



Australian Government

Australian Transport Safety Bureau

*Safe
Transport*

In-flight fuselage rupture and depressurisation QF30, 25 July 2008

A presentation to the 2009 ANZSASI Regional Air Safety
Seminar

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Australian Transport Safety Bureau



The event - from the cockpit.....

- VH-OJK, a Boeing 747-438 departed Hong Kong at 09:22 (local) on 25 July 2008, for the HKG-MEL leg of flight QF30.
- Aboard was a flight crew of three (Capt, FO & SO), cabin crew of 16 and 350 passengers (including four infants).
- Flight established in cruise at 29,000 feet – lower than the planned cruising altitude of 33,000 feet, due to conflicting air traffic at that level.
- At 10:17 (55 minutes after departure), the flight crew reported a 'loud bang or cracking sound' and an associated airframe jolt and left yaw.
- The engaged autopilot disconnected and the pilot flying (FO) assumed manual control. Multiple system-related EICAS messages were displayed, including warnings regarding the R2 door status, cabin altitude and anti-skid inoperative.



In the cockpit.....

- The flight crew commenced using oxygen and executed the 'cabin ALT non-normal' checklist, including the initiation of a rapid descent to 10,000 feet, which was reached at 10:24.
- At the time of the event, the aircraft was 475 km to the north-west of Manila. After a MAYDAY on the Manila FIR frequency, the decision to divert to Manila was taken and the aircraft set up for a left base approach to runway 06 at Ninoy Aquino International Airport.
- Weather for the local approach allowed visual navigation. All three ILS, the left VOR and the left FMC were inoperative.
- Landing on runway 06 at 11:12 was uneventful, with the aircraft allowed to roll-out with minimal braking due to the unavailability of the anti-skid system.
- The aircraft was shut-down on the runway, and after verified as being safe, was towed to a terminal gate for disembarkation.





In the cabin.....

- The flight cabin crew was comprised of staff with varying levels of experience – divided approximately evenly between those with around six weeks operational exposure, and those with many years.
- The cabin crew reported that the audible bang was ‘deafening’ or ‘the loudest thing they had ever heard’. Immediately afterward, oxygen masks dropped from most of the passenger service units (a small number did not deploy properly).
- Several cabin crewmembers reported physiological symptoms of the noise and depressurisation, including ear discomfort and ringing, however none sustained any incapacitating injury or physical condition.
- Several less experienced cabin crew members became very distressed during the incident. Senior crew reported that those staff were withdrawn from service for a period, after which they resumed normal duties.





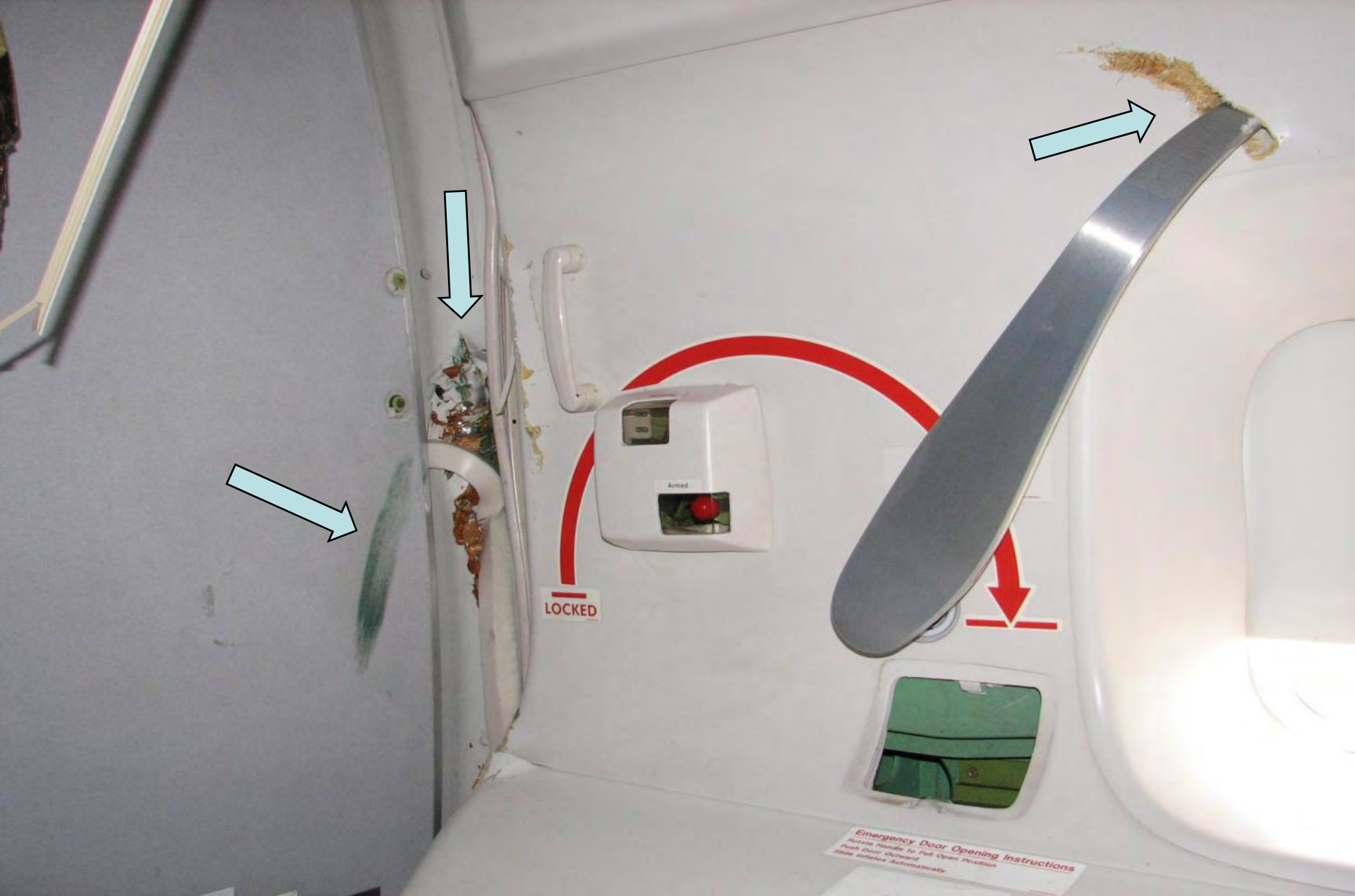


In the cabin.....

- During the diversion to Manila, cabin crew informed the flight crew of a significant degree of damage to the cabin around the R2 door, including, disruption of the floor, damage to overhead panelling and damage and movement of the door handle.
- The cabin crew member assigned to the R2 door position was assisting with a meal service and was not at their door station at the time of the event.
- Crew members reported that the automated Passenger Address system did not function during the depressurisation. The system alerts passengers to the need to use oxygen and instructs them on necessary actions, including mask use.
- None of the passengers aboard the aircraft reported any physical injuries to the cabin crew immediately following the depressurisation event, or to the operator's staff upon arrival in Manila.









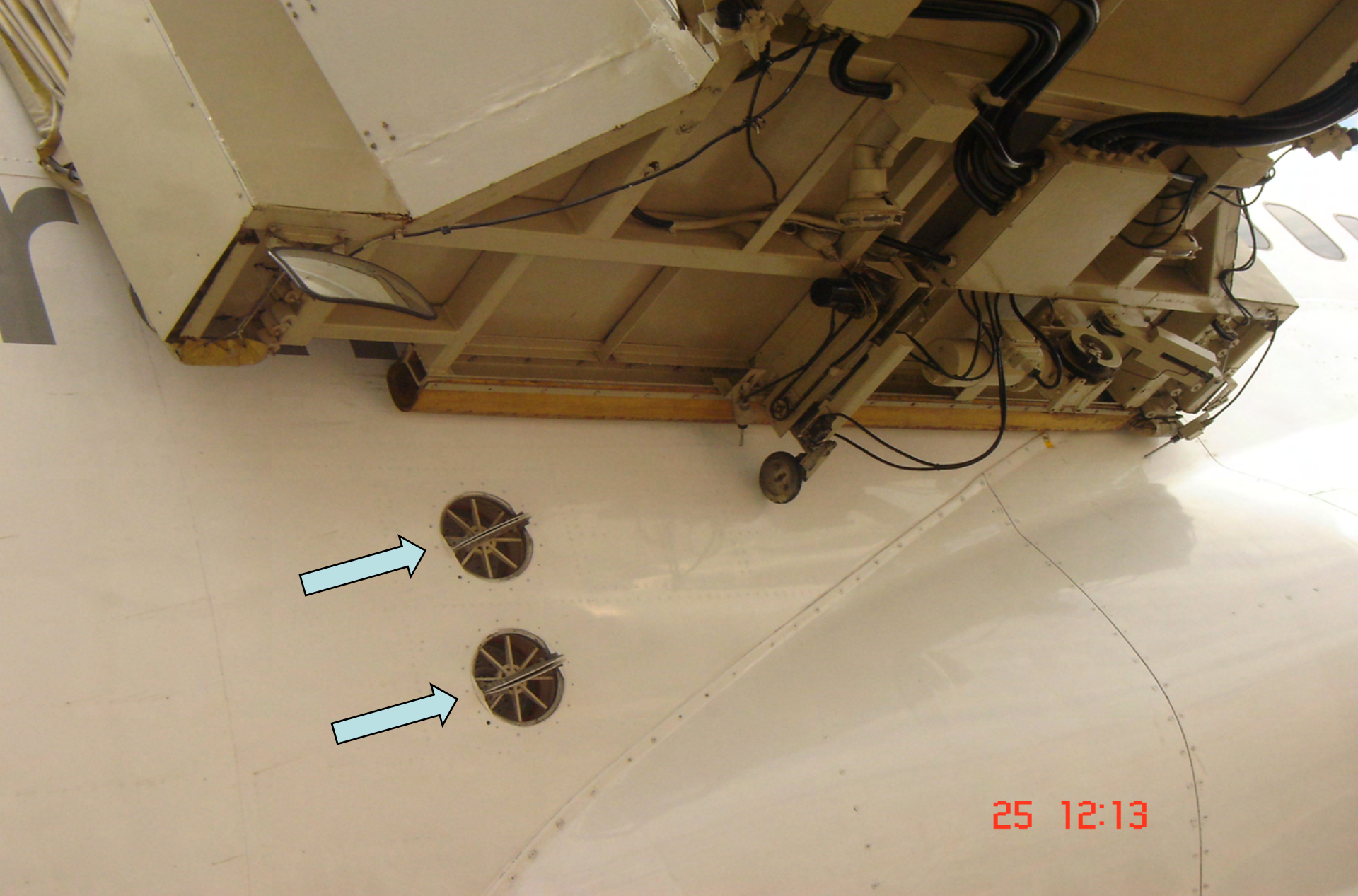
The investigation begins.....

- ATSB notified around 2.30 pm on the day of the event. Little information available initially, other than a B747 has “explosively depressurised and has a 2m hole in the fuselage”.
- ATSB team assembled on the basis of providing assistance to the Philippine investigation agency. Team of four made up from operations (piloting), maintenance (LAME) and forensic engineering (materials) specialties.
- Team departed Australia around 7.30pm, arriving in Manila around 6.00am the following day.
- Met initially with the local airline operations manager and security staff from the airline. Big security response, both locally and from Australia.
- The aircraft had been towed away from gate and isolated.

The investigation begins.....

- ATSB team met with Philippine Civil Aviation Authority (CAAP) staff. As the event occurred >12nm from the Philippine coast, the occurrence was over 'international' waters & thus responsibility for investigation fell to the State of Registry under Annex 13....ATSB now in the 'hot seat'.
- Convened a meeting with all parties present, to outline arrangements under Annex 13 and restrictions on release of information, entry to the aircraft and conduct of the investigation.
- External damage was a large rupture in the forward right side fuselage, immediately beneath the R2 door and located underneath the wing leading-edge to body transition fairing, which had been lost.
- Cargo protruding from rupture; severed and damaged wiring visible. Oxygen cylinders visible, with one absent. Pressure relief valve blow-out doors opened.





25 12:13

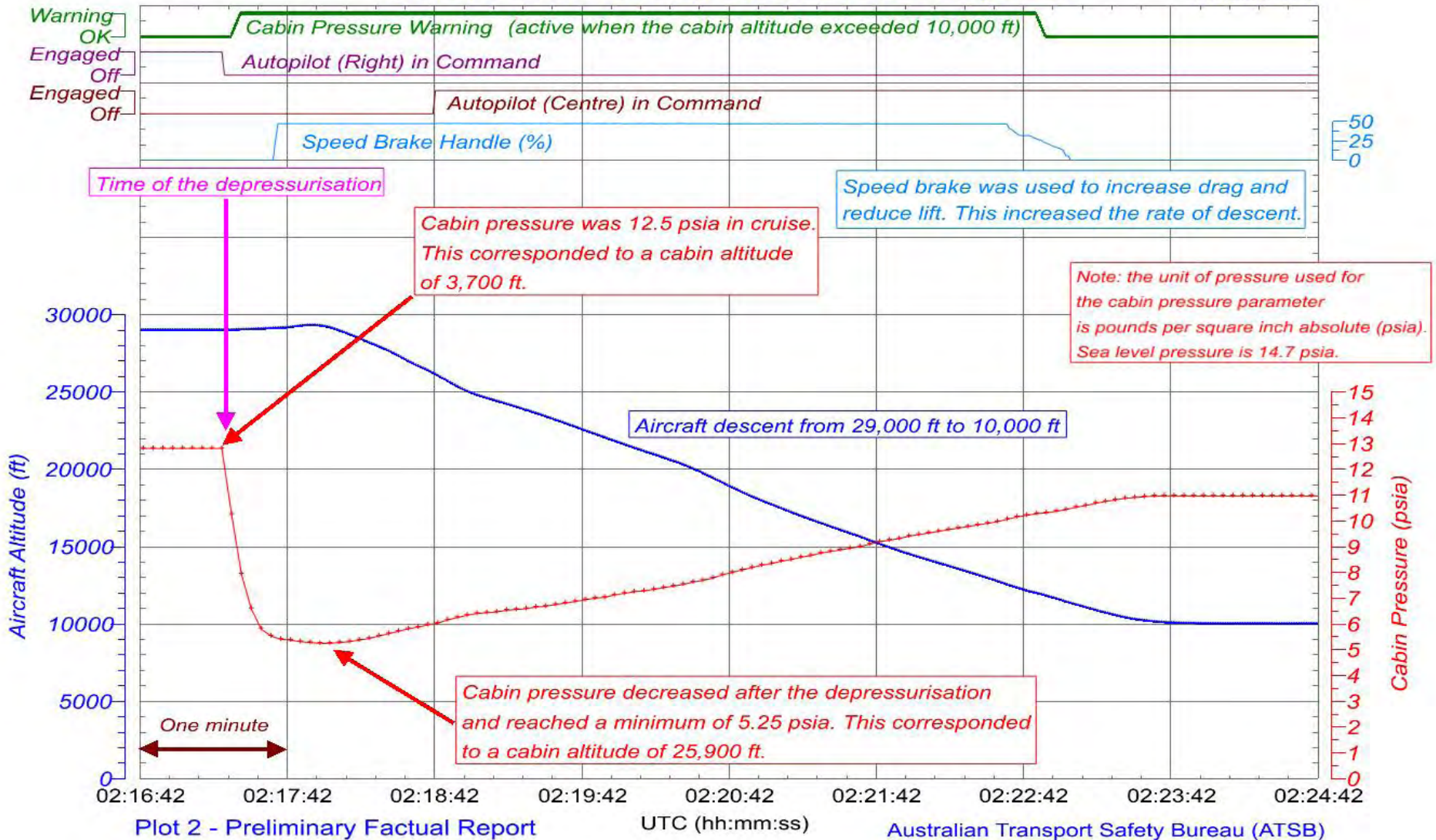


The investigation begins.....

- Initial entry to the aircraft with two ATSB investigators and Philippine police with bomb detection 'sniffer' dogs. Lots of police staff, many with cameras.....
- Aircraft cabin cleared for entry & general inspection of cabin, flight deck and electronics bay. Flight Data and Cockpit Voice recorders secured and removed; Quick Access recorder disk removed & all sent to Australia for download. Senior CAAP officer travelled to Australia to observe download process.
- Forward cargo hold – containers removed progressively and all areas inspected by local police / security / dog squads. Airline needed to clear baggage for return to passengers.
- Cargo adjacent to rupture was palletised & wrapped / netted. Partially disrupted in area near rupture, but no items lost. All general cargo with no dangerous goods.

VH-OJK B747-438 Depressurisation 25 July 2008

AO-2008-053



Plot 2 - Preliminary Factual Report
 Revised: August 13, 2008

Australian Transport Safety Bureau (ATSB)



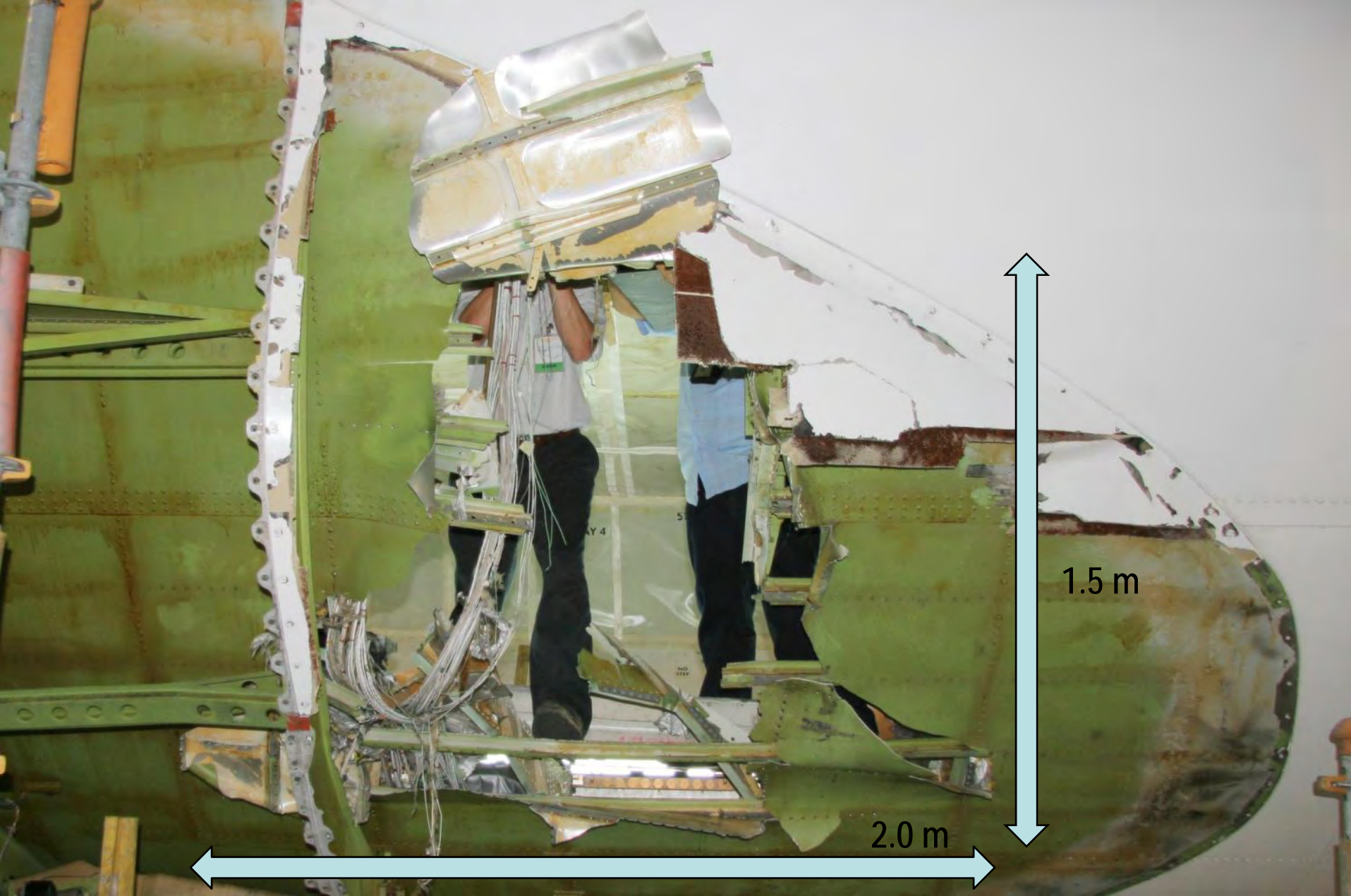






The airframe damage.....

- Stripping of the body panels revealed the full extent of the rupture – 2 m wide x 1.5 m high, in an inverted T shape. Approximately 1.7m² total exposed area.
- Several fractured transverse frames and longitudinal stringers, but no evidence of associated cracking, corrosion, seam-line failure or other potential pre-existing defects.
- One missing passenger oxygen cylinder (number-four from the bank of seven) along right side of cargo hold – immediately above ruptured area. Oxygen line connections broken away in overstress from the valve fittings. Remnants of the cylinder valve recovered from within the cabin near the R2 door.
- No part or remnant of the number-four passenger oxygen cylinder recovered – presumed lost during depressurisation.
- Circular hole in cabin floor immediately above number-four cylinder location.







Clues & evidence.....

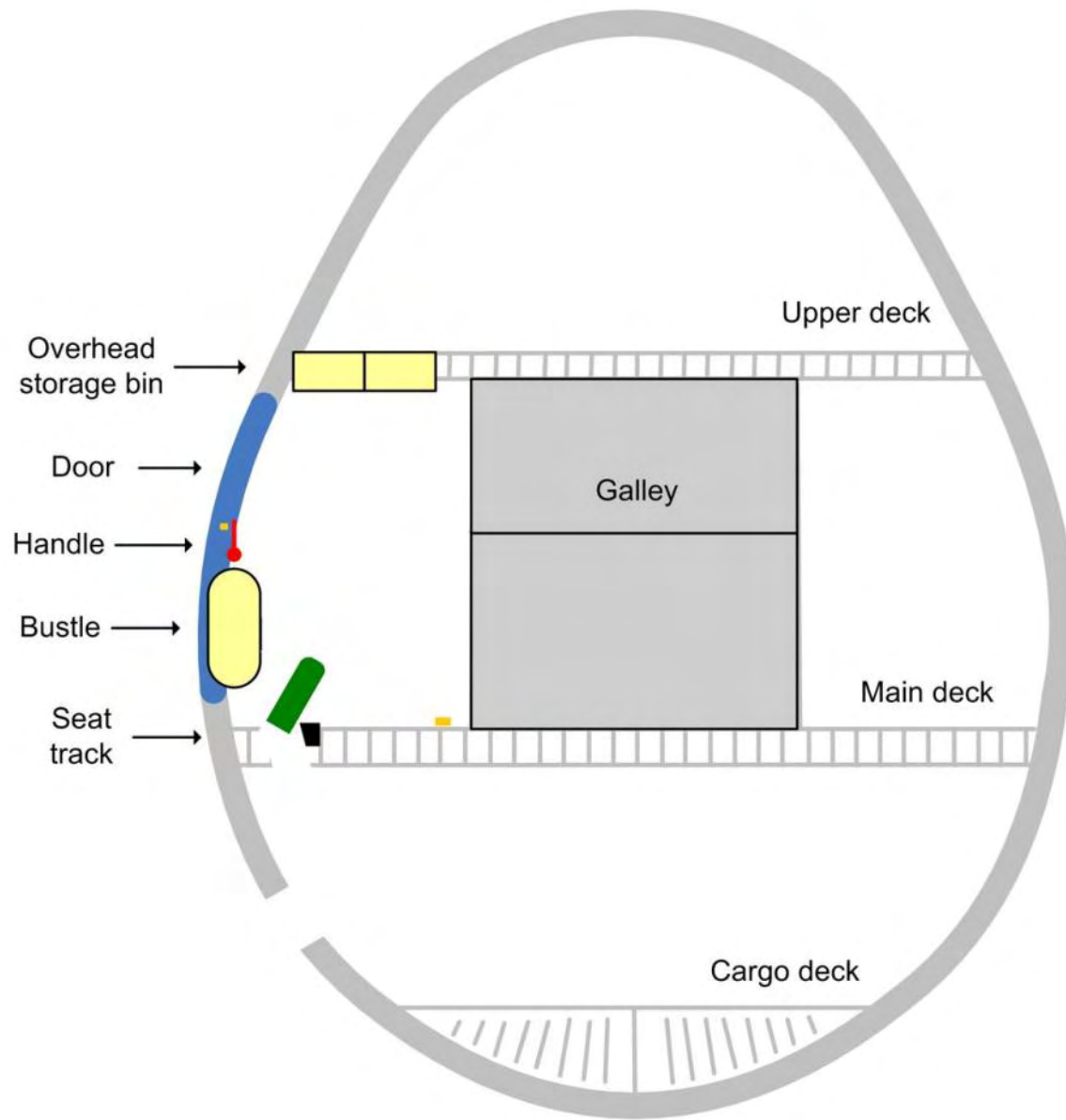
- Hole in cabin floor above missing cylinder.
- Unusual 'green paint' abrasion marks on cabin partition and door panelling.
- Cylinder valve body and handle fragments located within cabin.
- Valve body fragment recovered from within damaged area on door frame.
- Circular 'cut-out' within overhead panelling near R2 door – matches cylinder diameter.
- Semi-circular crushed area in compartment partition – diameter matches cylinder.











Managing the teams, media, stakeholders and OH&S.....

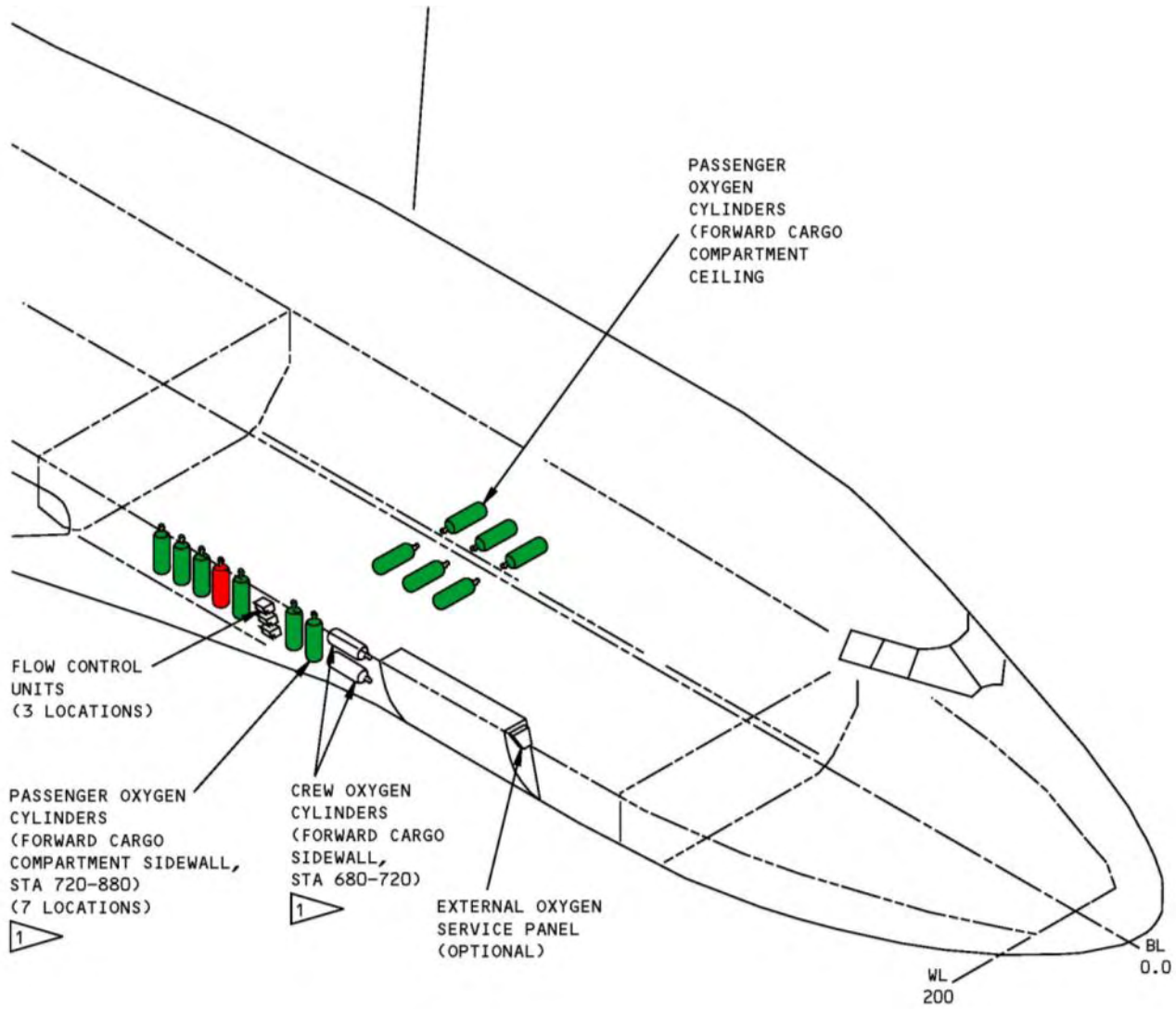
- Large number of associated people – both local and from Australia.
- Media interest very high – daily press conferences required.
- Investigation team organised under ICAO Annex 13 guidelines, with teams allocated to investigation areas (cabin, R2 door, oxygen systems, structures).
- Information security was challenging.
- OH&S concerns – R2 door emergency slide, EPAS pressure cylinder and general access to and from various parts of the aircraft.
- Aircraft able to be hangared from day 3 – useful for protection from afternoon thunderstorms!





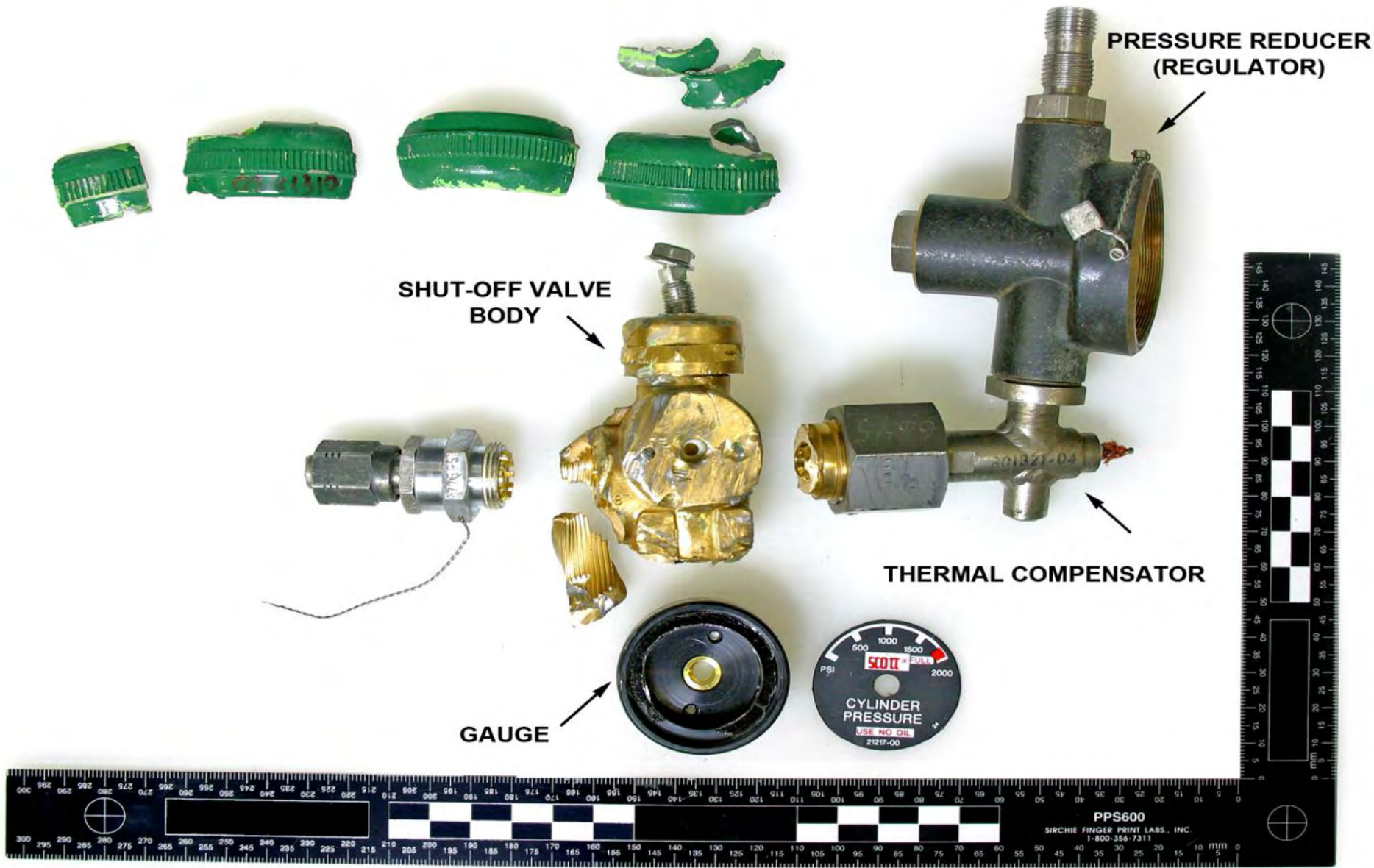
OK – we know the what, when & where.....what about the how & why?

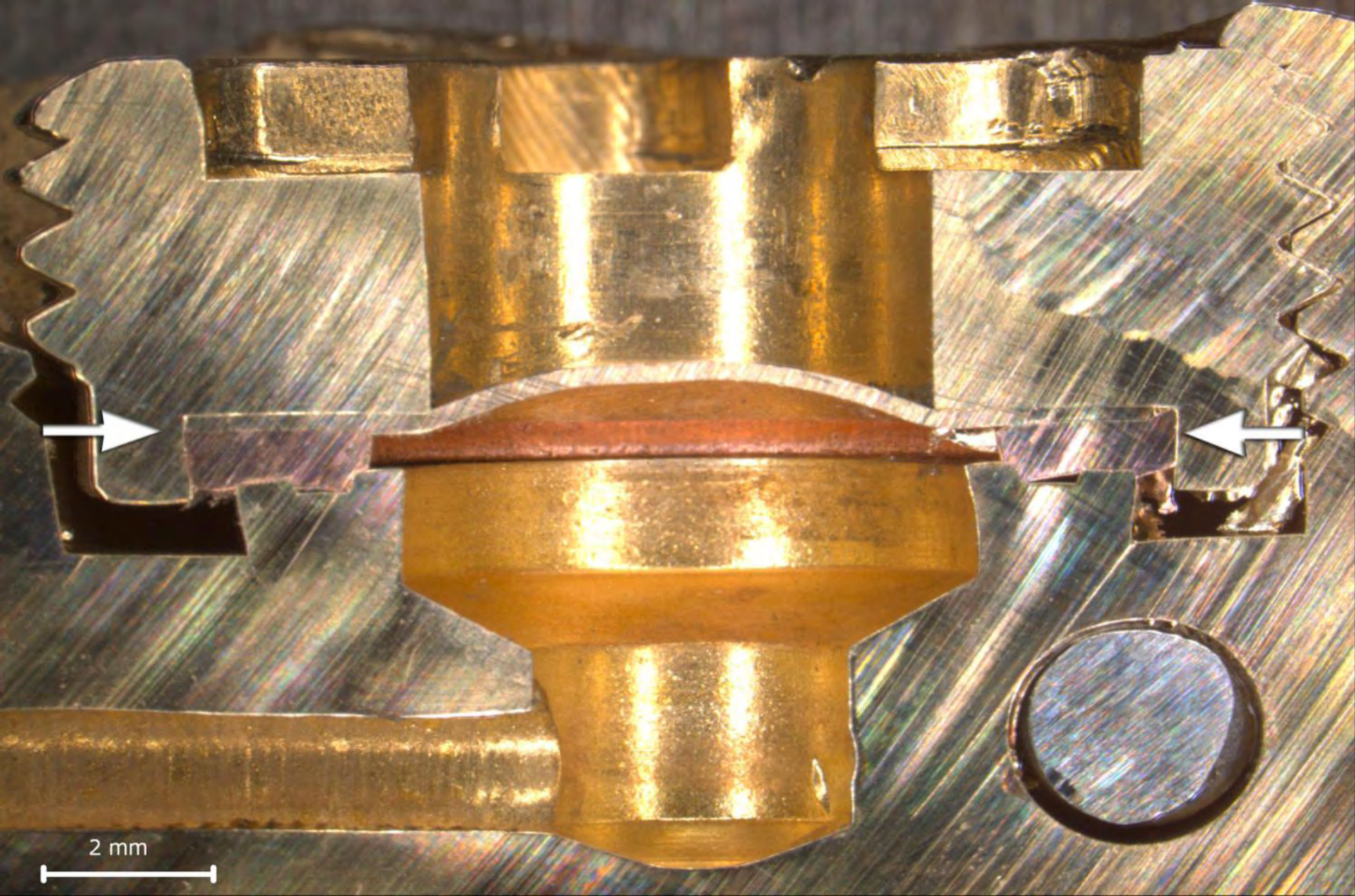
- Aircraft damage consistent with circumferential rupture of the number-four passenger oxygen cylinder; compromising the fuselage below and propelling the upper part of the cylinder through the cabin floor.
- Aviator's breathing oxygen cylinder – manufactured as a deep-drawn and forged item from a single blank of AISI4130 Cr-Mo alloy steel; heat-treated.
- Produced to the US DOT 3HT specification - nominal wall thickness is around 3.2 mm – no welded seams or end caps.
- Operating pressure 1,850 psi. Cylinders re-certified every 3 years by internal visual inspection and hydrostatic pressure testing to 3,080 psi.
- The failed / missing cylinder was manufactured in Feb 1996 and had been re-tested four times; the last being around two months before the failure.



A bit of forensic engineering.....

- The cylinder valve remnants were closely examined for any evidence of a combustion event – negative.
- The cylinder valve protective burst-disk was closely examined – found intact and typical of other similar disks in other cylinder valves.
- With assistance from Boeing, six other cylinders from the same production batch were located world-wide, and obtained by the ATSB for scrutiny.
- Those cylinders have been intensively examined, including repeating all of the original design certification tests, including material analyses, metallographic study, mechanical, non-destructive and pressure tests.
- No evidence of any deficiency in the cylinder design or manufacturing processes has been identified.











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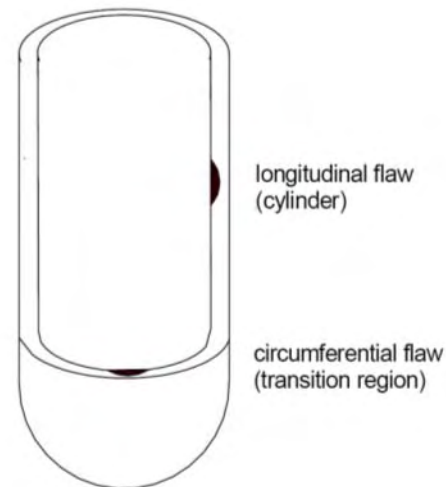


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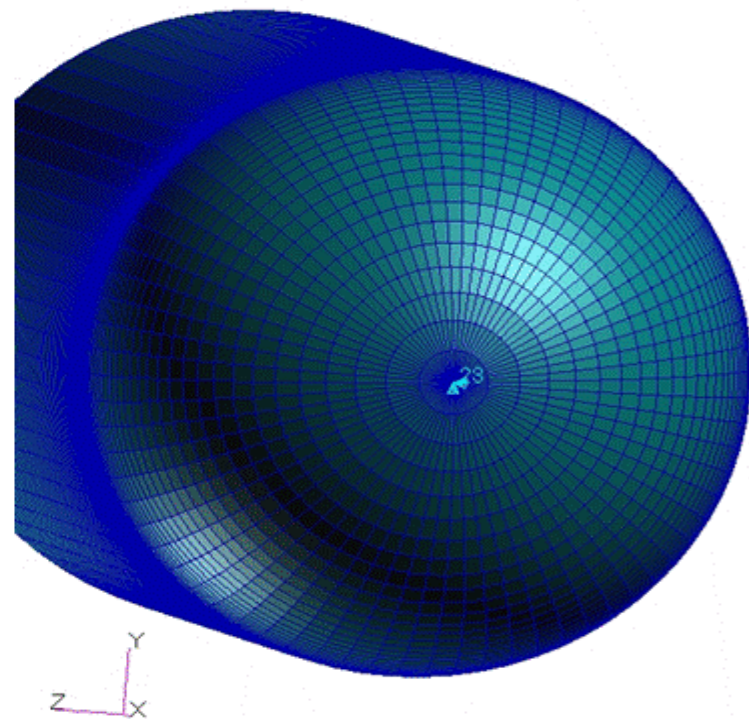
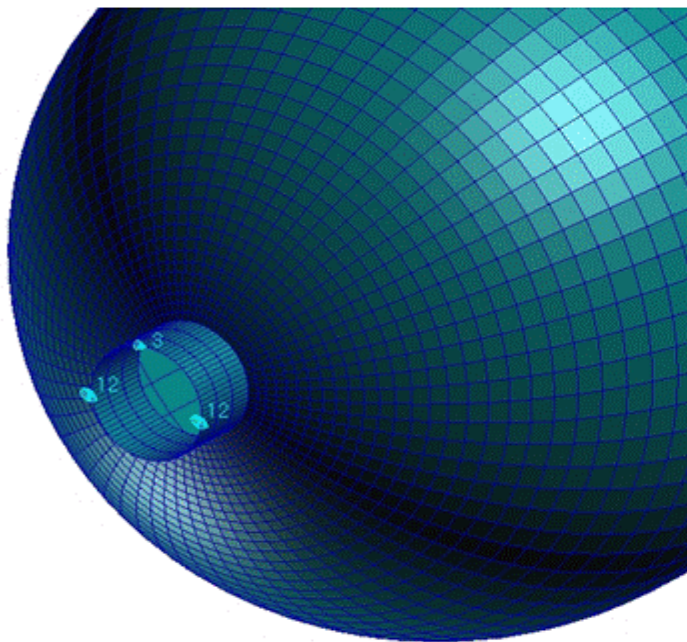
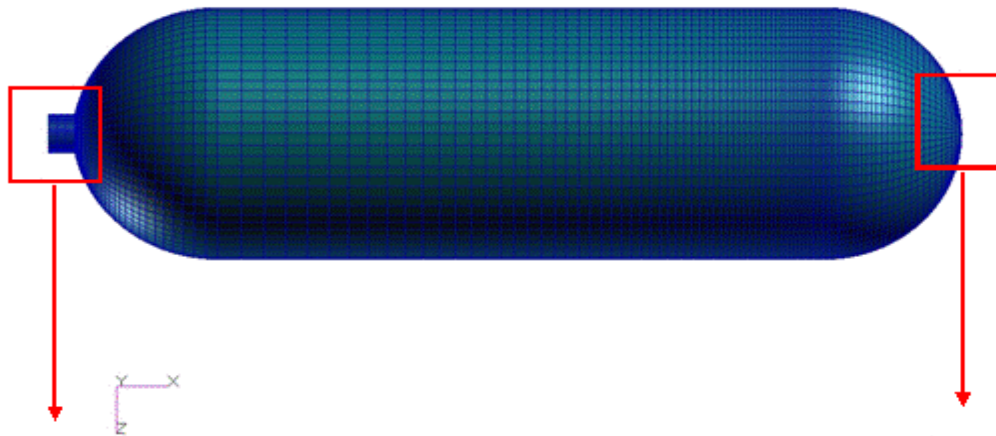


A bit more forensic engineering.....

- A finite element model was created to ascertain the stresses developed within the cylinder under internal pressure.
- Linear Elastic Fracture Mechanics (LEFM) methods were used to numerically estimate the size of a cylinder shell defect that could cause unstable fracture at both the cylinder service pressure (1,850 psi) and re-test pressure (3,083 psi).



- Work ongoing to examine the study findings and correlate with the investigation evidence.



Where to from here.....?

- Continuing examination of the exemplar (same production batch) cylinders, including the investigation of possible material compatibility issues.
- Validation of the numerical defect tolerance data, using hydrostatic and/or pneumatic tests on cylinders with artificial defects.
- Ongoing cabin safety / survival factors investigation, using data from interviews and passenger surveys (47% response rate so-far).
- Ongoing examination of the serviceability and performance of the cabin oxygen system, in light of the damage sustained.
- Continued examination of recorded data from the CVR, FDR & QAR, including a review of the operator's procedures for preserving a CVR recording following a serious incident or non-catastrophic accident.

Acknowledgements.....

The ATSB is keen to acknowledge the extensive and ongoing support of the following individuals and organisations in the conduct of the investigation:

- *Larry Doherty, Bill Fry and the Qantas Group Safety team.*
- *Qantas Airways security team.*
- *Qantas Engineering.*
- *Joe Sedor and team from the US National Transportation Safety Board.*
- *Management and staff of the Civil Aviation Authority of the Philippines.*
- *Management and staff of Lufthansa Technik, Philippines.*
- *Karly Pidgeon and staff from the Australian Office of Transport Security, Australian Embassy, Philippines.*
- *Australian Federal Police staff, Manila.*
- *Boeing office of air safety investigation.*
- *US Federal Aviation Administration – Office of Accident Investigation.*



Thanks & Questions!

