SPECIAL INVESTIGATION REPORT

BUREAU OF AIR SAFETY INVESTIGATION

BASI REPORT B/906/3024

Relocation of Jump Seat on QANTAS Airways Ltd Boeing 747-438, VH-OJF

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Bureau of Air Safety Investigation

Transport and Communications

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SYNOPSIS

Following representations by the Australian Flight Attendants' Association concerning a newly installed seating configuration on VH-OJF, a Qantas Boeing 747-400, a special investigation was undertaken to determine if safety standards had been compromised. The upper deck seating configuration on VH-OJF was compared to the previous exit configuration utilised on Qantas 747-400s. Further comparisons were made between the Boeing 747-200 and SPs operated by Qantas. The investigation determined that while the new seating configuration did meet the regulatory requirements, the previously installed standard did provide a far superior emergency exit facility.

1. INTRODUCTION

This special investigation was initiated after a letter was sent to the Minister for Transport and Communications by the Australian Flight Attendants' Association (AFAA). This communication detailed a number of objections to a seating configuration which had been installed on the upper deck of VH-OJF, a Qantas Boeing 747-400.

The Association's objections to the new seating configuration are:

(1) the downgrading of the upper deck emergency exits from Type A to Type I;

(2) the jump seat protrudes fully into the exit;

(3) no assist space is available;

(4) insufficient recess for the flight attendant to direct the evacuation;

(5) the reversal of the jump seat to a forward facing seat; and

(6) emergency procedures are not applicable to the exit.

The following report details the background to the investigation and addresses the issues raised by the flight attendant's union. The aim of the investigation was to evaluate the safety deficiencies, if any, of the new configuration in relation to the previous configuration and those in situ on other 747 series.

2. FACTUAL INFORMATION

When Boeing originally extended the upper deck of the 747 type aircraft it was anticipated that the newly modified cabin would accommodate between 80 and 90 economy class passengers. To ensure that the aircraft complied with the appropriate certification standards, a pair of Type A exits were located in the middle of the cabin. These gave the cabin the capacity to accommodate a maximum of 110 passengers.

2.1 Qantas Configurations

The upper decks of the Qantas 747-400s are utilised as a business class section rather than economy.

The originally installed seating configuration accommodated 38 passengers, with a pitch between the seats of 38" (965mm). Two flight attendants were positioned for take-off and landing on a rearward facing jump seat situated on the right hand side of the aircraft adjacent to the emergency exit. The free standing jump seat encroached on the emergency exit by 11" (279mm). The passageway to the exit was 45" (1143mm) when the jump seat is retracted. The exit could not be certified as a Type A exit as it could not comply with the assist space requirements. The exits on the upper deck were therefore classified on the US Federal Aviation Administration's (FAA) Type Certificate Data Sheet as Type Is. This classification was confirmed by the Australian Civil Aviation Authority (CAA), as Type I exits have a passenger capacity in excess of that planned to be carried on the upper deck.

In May 1990, Qantas changed the seating configuration on the extended upper deck of Boeing 747-400 aircraft VH-OJF. Prior to the delivery of the aircraft to Qantas, there had apparently been no consultation between the Engineering Department and the Safety Department within Qantas regarding the ramifications of the new seating configuration. The Safety Department at that time was not represented on the Interiors Committee which oversees the introduction of new seating configurations.

The modification to the upper deck of the 747-400 ensured that 36 business class seats could be positioned in the cabin at a seat pitch of 40" (1016mm). However, such an alteration necessitated the relocation of the flight attendant's jump seat. A free standing double jump eat was positioned adjacent to the left hand emergency exit, facing forward. As with the original configuration, the jump seat encroached on the exit. However in the newly modified cabin the seat infringed on still further on the exit to 12.4" (314mm), yet the exit still qualified as a Type I.

The new seating configuration does not comply with the FAA's certification standards. This is not a function of the dimensions of the passageways or the encroachment of the jump seat on the exit, but reflects Qantas desire for the seat backs in the row directly forward of the exit to recline into the escape path. The CAA have provided the configuration with a waiver allowing the seat backs to recline, under the proviso that the backs must be locked in a upright position on take-off and landing.

NOTE: Passageway widths have been taken as the distance from the bottom of the jump seat to the rear seat leg of the passenger row.

3. SAFETY ISSUES

3.1 Downgrading of Exit

As has been indicated previously, the exits on the upper deck meet the dimensions of a Type A, i.e. 42" (1067mm) by 72" (1829mm). However, the exits on Boeing 747-400s have never been classified as a Type A exit when upper deck passenger compliment was less than 45. The following requirements relate to Type A exits:

(i) there shall be an unobstructed passageway of at least 36" (915mm) wide leading from the exit to the nearest main aisle;

(ii) adequate assist-space next to the exit shall be provided at each side of the passageway, to allow crew members to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below 36" (915mm);

(iii) unless it is an over-wing exit a slide shall be installed capable of carrying simultaneously two parallel lines of evacuees.

(Ref.: *Civil Aviation Orders Section 101.0 3.3*)

Consequently, the AFAA's representation that the exit had been downgraded was incorrect as the exit was never classified as a Type A. However differences between the two seating configurations do exist, and these may impact on safety.

3.1.1 The original configuration

The original configuration has a passageway to the exit of 45" (1143mm) when the jump seat is retracted. No dedicated assist space is available for the primary flight attendant during an evacuation. Qantas's emergency procedures are such that the flight attendant is positioned with his/her back to the aft passenger seat proximate to the exit. This is shown in Figure 1.

As a consequence, the exits are rated as Type I which allows 45 passengers within the compartment. The following requirements relate to Type I exits:

(a) rectangular opening of not less than 24" (610mm) wide by 47" (1193mm) high, with corner radii not greater than one-third the width of the exits;

(b) floor level;

(c) sufficient space shall be provided next to the exit to permit a crew member to assist in the evacuation of passengers without reducing the width of the unobstructed passageway to the exit below (20") (508mm).

(Ref.: *Civil Aviation Orders Section 101.0 3.3*)

The passageway width in association with the rearward facing jump seat does give the illusion that the exit is in fact a Type A exit. This illusion may have led to the AFAA's belief that the exit was rated as a Type A.

3.1.2 The new configuration

In the new configuration, the exit still qualified as a Type I, as the seating configuration necessitated that the passageway to the exit is 35.4" (900mm). The assist space on the newly configured aircraft is certainly a deterioration of that on the original configuration, however it still meets the requirements (see Figure 2).

The cramped conditions in the new configuration are a function of the backs of the seats in the row forward of the jump seat bordering on the exit (see Figure 4).

Both exit configurations meet the certification requirements for a Type I exit, whose capacity is in excess of the number of passengers within the cabin, i.e. 45 as opposed to 36.

3.2 Protrusion of Jump Seat

Obviously, the amount that the jump seat protrudes into the exit is related to the passageway width. The illusion is that the new forward facing jump seat impinges on the exit to a significantly greater extent than the rearward facing jump seat, despite the differential being only 1.4" (35mm). Again, the spaciousness of the original configuration is a function of the space provided by the passenger seat facing the jump seat.

Figures 3 and 4 indicate the position when the flight attendants are seated. Problems would certainly be encountered if flight attendants were incapacitated during the impact phase of an accident and it became necessary to operate the exit adjacent to the jump seat. The difficulties encountered by passengers would probably be greater if the new configuration was in situ, as passengers would have to egress over the flight attendants rather than being able to move across the passenger seats to the exit (see Figures 3 and 4).

3.3 No Assist Space

To achieve the prescribed assist space on the newly configured aircraft, it is necessary to break-forward the seats in the row forward of the exit (see Figure 3). To state that no assist space is available is incorrect, however the new configuration provides little natural assist space and as such is certainly not as satisfactory as that on the originally installed seating layout.

With the new configuration in mind, it is easy to visualise the problems which would be encountered if the passengers in the row forward of the exit were incapacitated on impact. The flight attendants may find the difficulties in breaking forward the seat backs insurmountable, and consequently it would be impossible to achieve the assist space without encroaching on the passageway width to a significant degree.

3.4 Insufficient Recess

While the primary flight attendant position during an evacuation is the assist space, the secondary flight attendant is expected to direct passengers towards the appropriate exit. The AFAA insist that there is insufficient recess for the secondary to carry out this role. The Qantas training representatives indicated that regardless of the seating configuration on the 747-400, if the only operational exit was the one adjacent to the jump seat, the secondary flight attendant would position him/herself in the passageway to the other exit. The Bureau considers that this is an acceptable situation.

3.5 Reversal Of Jump Seat

The general consensus of opinion is that the best protection for flight attendants can be provided by rearward facing jump seats. This orientation generally protects the occupants by supporting the body and head against the deceleration during a crash (see Figure 5). Additionally, the fixtures required to attach a free-standing seat to the floor have greater strength if the seat is to face rearwards, due to the higher centre of gravity. As such the rearward facing jump seats may have greater crashworthiness.

All forward facing seats in the Qantas fleet have in the past been attached to some cabin structure, e.g. bulkheads. Such structures do not generally distort or fail during a crash. Nevertheless this may preclude seats from having an energy absorption potential. Evidence regarding the crashworthiness of a forward facing free standing seat is not available at present, and such lack of information is of concern to the investigators.

Occupants of jump seats are usually secured by a full harness, which ensures that they are less likely to rotate around the lap belt. The harness prevents the upper body from flailing, yet it provides no protection for the head, a part of the body which is at greater risk when the seat is facing forward (see Figure 5). However, while the heads of the flight attendants may flail around, the jump seat is so positioned that flight attendants are not likely to impact with a passenger seat nor are passengers likely to impact with the jump seat.

One advantage that the forward facing seat has over its predecessor is that it provides greater protection from flying objects during an impact, as debris is usually thrown forward.

Reservations are still held about the crashworthiness of the seat. However, as yet information is not available to dismiss or support these reservations. As such, the investigators are seeking further information.

3.6 Emergency Procedures

The emergency procedures manual provides flight crew with a set of procedures to be adopted in the event of an accident. Qantas attempts to keep a high degree of commonality between the aircraft types with regard to the procedures to be adopted. The generalised procedures such as checking for fire prior to opening exits, opening exits, blocking exits and ensuring chutes are inflated are just as valid for the new configuration as the originally installed configuration. However differences between the configurations do exist, consequently procedures must differ to reflect the modification and these need to be drawn to the attention of the flight crew. The training department instituted a dissemination programme as soon as they were aware of the ramifications of the new configuration.

Prior to staff operating on the newly configured 747-400 they were shown a video which identified the modified aspects of the jump seats and its impact on evacuation procedures, i.e. that it was necessary to lock the seat back in the upright position, and that the assist space could be achieved by pushing the seat backs forward. Further to this, the upper deck simulator at the ground training school has been modified to represent the new configuration. Flight attendants will be given the opportunity to practice such procedures during recurrent training.

Qantas therefore seems to have taken adequate provisions to ensure that flight attendants are aware of the specific procedures associated with the new configuration.

Notwithstanding the constraints of the investigation, it was apparent from discussions with Qantas representatives that the number of doors for which specific emergency procedures are required is on the increase. Procedures for the upper deck differ between the series of 747s. For example: the primary exit route on the 200 and SP series is the stairway, if the stairway is unusable then the upper deck slide is to be used, these are in different locations and operate in different ways. On the 300 series, the primary exit route is the slide. Indications are that intended changes to the 300 series will add another modification to the procedures which flight attendants are expected to incorporate into their knowledge base. Flight attendants are required to operate on all aircraft types and series within the fleet. The question which must be asked is, how many exceptions to the generalised procedures can flight crew be expected to integrate and adopt successfully.

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3.7 Other Aspects

3.7.1 Jump seat location

The location of the jump seat on the newly configured aircraft can hardly be considered optimal. The seat is so positioned that when the exit is open it would be possible for passengers to manoeuvre around the side of the seat adjacent to the exit. Consequently, two streams of passengers could meet at the top of the chute. This could disrupt the flow from the passageway and on the chute itself.

Other disruptions to the flow from the aircraft may also be achieved if the passengers attempt to throw themselves over the free standing seat.

3.7.2 Recline mechanism

The CAA has provided Qantas with a waiver for the new configuration which allows the seatbacks adjacent to the exit to recline into the passageway during flight. The seatbacks are locked on take-off and landing. It is conceivable that problems could occur if the locking mechanism failed during a heavy landing or impact.

3.7.3 Comparison with other 747 series

Up to this point comparisons have been made between the two seating configurations on the 747-400s, however it is also pertinent to make analogies between the 400 and other series operated by Qantas. As The 747-400 cabin has low density seating with exits situated in the middle of the cabin, it is also served by two flight attendants (ratio 1:18). These features would aid egress in an emergency. On the SP and 200 series, passengers would have to escape down the spiral staircase. In the case of the SP, 30 passengers directed by one flight attendant would have to negotiate the stairway, which is situated in the forward portion of the cabin.

The secondary escape route on the 747-400 is the stairway, which is superior to those which are used as the primary escape route on the 200 and SP series.

4. CONCLUSIONS

4.1 Findings

(1) The new configuration meets the certification requirements.

(2) The capacity of the exits is in excess of that within the cabin, i.e. a passenger seating configuration of 45 can be served by one pair of Type I exits.

(3) The passageway to the exit between the jump seat and passenger seat on the new configuration is approximately 10" (254mm) less than that on the original configuration. This is a function of the reversal of the jump seat.

(4) Passengers would certainly encounter difficulties in gaining access to the exit if the flight attendants were incapacitated.

(5) The configuration does not provide a natural assist space. It is necessary to break forward the seats in the row forward of the jump seat.

(6) The assist space would be difficult to achieve if the passengers in the seat row forward of the exit were incapacitated. If this were the case, the flight attendants would certainly reduce the left hand passageway to under that specified in the regulations.

(7) A suitable recess for the secondary flight attendant is available.

(8) Anecdotal evidence suggests the forward facing jump seat would probably provide less protection during impact than a rearward facing seat.

(9) The flight attendants are adequately secured and would be protected from flying objects which may be released during an impact.

(10) The flow of passengers to the exit may be impeded by:

  (i) the location of the jump seat. Passengers may be able to manoeuvre around the side of the seat adjacent to the exit. It is suggested that the jump seat is moved outboard to eliminate this hazard.

  (ii) the failure of the recline mechanism in the seat row forward of the exit.

(11) Qantas has modified its emergency procedures and training to take account of the alteration, and flight attendants are aware of such changes prior to operating on the aircraft.

(12) A representative of the Safety Department now sits on the company's Interior Committee. A policy which will hopefully ensure that the safety issues are considered from the very outset of the configuration.

4.2 Summary

The newly installed configuration on the upper deck of the 747-400 was considered by the investigation team to be a retrograde move.

The exit configuration may be deemed to be a degradation. However, it does meet the regulatory requirements. The upper deck of the 747-400, regardless of the seating configuration at the exit, does have advantages over some of the other configurations utilised on the upper decks of Qantas 747s.

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5. RECOMMENDATIONS

1. Qantas reconsider its decision to retrofit the upper deck of the 747-400 with the exit seating configuration which now exists on VH-OJF.

2. If the decision remains unchanged and all the 747-400 fleet are reconfigured to the VH-OJF standard, the jump seat should be repositioned so it is closer to the exit aperture. The relocation should ensure that a male in the 95th percentile can be seated without having to "twist" within the seat due to insufficient head or leg room. Evidence indicates that not only is it uncomfortable but it also reduces human tolerance to impact injury as the spinal column is twisted.

3. Consultation between all relevant departments within airlines should be undertaken prior to the introduction of new seating configurations, particularly those which involve the relocation of flight attendants.

4. The CAA, in consultation with the FAA, modifies its requirements for emergency exits to ensure that all exits which are manned by flight attendants have sufficient space next to the exit aperture. The assist space must allow the crew member to assist in the evacuation of passengers while not placing the crew member at undue risk of being ejected from the cabin.

Figure 1: Assist position, original seating configuration
Upper deck, Boeing 747- 400

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Figure 2. Assist position, new exit seating configuration, upper deck Boeing 747- 400 VH-OJF

NOTE: To achieve the assist position it is necessary to break-forward the passenger seat in the row forward of the exit.

Figure 3. Flight attendant seated, original seating configuration
Upper deck Boeing 747- 400 VH-OJF

Figure 4. Flight attendant seated, new seating configuration
Upper deck Boeing 747- 400 VH-OJF

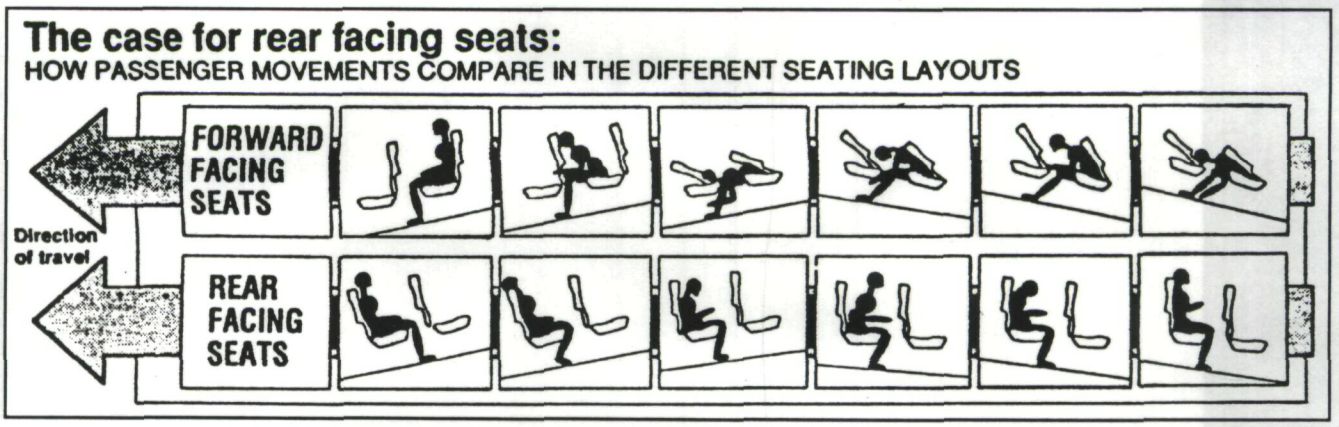

Figure 5. The case for rearward facing seats

NOTE: The occupants are only wearing lap belts.

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