Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report – 200601663

Final

Wirestrike – St Albans, NSW
4 April 2006
Bell Helicopter Company 206B III, VH-JIV

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Figure 1: Photo supplied by Integral Energy.

Figure 2: Copied from the National Guidelines for Aerial Surveillance of Overhead Electricity Networks. Reproduced with permission of, and available for purchase from, SAI Global Ltd distributors of Australian Standards at http://www.sai-global.com .

Abstract

On 4 April 2006 a Bell Helicopter Company 206B III helicopter was being operated on a survey of powerlines in the St Albans area of New South Wales with a pilot, two power supply company personnel and a photographer on board. At about 1000 Eastern Standard Time, the pilot observed a previously unseen single–strand telecommunication cable support wire rubbing against the copilot's door, and attempted to manoeuvre the helicopter clear of the wire. The helicopter lost directional control and commenced spinning to the right. However, the pilot cleared the wires and attempted a landing in an adjacent paddock. The helicopter came to rest on its right side and was severely damaged. One of the power supply company personnel received serious head injuries and the remaining occupants received minor injuries.

Safety action undertaken as a result of this accident included:

- by the power supply company, who acted to:
  - immediately suspend helicopter inspections
  - appoint an internal accident investigation team that would make recommendations for the recommencement of helicopter operations
  - engage an aviation risk management consultant to assess the hazards affecting the company's aerial surveillance operations and to assist the internal investigation team
  - implement a number of safety actions that were recommended by the internal investigation team.
- the removal by the telephone company of the single-strand telecommunication cable support wire that was struck by the helicopter.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances in order to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau prefers to report positive safety action in its final reports rather than making formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

FACTUAL INFORMATION

The information presented below, including any analysis of that information, was prepared principally from information supplied to the Bureau.

History of the flight

On 4 April 2006, a Bell Helicopter Company 206B III helicopter, registered VH-JIV, was being operated on a powerline survey in the St Albans area of New South Wales. On board the helicopter were the pilot, a power supply company observer in the front left seat, and a power supply company inspector and a photographer in the rear seats. The powerline survey was conducted annually in order to inspect and maintain the company's overhead powerlines in accordance with its Bush Fire Risk Management Plan.

The pilot reported that the survey was being conducted at a height of 3 to 5 ft higher than the highest powerline, and at 5 to 10 m laterally-displaced from those lines. The pilot also reported that he normally conducted powerline surveys at a speed of 25 to 30 kts and from the left of the wires being surveyed. That allowed the power supply company inspector, who was seated in the right rear seat, an optimal view of the wires.

The pilot reported that, at about 1000 Eastern Standard Time[1], the survey had progressed to a powerline that tracked in a south-easterly direction to a private residence. A short time later, the pilot observed a separate, and previously unseen single-strand wire rubbing against the copilot's door. That single-strand wire converged on the powerline and also tracked towards the private residence.

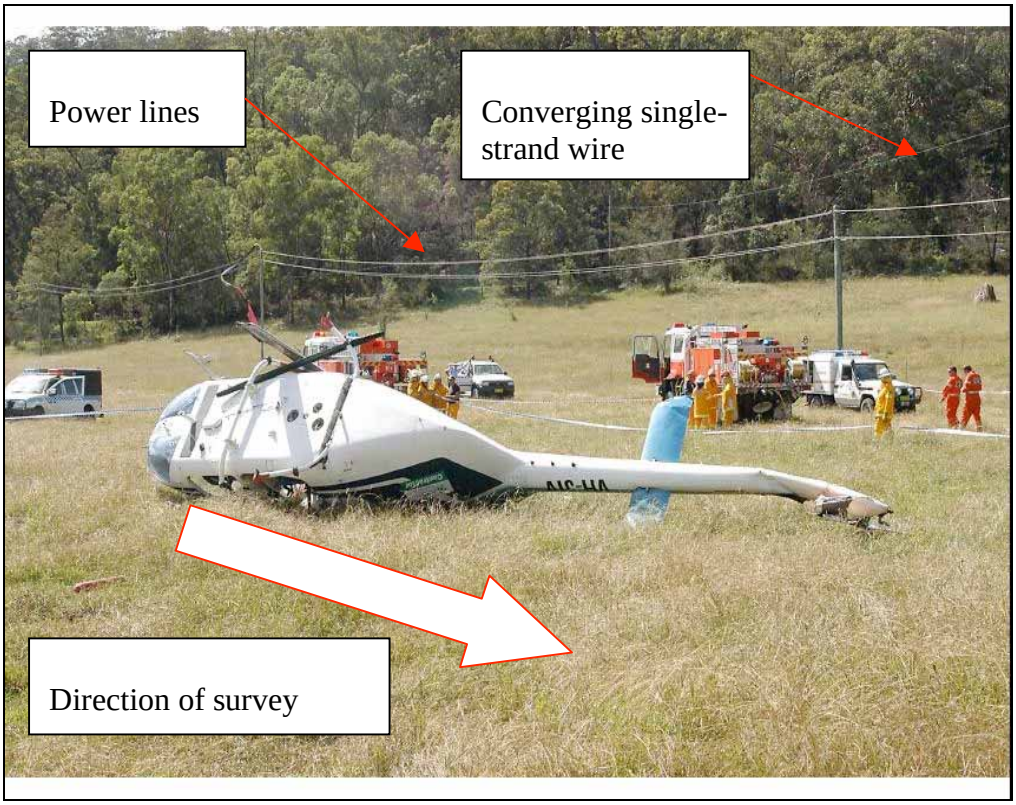
The pilot reported being 'boxed in' between the powerlines on his right, and the single-strand wire on his left. In response, he attempted to clear the single-strand wire. However, the tail rotor came into contact with the single-strand wire and the helicopter began rotating as it lost directional control.

The pilot climbed the helicopter clear of both sets of wires before attempting to land the helicopter in an upright position in an adjacent paddock. However, on contact with the ground, the helicopter rolled onto its right side, resulting in severe damage to the helicopter's skid landing gear, main and tail rotors and cabin structure (figure 1).

The power supply company observer sustained serious head injuries and the pilot, power supply company inspector and photographer suffered minor injuries. The pilot was the only occupant wearing a helmet and he reported that the helmet was damaged during the accident sequence.

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

Figure 1: Helicopter adjacent to survey wires



Operational information

The pilot was properly qualified to undertake the flight and had completed low flying training in accordance with Civil Aviation Order 29.10 Appendix 1, sub-paragraph 3(a).

The powerline survey was conducted under cover of a Low Flying Permit that was issued by the Civil Aviation Safety Authority (CASA). That permit authorised the conduct of powerline inspections by the operator below 500 ft above ground level (AGL) subject to the following conditions:

- those inspections were to be conducted in visual meteorological conditions[2] (VMC)
- the number of persons on board an aircraft was to not exceed the minimum necessary to perform the inspection. The operator indicated the understanding that the carriage of the photographer onboard the helicopter was necessary to perform the aerial surveillance of the powerline. That understanding was not consistent with the intent of the power supply company for that surveillance (see page 3, Carriage of passengers).

2 Prescribed ambient conditions for flight under the Visual Flight Rules. Includes flight visibility, distance from cloud and other conditions, depending on the height of the aircraft. See Aeronautical Information Publication ENROUTE (ENR) 1.2 Visual Flight Rules.

The investigation determined that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The helicopter's weight and balance were estimated to be within limits.

Visual meteorological conditions were reported in the St Albans area at the time of the occurrence and the wind was light and variable. No evidence was found to suggest that the weather or other ambient conditions influenced the circumstances of the accident.

Organisational information

The National Electrical Network Safety Code (the Code) was produced by The Electrical Supply Association of Australia (ESAA) as a primary document affecting electrical industry safety in Australia. The objectives of the Code included the promotion of safety as a priority for customers, the public and industry workers, and of nationally-consistent practices in that industry.

The National Guidelines for Aerial Surveillance of Overhead Electricity Networks (the Guidelines) were developed jointly by representatives of the electricity generation and supply industry in Australia and the ESAA in support of the Code. The Guidelines set out minimum industry standards, are advisory only, and are not intended to replace or override any legislation or other requirements made by higher authorities.

The contract for the supply of helicopter services to the power supply company included that the use of helicopters for powerline inspections was based on the requirements of the Guidelines. Elements of the Guidelines with the potential to have influenced the conduct of the occurrence flight included:

- **Carriage of passengers.** A passenger was defined in the Guidelines as 'any person in the aircraft other than the pilot or *monitor(s)*'[3]. The Guidelines stated that '*passengers shall* not be carried in aircraft conducting *Aerial Surveillance Work*'. In that regard, the power supply company indicated that the photographer was not essential to the conduct of the powerline surveillance operation.
- **Personal protective equipment.** The Guidelines required the consideration of the use of helmets during aerial surveillance work that incorporated the provision of communications systems. The power supply company indicated that employees were informed about the use and availability of helmets during pre-season briefings. There was no evidence that the use of helmets was discussed, or that they were made available to the power supply company employees or photographer on the day of the accident.
- **Rotary Wing Aerial Surveillance Zones.** The Guidelines placed restrictions on the conduct of aerial surveillance work in helicopters in terms of a number of Aerial Surveillance Zones as follows (Figure 2):
  - **Aerial Surveillance Zone – Hover (ASZ 1).** ASZ 1 extends from the ground to the height of the lowest conductor or wire. Operations within that zone are

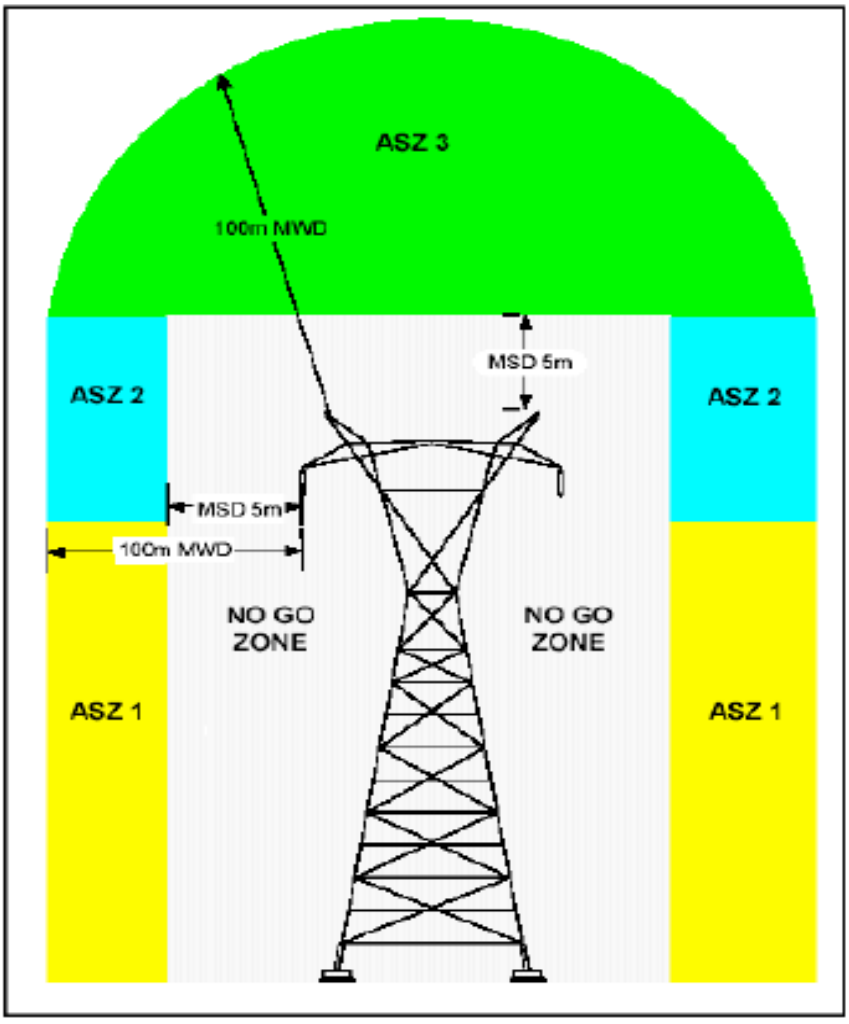
3 A monitor was defined as 'all person(s) required to observe and document the outcomes of the surveillance of *Overhead Electricity Networks* from an aircraft.'

restricted to the hover, with slow directional manoeuvring possible in order to conduct a detailed inspection of the asset.

– **Aerial Surveillance Zone – Restricted (ASZ 2).** ASZ 2 extends 'from the height of the lowest conductor/wire to 5 metres above the top of the structure and/or *overhead line[s]*', and from 5 to 100 m laterally displaced from that structure and/or overhead line(s). Operations within ASZ 2 are restricted to either hovering, or to a maximum speed as determined by the relevant power supply company and helicopter operator.

– **Aerial Surveillance Zone – Un-restricted (ASZ 3).** ASZ 3 extends from 5 m above the top of the supporting structure and/or overhead line(s) to a distance of 100 m from the structure and/or overhead line(s). Helicopters operating in ASZ 3 are considered to have unrestricted manoeuvrability.

Figure 2: Rotary Wing Aerial Surveillance Zones[4]



A risk management plan was developed by the power supply company in support of the development and ongoing management of the contract for the supply of

4 Copied from the National Guidelines for Aerial Surveillance of Overhead Electricity Networks. Reproduced with permission of, and available for purchase from, SAI Global Ltd distributors of Australian Standards at http://www.sai-global.com .

helicopter services. Included in that plan was a full risk assessment of the occupational health and safety (OH&S) and environmental risks affecting the provision of those services. As a result of that risk assessment, the power supply company promulgated the following shared action(s) or control(s) to be actioned by the power supply company and contractor in response to the identified risks:

- **Training and awareness needs.** Any induction training provided was to be in accordance with the requirements of the relevant ESAA guide for the inspection and patrol of overhead powerlines and OH&S regulations.
- **Licensing, permits, statutory approvals and regulatory requirements.** All operations were to be in accordance with CASA regulations.

The risk management plan included the appointment of an overall coordinator 'to induct staff and provide a single point of contact to monitor and enforce the plan'. In addition, the Overhead and Ground Line Inspections (OLI/GLI) and Pole Asset Managers were nominated to check that the helicopter services were compliant with the relevant purchasing specifications. The periodicity of those monitoring/enforcement and audit functions was not specified in the plan, and there was no evidence of the conduct of any specific enforcement or compliance auditing against the requirements of the plan since its approval on 28 May 2003.

However, the power supply company advised that, over the period of the agreement for the provision of helicopter services by the operator, the oversight of the operator had included:

- an ongoing, 'informal' and generally undocumented review of the delivery of helicopter services by the operator
- a process review of the provision of helicopter services by the operator that was carried out towards the end of 2003
- the completion of a supplier performance evaluation in February 2006. That evaluation concluded that the operator's overall performance 'exceeds expectations in part'.

Additional information

A number of previous investigations by the Australian Transport Safety Bureau (ATSB) and its predecessor, the Bureau of Air Safety Investigation, have identified a number of options with the potential to reduce the risk of wirestrikes associated with low-level aircraft operations. In particular, investigation report BO/200404285 (available at www.atsb.gov.au) identified a number of options for reducing the consequence and therefore risk of a wirestrike. Those options included the consideration of the use of helmets and full-cover clothing by aircraft occupants and, where possible, the installation of wire-strike protection systems.

In this accident, the pilot was the only occupant wearing a helmet.

A wirestrike protection system was not installed in the helicopter, and nor was it required to be by regulation. In addition, as described in ATSB investigation report BO/200404590 (also available at www.atsb.gov.au), the protection provided by such a system is influenced by the:

- attitude and speed of the aircraft over the ground at the time of impact with the wire
- tension of the powerline or other wire or cable struck by the aircraft
- angle at which the aircraft strikes the powerline or wire
- pilot reaction to the strike, or potential strike.

A second element of any risk management strategy is to minimise the likelihood, and therefore risk of a wirestrike. That relies on the low-level pilot and crew identifying, and then avoiding, any power cables or wires in the area of operation.

The factors influencing the visibility, and therefore identification and subsequent avoidance of power and other cables and wires can include the:

- pilot and crew's prior knowledge of the location of any wires
- presence and visibility of any supporting structure(s)
- diameter and make-up (or alloy) of the wire
- nature of the visible background to the wire; ambient light, in terms of its angle and intensity; and the presence or influence of any illusions.

In this instance, the single-strand wire:

- was not marked on the power company's survey maps of the area
- was reported to be unknown to the pilot, despite his having previously surveyed the power cables on a number of occasions
- was about 30 to 40 ft AGL, and about 10 ft higher than the powerlines
- converged with the powerlines
- was reported by the pilot to be not visible against the trees in the background and its supporting structures were reported to be hidden from view behind a tree line.

The single-strand wire was unused and had previously supported a telephone cable, but was not marked on the relevant telephone company's network charts. The telephone company had not removed that support wire after the telephone cable had been taken down, nor was there a statutory requirement for the company to have done so.

The telephone company reported that the capability existed for energy companies to contact the 'Dial Before You Dig' service in order to obtain information on the location of its overhead telephone cables. The potential limitations on accessing that service by energy companies included that:

- the height of telecommunication cables and supporting structure (including supporting wires such as the single-strand wire) is not always available
- the details of some telecommunication cable supporting infrastructure may not be recorded with the service

- because of the relative visibility of the precise location of above ground structures compared with underground infrastructure, the same level of detail for those structures is not provided as for below ground infrastructure.

The telephone company indicated the possibility that additional information on its infrastructure may be available for use by power companies on request.

ANALYSIS

The lateral displacement of the helicopter from the powerlines being surveyed meant that the pilot satisfied the minimum separation requirements applicable to operations within the Aerial Surveillance Zone – Restricted (ASZ 2) that were promulgated in the National Guidelines for Aerial Surveillance of Overhead Electricity Networks. In that case, the pilot ought to have been assured that the likelihood of his helicopter sustaining a wirestrike was minimal.

The location of the single-strand telecommunication cable support wire to the left of the helicopter's track, the obscuration of its support structures, and the nature of the environmental backdrop minimised the visibility of the single-strand wire. That, combined with the helicopter occupants' focus on the power supply cables to the right of the helicopter, minimised the likelihood that the pilot, or other occupants of the helicopter, would identify the previously unseen and uncharted single-strand wire. A particular problem was that the unidentified single-strand wire infringed ASZ 2, markedly increasing the likelihood that a wirestrike would, at some time, occur during a survey.

A number of variables have the potential to affect the utility of a wirestrike protection system. In this occurrence, the angle at which the helicopter struck the single-strand wire and location of the strike on the helicopter negated the potential for a wirestrike protection system, if installed in the helicopter, to have affected the consequences of the wirestrike.

The unintended consequence of the operator's misunderstanding of the relevance of the photographer to the aerial surveillance task was the unnecessary carriage of the photographer during that task. The resulting carriage of the photographer was contrary to the intent of the operator's Low Flying Permit and the National Guidelines for Aerial Surveillance of Overhead Electricity Networks. In terms of its potential consequence in the case of a wirestrike, that action increased the risk associated with the surveillance task. Similarly, the somewhat informal consideration of the possible benefits of the use of helmets by power supply company personnel during aerial surveillance operations and the decision to not wear helmets in this instance, further increased the potential consequence, and therefore risk of the task.

The less formal oversight of the supply of helicopter services than that required by the risk management plan did not appear to have specifically addressed the elements of the risk management plan that had the potential to have reduced the consequence of a wirestrike.

SAFETY ACTION

Power supply company

As a result of this accident, the power supply company undertook extensive safety action, including to:

- immediately suspend helicopter inspections
- appoint an internal accident investigation team that would:
  - investigate and report on matters relating to the accident
  - make recommendations for the recommencement of helicopter operations
- engage an aviation risk management consultant to assess the hazards affecting the company's aerial surveillance operations and to assist the internal investigation team
- implement a number of safety actions that were recommended by the internal investigation team.

A full description of the Safety Action that was undertaken by the power supply company is at Appendix A.

Telephone company

As a result of this accident, the telephone company indicated that the single-strand telecommunication cable support wire that was struck by the helicopter would be removed.

Civil Aviation Safety Authority

The Civil Aviation Safety Authority has indicated that, in conjunction with the Aerial Agricultural Association of Australia, it intends publishing a wirestrike article in the November-December 2006 issue of its Flight Safety Australia Magazine.

APPENDIX A: LOCAL SAFETY ACTION – POWER SUPPLY COMPANY

Immediate actions

Immediately following the accident, the power supply company (the company) acted to:

- suspended all helicopter inspections
- appoint an internal investigation team to:
  - investigate and report on matters relating to the accident
  - make recommendations in relation to the resumption of helicopter inspections
- appoint an aviation risk management consultant to assist the internal investigation team.

During its investigation, the internal investigation team provided the company's employees with regular updates regarding the progress of the investigation and the planning for the resumption of helicopter inspections. That included using staff newsletters and targeted briefing sessions for those employees that were normally engaged in aerial surveillance work.

In its Report, the internal investigation team made a number of recommendations, some of which required action prior to the resumption of helicopter inspections. In response, the company invoked a number of safety actions prior to resuming helicopter powerline inspections on 21 August 2006. Subsequently, a number of additional safety actions have, and continue to be actioned by the company.

A summary of those safety actions follows.

Safety actions implemented prior to the resumption of aerial inspections

Risk assessment of the conduct of Helicopter inspections

Initially, the company engaged an aviation risk management consultant to develop and assist with the implementation of Task/risk Profiles and Operational Risk Plans. Those profiles and plans were intended for application in the five task categories for which the company conducts helicopter inspections.

The content of the Operational Risk Plans included: the conduct of helicopter maintenance and refuelling; communication requirements affecting the conduct of aerial inspections; pre-flight briefing requirements; the identification and recording of hazards; the assessment of relevant risks; the applicability and use of personal protective equipment (PPE); training requirements in support of the aerial inspection task; the requirement for and conduct of audits; the management of helicopter service providers; and airborne procedures for application during the conduct of aerial inspections.

In addition, the Operational Risk Plans required the conduct of ‘reconnaissance flights’ prior to the conduct of aerial line inspections in order to identify and assess risks and hazards applicable to the planned inspections. Criteria have been developed for application during the consideration of whether a reconnaissance flight is required prior to an inspection.

Risk assessment of the operator

The aviation risk management consultant was also tasked to audit the contracted helicopter service provider’s (the operator) operations. That audit was in the form of a ‘gap’ analysis of the company’s newly developed Operational Risk Plans, as compared to those being used by the operator.

Initial audits were conducted of the operator on 1 and 2 July 2006, and an additional follow-up audit was conducted on 17 August 2006. Those audits included a review of the operator's Operations Manual.

Subsequent to the completion of the follow-up audit, the aviation risk management consultant recommended the resumption of helicopter inspections. The operator underwent an additional audit on the day on which helicopter inspections resumed.

Risk assessment affecting the use of PPE

The company also engaged the aviation risk management consultant to conduct a risk assessment of the relevant PPE for consideration for use during aerial inspections. That included the consideration of the relevance of the use of helmets and fire-resistant gloves and suits during inspections, and the circumstances in which such PPE, if adopted, should be used. Company employees that were involved in the conduct of aerial inspections were consulted during the risk assessment, and PPE suppliers provided exemplar equipment for examination by those employees as part of that process.

As a result of the risk assessment, and in consultation with the relevant employees, the company directed that all employees engaged in the conduct of aerial inspections must wear:

- fire-retardant flying suits and gloves
- an appropriate helmet that included a visor and communications system. Employees were permitted to trial a range of helmets and, based on the results of those trials, orders will be placed for the delivery of individually-fitted helmets.

Amendments to company policy

As a result of its work with the aviation risk management consultant, the company amended its policies relating to helicopter inspections. That resulted in the development of a Helicopter Operations Manual, which consolidated the company's policies affecting those inspections.

The newly developed Helicopter Operations Manual requires that:

- only essential crew, comprising a pilot and two monitors (one observer and one inspector) are to travel onboard a helicopter during the conduct of aerial line inspections
- passengers must not travel onboard a helicopter that is conducting aerial line inspections
- all helicopter crew must wear appropriate PPE during the conduct of aerial line inspections. That includes:
  - fire-retardant flying suits and gloves
  - a helmet that includes a visor and communications system.

General training - Employee Workshop

A training workshop was carried out on 18 July 2006 that involved all company employees engaged in the conduct of aerial surveillance and inspection work. During that workshop, the employees were provided with, among other things, information, instruction and training in the:

- lessons learned from the accident at St Albans
- requirements for, and use and care of employees' PPE
- Helicopter Operations Manual, including the explanation of the implications of the amended policies affecting the conduct of helicopter inspections
- content and effect of the Task/risk Profiles and Operational Risk Plans
- application of the company's risk assessment policies to the aerial inspection task.

Specific training - Crew Resource Management

The aviation risk management consultants were also engaged to deliver a number of Crew Resource Management (CRM) workshops to the company's employees that could expect to be involved in aerial surveillance and inspection work. That training addressed the risks, human factors and crew coordination issues affecting crews during the conduct of helicopter operations. In addition, the company has mandated an annual CRM currency requirement for relevant employees.

Contractual arrangements with the operator

Prior to the resumption of helicopter inspections, the company negotiated an amended interim contract with the operator. That contract was based on the Task Risk Profiles and Operational Risk Plans.

Safety actions implemented shortly after the resumption of flights

Formal performance review and audit of the operator

One week after the resumption of helicopter inspections, the aviation risk management consultant conducted a formal audit and review of the operator's performance. Follow-on audits and performance reviews of the operator's performance were carried out three weeks after the recommencement of aerial inspections and at the end of October 2006.

Ongoing safety action

Mapping and storage of data

The internal investigation team recommended the adoption by the company of a consistent approach to the collection, mapping and storage of data to ensure that hazards that were identified during the conduct of aerial inspections were documented for future reference.

In response, the company has commenced the first phase of the development of a solution to the collection, mapping and storage of data, which involves the use of a 'Geographic Information System' (GIS). Representatives from the company's Mapping Division met with aerial surveillance/inspections employees and, following that meeting, a mapping project was commenced whereby data collected by employees engaged in aerial surveillance/inspection work will be combined with the company's known network assets, and transferred onto the GIS maps. In addition, employees engaged in the ground inspection of company assets and powerlines have been instructed to convey data about risks and hazards to those assets and powerlines to the Mapping Division.

Exchange of information about infrastructure assets

The company will continue its initial discussions with the telephone company in an effort to formalise a process for the transfer of information about the organisations' respective network assets.

In addition, the company is actively participating in other initiatives to secure a formalised transfer of information about other organisations' network assets, including those proposed by the Department of Lands and the Rural Fire Brigade.

Tender for services

The company issued a 'Request for Tender' for the supply of helicopter services in support of the aerial surveillance/inspection requirement for a two-year term contract, with an option to extend that term for one year. The closing date for the tender was 25 October 2006.

The aviation risk management consultant assisted in the preparation of the 'Request for Tender', and will also be involved in assessing the tender submissions from prospective helicopter service providers.

Continued involvement of the aviation risk management consultants

The aviation risk management consultant has been retained by the company in support of any decisions affecting the use of helicopters for aerial surveillance/inspection.

Sharing lessons with the Industry

The company coordinated the development of an Industry Forum that was held on 18 August 2006. That forum was attended by other power supply companies and industry bodies from throughout Australia. At the forum, the company presented the lessons learnt as a result of the accident, and encouraged the establishment of industry standards and a uniform industry approach to the conduct of aerial surveillance/inspections.

Following the forum, a second power supply company invited the company to make a similar presentation to the second power supply company's staff. As a result of that presentation, the second power supply company has modified some of its existing aerial surveillance/inspection procedures.