ATSB Submission:

Senate Inquiry into Aviation Accident Investigations

Overview of the Submission

This submission is provided by the Australian Transport Safety Bureau (ATSB) to assist the Committee in its examination of the issues associated with the Terms of Reference of its inquiry into aviation accident investigations.

Part 1 provides an overview of the ATSB as an independent statutory agency charged with the function of improving transport safety. The ATSB is entirely separate from transport regulators, policy makers and service providers to avoid conflicts of interest and external interference while carrying out its functions. This section of the submission details the underlying principles on which the ASTB's no-blame safety investigations are based. It describes the statutory functions of the ATSB, and what are specifically not functions of the ATSB. Key terms and definitions used during ASTB investigations and contained in ATSB reports are also detailed in Part 1.

Part 2 provides a broad overview of the ATSB's investigation process, and identifies the four main elements—notification and assessment, investigation (which primarily relates to response and evidence collection), analysis and reporting. Commensurate with the terms of reference for the inquiry, this part focusses on the analysis and reporting elements.

Part 3 explains in more detail the ATSB's safety factor analysis process, which underpins the ATSB's overall analysis methodology. This part highlights the concept of testing for existence, influence and importance when examining safety factors, and describes the risk analysis process applied by the ATSB in the assessment of identified safety issues.

Part 4 details the processes used by the ATSB to manage identified safety issues and facilitate safety action to reduce risk. A critical aspect of this process is the focus given by the ATSB on encouraging pro-active safety action by relevant organisations to address safety issues, rather than the routine use of formal safety recommendations. When it issues formal safety recommendations, the ATSB looks to describe the safety issue clearly, while leaving scope for the action organisation to examine the range of options that may be available to address the issue.

Part 5 details the various parties identified as part of an ATSB investigation and describes the Directly Involved Party (DIP) process applied to draft reports. In particular, it details the formalised process used for evaluation of DIP submissions, how each submission may be classified, and what action(s), if any, may results from the submission.

Part 6 of this submission describes in detail the specific application of ATSB policy and procedure with respect to ATSB investigation AO-2009-072, the ditching of VH-NGA, 5 km SW of Norfolk Island Airport on 18 November 2009.

Part 1: Overview of the ATSB

The ATSB is an independent statutory agency established under the *Transport Safety Investigation Act 2003* (TSI Act). Legally, the organisation consists of three Commissioners: a Chief Commissioner (who is also Chief Executive) and two part-time Commissioners ('the Commission') who are responsible for the ATSB's functions. The ATSB's primary function is to improve safety in the aviation, marine and rail modes of transport through:

- independent 'no-blame' investigations of transport accidents and other safety occurrences;
- safety data recording, analysis and research; and
- fostering safety awareness, knowledge and action.

The ATSB is entirely separate from transport regulators, policy makers and service providers. In aviation, this means the ATSB is separate from the Civil Aviation Safety Authority (CASA), the Department of Infrastructure and Transport, Airservices Australia and airline operators. The ATSB's independent status is designed to minimise conflicts of interest and external interference while it carries out its functions.

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.

The ATSB performs its functions in accordance with the provisions of the TSI Act and the regulations made under the Act as well as, where applicable, relevant international agreements. In the aviation context, the primary international agreement of relevance is the Convention on International Civil Aviation (Chicago Convention). Under Article 26 of the Chicago Convention, Australia has an obligation to investigate all accidents involving international carriers and the ATSB fully discharges this responsibility. Other investigation obligations arise through the International Civil Aviation Organization (ICAO) standards and recommended practices (SARPS) in Annex 13 to the Convention that are adopted pursuant to Article 37. Annex 13 effectively extends the responsibility for investigation to accidents involving Australian aircraft as well as to a range of serious occurrences.

In Australia, international obligations are given legal force through domestic legislation. The TSI Act is the legal basis for the ATSB's Annex 13 role. Section 12AD of the TSI Act states:

> (1) The ATSB must ensure that the ATSB's powers under this Act are exercised in a manner that is consistent with Australia's obligations under international agreements (as in force from time to time) that are identified by the regulations for the purpose of this section.
> (2) The Chief Commissioner must ensure that the Chief Commissioner's powers under this Act are exercised in a manner that is consistent with Australia's obligations under international agreements (as in force from time to time) that are identified by the regulations for the purpose of this section.
> (3) In exercising powers under this Act, the ATSB and the Chief Commissioner must also have regard to any rules, recommendations, guidelines, codes or other instruments (as in force from time to time) that are promulgated by an

international organisation and that are identified by the regulations for the purposes of this section.

The independence and primacy of safety investigations under Annex 13 is provided for in the standards in paragraphs 5.4 and 5.6 of the Annex. However, cooperation and coordination with separate judicial or administrative proceedings is contemplated and, if relevant, aviation security authorities (see paragraphs 5.4.1, 5.10 and 5.11 of Annex 13). This is reflected in Sections 10 and 12AA(2) of the TSI Act.

Paragraph 3.1 of Annex 13 specifies that '*The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability*'. This is reflected in the Section 12AA(1) and (3) of the TSI Act:

12AA Functions of the ATSB

(1) The ATSB's function is to improve transport safety by means that include the following:

(a) receiving and assessing reports of transport safety matters, reportable matters, and other safety information that is prescribed by the regulations;

(b) independently investigating transport safety matters;

(c) identifying factors that:

(i) contribute, or have contributed, to transport safety matters; or

(ii) affect, or might affect, transport safety;

(d) communicating those factors to relevant sectors of the transport industry and the public in any way, including in any one or more of the following ways:

(i) by making safety action statements;

(ii) by making safety recommendations;

(iii) by issuing safety advisory notices;

(e) reporting publicly on those investigations;

(f) conducting public educational programs about matters relating to transport safety;

(g) any other means prescribed by the regulations.

…

(3) The following are not functions of the ATSB:

(a) to apportion blame for transport safety matters;

(b) to provide the means to determine the liability of any person in respect of a transport safety matter;

(c) to assist in court proceedings between parties (except as provided by this Act, whether expressly or impliedly);

(d) to allow any adverse inference to be drawn from the fact that a person was involved in a transport safety matter.

However, even though blame or liability may be inferred, or an adverse inference may be made, by a person other than the ATSB, this does not prevent the ATSB from carrying out its functions.

In plain language, the purpose of an ATSB safety investigation is to improve safety by identifying and reducing safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. In explaining the what, why and how of an occurrence, and in seeking to encourage safety

actions to improve future safety and avoid similar occurrences, ATSB reports may be read, particularly by the media, as implying blame.

Although the TSI Act specifically precludes the ATSB from apportioning blame or providing the means to determine liability, an investigation report must include factual material of sufficient weight to support its analysis and findings. This is alluded to in the last paragraph of section 12AA (3) of the TSI Act cited above. The ATSB endeavours at all times 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.

The ATSB uses standardised terminology to refer to key safety and risk concepts as follows:

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or
(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or
(c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that

(a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and
(b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Risk level: the ATSB's assessment of the risk level associated with a safety issue is noted in the Findings section of the investigation report. It reflects the risk level as it existed at the time of the occurrence. That risk level may subsequently have been reduced as a result of safety actions taken by individuals or organisations during the course of an investigation.

Safety issues are broadly classified in terms of their level of risk as follows:

- **Critical safety issue:** associated with an intolerable level of risk and generally leading to the immediate issue of a safety recommendation unless corrective safety action has already been taken.
- **Significant safety issue:** associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable. The ATSB may issue a safety recommendation or a safety advisory notice if it assesses that further safety action may be practicable.
- **Minor safety issue:** associated with a broadly acceptable level of risk, although the ATSB may sometimes issue a safety advisory notice.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

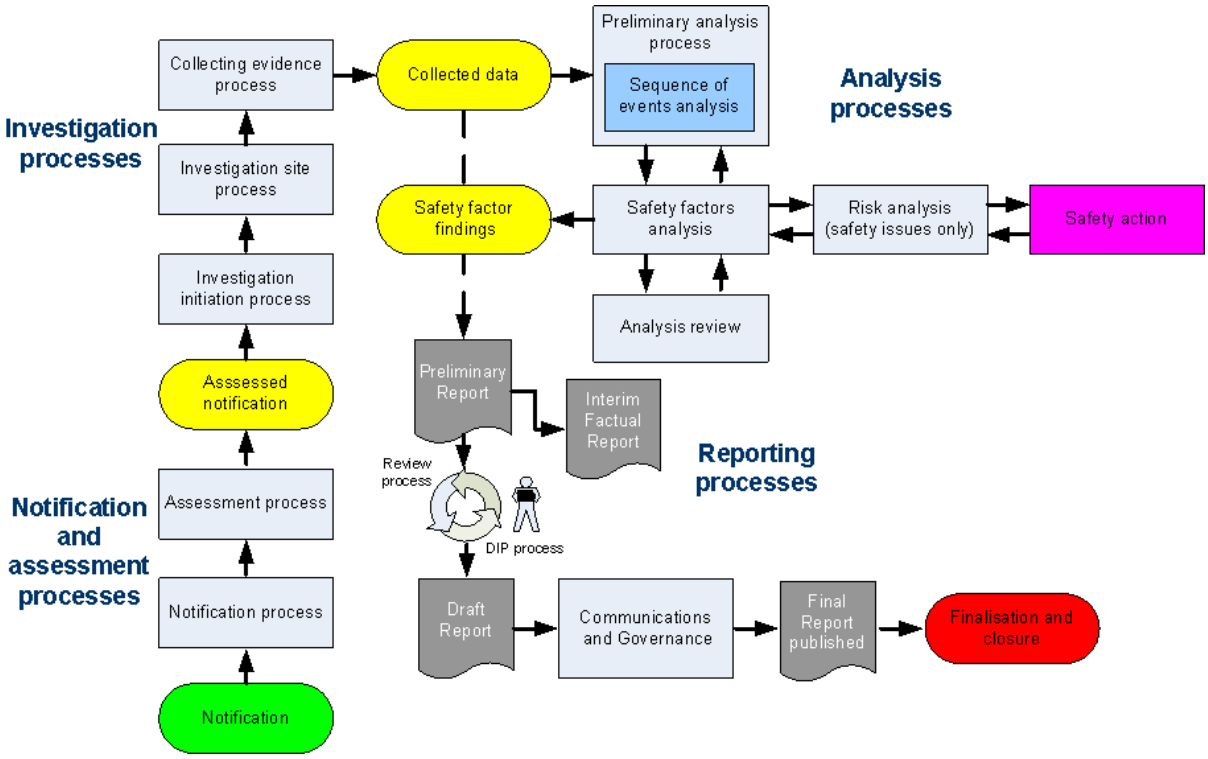
Part 2: ATSB Investigation Process Overview

Transport safety investigations are conducted by the ATSB in accordance with a defined set of procedures and protocols, designed to ensure consistency in methodology and implementation of the provisions of the TSI Act. The ATSB Safety Investigation Quality System (SIQS) provides policy, procedures, guidelines and tools for the conduct of all key investigation activities.

The main processes of ATSB safety investigation are:

- notification and assessment
- investigation
- analysis
- reporting

The figure below shows a high level view of the main ATSB safety investigation processes.



Although the focus of attention during an investigation will follow this order, it is important to note that they are not discrete processes and there is considerable overlap between them—for example:

- during data collection, some level of analysis is required to ensure that the data collection tasks are appropriately prioritised
- during analysis, the investigation team will generally identify a need to collect further data on some issues
- at any stage, a safety issue may emerge that may need to be communicated to relevant organisations and safety action sought before the investigation is complete

- report preparation of factual material can also commence at an early point in the investigation.

In view of the Terms of Reference of the inquiry, this submission briefly covers the investigation element, but focusses on the analysis and reporting elements of the process.

Investigation

The investigation processes involve:

- an initial response
- initiating the investigation
- investigation site (may or may not involve an on-site visit)
- data collection

The output from these processes is collected data and preliminary analysis. Collection of evidence involves collecting data on a range of topics using a variety of different techniques. The main types of data can be classified as:

- physical
- testimonial (that is, obtained from interviews or surveys)
- documentary
- recorded data (that is, from vehicle recorders as well as a number of other devices such as GPS receivers and radar/ATC systems).

In general terms, data is collected on:

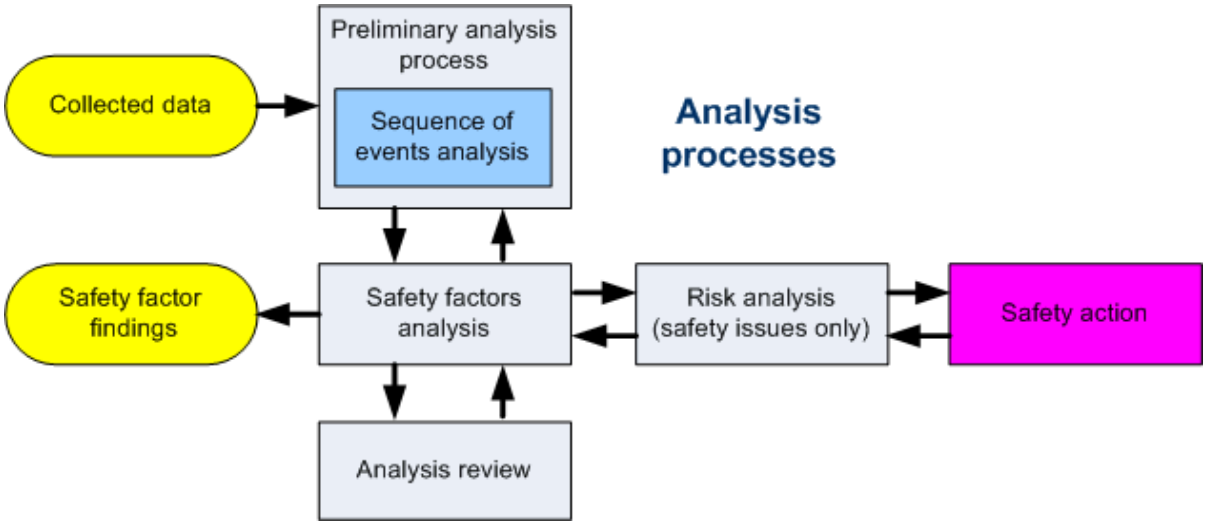
- the sequence of events
- personnel
- equipment
- environmental factors
- organisations.

Data is not limited to these categories. Data may be collected on anything deemed necessary if it could affect safety.

Analysis

Analysis involves three main processes:

- preliminary analysis
- safety factor analysis
- risk analysis.



The outputs from these processes are safety factor findings and safety action development. Analysis is where the collected data is reviewed and then converted into a series of arguments, which produce a series of relevant conclusions. The primary types of conclusions are concerned with contributing factors and safety issues. Analysis relies on informed judgement and is, to some extent, subjective. However, useful, realistic and widely accepted conclusions can be drawn using well-defined concepts, a structured set of steps and a team-based approach.

The safety factor analysis element and the risk analysis process element surrounding safety issues are both discussed in more detail later in this submission.

Reporting

Reporting involves the investigator in charge (IIC)/investigation team preparing a draft report, followed by draft report review and approval processes, consisting of:

- internal team, peer and management reviews of draft reports
- approval for release of the draft report to directly involved parties (DIPs)
- assessment of DIP comments by IIC/team
- finalisation of final report
- review and approval of final report by the ATSB's Commissioners
- advance release of final report to DIPs and other relevant parties
- public release of final report

The Directly Involved Party process is discussed in more detail in Part 5 of this submission.

Part 3: ATSB Safety Factor Analysis

The purpose of a *safety* investigation is to enhance safety, not to apportion blame or liability. A safety investigation into an occurrence enhances safety by determining the contributing and other safety factors associated with the occurrence and identifying safety issues, which can be communicated to relevant organisations who are best placed to take relevant safety action in response. It can also enhance safety by providing information about the circumstances of the occurrence and the factors involved in the development of the occurrence to the transportation industry.

The quality of a safety investigation's analysis plays a critical role in determining whether the investigation results are accepted and whether it has been successful in enhancing safety. However, safety investigations require analysis of complex sets of data and often the available data can be vague, incomplete and misleading. Given the importance and complexity of investigation analysis and its necessary reliance on investigators' judgements, the ATSB has developed a comprehensive investigation analysis framework. The framework consists of:

- a defined process or workflow for conducting analysis activities
- standardised terminology and definitions
- an accident development model (termed the ATSB 'investigation analysis model') and
- policies, guidelines, tools and training for investigators.

As with all analysis approaches, the ATSB framework is open to scrutiny and has at times been subject of discussion or opinion, particularly regarding the standard of proof used to determine contribution to the development of an occurrence and the nature of the ATSB investigation analysis model. In terms of standard of proof, the ATSB framework defines a 'contributing safety factor' as a safety factor that, if it had not occurred or existed at the relevant time, then either the occurrence would probably not have occurred, adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or another contributing safety factor would probably not have occurred or existed. The term 'probably' was defined as being equivalent to 'likely' and meaning more than 66 per cent likelihood, consistent with other internationally accepted definitions.

Because of its focus on future safety, the ATSB definition adopts a 'link-by-link' approach, where the judgement about whether a safety factor contributed to the development of an occurrence is made in terms of its relationship to another contributing safety factor. In contrast, other types of investigations (particularly those whose purpose is to determine responsibility) generally use a 'relative-to-occurrence' approach. With the relative-to-occurrence approach, judgements of contribution are made in terms of the safety factor's relationship to the occurrence itself. The ATSB analysis framework involves a higher standard of proof than in Australian coronial inquests or civil legal proceedings for factors relatively close in proximity to the occurrence (that is, more than 66 per cent versus more than 50 per cent). But as an ATSB safety investigation proceeds to identify contributing safety factors more remote from the occurrence, the degree of relationship of the factors to the occurrence itself will generally decrease using the ATSB framework.

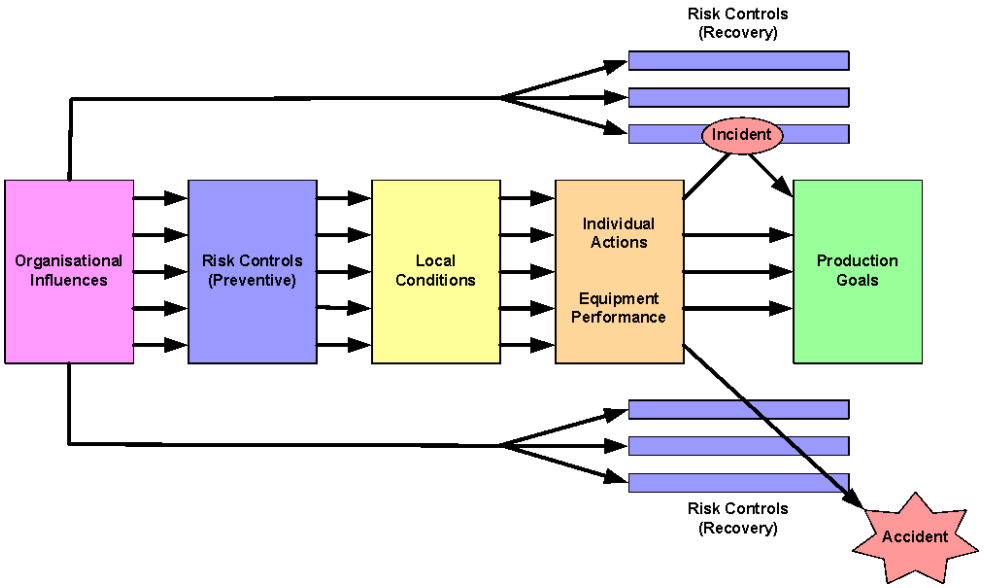
The differences between the ATSB approach to determining contribution and other approaches may be a matter of nuance in many situations, and similar findings may result regardless of the approach being used. Nevertheless, there is also the potential for different

sets of findings to be produced. More specifically, the ATSB's link-by-link approach together with a 'probable' standard of proof has the following advantages over many other investigation analysis approaches:

- It better enables the search for potential safety issues, particularly those more remote from an occurrence. The enhanced searching will result in more safety issues being identified and communicated to relevant organisations to enhance safety.
- It has greater potential for providing a richer or more detailed description of the factors involved in the development of an occurrence, which provides better learning opportunities for the transport industry.
- It is more distinct from the approach used in legal proceedings for determining blame or liability. Therefore, there is less potential for the existence of barriers to learning or safety action due to an investigation's findings being associated with such legal proceedings, or interpreted with such proceedings in mind.

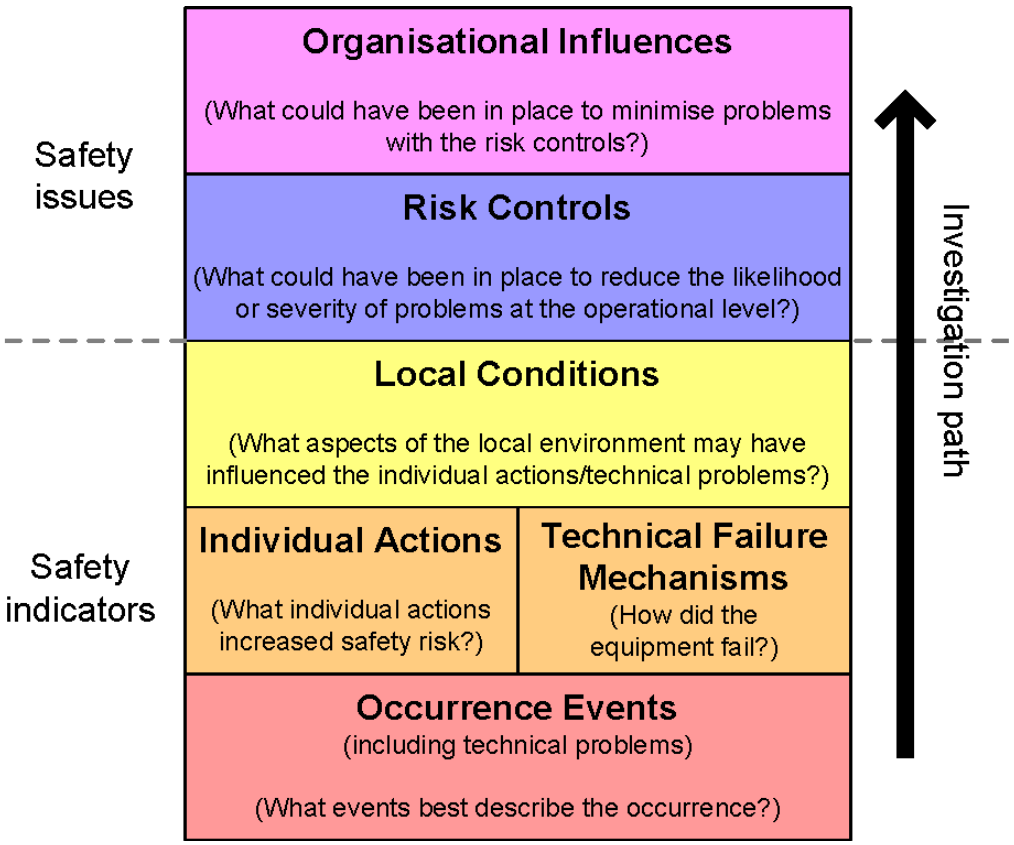
The analysis model

The ATSB investigation analysis model is based on the widely used Reason model of organisational accidents and consists of five levels of safety factors: occurrence events, individual actions, local conditions, risk controls and organisational influences, as depicted in the figure below.



The ATSB model does not attempt to describe all of the complexities involved in the development of an accident, but attempts to provide a general framework that investigators can use to guide data collection and analysis activities during an investigation.

The components outlined in the ATSB model can be simplified into a diagram showing five levels of safety factors, as shown in the figure below.



From an investigation viewpoint, the most useful way of identifying safety factors at each of these five levels is to start at the bottom and work up, asking a series of strategic questions. General questions for each level are shown in brackets in the relevant level in the diagram above. The most important safety factors to identify are those that occur at the risk control and organisational influence levels. These are the levels where changes can be made which can have a meaningful influence on safety. Safety factors which exist at these levels are safety issues.

When examining risk controls and organisational influences, the concept of practicability is important—that is, the extent to which it is reasonable or practicable for a particular organisation to have addressed a particular issue at a particular time.

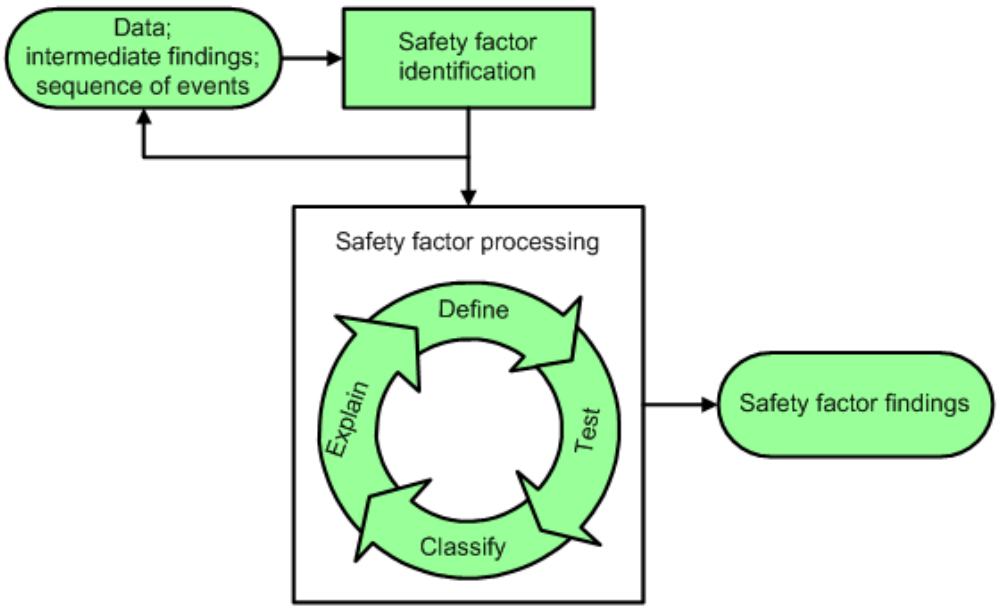
Judgements about practicability need to be based on the concept of acceptable risk. Therefore, the risk associated with the issue needs to be considered, but considered in terms of the extent to which the risk could have been reduced and how easy or how costly it would have been to achieve this reduction. This concept becomes important during the assessment of the safety risk associated with a safety issue.

Safety factor analysis is the heart of the investigation process. It involves a structured process to determine which events and conditions were safety factors, with an emphasis on determining the contributing safety factors and safety issues. There are five main activities involved in safety factor analysis:

- identifying potential safety factors
- defining each potential safety factor

- testing each potential safety factor to determine if there is sufficient evidence to conclude whether it was a contributing safety factor, or was otherwise important
- classifying each verified safety factor in the occurrence database
- explaining each verified safety factor (by identifying additional safety factors).

The figure below shows the safety factor analysis process and the relationship between safety factor identification and safety factor processing.

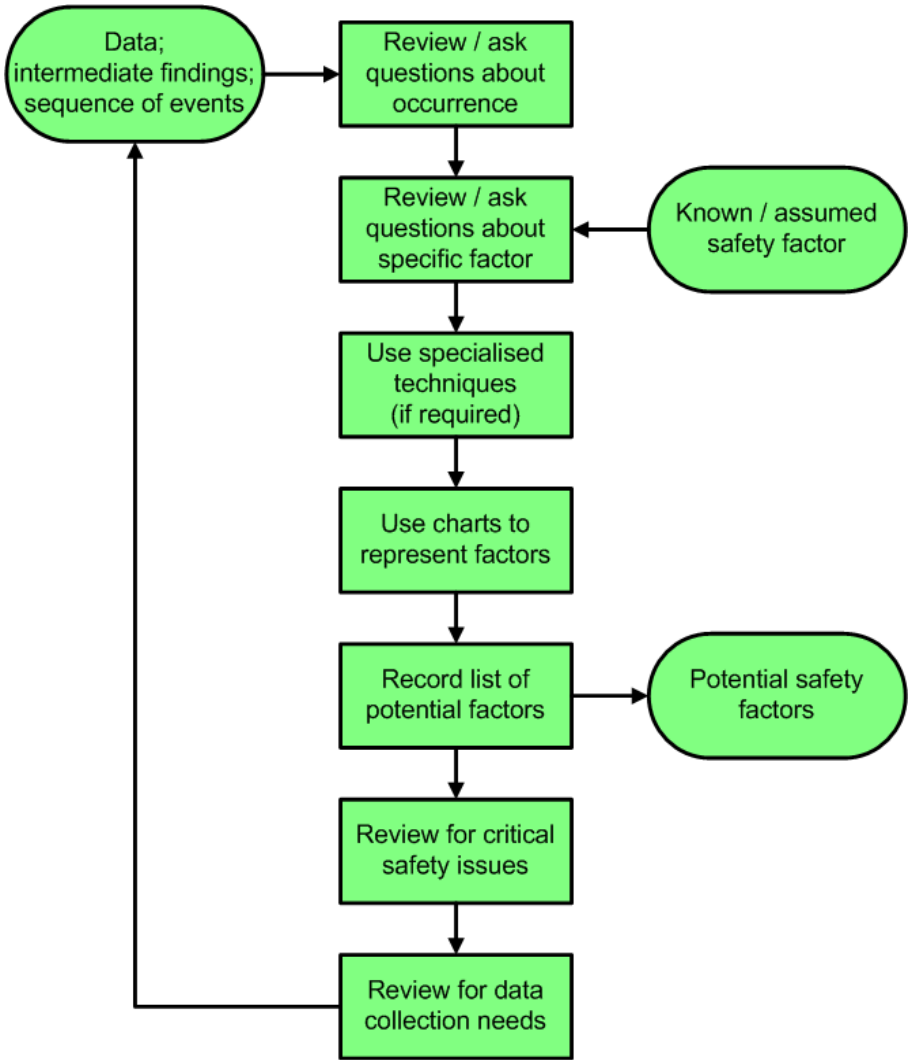


As can be seen on the preceding diagram, safety factor analysis consists of two sub-processes:

- **Safety factor identification** – conducted soon after the investigation starts, and focuses on identifying potential safety factors. This may be repeated at regular intervals until there is sufficient data available to conduct the next process.
- **Safety factor processing** – conducted after most of the relevant data has been collected. This process focuses on each potential safety factor that has been identified as needing further analysis. Further analysis involves defining, testing and classifying the factor. It then involves identifying the reasons why the factor existed (that is, it involves identifying additional potential contributing safety factors).

Safety factor identification

The figure below shows the safety factor identification process.



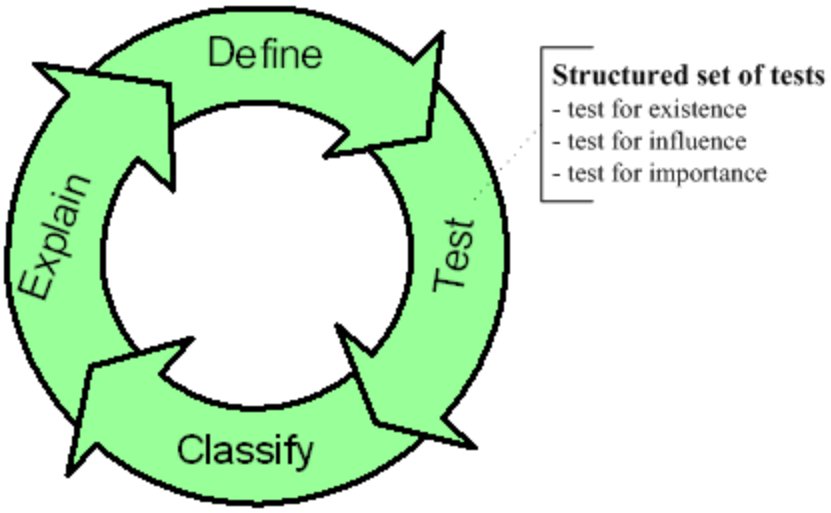
In the initial stages of the investigation, safety factor identification focuses on asking generic questions about the occurrence to identify potential safety factors. As the investigation progresses, it becomes possible to start asking more focused questions to identify additional factors which may have contributed to those factors already known or assumed. The latter stages of the process reflect the main aims of safety factor identification—that is, to identify potential critical safety issues and data collection needs.

Identification of safety factors is essentially about developing hypotheses or proposed findings. Hypothesising is a necessary and important part of developing findings regarding safety factors.

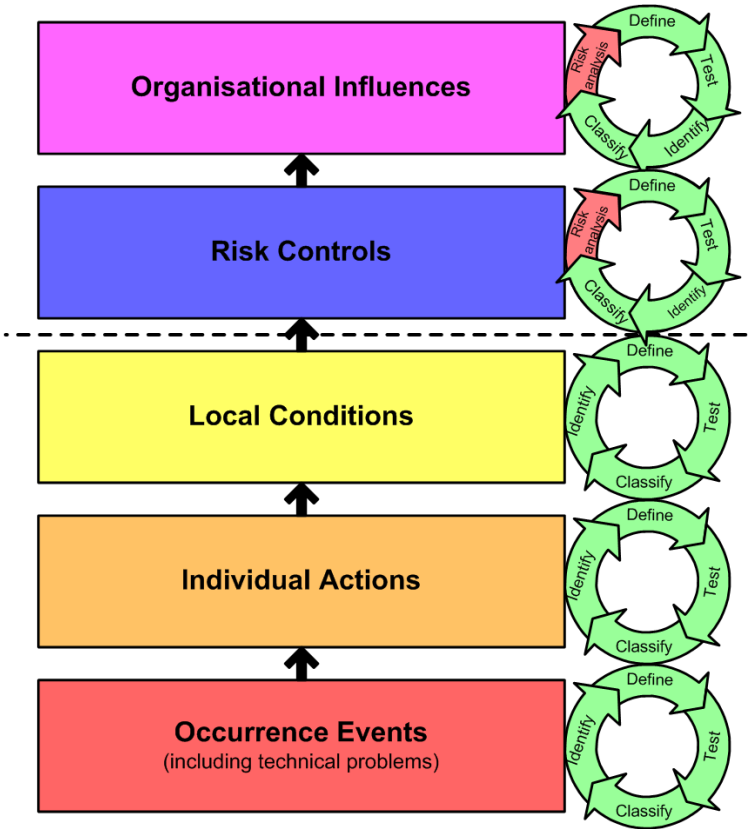
Safety factor processing

Safety factor processing focuses on each potential safety factor that has been identified as needing further analysis. Further analysis involves defining, testing and classifying the factor. It then identifies potential contributing factors to explain the safety factor. These activities are repeated in an iterative process until all of the relevant safety factors have been identified and tested. This involves gradually working up the levels of the investigation analysis model (see Relationship to investigation analysis model on the next page).

The figure below shows the safety factor processing process.



The figure below shows the relationship between safety factor processing and the ATSB investigation analysis model.



Note: For *safety issues*, there is also a requirement to do a risk analysis for any safety factors that have been confirmed as contributing safety factors or other (important) safety factors.

Proposed safety factors are verified by using a structured set of tests:

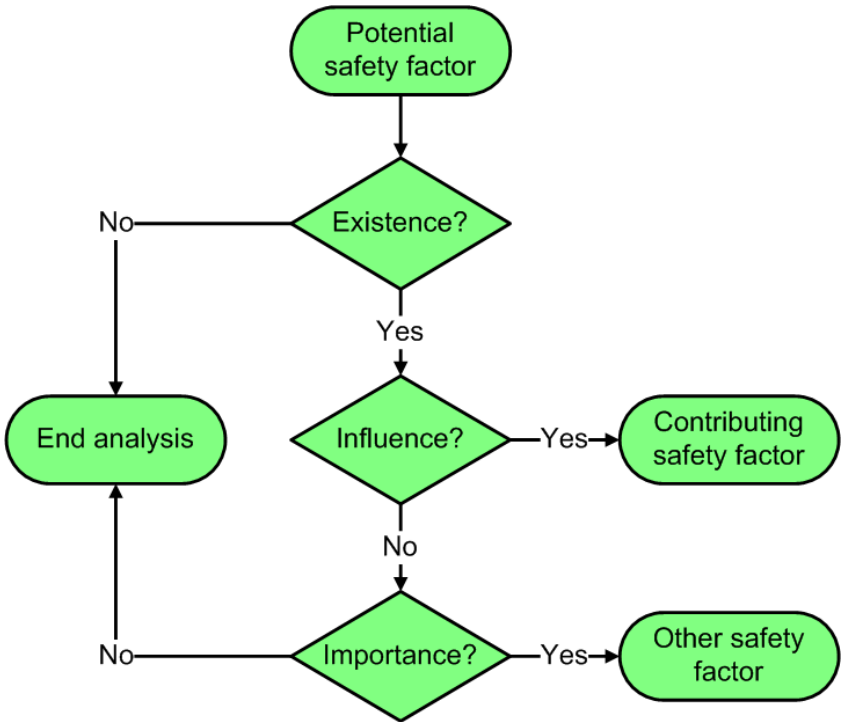
- test for existence

- test for influence (on the occurrence or other safety factors)
- test for importance.

In simple terms, each potential factor is reviewed to determine if it existed, if it had an influence and/or if it was important. The result of these tests determines the type of safety factor—more specifically:

- Existence + Influence = Contributing safety factor
- Existence + Importance = Other safety factor

Each of the tests can be regarded as a separate argument requiring a separate evaluation. The figure below shows the process for testing potential safety factors.



The ATSB Analysis model is supported by a specific analysis module within the ATSB Safety Investigation Information Management System (SIIMS). The testing process within SIIMS utilises a safety factor table, composed of three parts covering each of the tests. The parts for the test for existence and the test for influence are presented as a basic evidence table, whereas the test for importance is simply a free text box requiring justification. In SIIMS, the safety factor evidence table is one component of the safety factor form. Other fields are provided to record the process and assessment, and other tables, lists and tools can be used as necessary to examine specific issues.

The steps involved in assessing an existence and influence argument are similar. Having developed a proposed finding or hypothesis, it is important to determine in a structured and methodical way, whether the event or condition associated with the safety factor actually existed. For some situations, there will be clear and direct evidence supporting the argument and no contradictory or conflicting evidence. This is more often the case for occurrence events and individual actions. In other situations, particularly for local conditions and organisational influences, the evidence will not always be clear and direct. Investigators need

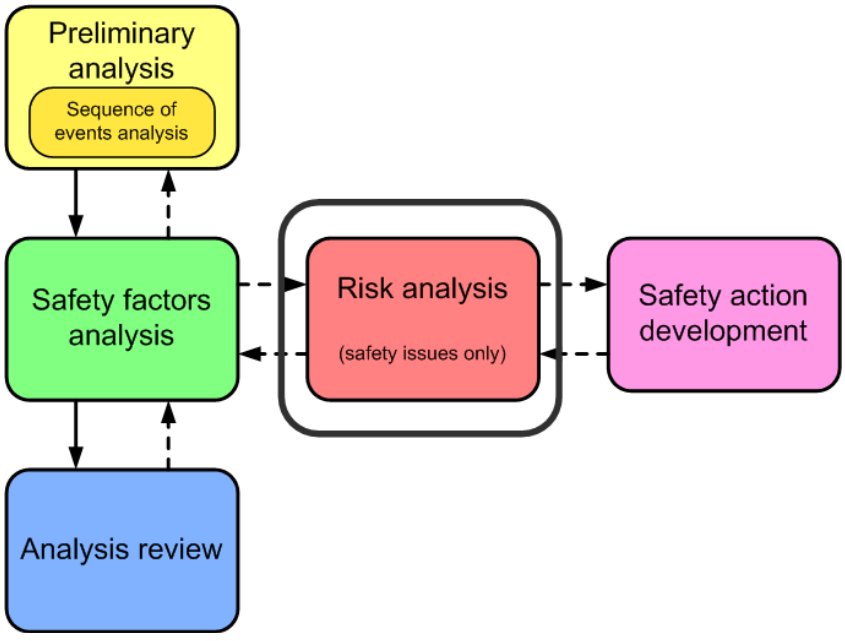
to review all related information and identify specific relevant items of information related to the safety factor. Evaluation of the strength of each piece of evidence is then needed, including a determination of evidence that supports and opposes the finding. If after evaluation of all the associated evidence it is not possible to conclude that the safety factor probably existed (using a benchmark of 66%), the analysis process for that safety factor ceases. If existence is probable, the process moves to the test for influence.

As noted above, the steps for assessing an influence argument are similar, with identification of evidence, evaluation of the strength of each item of evidence and evaluation of the overall strength of the potential finding, leading to a decision as to whether, regardless of its existence, the safety factor probably (again using the benchmark of 66%) influenced the occurrence under investigation. If so, the safety factor would be included as a 'contributing safety factor'; if not, consideration must then be given to whether the safety factor is important. The tests for existence and test for influence often become difficult to separate, and both set of questions can often be used together.

The aim of the test for importance is to answer the following question: Is the proposed factor worth analysing further (even though it cannot be demonstrated to have had an influence this time)? Only those potential safety factors that have passed the test for existence and then failed the test for influence should be considered for the test for importance. The steps involved in assessing an importance argument are similar to the existence and influence arguments. However, the importance part of the safety factor evidence table has a different format. Because the argument can rely more on opinions and assumptions than evidence, a simple text box is used rather than a set series of columns. The importance argument is more focussed on justifying why the proposed safety factor should be subject to further analysis, in terms of identifying the reasons for the factor and also (in the case of safety issues) subjecting the proposed factor to a risk analysis.

Safety issue risk assessment

The figure below indicates where risk analysis is located in the safety investigation analysis process.



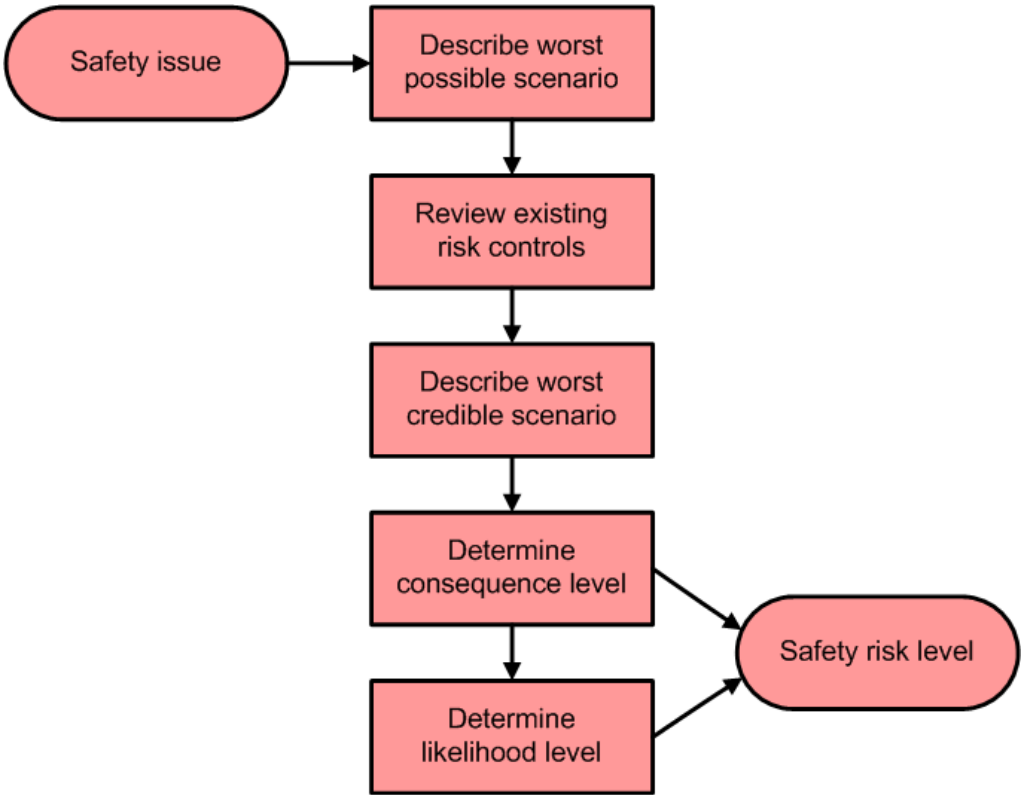
Risk analysis provides a structured process to determine the risk level associated with any identified safety issues. The Australian (and international) standard AS/NZS ISO 31000:2009 outline a full risk management process. The table below compares the ISO risk management process with the activities involved in an ATSB safety investigation. The basic process is the same—there are some differences at the beginning and the end which reflect the differences in purpose between a proactive risk management process and a safety investigation. They also reflect the differences between the responsibilities of an organisation managing its risks and the responsibilities of an independent investigation organisation.

AS/NZS ISO 31000 risk management process	ATSB investigation activities
Establish the context	Context is primarily determined by the nature of the transport safety matter being investigated, the ATSB's objective of enhancing safe transport, and the ATSB's policies, procedures and guidelines for conducting investigations.
Hazard identification	Safety issues are identified, defined and tested during safety factors analysis.
Risk analysis	Risk analysis stages, as described in this chapter.
Risk evaluation	Full evaluation of the risk is the responsibility of the organisation(s) responsible for the safety issue. ATSB investigations conduct an evaluation to the extent necessary to determine what the ATSB should do to facilitate safety action.
Risk treatment	Treatment of the risk is the responsibility of the organisation(s) responsible for the safety issue. ATSB only facilitates safety action by relevant organisations. This may involve issuing safety recommendations or safety advisory notices.
Monitor and review	Monitor and review is the responsibility of the organisation(s) responsible for the safety issue. ATSB may monitor progress of safety action taken in response to a safety recommendation.
Communicate and consult	Conducted throughout a safety investigation. Particularly important during the facilitation of safety action.

The ATSB risk analysis process is consistent with the principles outlined in AS/NZS ISO 31000:2009. In the context of an ATSB safety investigation, risk analysis involves determining the level of safety risk associated with a safety issue. The result is a classification of the safety issue as either:

- critical
- significant
- minor.

This classification determines the degree of effort the ATSB will use to facilitate safety action by the relevant organisation(s). The figure below shows the ATSB process for conducting risk analysis for a safety issue.



The safety issue risk analysis is not intended to be a complete analysis as may be required for the purposes of a safety case or as part of a formal cost-benefit analysis. It is intended to be a structured, objective and efficient analysis to determine whether the safety issue has a risk level which warrants corrective action by another organisation. The analysis will generally be qualitative rather than quantitative in nature.

Risk analysis requires estimating the consequence level and likelihood level associated with the safety issue. The most practical way of estimating consequence and likelihood levels is to base them on a hypothetical occurrence (or scenario). This approach is generally the most practical, particularly for safety issues that are related to risk controls.

During a safety investigation, the risk analysis process initially considers the situation as it existed at the time of the occurrence or the relevant transport safety matter occurred. In doing so, the investigation considers the risk as it relates to the 'worst credible scenario'. A precursor is a consideration of the 'worst possible scenario'.

The difference between the two scenarios is as follows:

- **Worst possible scenario** – the worst occurrence—in terms of the severity of its consequences—that could occur as a result of the safety issue. No consideration is made regarding the risk controls or management processes in place to reduce the consequences or likelihood of such a scenario.
- **Worst credible scenario** – the worst occurrence—in terms of the severity of its consequences—that could occur as a result of the safety issue, after consideration has been made of the risk controls and management processes in place to minimise risk. These risk controls and management processes will generally reduce the level of adverse consequences associated with the worst possible occurrence. In other words, the worst credible scenario has to be a

plausible, feasible or reasonably believable scenario. It is the most adverse occurrence that could realistically be expected to occur as a result of the safety issue.

Using the worst possible scenario as the basis of estimates of consequence and likelihood levels will generally lead to the selection of the highest level of consequence in the risk matrix. It is technically possible that almost any safety issue could result in a catastrophe. Even under the worst credible scenario, regard needs to be given to the normal expectation of compliance with existing risk controls, such as rules and standard operating procedures. To do otherwise would similarly result in the potential for any safety issue considered under a worst credible scenario to result in a potentially catastrophic outcome.

Once the worst credible scenario has been described, having regard for the various risk controls and defences that are in place, the safety issue risk analysis moves to an assessment of consequence and likelihood to determine the classification of the level of associated risk. The following tables describe scale of consequence and likelihood ratings adopted for ATSB safety issue risk assessment purposes.

Consequence table

	Minimal	Moderate	Major	Catastrophic
Aviation				
Air transport > 5,700 kg (fare-paying passengers)	Minor incident only (e.g. birdstrike)	Incident	Accident; Serious incident; Incident with many minor injuries	Accident with multiple fatalities, or aircraft destroyed plus fatalities / serious injuries
Air transport > 5,700 kg (freight); Air transport < 5,700 kg (fare-paying passengers)	Incident	Accident; Serious incident; Incident with many minor injuries	Accident with multiple fatalities, or aircraft destroyed plus fatalities / serious injuries	N/A
Other commercial operations	Accident; Serious incident; Incident with many minor injuries	Fatal accident; Accident with aircraft destroyed or multiple serious injuries	N/A	N/A
Private operations	Accident with aircraft destroyed or multiple serious injuries	Fatal accident	N/A	N/A

Likelihood table

Level	Descriptor	Description	Indicative frequency
A	**Frequent**	Is expected to occur	One (or more occasions) per year
B	**Occasional**	Probably will occur in the medium-term future	One in 10 years
C	**Rare**	Could occur in some circumstances	One in 100 years
D	**Very rare**	Not expected to occur except in exceptional circumstances	One in 1,000 years (or less)

The table below shows the risk matrix to calculate the level of risk once the consequence and likelihood levels have been identified.

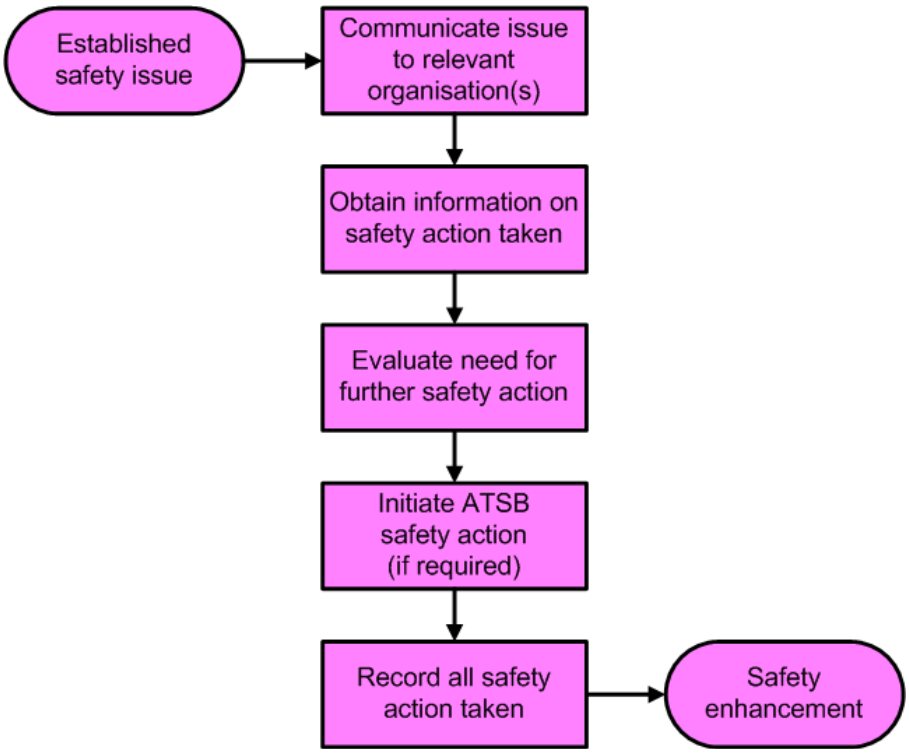
Risk rating matrix

		Consequences			
		Minimal	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Frequent**	Significant	Significant	Critical	Critical
	Occasional	Minor	Significant	Significant	Critical
	Rare	Minor	Minor	Significant	Critical
	Very rare	Minor	Minor	Minor	Significant

The analysis module in SIIMS has functionality to complete and record the above activities for each safety issue. It also provides for multiple risk analyses to be undertaken for each safety issue, and procedures require that another risk assessment be undertaken following advice of safety action to determine if the level of risk has reduced to an acceptable level. More information about the management of safety issues and safety action is contained in the next part if this submission.

Part 4: Management of Safety Issues and Safety Action

'Safety action' is the term used to describe the things that organisations and individuals do in response to the identification of safety issues, in order to prevent accidents and incidents. The ATSB process involved in facilitating safety action is shown below. The activities involved are different, depending on the risk level of the safety issue—the key differences are shown in the table that follows.



The table below shows the relationship between risk level and the different ATSB safety action development activities.

Current risk level	Suggested ATSB actions
Critical (intolerable range)	• Immediately communicate safety issue to relevant organisation(s). • As soon as possible, obtain information on safety action taken or proposed to be taken by the relevant organisations. • If safety action not sufficient to reduce risk level to below critical, then issue safety recommendation as soon as possible.

Significant (ALARP applies)	• As soon as possible, communicate safety issue to relevant organisation(s). • As part of regular liaison activities, obtain information on safety action taken or proposed to be taken by the relevant organisations. • If safety action not sufficient to reduce risk level to ALARP, then issue a safety recommendation or a safety advisory notice with the final report.
Minor (broadly acceptable)	• As part of regular liaison activities, communicate safety issue to relevant organisation(s), and advise them that the ATSB does not consider the issue to be significant at this time. • Before completing final report, obtain information about whether safety action has been taken. • If safety action has been taken, include this information in the final report. (Safety Recommendation not issued but may issue Safety Advisory Notice)

Traditionally, accident investigation agencies produce final reports and issue safety recommendations to other organisations or individuals, to encourage change in order to prevent a recurrence of an accident. However, the ATSB has recognised that this prescriptive approach can have a negative effect on change, in that it is usually done after the completion of an investigation and any recommendations may require consideration of a range of factors before any tangible change is effected. In some cases the recommendation may be rejected by the target organisation and no changes happen at all.

The ATSB has moved away from this traditional view of making recommendations in final reports and instead identifies Safety Issues during the course of an investigation, communicates these issues to the relevant organisations for consideration, and then reports on the safety actions taken to address the issues. In this regard, the ATSB prefers to encourage proactive safety actions that address the safety issues identified in its reports. Other benefits of this approach are that the stakeholders are generally best placed to determine the most effective way to address any Safety Issues and the publication of the Safety Actions undertaken is generally viewed very positively.

This approach has marked benefits in regard to improving safety, in that identified safety issues are usually addressed before the final report is issued, and all safety actions taken by organisations are reported in the ATSB final report. In the event that no, or limited, safety actions are taken, the ATSB can still issue a formal safety recommendation. This process is identified in the ATSB's Annual Plan and forms a part of the ATSB's Key Performance Indicators.

The following table summarises the ATSB's performance against the key performance indicators relating to safety issues/action set out for Program 1.1 in 2011–12.

Key performance indicator	**Target**	**Result**
Safety action is taken by stakeholders to address identified **critical safety issues**.	100%	None identified
Safety action is taken by stakeholders to address identified **significant safety issues.**	70% or higher	89% adequately addressed

The two tables below detail the number and risk level of safety issues identified during 2011-2012 and the number of discrete safety actions taken to address the issues.

Summary of safety issues identified in 2011–12

Number of safety issues	**Aviation**	**Marine**	**Rail**	**Total**
Critical	None	None	None	*0*
Significant	11	12	5	*28*
Minor	36	17	20	*73*
Total	*47*	*29*	*25*	*101*

KPI outcomes for significant safety issues identified in 2011–12

Status of significant safety issues	**Aviation**	**Marine**	**Rail**	***Total***	***Per cent***
Adequately addressed	8	12	5	25	*89%*
Partially addressed	1	0	0	1	*4%*
Not addressed	0	0	0	0	-
Safety action still pending	2	0	0	2	*7%*
Total	*11*	*12*	*5*	*28*	

It is apparent that, in the majority of cases, the safety action taken by the relevant organisations has reduced the level of risk to an acceptable level. This responsive action effectively negated the need to for the ATSB to issue formal safety recommendations in these instances.

The ATSB does not implement risk treatments. To achieve safety enhancement, the ATSB facilitates safety action by communicating the safety issues it identifies to the relevant organisations. The timeliness and method of communication varies depending on the risk level associated with the safety issue.

The early identification of safety issues in the transport environment is central to the ATSB's investigation process. As indicated in the table above, the ATSB communicates safety issues as they are identified, in order to facilitate timely safety action.

Safety action can be classified into the following types:

- **Non-ATSB safety action** – local or systemic action taken by an organisation or individual in response to the findings of an ATSB safety investigation (or other investigation into the matter being investigated by the ATSB), prior to the release of any ATSB safety action.
- **ATSB safety action** – formal activities conducted by the ATSB to initiate additional safety action by relevant organisations. ATSB safety action, such as issuing safety recommendations and safety advisory notices, are normally a last resort. It is generally used when other attempts to facilitate sufficient safety action have not been successful, and the risk level is still either critical or significant (and not ALARP).

As noted above, the ATSB prefers to encourage relevant organisations to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use the provisions of the TSI Act to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent and timeliness of corrective action undertaken by the relevant organisation. This approach is consistent with ICAO Annex 13 standards and recommended practices, which note that nothing is intended to preclude the investigation authority from making proposals for preventative safety action other than through safety recommendations.

To that end, draft reports contain the following standardised text, aimed at encouraging the provision of such information, noting that it would be expected that any significant or critical safety issue would have been the subject of previous communication with the relevant organisation:

> The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.
>
> Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the [aviation, marine, rail - as applicable] industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

In final reports, the second paragraph above is replaced with:

> All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The report then details the safety issues and associated safety actions, including where necessary, formal safety recommendations.

The standards in Annex 13 require that where a recommendation is issued, the State receiving the recommendation must respond within 90 days of the transmittal correspondence, with details of the preventative action taken or under consideration, or the reasons why no action will be taken.

Section 25A of the TSI Act reflects the Annex 13 Standards as follows:

> (2) The person, association or agency to whom the recommendation is made must give a written response to the ATSB, within 90 days of the report being published, that sets out:
>
> (a) whether the person, association or agency accepts the recommendation (in whole or in part); and
>
> (b) if the person, association or agency accepts the recommendation (in whole or in part)—details of any action that the person, association or agency proposes to take to give effect to the recommendation; and
>
> (c) if the person, association or agency does not accept the recommendation (in whole or in part)—the reasons why the person, association or agency does not accept the recommendation (in whole or in part).
>
> (3) A person commits an offence if:
>
> (a) the person is someone to whom a recommendation is made in a report published under section 25; and
>
> (b) the person fails to give a written response to the ATSB within 90 days setting out the things required by paragraphs (2)(a), (b) and (c) (as applicable).
>
> Penalty: 30 penalty units.
>
> (4) Subsection (3) applies to an unincorporated association as if it were a person.
>
> (5) An offence against subsection (3) that would otherwise be committed by an unincorporated association is taken to have been committed by each member of the association's committee of management, at the time the offence is committed, who:
>
> (a) made the relevant omission; or
>
> (b) aided, abetted, counselled or procured the relevant omission; or
>
> (c) was in any way knowingly concerned in, or party to, the relevant omission (whether directly or indirectly or whether by any act or omission of the member).

As is apparent from the Annex 13 standards and the TSI Act, ATSB safety recommendations (like equivalent organisations world-wide) are not enforceable. That reflects the role of the independent safety investigation agency as opposed to the role of a regulator. When safety recommendations are issued by the ATSB, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. It is also a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes appropriate, or to

raise general awareness of important safety information in the industry. There is no requirement for a formal response to a safety advisory notice, although the ATSB will publish any response it receives.

The ATSB assesses action taken in response to a safety issue recommendation as either:

- adequately addressed
- partially addressed
- not addressed
- no longer relevant
- withdrawn

Where the ATSB is advised that safety action is in progress or is proposed to be undertaken, the safety action is placed on 'Monitor' pending finalisation/implementation of the safety action. Tools within the analysis module of SIIMS enable recording and monitoring of all aspects of safety issues, including setting of alerts to prompt checking of progress on safety action in circumstances such as when a safety action is on 'Monitor'.

As noted above, once an organisation has taken safety action (whether pro-active after communication of the safety issue by the ATSB or as a result of a recommendation), the ATSB conducts another risk assessment to determine if the level of risk has reduced to an acceptable level. If it has, then no further action is taken. However, if the level of risk remains at the significant level, the ATSB will consider whether there is a realistic prospect of reducing the risk further and if necessary pursue further safety action.

Part 5: Communications between Agencies and Directly Involved Parties during an Investigation

Overview

Effective and open communication between parties involved in a transport safety matter directly predicates the ability of any agency to conduct an efficient and effective safety investigation into the matter, and consequently, the ability of that agency to ensure that the necessary safety action is identified and implemented. This in recognised in Annex 13, which includes specific requirements and entitlements for contracting States relating to matters of communication and exchange of information following an aviation accident or serious incident. The Annex also provides for confidentiality provisions in the exchange of certain types of information; recognising that the disclosure of such information may have an adverse effect on future investigations.

Similar confidentiality provisions are reflected in the TSI Act, primarily in:

- Section 26 in relation to draft reports
- Sections 50 to 53 in relation to on-board recording (OBR) information
- Section 60 to 62 in relation to Restricted Information[1]

Annex 13 standards require that a draft report be sent by the State conducting the investigation to other States, including that of registry, operator, design and manufacture, inviting their 'significant and substantiated comments' on the draft report. In this international context, the parties are provided 60 days to provide comment. In the Australian domestic context, the TSI Act reflects the Annex 13 standard via Section 26, as follows:

> **26 Draft reports**
>
> (1) The ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate, for the purpose of:
> (a) allowing the person to make submissions to the ATSB about the draft report; or
> (b) giving the person advance notice of the likely form of the published report.
>
> (2) A person who receives a draft report under subsection (1) or (4) must not:
> (a) make a copy of the whole or any part of the report; or
> (b) disclose any of the contents of the report to any other person or to a court.
>
> Penalty:
> (a) in the case of a contravention of paragraph (a) – 20 penalty units; or
> (b) in the case of a contravention of paragraph (b) – imprisonment for 2 years.
>
> (3) Strict liability applies to the element of the offence against subsection (2) that the draft report is received under subsection (1) or (4).

[1] Restricted Information is defined in Section 3 of the TSI Act.

(4) Subsection (2) does not apply to any copying or disclosure that is necessary for the purpose of:
(a) preparing submissions on the draft report; or
(b) taking steps to remedy safety issues that are identified in the draft report.

Note: A defendant bears an evidential burden in relation to a matter in subsection (4). See subsection 13.3(3) of the *Criminal Code*.

(5) A person who receives a draft report under subsection (1) or (4) cannot be required to disclose it to a court.

(6) A person who receives a draft report under subsection (1) or (4) is not entitled to take any disciplinary action against an employee of the person on the basis of information in the report

(7) A draft report provided under subsection (1) must not include the name of an individual unless the individual has consented to that inclusion.

When communicating during the conduct of a transport safety investigation, the ATSB must take account of, and address, a broad range of considerations – many of which require a balanced approach between the disclosure and protection of information. Key considerations include the need to:

- be aware of, and respect the information requirements of other investigations and inquiries relating to the same occurrence (police/coronial, regulatory compliance, insurance assessment, civil litigation)
- share draft information between parties to ensure factual accuracy and, where possible, obtain confirmation/verification of data and events
- afford natural justice to parties that may be the subject of adverse commentary
- adhere to the principles of a just culture[2]
- assure confidentiality and privacy
- respect freedom of information provisions
- comply with international protocols and legislative provisions
- openly communicate all investigative findings
- communicate all relevant safety messages stemming from the investigative findings
- encourage effective safety action and the mitigation of safety issues.

Classification of parties to an ATSB investigation

ATSB procedures notionally classify individuals or parties to an occurrence investigation in accordance with their level of involvement in the occurrence event. The classification framework is used to delineate the extent of communication and consultation undertaken during the investigation and the reporting process. The ATSB party framework is as follows:

- **Directly-involved party (DIP)** – these are the individuals or organisations that were directly involved in a transport safety occurrence or may have influenced

[2] A *Just Culture* as defined by ICAO is a working culture where front line operators or others are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated.

the circumstances that led to an occurrence and/or whose reputations are likely to be affected following the release of the investigation report. Typically, these would be the relevant regulatory authority (CASA), the operating crew and the operating organisation. Depending on the circumstances of the occurrence, other DIPs may include:

  - the owner
  - the manufacturer
  - cabin crew
  - the maintenance provider
  - the air traffic control service provider or marine port authority track access provider
  - ICAO States in accordance with Annex 13

- **Party with an involvement (PWI)** – Parties with an Involvement are those individuals or organisations that, while not directly involved in a transport safety occurrence, have been significantly affected by the occurrence or have provided significant assistance to the investigation or can assist in the promotion of transport safety. Parties with an Involvement may include the relevant governmental Minister, the executive of the Department of Infrastructure and Transport, the relevant State Coroner and the next-of-kin of any deceased operating crew, with others considered on a case-by-case basis as necessary

- **Interested party (IP)** – Interested Parties are those individuals or organisations that have been affected by the occurrence and/or are likely to receive media attention in relation to the occurrence. Interested Parties include passengers, next-of-kin (other than of the deceased operating crew) and relevant unions and associations.

- **Other party (OP)** – Other Parties are those individuals or organisations that have expressed a desire to be kept informed of progress of the investigation.

Directly Involved Party process

A primary aim of the draft report DIP process is to provide an opportunity for the making of submissions on the factual accuracy of the report. The DIP process provides the opportunity for a DIP to present evidence in support of what they view to be factual inaccuracies or omissions in the ATSB's investigation report. This consultation and report review processes is also important to provide an opportunity for natural justice to parties where there is the likelihood that their interests, rights or legitimate expectations may be adversely affected by the release of a final report.

The DIP process also provides a last opportunity for organisations to provide the ATSB with information on, or updates to, any safety action that may have been taken, or be proposed to be taken in response to identified safety issues.

Reports are distributed to DIPs in accordance with the matrix below. The matrix also includes the default distribution arrangements of the various other parties:

Party	Preliminary Report	Interim Factual Report	Draft Report	Final Report
Directly Involved Party (DIP)	In advance	In advance	In advance for comment	In advance
Party with an Involvement (PWI)	In advance	In advance	In advance for information	In advance
Interested Party (IP)	In advance	In advance	N/A	In advance
Other Party (OP)	Notified on issue	Notified on issue	N/A	Notified on issue

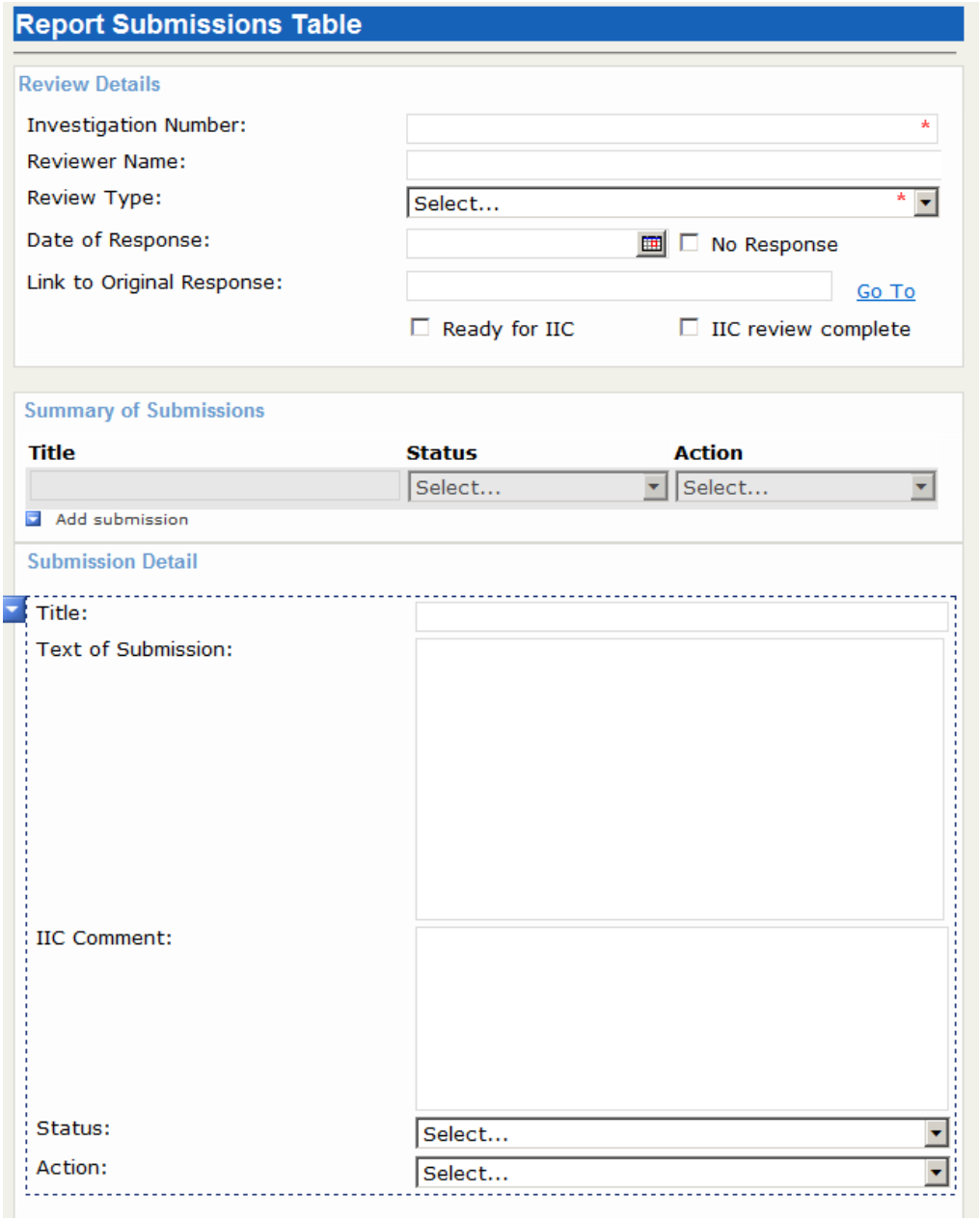
As indicated in the table above, DIPs are provided with an advance copy of a draft report for comment and an advance copy (normally 8 working days) of all other reports for information. Parties with an interest (PWIs) are provided with an advance copy of the draft report 'for information' but are not normally invited to submit comment on the draft report. However, where comment is received, the ATSB treats such comments as the same way as a DIP comment. All PWIs are provided with an advance copy of preliminary, interim and final reports (usually 8 working days before their public release) Interested Parties are provided with an advance copy of preliminary, interim and the final reports (normally 8 working days before their public release). Other Parties will be either notified once reports are public or else provided with a copy of reports at the time of public release.

Directly Involved Parties are normally given 28 days within which to provide written submissions. Extension of this time is usually provided where requested, but must be authorised by the relevant General Manager. All DIPs resident in other ICAO States are encouraged to respond within 28 days, but will be permitted the 60 days provided for in the Annex 13 standard. Where the organisation or individual seeks to have the content or findings of the ATSB draft report changed, they are requested to provide the ATSB with factual evidence that appropriately supports their propositions and substantiates the changes or inclusions sought.

All submissions received by the ATSB in response to the DIP process are formally assessed against information previously gathered by the ATSB during the investigation. The outcome of that assessment is documented alongside the submission in a standardised Submission Table within SIIMS.

In completing the Submission Table, (see copy below) the investigator-in-charge must assess each written DIP submission and record the following:

- the status of the submission as either 'noted', 'accepted', 'partly accepted' or 'rejected', along with a written justification for that assessment, having regard to associated evidence
- what action is proposed in response, recorded as either 'change to report', 'further investigation' or 'no action required'
- an outline of any further inquiries the IIC intends to make as a result of new evidence provided in the DIP submissions.



In considering the written submissions, the IIC is required seek clarification or further evidence from the DIP where considered necessary in order to make an informed decision on those comments.

In circumstances where the consideration of DIP submissions results in substantive changes to the draft report content, structure or investigative findings, a supplementary draft report incorporating the changes will be provided to directly-involved parties and further submissions sought.

Report approval and release process

Following the finalisation of this process, the report is subject to review and approval (having regard to DIP submissions) at the Manager, General Manager and Commission levels, before being approved for publication, noting that approval for publication of the final report under section 25 of the TSI Act can only be given by the Commission and cannot be delegated.

Once the report has been approved for release, advance copies (normally 8 working days ahead of the scheduled publication date of the final report) are provided to DIPs, PWIs and IPs.

Reactivating an investigation

ATSB policy provides for the reactivation of any transport safety investigation in circumstances where new and significant information (in relation to the matter that was investigated) is brought to the attention of the ATSB. This might include:

- new information that has been tendered as evidence in a coronial inquiry that was not previously made available to ATSB investigators
- important new physical evidence that has become available to the ATSB
- the results of research which may be directly relevant to the investigation.

Reactivation of an investigation allows the examination and analysis of the new information under the same legislative provisions as the initial investigation. If the review and analysis of the additional information:

- **Does not require any changes to the original investigation Findings** – the original report must remain unchanged. A supplementary report detailing the new information and analysis must be prepared and posted on the same 'page' on the ATSB website as the original report.
- **Requires changes to the original investigation Findings** – any relevant sections of the original report must be removed where practicable and the reader referred to the supplementary report. The supplementary report must be prepared and posted on the same 'page' on the ATSB website as the original report.

Part 6: ATSB investigation AO-2009-072 — Ditching – Israel Aircraft Westwind 1124A aircraft, VH-NGA - 5 km south-west of Norfolk Island Airport, 18 November 2009

This part describes in detail the specific application of ATSB policy and procedure to ATSB investigation AO-2009-072; the ditching of VH-NGA, 5 km south-west of Norfolk Island Airport on 18 November 2009. In doing so, it reviews the main ATSB safety investigation processes (see Part 2 of this submission) as applied to this investigation. That is the:

- conduct of the investigation
- analysis of the evidence obtained
- development and publication of the investigation report.

Conduct of the investigation

Initiating the investigation

The decision to investigate was made on 19 November 2009, reflecting the ATSB's focus on investigating passenger transport occurrences, including those involving small aircraft undertaking humanitarian aerial work (such as aeromedical evacuation and search and rescue flights). The decision to investigate is a formal one under the TSI Act and brings to bear the information gathering and other powers and protections of the TSI Act.

An initial team of four investigators was allocated to the investigation in the operations (pilot), licenced aircraft mechanical engineer (LAME), human performance and technical investigator disciplines. The operations investigator also fulfilled the role of investigator in charge (IIC). The team was supported at various times by up to eight other specialist investigators as and when required.

Investigation site process

After an initial interview of the captain on 23 November 2009, work commenced to examine the capability and need to recover the aircraft's cockpit voice (CVR) and flight data recorders (FDR). Subsequently, on 27 November 2009 the ATSB executive approved the investigation team's deployment to Norfolk Island to search for the aircraft using the ATSB's handheld 'pinger' locator.[3] They also approved funding of up to $20,000 to recover the recorders and were open to discussions on further expenditure if required. After locating the aircraft wreckage, the ATSB was assisted by Victoria Water Police in videoing the wreckage. Police also advised the ATSB on the necessary logistics and accompanying risks associated with any attempt to recover the aircraft recorders.

[3] A battery-powered underwater locator beacon (ULB) or pinger is attached to the outside of CVRs and FDRs and commences transmitting an acoustic signal automatically once submerged. The acoustic signal contains no position information and relies on separate detection equipment (a pinger receiver) to triangulate the position of the ULB.

On 25 January 2010 a briefing was provided to ATSB managers by the IIC in consideration of whether to recover the aircraft's CVR and FDR. As a result of that meeting, the decision was made by the Chief Commissioner that, since the CVR was unlikely to have any information directly relevant to the potential key safety issues of the investigation that would not be available from other sources, expenditure estimated at a minimum of $200,000 to recover the CVR/FDR did not represent an efficient and effective use of ATSB resources. The costs and dangers of the proposed retrieval were high; the safety benefits to the investigation low; and the ATSB has a responsibility to manage public resources prudently.

Collecting evidence process

The collection of evidence commences once there has been a decision to investigate. The majority of the evidence for the investigation was obtained under Section 32 of the TSI Act and as such became 'restricted information' under Section 3 of this Act. Section 32 compels those having the required evidence to produce it to the ATSB but importantly avails those persons protection from self-incrimination. It also ensures that the restricted information gathered as part of that process is protected from release without due process and consideration.

Evidence collection is an iterative process, as in this investigation, because its collection in turn informs the need for additional evidence or for explanatory information. This is the basis for the development by investigators of hypotheses as to the development of an occurrence, which can themselves evolve and change as an investigation progresses.

Sources of evidence during this investigation came both from within Australia and overseas. Of critical importance were the recollections of the flight crew and passengers, the relevant personnel at Norfolk Island Airport, and the Norfolk Islanders that were involved in the rescue of the aircraft occupants. Each was interviewed on at least one occasion and their recollections were integrated with recorded information and/or transcripts from Fiji air traffic control (ATC), high frequency radio recordings of conversations between Nadi and Auckland ATC and the aircraft, the Unicom frequency at Norfolk Island and of the submission of the flight plan by the pilot in command. A number of the operator's personnel were also interviewed.

The flight crew were also taken through a flight reconstruction that included a discussion of the content and implications of the recorded radio transmissions.
The evidence obtained from the Victoria Water Police underwater video and photographic records has already been highlighted.

Also important in the case of an investigation involving a commercial operation is an understanding of the operator and its systems. This is possible via the examination of the operator's publications, procedures and records and by the review of any surveillance of the operator by the Civil Aviation Safety Authority (CASA) in the period leading up the occurrence. In this instance a number of CASA surveillance files were obtained and examined. The results of two non-CASA external audits of the operator by medical evacuation service providers were also reviewed.

A sample of other operators' fuel planning and in-flight management procedures, including of another aeromedical evacuation operation, were also obtained and compared with those of the operator of VH-NGA. In particular, those operators' procedures and requirements in the

case of deteriorating weather at a destination that did not previously require an alternate were examined.

Together with a large number of Civil Aviation Regulations (CAR) and Orders (CAO), the Aeronautical Information Publication places many requirements on the conduct of flights such as that to Norfolk Island. These, and an operator's requirements as set down in their operations manual, are important risk controls and set the context for operations. In addition, Civil Aviation Advisory Publications provide guidance as to how an operator and pilots might satisfy the requirements of the CARs and CAOs. Relevant regulations, orders and CAAPs were obtained and proved integral to the investigation.

In respect of the operator's publications, procedures and records, evidence included the operations manual, aircraft data and flight and operational planning documentation. The flight crew's training records were also examined and their qualifications, proficiency and experience confirmed. Flight and duty time records were also obtained and integrated with the flight crew's reports of their activities in the period prior to the flight. This data was examined to understand the possible influence of any fatigue on the flight crew's performance during the flight.

In respect of the aircraft, its aircraft and maintenance logs and engine documentation were reviewed in terms of the operator's system of maintenance. As is the case in most investigations, the aircraft file was obtained from CASA and examined. Application of the reported fuel uplift and other operational data to the aircraft's weight from the aircraft records allowed an estimation of the aircraft's weight and balance on the day of the accident.

An understanding of the weather affecting the flight, and weather information relevant to it, were very important to the investigation. In this regard, copies of the relevant aerodrome forecasts (TAF) and observations (METAR) for Norfolk Island were obtained from the Bureau of Meteorology. TAFs and METARs were also obtained for Nadi in Fiji and Tontouta in New Caledonia. Flight crew and witness reports of the actual weather affecting Norfolk Island were also pertinent. A number of pilots were then interviewed to understand their application of the relevant meteorological products in terms of a last point of safe diversion. More specifically, these pilots' approaches were examined in the context of deteriorating weather at a destination that did not previously require an alternate.

Preliminary factual report

Consistent with section 7.4 of Annex 13 and ATSB policy and procedures, the investigation team began preparing a preliminary factual report (PFR) shortly after the accident. As their name suggests, PFRs report the facts as known early in the investigation. Readers of ATSB PFRs are cautioned about the possibility that new evidence may become available that alters the circumstances as depicted in such a report.

There is no analysis of the early facts as reported in a PFR. This can be somewhat frustrating for some stakeholders. However, readers of ATSB PFRs are advised of the intended future lines enquiry and of any safety action already taken by relevant parties to prevent a recurrence of the event. In the case of the Norfolk Island PFR, the then future lines of enquiry included further examination and analysis of

- meteorological information and its effect on the decision making and actions of the crew during the flight

- fuel planning relevant to the flight
- operational requirements that were relevant to the conduct of the flight
- crew resource management
- aeromedical flight classification and dispatch.

In respect of safety action to prevent a recurrence of the ditching at Norfolk Island, early action was reported to have been taken by the operator to check and revalidate the operator's commercial Westwind pilots. This included an examination of the operator's policies and procedures, safety management systems, the use and application of threat and error management principles, and the Instrument Flight Rules

The development and release of a PFR does not involve a directly involved party process. However, directly involved and other stipulated parties are afforded an 8-day advanced release period before the release of a PFR to the public. The Norfolk Island PFR was dispatched to the respective parties in accordance with section 26 of the TSI Act on 24 December 2009. The report was released to the public in accordance with section 25 of the TSI Act on 13 January 2010.

No safety issues were identified by the ATSB in the period preceding the release of the Norfolk Island PFR. However, in its media release that accompanied the release of the report, the ATSB advised that, should any critical safety issues emerge that required urgent attention, the ATSB would immediately bring such issues to the attention of the relevant authorities who were best placed to take prompt action to address those issues.

Analysis of the evidence obtained

Preliminary analysis

A degree of preliminary analysis necessarily begins at the initiation of an investigation and informs the ongoing development of hypotheses that are later more formally examined as part of the safety factor and risk analyses processes. In addition, this ongoing development and preliminary examination of hypotheses informs the need to collect additional evidence or to supplement or clarify that already obtained.

More specifically, preliminary analysis is important in the development and understanding of the sequence of events (or timeline) in the development of an occurrence. In the case of complex investigations, a number of sequences of events specific to differing lines of enquiry may be more efficient, before their being integrated as the investigation progresses. In the case of the Norfolk Island investigation, a sequence of events was developed that integrated the flight from Apia to Norfolk Island, the weather affecting the flight, and the events after the aircraft arrived at Norfolk Island.

Also important is an understanding of the flight crew's health, disposition and well-being in the period leading up to the flight. In this respect, ATSB investigations seek an understanding of at least the 72-hour period preceding an occurrence, resulting in another sequence of events that is able to be integrated with the commencement of an occurrence flight. Sources of information in the Norfolk Island investigation that were used to develop this crew-related sequence of events included flight crew interviews, recorded data and the operator's rostering records.

A timeline was also developed of the aircraft and its system's maintenance and serviceability. However, neither the aircraft nor its systems were found to be a factor in the occurrence.

Ultimately, the potentially numerous sequences of events are reported in the final investigation report. The respective sequences of events in the development of the Norfolk Island ditching are reported in the *History of the flight*, *Personnel information*, *Aircraft information*, *Meteorological information* and *Survival aspects* sections of the final report.

As can occur at any time during an investigation, a safety issue was highlighted early in the Norfolk Island investigation that identified there were no regulations or other guidance for application by flight crews when making in-flight, weather-related decisions in a changing meteorological environment. This reduced the reliability of flight crew in-flight decision making, and increased the risk of an aircraft arriving at a destination with insufficient fuel to continue to an alternate aerodrome, if the weather at the intended destination had deteriorated below its landing minima.

Based on an early understanding of the facts to hand at the time, an initial assessment of the associated safety risk identified this safety issue as being 'critical'. Consistent with its preference to encourage relevant organisations to initiate proactive safety action to address any identified safety issues, and the then understood criticality of the identified safety issue, a meeting was convened by the ATSB with CASA officers on 3 February 2010 to highlight the issue. In addition, the ATSB sought an understanding at the meeting of the potential for safety action by CASA. The indication from the CASA officers was that they understood the issue, and that it should be progressed with CASA management.

Subsequently, on 12 February 2012 CASA sought formal advice of the safety issue and a request for CASA's assistance in its resolution. CASA felt that such a letter would 'kick-start' its consideration of, and response to the issue. A letter was sent to CASA explaining the safety issue and seeking its resolution on 26 February 2012.

In response, on 26 March 2012 CASA advised that it considered the current legislative regime, when combined with the extant aeronautical knowledge training requirements and published guidance material, allowed pilots to arrive at appropriate in-flight decisions. CASA also advised that it was reviewing the existing regulations and guidance with a view to their amendment as appropriate.

The amendments that were being developed by CASA were reported to be in two phases. In Phase 1, CASA proposed requiring all passenger-carrying commercial flights to remote islands to carry sufficient fuel for the flight to divert to an alternate aerodrome after reaching its initial destination, regardless of the forecast meteorological conditions at the destination. This necessitated the development of amendments to CAO 82.0 and CAAP 234-1. The CAAP would be amended to include guidance on considerations for operations to remote aerodromes and the circumstances when a pilot should consider a diversion.

Phase 2 of CASA's proposed amendments would entail a more comprehensive review of the in-flight fuel management guidance in CAAP 234-1. CASA intended strengthening the requirements affecting in-flight fuel management, including that a pilot should not, if an alternate aerodrome is available, continue a flight to the intended destination if a landing could not be carried out with the required fuel reserves intact.

Overall, CASA was of a mind that it was safer to provide guidance to pilots on what might be considered in situations such as affected the flight to Norfolk Island, rather than prescriptively stipulating actions to be taken by a pilot or flight crew. CASA was concerned that such prescription might result in new threats with the potential to compromise safety.

In the event, given the advice by CASA of safety action to address the safety issue, the ATSB did not issue a formal safety recommendation. The safety action taken by CASA in respect of this safety issue is reported in the ATSB's final investigation report.

Safety factor identification

As indicated previously, the identification of safety factors commences early in the investigation in terms of the development and consideration of hypotheses by the investigation team. Safety factor identification aims to identify potential critical safety issues and data collection requirements. As an example, in the case of the Norfolk Island investigation, this early identification (and then processing) of the above weather-related decision-making factor culminated in efforts to address the resulting safety issue with CASA.

Additional safety factors that were identified for subsequent processing resulted from actions by the crew – termed individual actions – or were a function of sub-optimal risk controls or organisational influence. As evidenced in the *Safety action* section of the ATSB investigation report, it is at the risk control and organisational influence levels that changes can be made that have a meaningful influence on safety. Safety factors at those levels are termed 'safety issues'.

Safety factor processing – existence

Safety factor processing involves the iterative definition, testing and classification of the identified safety factors. Tests of existence, influence and importance are applied to determine whether the factors represent contributory or other safety factors.

As is more often the case with occurrence events and individual actions, the existence of the individual action-related contributory and other safety factors in the ATSB investigation was established based on clear and direct evidence as highlighted in the investigation report. In general, existence was shown by comparing the crew's actions in preparation for and during the flight with extant regulatory and operator requirements and guidance.

In terms of the risk control- and organisational influence-related safety factors, additional data collection was required to prove existence. This involved examining the extent and content of the available requirements and guidance on fuel planning and in-flight weather management. In addition, the guidance provided to pilots by other similar operators was reviewed to understand whether these factors were operator specific or had effect across the industry. Finally, a number of other similarly qualified pilots were interviewed to determine how they might have performed in similar circumstances to those experienced by the flight crew en route to Norfolk Island.

Safety factor processing – influence

Influence was shown in the case of the three *Contributory safety factors* as, in the first instance, when the weather at Norfolk Island indicated the need to divert, the crew's

incomplete pre-flight preparation and planning precluded a full understanding of the hazards affecting the flight. In addition, the availability and suitability of any alternate destinations could not have been known on the information obtained as part of that planning. Together with the crew's delayed comprehension of the deteriorating weather at Norfolk Island, each factor influenced how the crew considered the need to divert. In consequence, they concluded that it was safer to continue to Norfolk Island than to consider a diversion to a suitable alternate aerodrome.

Safety factor processing – importance

In respect of the remaining safety factors, influence could not be shown at the 66% probability criterion. However, each was important and therefore an *Other safety factor* as it represented an event or condition that increased safety risk, and was worthy of additional analysis.

In the case of the two identified safety issues, this included the conduct of a safety risk analysis.

Safety issue risk assessment

As shown in the ATSB investigation, the identification of safety issues is an iterative process, with the result that safety issues can be identified at any stage of an investigation. As previously described, what was assessed early in the investigation as a critical safety issue was brought to CASA's attention in order for that authority to address the safety issue. Ultimately, this risk rating was modified as the investigation progressed and obtained additional evidence and understanding of the issue but safety action was still undertaken by CASA in consequence.

The early identification of safety issues and the urging of immediate action to address critical safety issues is not unusual. In the case of the investigation into the uncontained engine failure that occurred overhead Batam Island, Indonesia on 4 November 2012 a critical safety issue was identified by the ATSB early in the investigation. Safety action was taken by the relevant organisation to address the issue within 30 days of the occurrence.

The ATSB risk methodology examines the worst credible occurrence scenario in terms of its likelihood and consequence to establish the safety risk associated with the identified safety issue. Likelihood and consequence tables are used to inform this assessment. Application of the worst credible scenario accounts for the effect of in-place risk controls and management processes that generally act to reduce the level of adverse consequences associated with the worst possible scenario.

The worst credible scenarios in respect of the Norfolk Island safety issues were each significantly influenced by the in-place risk controls and management processes. These included the requirements and guidance in the relevant CARs and CAOs, the operator's operations manual, the Aeronautical Information Publication and CAAP 234-1. Flight crew qualifications and the associated competencies, training and proficiency requirements were also identified as risk controls affecting the determination of the worst credible scenario.

As the Norfolk Island investigation progressed, an increasing understanding of the number and effect of the extant risk controls resulted in the modification of the worst credible

scenario from the loss of an aircraft with multiple fatalities, to a serious incident due to a low fuel quantity emergency. In this regard, the risk rating when the report was presented in draft to management was assessed as 'Significant'. During management review, the consequence rating applicable to the aerial work category of operations and likelihood of this scenario were then applied to the ATSB's risk rating matrix to determine the associated level of safety risk (the flight to Norfolk Island was an aerial work flight). This resulted in a risk rating for each safety issue of 'Minor'.

Development and publication of the investigation report

Preparation of the draft report

Initial responsibility for the development of an investigation report rests with the investigator in charge (IIC), who works with the investigation team members to present a draft report for peer review. Appendix-1 to Annex 13 highlights the need for sufficient information in an investigation report to allow an understanding of the factual information, analysis and conclusions/findings. Team consensus with the draft report and status of the investigation is confirmed before the investigation and report is reviewed by a peer or group of peers (depending on the extent of the investigation and report).

In the case of the Norfolk Island investigation, the peer review was carried out by an investigator from the ATSB's Brisbane regional office. This was later supplemented by an operations investigator and the Team Manager from that office. After the IIC and peer reviewer(s) have worked through any points of contention, addressed any need for additional evidence or work to analyse evidence already held, or considered the amendment of the draft report, the draft report progresses to management review.

Depending on the nature and scope of an investigation and report, management review of the draft report can include by the team manager with oversight of the investigation, the General Manager and then the Commission. Based on the nature and scope of the draft Norfolk Island investigation report, it was not reviewed by the Commission and the General Manager approved its release to the directly involved parties (DIP) for comment on its factual accuracy on 26 March 2012. Comments were requested from DIPs by 23 April 2012.

It is not unusual for DIPs to seek an extension to the period allowed for providing comments and in general the ATSB will attempt to accommodate any reasonable request. A number of DIPs to the Norfolk Island investigation were provided with an extension of up to 3 weeks to the period for commenting on the draft report.

Assessment of DIP comments

The IIC imports all DIP comments into separate report submission tables, one for each DIP. All comments are then considered in terms of any additional evidence provided by the respective DIP as to errors of fact in the draft report, of the possible need to re-investigate aspects of the occurrence, or of the need for additional facts or clarification. If required, changes to the draft report are proposed by the IIC, including in consideration of proposals by DIPs for textual changes that may not be supported by any evidence or query the factual basis of the report. In this regard, if there is no implication for the validity of the report or its findings, the ATSB's preference is to align with DIP requests for textual change.

As a result of the changes to the draft report, a second or mini-DIP period was agreed and the revised draft report was forwarded to affected parties on 16 July 2012. This mini-DIP period closed on 26 July 2012.

Assessment of mini-DIP comments

The above process in respect of the initial DIP process was also applied to the mini-DIP comments. This included the consideration of a CASA Special Audit Report of 25 November to 15 December 2009, which was effectively submitted as a DIP comment by one of the parties.

In all cases, changes were incorporated into the report that were either supported by evidence as provided by the parties, or that were textual in nature and able to be accommodated without affecting the validity of the report or its findings.

Review and approval of the final report

After the IIC has completed the consideration of the evidence in support and effect of any DIP comments, the effect of any 'accepted' or 'partially accepted' comments is included in the final report that is forwarded to ATSB management for review. As part of that review, management reviews the relevant DIP submission tables and any evidence provided.

Approval for the release of final reports to the public under section 25 of the TSI Act is by the Commission. This approval cannot be delegated to other officers. To facilitate this process, all original DIP submissions are forwarded to the Commission together with the proposed final report. This allows the Commission to consider DIP comments fully and independently of the investigation team and management.

Final report advanced release to directly involved and other parties

The Norfolk Island final report was approved by the Commission for release to the public under section 25 of the TSI Act on 16 July 2012. The report was dispatched to the DIPs and other parties by way of 'advanced release' on 21 August 2012 and released to the public on 30 August 2012. In the intervening period, comments were received from another of the parties in respect of how the report might be misinterpreted or misunderstood by readers. As with all other comments, they were also fully considered and changes were made to the final report.

Changes to the final report after its publication

On 31 August 2012 (1 day after its public release) an apparent error was reported to the ATSB between:

- paragraph three on page six of the report, which recorded Fijian air traffic control (ATC) as reporting '...the cloud [in the 0630 METAR at Norfolk Island] as being Few at 6,000 ft and Broken at 2,400 ft above the ARP [aerodrome reference point]; and
- the 0630 METAR in Appendix B to the report, which recorded the cloud as Few at 600 ft and Broken at 2,400 ft above the ARP.

A review of the report by ATSB officers incorrectly deduced that the 6,000 ft base of the Few cloud was a typo and corrected it to read 600 ft as per Appendix B. The amendment was published to the ATSB website on 31 August 2012.

Subsequently, the initial caller who reported this apparent error again contacted the ATSB to clarify the cloud base at Norfolk Island and a more in-depth review of the evidence was carried out. This included a review of the Fiji ATC radio recording. This review revealed that the original text in the investigation report was correct; Fiji ATC did (incorrectly) advise the pilot of there being Few clouds at Norfolk Island with a base of 6,000 ft. This report should have advised the pilot that the reported lowest cloud was Few at 600 ft. As a result, the report was amended to read:

> ...incorrectly reporting the cloud as being Few at 6,000 ft and correctly reporting Broken cloud at 2,400 ft above the ARP (see Appendix A for the controller transcript and Appendix B for the 0630 METAR).

This enhanced text restored the initial report but also provided additional context for readers. The reworded report was placed on the ATSB website on 3 September 2012.

At present the ATSB has no means in place to track changes to final reports for its readers. This is not ideal and the Commission has directed that a mechanism be developed to ensure that readers of ATSB reports are informed of:

- when a change has been made to a final report;
- what the change is; and
- given an explanation for the change if it is substantive and the reason for the change is not clear from the context.

The ATSB is working to have this issue resolved shortly.