NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

January 16, 2009

FIRE INVESTIGATION FACTUAL REPORT Report No. 09-003

A. ACCIDENT

Place	:	San Francisco, California
Date	:	6/28/2008
Vehicle	:	Boeing 767-200 Freighter
NTSB No.	:	DCA08MA076
Investigator	:	Lorenda Ward

B. FIRE GROUP MEMBERS

Joseph Panagiotou	NTSB	Fire Group Chairman
David Blake	FAA	Fire Group Member
Rob Morrison	FAA	Fire Group Member
Matthew Anglin	BOEING	Fire Group Member

C. ACCIDENT SUMMARY

On June 28, 2008, about 2215 Pacific daylight time (PDT),[1] an ABX Air Boeing 767-200, registration N799AX, operating as flight 1611 from San Francisco International Airport (SFO), San Francisco, California, experienced a ground fire before engine startup. The fire was located in the supernumerary area,[2] so the two pilots had to egress the airplane through the cockpit windows. No injuries were reported, and the airplane was substantially damaged. The cargo flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121. At the time of the fire, the airplane was parked near the DHL loading facility and all of the cargo had been loaded

[1] All times in this report are PDT based on a 24-hour clock unless otherwise noted.
[2] The supernumerary area is the portion of the airplane that is located directly aft of the cockpit and forward of the main deck cargo compartment. This area is where the lavatory, galley, and three non-flight crew seats are located.

D. DETAILS OF THE ON SCENE INVESTIGATION

The fire group arrived on scene on Monday morning June 30, 2008, and began the examination of the accident aircraft that afternoon. Additionally, a follow up examination of the accident aircraft took place on August 5th.

Aircraft Exterior

The exterior of the aircraft when viewed from ground level (figure 1) exhibited fire damage in an area between the left flight deck window and the L1 door. This damage was blistered paint and melted fuselage skin which created an opening into the aircraft. When using a lift truck and viewing the aircraft from above, large areas of crown burn-through were observed (Figure 2). The burn-through areas were centered over the lavatory and the supernumerary compartment of the aircraft. No other areas of the aircraft exterior exhibited any signs of fire damage.

Figure 1: Exterior view of the accident aircraft showing burn-through damage at lavatory location.

Figure 2: Burn-through on crown of accident aircraft centered over the supernumerary compartment

Main Deck Cargo Compartment

The main deck cargo compartment was located in the above deck area of the aircraft just behind the supernumerary compartment and extended the length of the aircraft to the tail cone. Separating the supernumerary compartment from the cargo compartment was a smoke barrier wall and the 9G net. Between the smoke barrier wall and the 9G net was a narrow walkway approximately two and a half feet wide. There was a door on the smoke barrier wall on the left side of the aircraft allowing movement between the supernumerary compartment and the cargo compartment. There was a large cargo door on the left side of the aircraft for loading and unloading cargo containers from this compartment. The way this aircraft was configured, it had room for 19 containers (figure 3) by having two containers per each cargo position plus a single container at the rear most position. The accident aircraft had all 19 containers loaded.

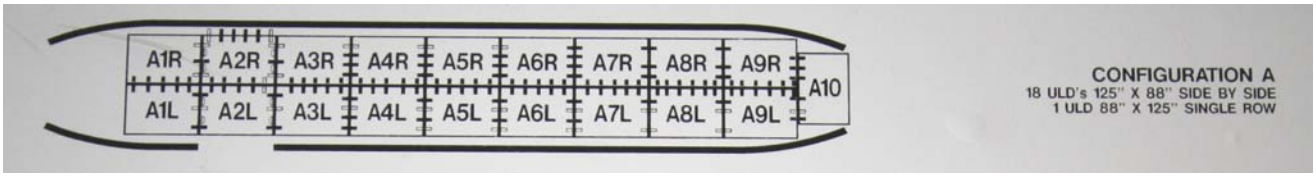

Figure 3: Cargo loading configuration for accident aircraft

The main deck cargo door was opened to inspect the interior of the cargo compartment. The cargo position at the location of the door is cargo position A2L as seen in the diagram of figure 3. The container at this position (figure 4) had soot adhering to its surfaces, with a heavier concentration along the top half of the container. The contents of this container had a light coating of soot on them but no other type of fire damage.

Figure 4: Container A2L in position at cargo door location

Container A2L was removed to inspect container A2R. This container can be seen in figure 5 below. This container exhibited external thermal damage, more heavily concentrated along the top half, but no fire damage to the packages inside, except for a light soot coating. The top two feet of this container exhibited areas of melted clear Lexan window material and the top of the rollup door was charred. This container was removed from the aircraft to examine containers A1L and A1R. The cargo liner above the number two cargo loading position was heavily fire-damaged and mostly missing or hanging vertically. From the number two cargo position, the aft-facing portions of the cargo containers in position one could be examined. The backs of these containers can be seen in figure 6. These containers had sustained thermal damage and soot accumulation to their upper portions. Viewing these containers from the forward facing side, by entering the cargo compartment from the supernumerary compartment, revealed that the front and top portions of these containers had sustained thermal damage resulting in burn-through and melting of the forward facing container walls (figure 7). Both containers were melted from a height of 55 inches above the floor in the center of the cargo compartment extending outboard and up to the top of the container on the outboard edges. The A1R container was loaded with rugs, which did not appear to have been involved in the fire (figure 8). The rolled up rugs had some external damage to their packaging in the form of

soot and charred material, but had not otherwise been involved in the fire. The A1L container had an assortment of cardboard boxes inside (figure 8). This container was filled to approximately 40% capacity by volume. The top layer of boxes inside this container had charred sides and heavy deposits of soot. The damage to the boxes was external and confined to the top most layer, indicating that the fire did not originate from within one of the packages of this container. The remaining containers in the main deck cargo compartment, from cargo position two and aft, were progressively less affected by the fire along on their tops. Some of containers that had Lexan windows, had melted areas which created an opening into the container. The contents of these containers were not involved in the fire. A light coating of soot was seen on some of the packages inside these containers.

Directly in front of the two containers in the number one position was the 9G cargo net. The upper portion of the 9G cargo net was missing from a height of 32 inches above the floor in the center outward and up to just below the top of the cargo containers on the upper outboard edge. The remaining sections of the cargo net were heavily charred and sooted. At the base of the 9G net there were blobs of plastic material stuck to the floor that appeared to have originated from the material of the 9G net.

Above the number one cargo position and extending aft, the cargo liner along the ceiling was mostly missing (figure 9). Portions of charred cargo liner material were hanging vertically from the ceiling in various locations.

Figure 5: Container A2R in position inside the main deck cargo compartment

Figure 6: Aft facing portions of containers A1L and A1R

Figure 7: Forward facing portions of containers A1L and A1R

Figure 8: Contents of the containers in the number one cargo position

Figure 9: Ceiling cargo liner missing above cargo positions 1 and 2

The smoke barrier wall separating the main deck cargo compartment from the supernumerary area was constructed of a fiberglass-faced honeycomb-core composite panel material. The wall was constructed with a lateral center section and aft angled outboard sections (figure 10). The aft fiberglass face, of the smoke barrier wall, was mostly intact and the decorative finish was burned along the upper areas but was mostly present on the lower areas. The top edge of the vertical wall was no longer connected to upper aft angled section and the remains of the wall had fallen aft into the area between the 9G cargo net and the original location of the wall. The lower edge was still mostly connected to floor structure. When

the fallen center section was raised back into the upright position (figure 11), it extended to a height of 77 inches above the cabin floor. The forward facing fiberglass face of the center section of the wall was charred from floor to ceiling and detached and/or missing in most places. The honeycomb inner section of the center section of the wall was either missing or charred in most locations. An 18 inch wide by 18 inch high section on the lower edge of the middle of the lateral wall was burned away. The left and right lateral wall sections were not connected. An aluminum strip normally connects the two sections but was melted away on the accident airplane. There is normally an upper section of the center wall that extends up and aft to connect to the ceiling of the cargo compartment near the top of the 9G cargo net. Some sections of this material were observed partially attached to parts of the center wall and partially attached to some sections of cargo liner ceiling material that had also collapsed from its normal position.

Both the left side of the angled outboard section (figure 12), which contained the cargo compartment entry door, and the right side of the angled section (figure 13), which contained an upper and lower blowout panel, were still standing. The forward facing fiberglass face of these wall sections was charred from top to bottom. The aft facing fiberglass face was charred in the upper section and sooted but unburned in the lower section. The right, aft angled, portion of the smoke barrier wall in this area had undamaged cargo liner from the floor up to approximately 35 inches on the front and 50 inches on the rear. The cargo liner was charred above the undamaged portion and further up it was detached from the structure and hanging down exposing the insulation material behind. The insulation's face sheet was burned off and the fiberglass batting was blackened. The fire damage to this wall sloped upward from the front to the rear. The same fire damage was observed on the left side aft angled portion of the smoke barrier wall with approximately the same proportions of unburned, charred and detached cargo liner. The door located on the left portion of the wall connecting the main deck cargo area to the supernumerary area was undamaged at the base and showed progressively more charring going towards the top. The blow out panels on the right side portion of the smoke barrier wall retained the decorative face sheet on the aft face and were charred on the forward face. The blow out panels were found detached from the smoke barrier wall. Overall, the smoke barrier wall was more heavily damaged in the center with the damage extending up and outwards. The galley mat in this area between the smoke barrier wall and 9G net was intact and retained its non-slip texture. In the middle of the floor in this area there was some debris adhering to the galley mat at the base of the smoke barrier wall near the aircraft's centerline. No sign of blast damage or an overpressure event was observed in this area.

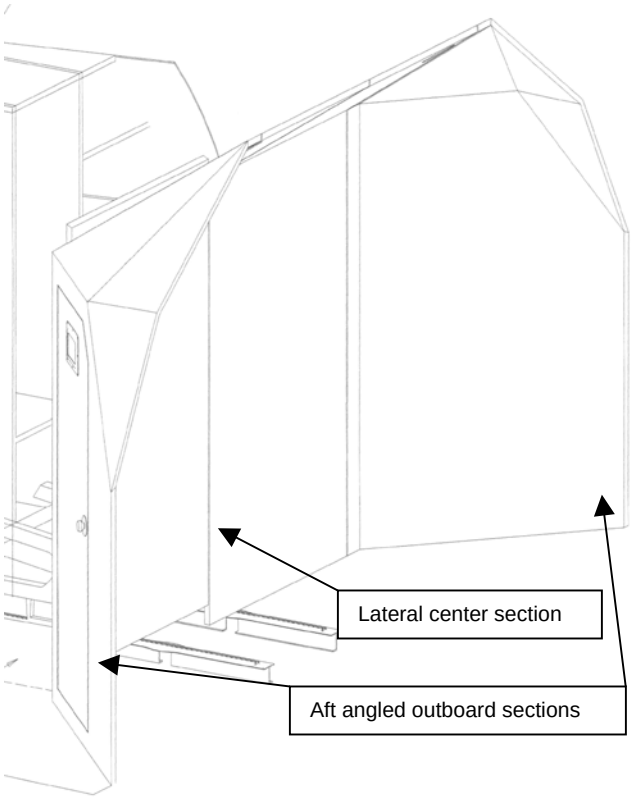

Figure 10: Diagram depicting the original shape of the smoke barrier wall

Figure 11: Aft facing side of smoke barrier wall. The wall is being held up in place after the loose fire debris had been removed from the area.

Figure 12: Left side of smoke barrier wall

Figure 13: Center and right side of smoke barrier wall

Flight Deck Area

In the flight deck, the captain's and first officer's escape windows were found in the open position (figure 14). The ceiling area of this compartment was covered with soot, as were almost all of the other surfaces inside the flight deck (figures 15, 16). Heavy thermal damage was more notable in the aft portion of the flight deck ceiling. The flight deck ceiling housed the circuit breaker panels (figure 17). The aft most sections of the panels had been exposed to high temperature and some of the breakers had fallen down onto the floor and onto the two seats behind the captain's and first officer's seats. The bulkhead separating the flight deck from the supernumerary area of the aircraft was damaged by fire. The fire damage was in the form of charring and discoloration of the panels. This damage was concentrated along the upper portions of this bulkhead and did not extend all the way down to the floor. The thermal damage extended approximately 3 feet downwards from the ceiling. The remaining distance, from the thermal damaged area down to the floor, was covered with a light soot coating but was otherwise intact. On the left side[3] of this bulkhead wall, outboard of the door, was a small area of burn-through approximately one foot in diameter. There was also a small area of burn-through in the bulkhead wall to the right of the flight deck door up towards the ceiling. The fire damage indicated that the fire entered the flight deck from the aft of the aircraft and worked its way from the flight deck ceiling forward and downwards. No sign of blast damage or an overpressure event was observed in this area.

Figure 14: Flight deck of accident aircraft

[3] References to left or right in this document always relate to aircraft left or right even when not explicitly stated.

Figure 15: Left side of flight deck

Figure 16: Right side of flight deck

Figure 17: Circuit breaker panel on flight deck ceiling

Supernumerary Compartment

The supernumerary compartment was the portion of the aircraft between the smoke barrier wall and the flight deck bulkhead. This area contained seating for three passengers in the form of a bench seat, which was located in the center of this area at the base of the smoke barrier wall (figure 18). The supernumerary compartment also contained a small galley area and a lavatory compartment (figure 19). Two aluminum electronic boxes were mounted on the forward right side of the smoke barrier wall (figure 20, 21). The upper box measured 15 inches high x 14 inches wide x 12 inches deep and housed the weight and balance computer. The forward facing surface of this device was completely melted except for a very small corner on the lower outboard edge. The inboard face was mostly present except for a small melted area on the forward inboard side. The remaining surfaces were charred and sooted. The lower box contained a printer that was partially melted on the inboard upper corner. The remaining surfaces were intact but charred and sooted. The emergency locator transponder (ELT) was originally above and to the right of the weight and balance computer. It was found on the floor on the right side of the supernumerary area near the base of the R1 door (figure 21). The aluminum casing of the ELT was severely melted along the top half. Two D size lithium batteries that were found, after disassembly, to have vented, were the power supply for the ELT. One vented from the top and one appeared to have vented from the top and side (figure 22).

The fire completely consumed the seats of the supernumerary compartment and only small portions of the seat frame remained. A portion of the right side of the seat frame was

found in its original position loosely attached to the floor slightly inboard of the weight and balance computer. A portion of the left side of the seat frame was found to have fallen into the opening in the floor leading to the electronic and equipment bay below. The cover to this opening had been removed by the fire fighting crew in their attempts to gain access to the supernumerary area from below deck. The galley mat in the supernumerary area was heavily fire-damaged in the center portion of the compartment. A hole was present in the floor in the location where the middle seat would have been located. This location would have had a grill vent leading to the E&E bay below. The fire consumed the grill vent. The fire damage to the floor was heaviest in the area that would have been under the passenger seats. Moving radially outward from the area under the seats, the fire damage to the floor abated such that within a few feet inboard of both the L1 and R1 doors, the galley mat was undamaged and retained its original non-slip texture. The fire consumed the ceiling panels in the supernumerary compartment and only charred portions were found lying on the floor. The crown of the aircraft above the supernumerary compartment had burned through. There were two large burn-through areas one to the right and one to the left of the crown centerline. There was also a smaller burn-through area on the skin above the lavatory. Two small burn-through holes were also noted in the centerline of the crown at the forward most area of the supernumerary. Electrical wiring found in the supernumerary compartment, which would have been concealed above the ceiling panels, was examined for signs of arcing. No such evidence was observed.

Figure 18: Supernumerary compartment of an exemplar aircraft. Panels removed on from of bulkhead containing oxygen mask stowage boxes.

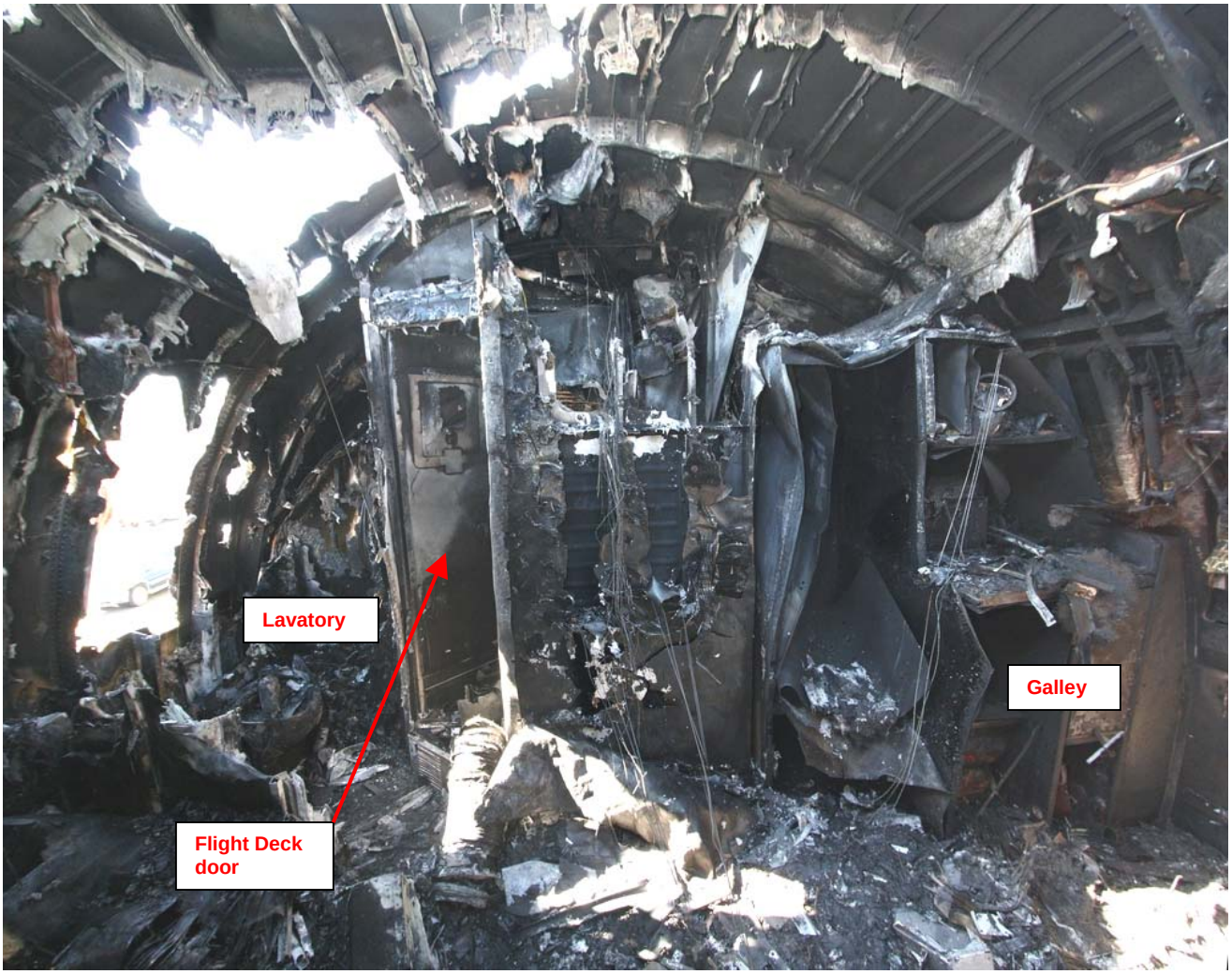

Figure 19: From inside the supernumerary compartment looking forward

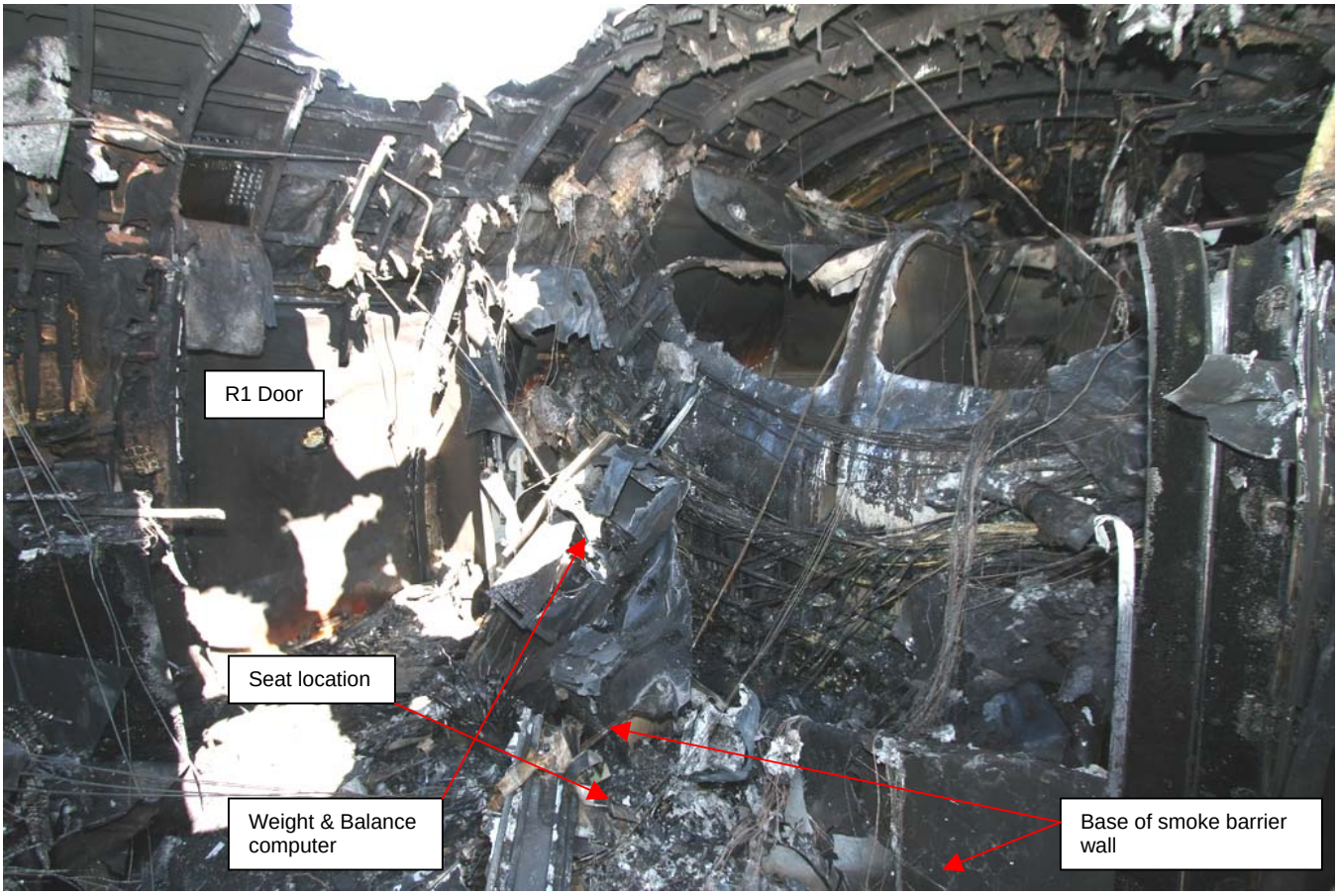

Figure 20: From inside the supernumerary compartment looking aft

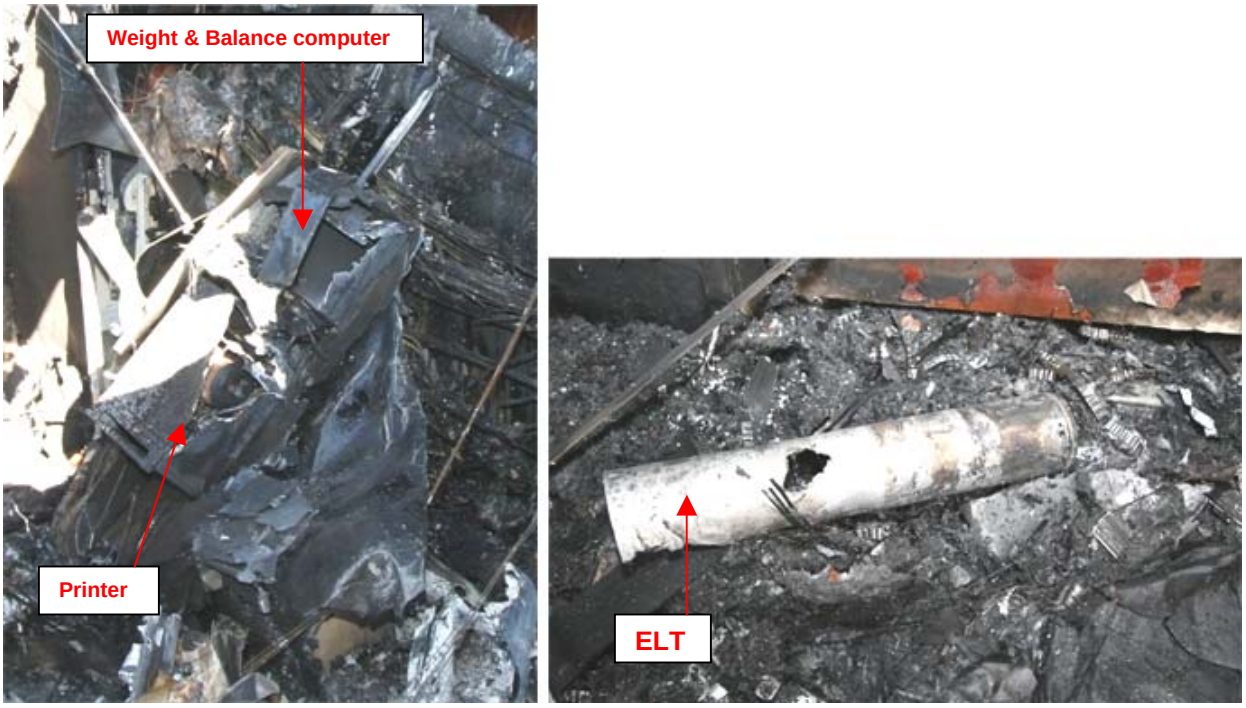

Figure 21: Remains of Weight & Balance computer, Printer and ELT

Figure 22: Vented D size Lithium batteries from ELT

The galley area of the supernumerary compartment was heavily sooted. The cabin ceiling above the galley was mostly missing up to the crown. The galley's upper right storage compartment was missing its door, with the hinge still hanging on the galley structure. Inside the cubby were the remnants of 14 bottles of water, 2 bottles of creamer, numerous packets of sugar, and a half full (approximately 30oz) can of Swiss Miss hot chocolate. Underneath this compartment was the microwave and coffee pot. The microwave had heavy thermal damage and the coffee pot next to it was intact but with heavy sooting. All the shelves and walls of the galley were mostly intact, but heavily sooted. The left-most galley wall, next to the center of the flight deck bulkhead, buckled and collapsed from thermal and fire damage. The trashcan was found to be empty and intact as well as the 2 life rafts adjacent and under the trash can area. The insulation blankets above the galley were still in place, with only the batting material burned away. The soot became heavier on the blankets further up towards the crown area. The insulation around the area of the supernumerary oxygen supply line was in good shape and still had its batting material on it. The electrical wiring around the area of the oxygen supply line was fire damaged but intact with no signs of arcing. No signs of arcing or other failure were noticed on the stainless steel oxygen supply line either.

The lavatory compartment sustained very heavy fire damage. The forward wall of the lavatory was burned through in areas at the top and in the center. Through the area in the center the flight deck was visible. The top area was approximately 8" tall and followed the fuselage arc from left up to the right to the inboard wall of the lavatory. The reinforcement had pulled away from the structure on the upper left. The center area where burn-through occurred was approximately 30 inches tall and 24 inches wide at its largest dimensions. There was a small area on the upper right portion of the burn-through area through which papers stowed in the flight deck cabinet behind the pilot were visible. Moving outward from the center burn-through area, the layers of the wall became less damaged. There were remnants of open mesh woven reinforcement around the burn-through opening, and areas of charred honeycomb and woven reinforced face skins around that. Lower portions of the wall were leaning into the side of the toilet. The least amount of damage to the wall was at the floor. At the floor the face skins of the composite panel had the fiber reinforcement intact except the resin had been consumed. The metal post on the inboard side of the wall was exposed. The entire wall was heavily sooted. The oxygen bottle that was mounted on the upper left portion of the wall was found in the lavatory toilet, in the upside-down position. It had been discharged, and the mounting brackets were not found. The lavatory door was not present. It would have been approximately 18 inches wide, with a 3 inches tall panel section above the door. The short wall sections forward and aft of the door were also mostly missing. The aft wall of the lavatory, located just forward of the L1 door, was fully consumed down to a maximum height of 37 inches. This maximum height point was measured from an aluminum post imbedded in the composite panel. On the outboard side of the wall near the fuselage structure, the wall was consumed down to the top of the aluminum life vest storage compartment. The life vests that remained in the cubby were heavily charred on the covers. On the inboard side of the wall, the wall was consumed down to a maximum height of 23 inches. On the portion of the wall that remained, the resin in the face skin was burned away and the remaining honeycomb was heavily charred. The aft face skin was folded down and hanging backwards towards the floor. The oxygen bottle that was mounted on the center of the wall near the floor was discharged and found on the floor at the base of the wall. The control panel that would have been mounted at the top of the wall was missing. The trash can fire extinguisher was found to have

discharged and was still inside the waste bin. The stainless steel sink deck was not found in its as-installed location, and had been placed in the flight deck. The stainless steel toilet was still in place. The outboard lavatory wall, installed just inboard of the fuselage, was fully consumed. Behind where the wall once was located, the fuselage skin was melted by the fire and later cut open further by fire rescue crews. The hole in the fuselage was used as the main entry point for investigators during the investigation. The flight deck door (figure 23) was not penetrated by fire. The hinges on the door were still functional on the left outboard side and the door swung inward towards the flight deck. The resin on the surface of the face skins of the door had been consumed. There were upper and lower decompression panels mounted in the door. The resin on the surface of the face skins of the decompression panels had been consumed. The outer ply on the upper decompression panel had an approximately 5 inches by 5 inches section that had been consumed. The majority of the door was heavily sooted, with an area extending from the left middle half upwards to the right that was gray in color. The grill beneath the door mounted to the threshold was mainly intact, except for a small portion in the upper left corner, approximately 2 inches by 2 inches in size, which had melted away. Above the door there were remains of molten aluminum that had dropped down into the doorway. The small panel above the door had been burned through at the top. The resin had been consumed from this small panel, which would have been installed above the ceiling height.

Figure 23: Flight deck door

Supernumerary Compartment Oxygen System

The emergency oxygen system for the supernumerary compartment would have provided for the use of three oxygen masks. A high-pressure oxygen cylinder that was located below deck, forward of the E&E compartment, supplied the oxygen to the system (figure 24). A regulator reduced the pressure of the oxygen to 70 psig as it was transferred to the supernumerary compartment via stainless steel tubing. The stainless steel tubing would run vertically upward from below deck to above ceiling height on the main deck in the area forward and outboard of the galley. The tubing then would have crossed the overhead area above the ceiling panels and then dropped down into the bulkhead containing the oxygen mask stowage boxes (figure 25).

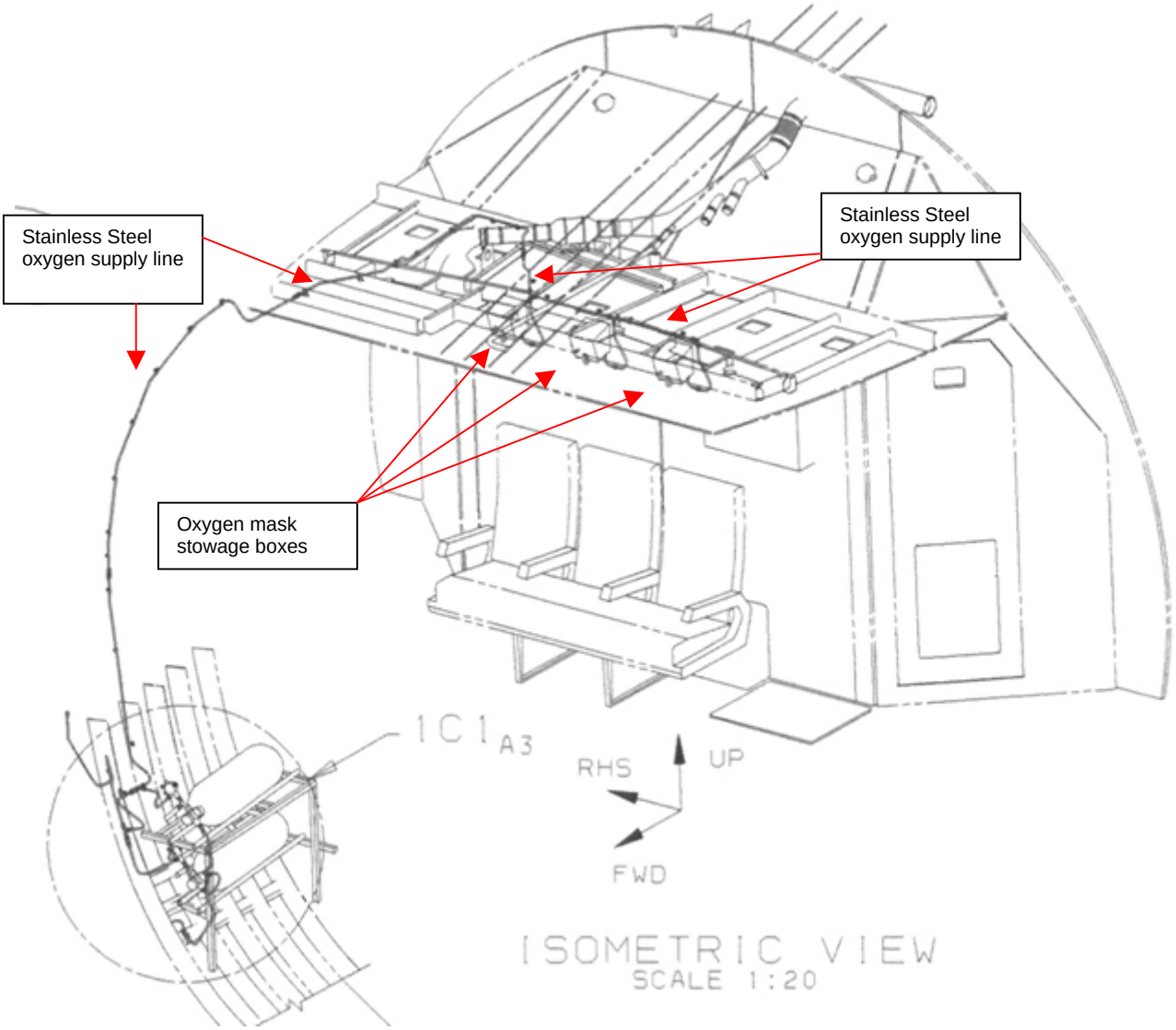

Figure 24: Drawing of supernumerary oxygen system supply line routing

Figure 25: Exemplar bulkhead containing oxygen mask stowage boxes, lights and vents. Face panels of bulkhead have been removed in photograph.

The bulkhead containing the oxygen mask stowage boxes would have been secured to the center portion of the smoke barrier wall, just above the three-person seat. The bulkhead would have been constructed from composite panel and aluminum frame sections. The stainless steel tubing, having dropped down into the bulkhead, would have connected to the oxygen mask stowage boxes by flexible oxygen lines (figure 26). The flexible oxygen lines would have connected to the stainless steel supply line on one end and connected on the other end to a stainless steel tube formed into a 90° bend. The stainless steel 90° tube would have fittings on the ends for attaching the flexible oxygen line to the oxygen mask stowage box (figure 26)

The main portion of the oxygen system that was found intact was the stainless steel tubing that extended from behind the bulkhead in the galley area and was routed above the ceiling and then downwards terminating at three separate threaded fittings. This stainless steel tubing was hanging down, from ceiling height near the galley area, to about floor level in the area where the three-person seat would have been. The tubing was intact with no visible damage except for some surface oxidation (figure 27).

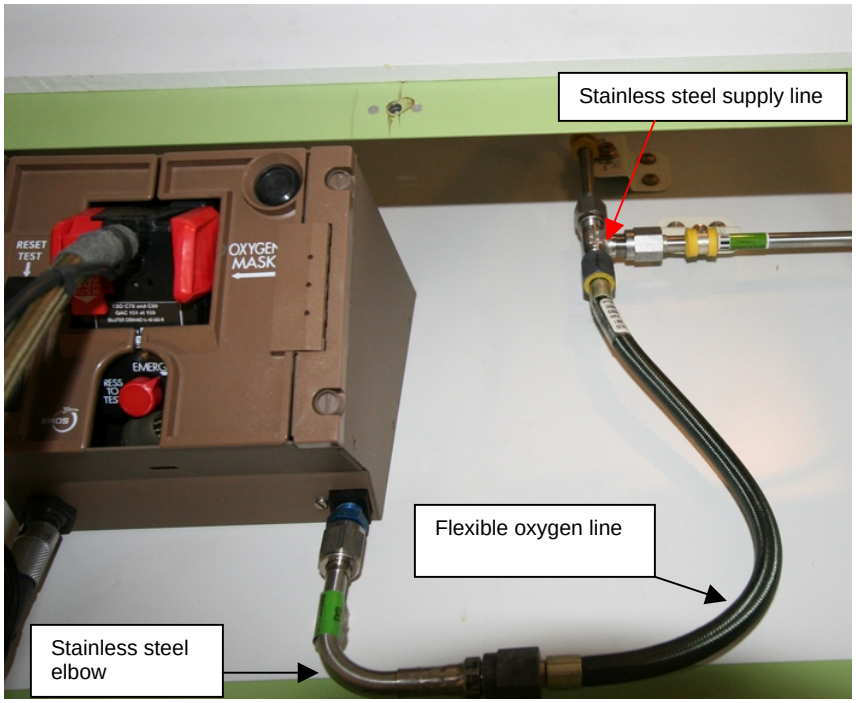

Figure 26: A flexible oxygen line connects the stowage box to the supply line

Figure 27: Stainless steel oxygen supply line in supernumerary compartment, held in position by investigators

In addition to the stainless steel supply line, three stainless steel 90° elbows (figure 28) were recovered. One was found towards the left side of the aircraft near the base of the smoke barrier wall and the other two were found slightly to the right of the aircraft's centerline at the base of the smoke barrier wall, outboard of the three-passenger seat. The one found on the left consisted only of the stainless steel portion of the elbow with minimal remnants of the aluminum fittings that would have been attached to it. Of the two elbows found towards the right, one was found in two separate portions, with each of these portions exhibiting melting. The aluminum fittings from the flexible oxygen line and the stowage box were still attached to the two portions of the 90° elbow. The portion which would have been connected to the flexible oxygen line had a small, approximately three inch, portion of helically wound wire attached to the fitting on the end. The second of the two 90° elbows found to the right of the centerline had a small portion an aluminum fitting remaining. That fitting would have attached it to the mask stowage box. These three elbows were retained for laboratory examination.

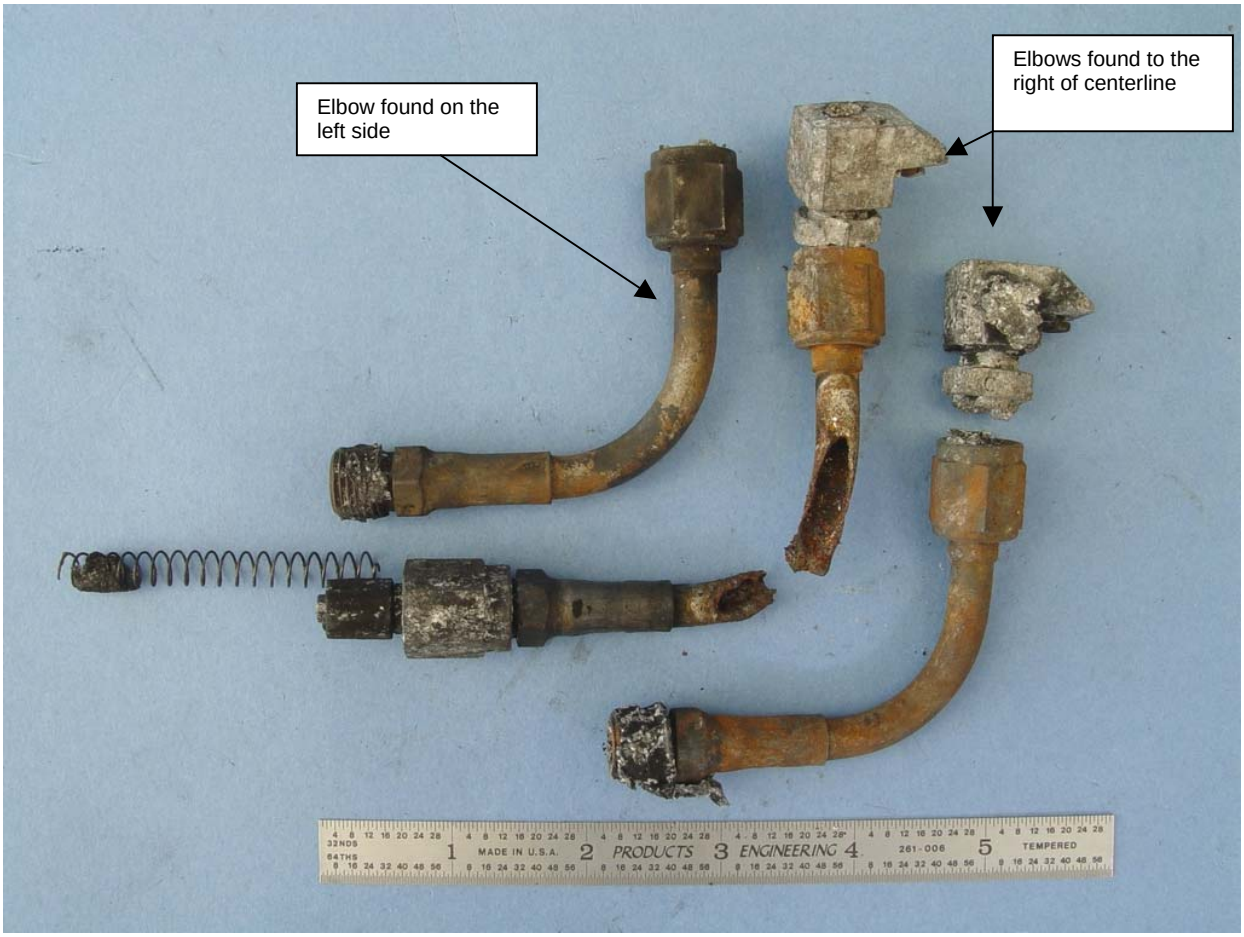

Figure 28: Stainless steel 90° elbows recovered from the supernumerary compartment

An aluminum box-like component was recovered from an area outboard of the seat near the weight and balance computer at the base of the smoke barrier wall. This box resembled a partially melted oxygen mask stowage box, and was retained for later examination. Other small items such as fittings, bits of hose-like material and other debris resembling oxygen system components were collected for examination.

The oxygen cylinder located below deck, which would supply the supernumerary compartment oxygen system, was found empty. This cylinder was reported to have a pressure of 1580 psig during the pre flight check. The oxygen cylinder valves and regulator valve stems, for both the flight deck and supernumerary compartment oxygen system cylinders, were examined for damage. These components were found in reasonably good condition with no obvious defects. The regulators were taken for examination at the manufacturer.

Flight Crew Interview

The captain and first officer were interviewed regarding their observations and the circumstances during the fire event. The interview took place inside an exemplar aircraft so that the crew could relate the description more effectively. The following is the summary of the interview.

The first officer stated that maintenance checks had been performed and everything checked out OK. Weight and balance calculations were done and the aircraft was ready to be towed. The L1 door was open when the loadmaster exited the aircraft. The first officer then entered the supernumerary area and closed the L1 door and looked into the lavatory and then made sure the lavatory door was secured before entering the flight deck and closing the door behind him. As the first officer was buckling himself into his seat he heard a sound like an airflow change of direction or a valve repositioning (the captain did not hear this). After being buckled in, the first officer and captain heard a pop sound (or a muffled bang). The first officer thought it was a pneumatic duct letting loose. A rushing air sound was heard and the sound was increasing in intensity. This was accompanied by a flapping and fluttering sound. The captain turned off both packs thinking the rushing air noise was related to the pack. The noise of rushing air continued to increase. The first officer got up and opened the flight deck door. Standing in the door he observed thick black smoke along the ceiling and a red glow towards aircraft right. He leaned slightly further out and observed flames along the bottom of the ceiling. The fire was surface burning. The fire did not appear to be jet-like or directional in any way. The fire was in the plane of the weight and balance computer at a level near the ceiling height. Although the fire was in the plane of the weight and balance computer, the fire did not extend down to that component when observed by the First Officer. The smoke was very noxious and hurt the first officer’s lungs preventing him from taking a second breath after opening the flight deck door. The first officer then closed the flight deck door and informed the captain that they would need to evacuate from their emergency escape windows. The first officer used his escape rope to exit through his window. The captain opened his window and began to feel for the escape rope, which is stowed overhead, above his seat. He had his eyes closed because the heavy smoke was burning them. In the mean time the ground crew had positioned the stairs at his emergency window so he exited by the stairs instead. During this

event, the smoke detectors, both in the main deck cargo compartment and the lavatory had not actuated according to the crew. Shortly after exiting the window they heard the first smoke detectors going off. The first officer estimates that the time between his re-entry into the flight deck and the occurrence of the pop sound was slightly less than a minute. The time between the pop sound and looking into the supernumerary area was about 15 seconds.

Parts Retained for Laboratory Examination

- Exemplar oxygen mask boxes with masks
- Exemplar flexible oxygen lines
- A portion of the ventilation duct from the supernumerary compartment
- A portion of an oxygen mask stowage box
- A portion of an oxygen mask
- Small pieces of flexible oxygen hose
- Small pieces of oxygen mask head harness
- Fittings from oxygen masks
- Stainless steel oxygen supply lines from galley area to bulkhead above seats
- Two stainless steel 90° elbows
- Two portions of one stainless steel 90° elbow

Joseph Panagiotou
Fire & Explosion Investigator