



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December 2, 2003

In reply refer to: A-03-55 and -56

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On January 23, 2003, a Singapore Airlines (SIA) Boeing 747-400 experienced a complete loss of information on all six integrated display units (IDU)¹ on the flight deck instrument panels while in cruise flight from Singapore to Sydney, Australia. The pilots flew the airplane for 45 minutes using standby flight instruments while they communicated with SIA maintenance personnel about the problem. SIA maintenance personnel advised the flight crew to pull out then push back in (or cycle) the circuit breakers for the EFIS/EICAS² interface units (EIU), which returned the IDUs to normal operation. The flight continued to Sydney and landed without further incident.

A similar event occurred on another SIA B747-400 on November 6, 2001. As the airplane climbed to flight level 360 for the Sydney-to-Singapore flight, the flight crew observed a cabin altitude caution message and an increase in cabin altitude.³ Unable to control the cabin altitude, the flight crew declared an emergency. During the emergency descent, all six IDUs went blank. The flight crew used standby instruments for the return flight to Sydney and landed without further incident. After landing, maintenance personnel returned the six IDUs to normal operation by cycling the EIU circuit breakers.

¹ The six IDUs of the airplane's integrated display system include the captain's primary flight display (PFD) and navigation display (ND), the first officer's PFD and ND, and the main and auxiliary engine indication and crew alerting system (EICAS) displays. The PFD and ND displays provide the pilots with attitude, altitude, airspeed, heading, and rate of climb and descent information. The EICAS displays provide the flight crew with the airplane's engine indicating information and annunciate advisories, cautions, and warnings. Without these displays, the flight crew is required to use standby flight instruments, which consist of an altimeter, airspeed indicator, and artificial horizon/attitude indicator; the Boeing 747-400 does not have standby engine instruments. The loss of the IDUs would also eliminate the flight crew's access to data from the traffic alert and collision avoidance system, enhanced ground proximity warning system, and weather radar.

² EFIS is an acronym for electronic flight instrument system and, as mentioned above, EICAS stands for engine indication and crew alerting system. In Boeing's nomenclature, the "E" in EIU represents both EFIS and EICAS.

³ Postincident investigation determined that the cabin altitude caution message was displayed due to the failure of one of the input/output processor cards for the left EIU.

The Civil Aviation Administration of Singapore is conducting an investigation of the January 2003 event, and the Australian Transportation Safety Board conducted the investigation of the November 2001 event.⁴ Findings thus far indicate that, in both instances, all six IDUs blanked because all three of the airplane's EIUs stopped transmitting data over a period of time.⁵ The EIUs are identical to provide triple redundancy and are responsible for collecting, formatting, and generating/outputting the signals for data shown on the six flight deck displays, as well as collecting information from and providing information to numerous airplane systems. The loss of all three EIUs prevents the flight crew from accessing airplane system information via EICAS and causes the disconnection of the airplane's autothrottle system, which flight crews typically activate during the cruise phase of flight to automatically monitor and control the throttles. Because the B747-400 does not have standby engine instruments, the flight crew has only the position of the engine thrust levers to monitor engine performance.

The cause of the EIU failures in the two SIA events has not been determined, and the investigations have not identified any changes to the EIU design that would prevent another blanking of all six IDUs. The Safety Board, in conjunction with the Australian and Singaporean authorities and Boeing, is continuing to investigate the cause of this malfunction. However, in the interim, Boeing has provided a procedure to B747-400 operators that is similar to the method used to restore the displays in both SIA B747-400 display-blanking events. On February 25, 2003, Boeing issued Operations Manual Bulletin (OMB) #SIA-186, which states, "In the unlikely event all six display units blank, cycling the left and center EIU circuit breakers may recover the display units." The OMB also requests that the bulletin be placed in the OMB Record page of the airplane operations manual.⁶

Based on findings to date in the investigations of both SIA IDU blanking events and a review of the B747-400 integrated display system, Boeing's recommendation to cycle the EIU circuit breakers to restore EIU functionality appears to be a reasonable temporary action until a permanent solution is determined.⁷ However, in the event that all six flight displays blank, flight crew workload would significantly increase, and a crew would need to be able to rapidly identify and execute the appropriate sequence of actions to address the problem. It is unrealistic to expect a B747-400 flight crew faced with a loss of cockpit displays and autothrottles to rapidly locate corrective actions in the operations manual. Instead, the procedure outlined in Boeing's OMB should be identified as a non-normal checklist procedure and incorporated in the quick-reference handbook to facilitate flight crews' access to this information.

⁴ Under the provisions of Annex 13 to the Convention on International Civil Aviation, the National Transportation Safety Board is participating in these investigations as an Accredited Representative for the State of Manufacture.

⁵ In the January 2003 event, two EIUs stopped transmitting at the same time, followed by the third about 1 minute later. In the November 2001 event, the right EIU and part of the left EIU failed at the same time. About 7 minutes later, the rest of the left EIU and the center EIU failed.

⁶ This section of the operations manual is used to log revisions to the manual and typically includes bulletins to note changes to the airplane.

⁷ Boeing representatives have indicated that they are currently exploring changes to the EIUs to address this issue.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that all Boeing 747-400 operators incorporate the procedures detailed in Boeing Operations Manual Bulletin #SIA-186 into a non-normal checklist procedure for inclusion in the quick-reference handbook until a terminating action is developed. (A-03-55)

Advise the Safety Board when a terminating action that addresses the blanking of integrated display systems on Boeing 747-400s is developed and implemented. (A-03-56)

Chairman ENGLEMAN, Vice Chairman ROSENKER, and Members CARMODY, GOGLIA, and HEALING concurred with these recommendations.

By: Ellen G. Engleman
Chairman