Report 00-012

temporary loss of air traffic control communications system

Christchurch main trunk air traffic services centre

25 October 2000

Abstract

On Wednesday 25 October 2000 at 1936, the Christchurch main trunk air traffic services centre communications system experienced an unanticipated complete power loss during non-routine maintenance. The power loss caused a loss of normal radio and telephone communications to the centre for several minutes. Each terminal controller and the controllers for 2 of the 5 area sectors had independent battery-powered radios available. Independent telephone links and all radar information to the centre remained operational.

A subsequent modification to the system should prevent a similar occurrence.

Safety issues identified were the availability of independent telephones and the emergency section of the Instrument Flight Guide not containing information for pilots in the event of a loss of air traffic control communications. A safety recommendation concerning independent telephones was made to the Airways Corporation of New Zealand Limited. The Civil Aviation Authority had accepted a prior safety recommendation for the Instrument Flight Guide to include information regarding a loss of air traffic control communications, but the recommendation had not been implemented at the time of the incident. The authority advised it was taking action to ensure implementation of the prior recommendation.

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

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1. Factual Information

1.1 On Wednesday 25 October 2000 at 1936[1], the Airways Corporation of New Zealand Limited (Airways) Christchurch main trunk air traffic services centre radio and telephone communications system (GAREX) experienced a complete power loss for about 5 minutes. The terminal control areas and 2 of the 5 area sectors had independent battery-powered standby radios available for the controllers. Limited telephone and cellular telephone communications independent of the GAREX were available. No in-flight difficulties resulted. Some aircraft departures were delayed and some aircraft in-flight were held temporarily until appropriate instructions could be issued.

1.2 The services disrupted were all normal radio and telephone communications into and out of the Christchurch centre through the GAREX air traffic controllers' console positions. The air traffic services centres in other parts of the country were able to communicate normally. Independent telephone communications from the centre were available but some area sector controllers did not have ready access to independent telephones. In one instance, a controller contacted another centre by relaying by radio via an aircraft.

1.3 Each terminal control area and area sector had a main, an alternate, a secondary and an independent battery-powered standby radio system, except for Taranaki, Kaikoura and South area sectors, which had the main, alternate and secondary radio systems but no independent battery-powered standby radio system. Those area sector controllers without an independent standby radio could contact aircraft through the adjacent area or terminal sector frequencies or through other aircraft.

1.4 The Christchurch centre GAREX system provided the main trunk air traffic control voice communications throughout the country. Terminal and area controllers operated from the Christchurch centre at their respective console positions.

1.5 Two independent city electrical power supplies normally powered the Christchurch centre, including the GAREX system. A standby generator or a standby battery power pack was available to power the centre and GAREX system in the event both main power supplies were disrupted. In addition, the GAREX had its own standby battery power pack that was independent from the other power sources. The main power source normally charged the batteries.

1.6 At the time of the incident, non-routine maintenance was being carried out to replace the standby battery power pack with an improved system incorporating 3 parallel battery power packs. The maintenance had been scheduled to coincide with a time of lighter than normal traffic demands in the event an unforeseen problem occurred.

1.7 A fuse protected the standby battery power pack from any excessive power. A single isolating switch could be operated to disconnect the battery power pack from the main 48-volt power source and GAREX system. The single isolating switch was to be replaced with 3 switches. In order to replace the switch it needed to be disconnected from the main and standby power sources. The fuse was removed to cut off main power to the isolating switch, and the switch was then turned off to disconnect the battery power pack from the system.

[1] Times in this report are New Zealand daylight time (UTC + 13 hours) and are expressed in the 24 hour mode.

1.8 The GAREX had a built-in protection system that allowed it to be shut off from the main and standby power systems by a solenoid-actuated switch. A cutout switch located on the front power supply panel controlled the solenoid-actuated switch. The solenoid was powered via the main or standby power systems or the GAREX standby battery power pack. The solenoid, when powered, held its switch contacts closed, enabling power to be supplied to the GAREX. If the cutout switch was operated it would cut all power to the solenoid. The de-powered solenoid would then open its switch contacts, disconnecting the GAREX from its main and standby power supply sources. The cutout switch was protected from inadvertent operation by a clear perspex panel.

1.9 The standby battery power pack fuse was situated in and before the line that supplied main power to the solenoid. The purpose of the fuse was to protect the battery power pack. Once the fuse was removed the main power supply to the solenoid was disrupted, but the solenoid remained powered by the standby battery power pack. When the battery power pack isolating switch was turned off it removed its power supply to the solenoid. The solenoid switch then opened, cutting main power to the GAREX (see Figure 1).

1.10 The GAREX system maintenance manual outlined the procedures to be followed when performing maintenance. Airways said it followed those procedures. Before technicians could work on the GAREX they had to be certified as being competent by passing a competency test.

1.11 The maintenance manual contained two GAREX wiring circuit drawings, but these drawings did not show the placement of the power supply connection to the solenoid-actuated switch. No previous maintenance had been carried out requiring the removal of the standby battery power pack fuse. The GAREX manufacturer had not issued any cautions regarding removal of the fuse. Prior to the maintenance the technicians carried out a scenario analysis to determine the likely effects of removing the fuse, but had not anticipated any power loss. Power was lost for some 4 or 5 minutes before the fault was rectified, the power restored and testing commenced.

1.12 Following the power loss Airways identified a wiring deficiency in the GAREX system circuitry. The deficiency allowed the solenoid to be de-powered if the standby battery power pack fuse was removed, while the standby battery power pack was also disconnected. Airways advised that the solenoid main power supply circuitry would be modified by connecting it before the battery power pack fuse, thereby eliminating the potential for a similar occurrence. Other means of manually shutting off the GAREX from its power sources existed and could also be used to quickly turn off power to the system.

1.13 In April 1998 Airways was re-certified under the Civil Aviation Rules to provide air traffic and aeronautical communication services. Civil Aviation Rule Part 172.57 requirements included that area control centres be provided with equipment enabling, "…to the fullest extent practical, two-way voice communication … with aircraft in, or adjacent to, airspace for which the applicant has responsibility; …". The rule also stated that the equipment "…shall have a level of reliability, availability, and redundancy, that minimises the possibility of failure, non-availability, or significant degradation of performance." The Airways, Civil Aviation Authority approved, exposition showing its method of compliance with Civil Aviation Rules did not specifically state independent standby radios were to be provided.

1.14 When Airways was re-certified under Civil Aviation Rules, each terminal area and one area sector had an independent standby radio system. Airways advised that although the Civil Aviation Rules did not specifically require standby radio systems for the area sectors, it had already provided one additional area sector with an independent standby battery-powered radio since re-certification. Work was in progress to provide the remaining 3 area sectors with independent standby radio systems and Airways expected the work to be completed by 31 March 2001.

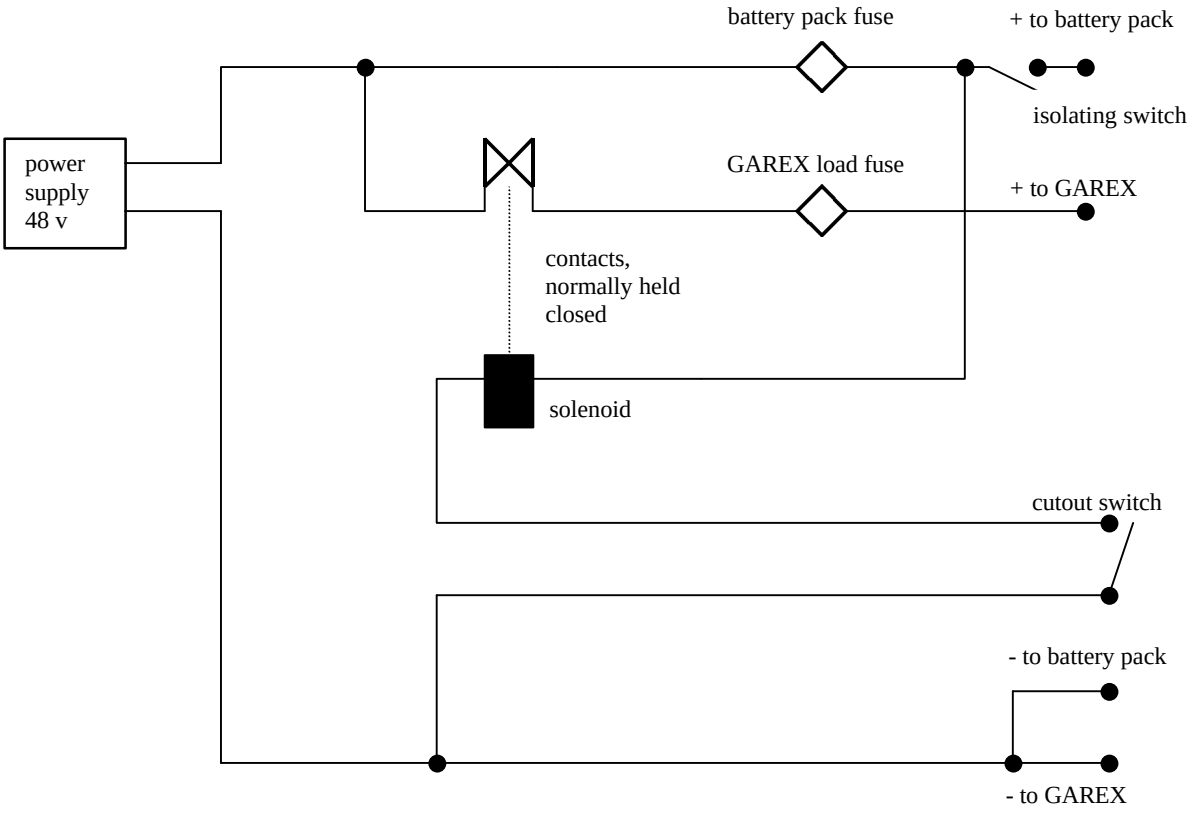

Figure 1
Simplified GAREX power connection diagram

1.15 In 1997 the Commission investigated an incident (report 97-007) involving a temporary loss of air traffic control radio communications in the Wellington region. That failure resulted from software maintenance action and was unanticipated.

1.16 Report 97-007 identified the need for pilots to be provided with adequate information and advice on how to deal with a failure of air traffic control communications. The Commission recommended to the director of the Civil Aviation Authority that he, "review the EMERGENCY section of the IFG [Instrument Flight Guide] with a view to ensuring that the scope of the communication failure part of that section is sufficiently comprehensive to provide pilots with information and advice on actions to be taken in the event of a failure of communications from air traffic control (059/97)".

1.17 The director of the Civil Aviation Authority responded to the recommendation by stating, "It is expected that the review of the relevant section of the Instrument Flight Guide will be initiated before the end of 1997, consultation with industry will take place early in the first half of 1998 and agreed changes would be in place by 30 June 1998. The timing of these matters is, to a large extent, governed by the AIRAC [aeronautical information regulation and control] publishing cycle."

1.18 On 25 October 2000, at the time of the GAREX power loss, no information dealing with an air traffic control loss of communications was available in the emergency section of the IFG. On 5 December 2000 the Civil Aviation Authority advised that, "the Manager Aeronautical Services will amend the Emergency section of the IFG to reflect actions to be taken by aircraft in the event of ATC [air traffic control] radio failure. The Traffic Information Broadcasts by Aircraft (TIBA) section will remain in the planning manual. In the long term it is proposed that rule 91.429 will also be modified to reflect the actions to be taken by aircraft in the event of ATC radio failure." The Civil Aviation Authority advised the Instrument Flight Guide amendment should be incorporated by 17 May 2001 or 12 July 2001.

2. Analysis

2.1 This incident was of concern because any loss of air traffic control communications between the various air traffic services centres and with aircraft has the potential to create a risk of collision. In this instance the risk was low, because it occurred at a time of day when traffic was light and independent standby radios were available, except in 3 area sectors. Those area sectors had minimal traffic, and some other means of communicating with aircraft in those sectors existed. Although there were independent telephone links to the Christchurch centre, not all the controllers had ready access to independent telephones. This limited their ability to communicate with other air traffic services centres. No in-flight difficulties were reported but some delays occurred. System power was restored within 5 minutes, and following testing all normal services were operating again within 15 minutes.

2.2 Although the GAREX system had several layers of power supply redundancy, there was a single failure point latent in the system because of a design deficiency. The failure point was not obvious and had not previously been identified. During normal operation a complete power loss was unlikely. In this instance the power loss was induced by the non-routine maintenance. Although a scenario analysis had been carried out before undertaking the non-routine maintenance, the single failure point was undetected. The subsequent action taken by Airways to eliminate the failure point should enhance the reliability of the system's power supply redundancy and prevent a similar occurrence.

2.3 Airways advised that although scenario analyses were routinely carried out prior to commencing non-routine maintenance, it had not formalised the procedures. Subsequently, Airways said it has initiated a process to establish formal procedures for detailed scenario analysis before any non-routine maintenance on critical systems is commenced.

2.4 This incident demonstrated that a loss of normal air traffic control communications can occur and illustrated the importance of having some independent means of communication. Civil Aviation Rules required the voice communications equipment to have a level of redundancy that minimised the possibility of failure and non-availability. The level of communication redundancy minimised that possibility, particularly in the terminal areas and 2 area sectors. In this instance system redundancy provided for continued but limited communications. The action taken by Airways to provide independent battery-powered standby radio systems for the 3 remaining area sectors should further enhance radio communication redundancy throughout the country. Airways should also ensure all controllers have ready access to independent telephones to enhance telephone communication redundancy.

2.5 This incident again highlighted the point that no matter how much diversity is designed into the system, some additional advice to pilots is needed to ensure basic levels of safety and orderliness can be maintained in the event of a loss of air traffic control communications.

2.6 The need for additional advice to pilots was first addressed in the Commission's report into a different temporary loss of air traffic control communications in 1997. A safety recommendation was then made to the director of the Civil Aviation Authority to include information and advice for pilots in the emergency section of the Instrument Flight Guide, in the event of a failure of air traffic control communications. Although the recommendation was accepted, procedural delays prevented any action being finalised before the incident. Pilots could potentially have used that information during the incident. The action the Civil Aviation Authority advised it is now taking to implement the recommendation should ensure appropriate information will be available to pilots in the event of a loss of air traffic control communications.

3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 The Christchurch main trunk air traffic services centre radio and telephone communications system power loss was an unanticipated result of non-routine maintenance action, and stemmed from an unidentified single failure point.

3.2 The proposed modification to the system circuitry should prevent a similar recurrence of the power loss.

3.3 The controllers' ability to limit the disruptions would have been improved if each controller had ready access to an independent telephone.

3.4 Ongoing improvements for the availability of independent standby radio systems, as outlined in paragraph 1.14, should enhance radio communication redundancy.

4. Safety Recommendation

4.1 On 27 February 2001 the Commission recommended to the chief executive of the Airways Corporation of New Zealand Limited that he:

4.1.1 ensure all controllers have ready access to a telephone independent from the main system. (135/00)

4.2 On 12 March 2001 the chief executive of the Airways Corporation of New Zealand Limited replied, in part:

4.2.1 As previously advised this recommendation has been accepted by Airways and has been implemented.

Implementation was complete on 1 February 2001. Each sector to which the recommendation is relevant has had installed either a standard telephone circuit routed through a PABX which is independent of the GAREX system or a cellphone. Each of the Terminal sectors has sole access to its own standby phone. The Area sectors which are less complex and have less urgent need for such standby provisions share two lines . . .

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Hon. W P Jeffries
Chief Commissioner