navigating back to LAX. The crew is trained to notify ATC if they are jettisoning fuel, but as with the procedural consideration to jettison above 4000', all of these are based on pilots discretion depending on the event occurring and are not required by FAA regulation.

As a result of this investigation, the Delta CMO made the following recommendations:

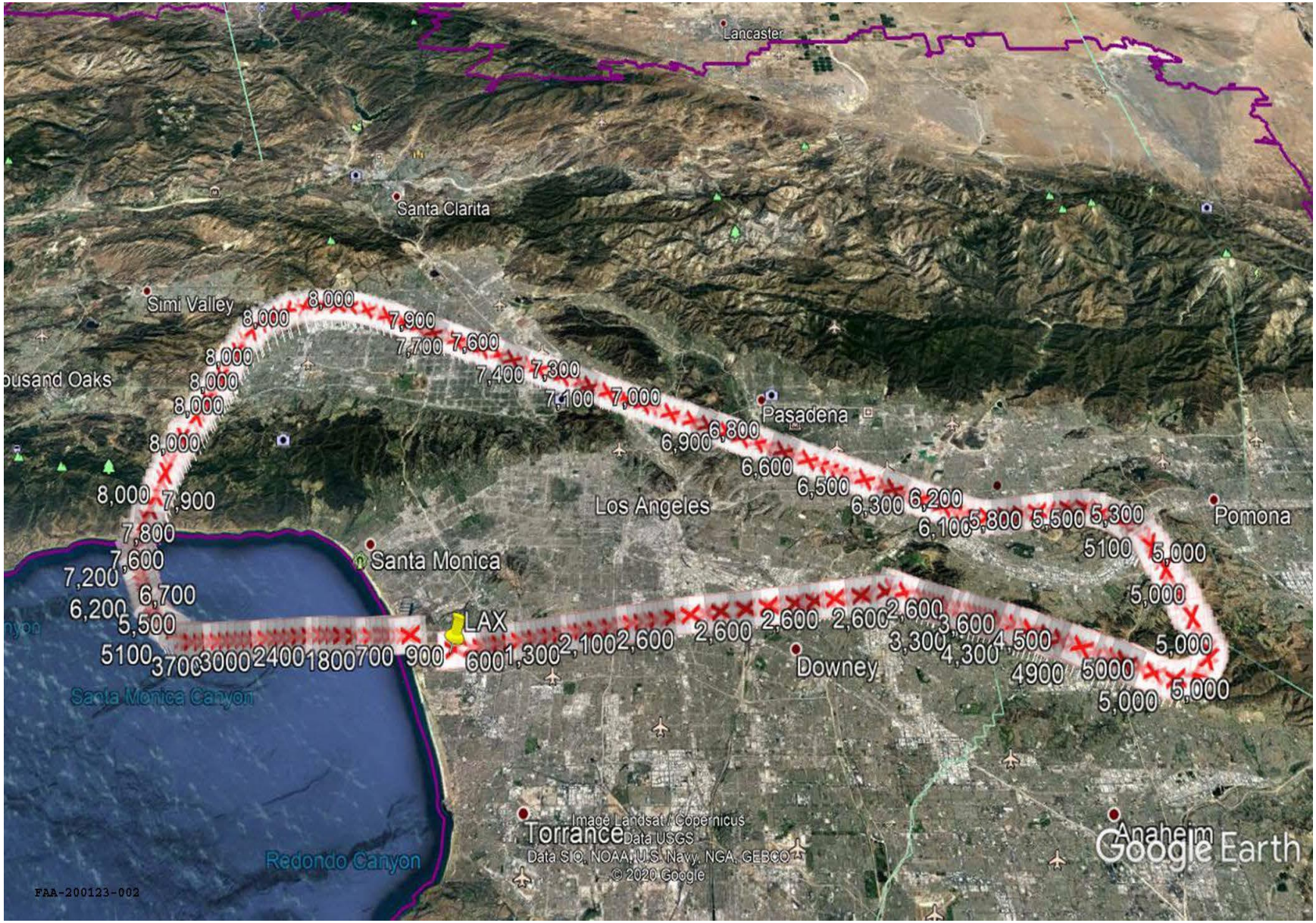
- Clarify QRH language to align with the FCTM and FOM in regard to items to consider during Fuel jettison (See bottom of page 2 above)
- Review overweight landing procedures and fuel jettison training philosophy

Delta is in the final stages of determining the appropriate response to this event. The following items are in-work:

- [redacted]

- [redacted]

The CMO expects these final decisions to be made shortly and will work concurrently with Delta on their final implementation.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