ICAO

Doc 9756

Manual of Aircraft Accident and Incident Investigation

Part IV — Reporting

Third Edition, 2020

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

FOREWORD

The purpose of this manual is to encourage the uniform application of the Standards and Recommended Practices contained in Annex 13 and to provide information and guidance to States on the procedures, practices and techniques that can be used in aircraft accident investigations. Since accident investigations vary in complexity, a document of this kind cannot cover all eventualities. The more common techniques and processes, however, have been included. Although this manual will be of use to experienced and inexperienced investigators alike, it is not a substitute for investigation training and experience.

This manual is issued in four separate parts as follows:

Part I — Organization and Planning;

Part II — Procedures and Checklists;

Part III — Investigation; and

Part IV — Reporting.

Because this manual deals with accident, serious incident and incident investigations, for reasons of brevity, the terms “accidents” and “accident investigation”, as used herein, apply equally to “incidents” and “incident investigation”.

The following ICAO documents provide additional information and guidance material on related subjects:

— Annex 13 — *Aircraft Accident and Incident Investigation*;

— *Manual on Accident and Incident Investigation Policies and Procedures* (Doc 9962);

— *Manual on Regional Accident and Incident Investigation Organization* (Doc 9946);

— *Human Factors Training Manual* (Doc 9683);

— *Manual of Civil Aviation Medicine* (Doc 8984);

— *Hazards at Aircraft Accident Sites* (Circular 315);

— *Training Guidelines for Aircraft Accident Investigators* (Circular 298); and

— *Human Factors Digest No. 7 — Investigation of Human Factors in Accidents and Incidents* (Circular 240).

This manual, which supersedes the *Manual of Aircraft Accident Investigation* (Doc 6920) in its entirety, will be amended periodically as new investigation techniques are developed and new information becomes available.

Throughout this manual, the use of the male gender should be understood to include male and female persons.

Readers are invited to submit material for possible inclusion in subsequent editions of this manual. This material should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec
Canada H3C 5H7

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Chapter 1

THE FINAL REPORT

1.1 GENERAL

1.1.1 The Final Report of an aircraft accident investigation is the foundation for initiating the safety actions which are necessary to prevent further accidents from similar causes. Therefore, the Final Report on an accident must establish in detail what happened, how it happened and why it happened. The findings, causes and/or contributing factors of the Final Report should lead to safety recommendations so that appropriate preventive measures can be taken.

1.1.2 The Final Report should provide:

a) a record of all the relevant facts (including any conflicting evidence);

b) an analysis of the relevant facts;

c) conclusions in the form of findings, causes and/or contributing factors; and

d) safety recommendations.

The findings, causes and/or contributing factors of a Final Report should point clearly to the safety issues that need to be addressed.

1.1.3 The Final Report is usually the report of the investigator-in-charge or the accident investigation authority. The report should cover in detail all relevant aspects of the investigation. When the investigation of an accident is organized by establishing specialized groups, each group chairperson should submit a written report to the investigator-in-charge together with all supporting documentation and data covering the facts and findings established. The Final Report will be drafted based, to a large extent, on the reports of the various groups. The investigator-in-charge is responsible for ensuring that the Final Report is written in a consistent and uniform style.

1.1.4 The investigation of a general aviation accident seldom requires organization into groups. Such investigations are usually carried out by one or two investigators. As in the case of a major investigation, the responsibility for the completeness and quality of the Final Report rests with the investigator-in-charge and the accident investigation authority.

1.2 GROUP REPORTS

In consultation with the group members, the group chairperson is responsible for scrutinizing the evidence gathered in relation to the tasks assigned to the group and for drafting a group report, which presents all the facts relevant to the activities of the group. Also, the group chairperson should draft an analysis of the facts that the group has established, draft the findings of the group's investigation, and make proposals for safety recommendations. A group report should be presented in the format outlined in 1.2.1 to 1.2.5.

1.2.1 Introduction

This section gives brief identification details of the accident and lists the names, titles and affiliations of the group members. Matters of organization, such as the forming of subgroups to handle specific tasks within the terms of reference of the group, should be explained. For example, in the case of the Operations Group, subgroups such as a Witness Group and a Performance Group are sometimes formed. The terms of reference for the group and subgroups, and brief details of the time and location of investigation activities, should also be recorded in this section.

1.2.2 Investigation

The facts, conditions and circumstances established by the group should be presented under appropriate headings describing the areas investigated. For example, in the case of the Operations Group, headings would include crew histories, flight planning, dispatch, and aircraft mass and balance. All the relevant facts, whether or not considered significant to the findings of the group, must be included. Relevant documentation should be attached to the group report.

1.2.3 Analysis

The analysis discusses the significance of the facts stated in the previous section of the group report and presents the group's analysis of those facts as they pertain to the terms of reference of the group. This information should be presented in a logical way that leads to, and supports, the findings.

1.2.4 Conclusions

The conclusions section of the group report should contain the substantiated findings of the group's investigation. An indication of the findings of the group which are considered to be factors in the accident will assist the investigator-in-charge in the drafting of the Final Report.

1.2.5 Safety recommendations

The group report should include information on any safety issues established, safety actions already taken, proposals for safety recommendations and other forms of safety action, as appropriate.

1.3 FORMAT AND CONTENT OF THE FINAL REPORT

1.3.1 An investigation into an aircraft accident is not complete until all the relevant facts revealed by the investigation, the analysis of the facts, the conclusions and the safety recommendations have been recorded in the Final Report. The Final Report should be structured logically and written in clear and concise language. The report should explain what happened, how it happened, why the accident happened, and it should address the safety issues involved. A standardized format of the Final Report assists in the production of a complete and reliable record of the investigation of the accident.

1.3.2 In a major investigation, the investigator-in-charge receives the group reports and is responsible for the development and the drafting of the Final Report. The Final Report should be a comprehensive report of the whole investigation. The factual information collected during the investigation should form the basis for the analysis section of the report, which leads to and supports the establishment of the findings, causes and/or contributing factors, and safety recommendations. The standardized format for the Final Report, which is contained in the Appendix to Annex 13,

provides a well-structured record of the investigation. The Final Report contains five parts: Introduction (Title and Synopsis), Factual Information, Analysis, Conclusions (Findings, Causes and/or Contributing Factors) and Safety Recommendations.

1.3.3 Detailed guidance on the format and content of the Final Report is in Appendix 1 to Chapter 1. Appendix 2 provides guidance on report-writing conventions, and Appendix 3 presents a list of symbols and abbreviations which might be used in a Final Report. Appendix 4 contains a list of descriptive technical and Human Factors terms and their definitions while Appendix 5 lists examples of findings that might be used in accident reports.

1.3.4 The Final Report of an investigation, including its recommendations, is the catalyst for preventing further occurrences. Therefore, the Final Report must establish in detail what happened, how it happened and why it happened. For reporting on small investigations, many States have created abbreviated report formats that contain only the history of flight, information on the deficiencies discovered by the investigation, analysis of the factors contributing to the occurrence, and findings related to the deficiencies. Short reports have some advantages, including the reduction of resources required for the investigation and the time required to produce the Final Report.

1.3.5 Some States have created report forms that contain narrative sections, wherein the sequence of events is described; point-form sections, wherein free text can be entered; and check-off boxes for certain parameters that will facilitate data storage and extraction for statistical programmes. A well-designed form could serve as an investigation checklist and/or as the Final Report of the investigation.

1.4 CONSULTATION ON THE DRAFT FINAL REPORT

1.4.1 In accordance with Annex 13, the State conducting the investigation shall send a copy of the draft Final Report to the State which instituted the investigation and to all States that participated in the investigation, inviting their significant and substantiated comments on the report. The State conducting the investigation should also send copies of the draft Final Report to the operator and the organizations responsible for type design and final assembly of the aircraft, through the State of the Operator, the State of Design and the State of Manufacture, respectively, in order to enable the operator and such organizations to submit comments on the draft Final Report. When sending the draft Final Report to recipient States, the State conducting the investigation should consider using the most appropriate means available, such as facsimile, e-mail, courier service or express mail. When the draft Final Report is sent by electronic means, secure transmission methods should be used, when available.

1.4.2 States shall not circulate, release or give access to a draft report or any part thereof, any group reports or any other investigation documentation obtained during an investigation of an accident, without the express consent of the State which conducted the investigation, unless such reports or documents have already been published or released by that latter State.

1.4.3 If the State conducting the investigation receives comments within sixty days of the date of the transmittal letter, it shall either amend the draft Final Report to include the substance of the comments received or, if desired by the State that provided the comments, append the comments to the Final Report. Usually, comments to be appended to the Final Report are restricted to non-editorial, specific technical aspects of the Final Report, upon which no agreement could be reached.

1.4.4 If the State conducting the investigation receives no comments within sixty days, it shall issue the Final Report, unless an extension of that period has been agreed by the States concerned.

1.5 RELEASE AND DISTRIBUTION OF THE FINAL REPORT

1.5.1 The State conducting the investigation shall release the Final Report in the shortest possible time and, if possible, within twelve months of the date of the occurrence. If the report cannot be released within twelve months, the State conducting the investigation shall release an interim statement on each anniversary of the occurrence detailing the progress of the investigation and any safety issues raised.

1.5.2 Related to the release of Final Reports, Annex 13, 6.6.1 recommends that "*If the State conducting the investigation does not make the Final Report or an interim statement publicly available within a reasonable timeframe, other States participating in the investigation are entitled to request in writing from the State conducting the investigation express consent to release a statement containing safety issues raised with such information as is available. If the State conducting the investigation gives express consent or does not reply to such a request within 30 days, the State making the request should release such a statement after coordinating with participating States."* An important aspect of this recommendation is the concept of a reasonable timeframe and what this may constitute.

1.5.3 The possibilities that may cause a delay in the publishing of the Final Report need to be assessed. A worldwide review related to the release of Final Reports assessed 1 157 occurrences of fatal accidents between 1990 and 2016 involving civil aircraft of a maximum mass of over 5 700 kg. The review determined that of the occurrences where a Final Report was generated and made publicly available, 25 per cent were made publicly available within one year of the occurrence; 65 per cent within two years; 84 per cent within three years; and 94 per cent were concluded in four years. In addition to the aforementioned, the following factors should be taken into consideration in determining a "reasonable timeframe" for the issuance of the Final Report or an interim statement:

a) the availability of an interim statement(s) released by the State conducting the investigation on each anniversary of the occurrence, detailing the progress of the investigation and any safety issues raised, should the Final Report not be publicly available within twelve months;

b) the level of complexity of the investigation of the occurrence may extend the time necessary to finalize the investigation, which may result in the Final Report being published in a two- to four-year period, as indicated above;

c) a higher credibility is usually given to safety lessons shared promptly, which are likely to have a stronger impact on accident prevention and on the enhancement of safety; and

d) the prompt sharing of safety lessons on systemic deficiencies (e.g. those not solely related to a specific aircraft type, operator, manufacturer, maintenance organization, or air navigation service provider) may provide safety benefits at a global level, including to States not participating in the investigation.

1.5.4 In addition to the release and distribution of the Final Report within the State, the State conducting the investigation shall send the Final Report, with a minimum of delay, to:

a) the State which instituted the investigation;

b) the State of Registry;

c) the State of the Operator;

d) the State of Design;

e) the State of Manufacture;

f) any State having suffered fatalities or serious injuries to its citizens;

g) any State which provided relevant information, significant facilities or experts; and

h) ICAO, if the involved aircraft is of a maximum mass of over 5 700 kg.

1.6 RELEASE AND DISTRIBUTION OF SAFETY RECOMMENDATIONS

1.6.1 At any stage of the investigation of an accident or incident, the investigation authority of the State conducting the investigation shall recommend, in a dated transmittal correspondence to the appropriate authorities (including those in other States, and to ICAO when ICAO documents are involved), any preventive action that it considers necessary to be taken promptly to enhance aviation safety.

1.6.2 A State that receives safety recommendations shall inform the proposing State, within ninety days of the date of the transmittal correspondence, of the preventive action taken or under consideration, or the reasons why no action will be taken.

1.6.3 A State conducting the investigation, or any other State issuing a safety recommendation, must implement procedures to record the responses to the safety recommendation issued. A State that receives a safety recommendation must implement procedures to monitor the progress of the action taken in response to that safety recommendation.

1.6.4 States are required to inform ICAO, i.e. the Accident Investigation Section of ICAO's Air Navigation Bureau, in a dated transmittal correspondence, of issued safety recommendations of global concern (SRGCs) as well as the responses received concerning these recommendations. An SRGC is defined as "a safety recommendation regarding a systemic deficiency having a probability of recurrence, with significant consequences at a global level, and requiring timely action to improve safety". Examples of what is and what is not an SRGC are listed in Appendix 6 to Chapter 1.

1.6.5 For the purpose of advancing aviation safety, SRGCs, as well as the responses received thereto, sent to ICAO will be recorded in an ICAO central database that is publicly available. States, even if they are not the addressee of the SRGC, should regularly monitor this database for awareness and adoption of timely corrective action as appropriate.

Note.— Appendix 6 to this chapter contains more detailed guidelines on the identification, drafting and follow-up of safety recommendations.

1.6.6 In general, safety recommendations are addressed to a State's regulatory/safety oversight agency and may not be widely disseminated. To this effect, the ICAO central database is a means to enhance awareness of other States' regulatory/safety oversight agencies, accident investigation authorities, airlines, etc. about SRGCs and their responses for the purpose of accident prevention measures, resulting in the enhancement of safety.

1.7 ELECTRONIC LIBRARY OF FINAL REPORTS

1.7.1 In accordance with the provisions in ICAO Annex 13, a State shall send to ICAO a copy of the Final Report on its investigations into accidents and incidents involving aircraft of a maximum mass of over 5 700 kilograms. Whenever practicable, the Final Report sent to ICAO is to be prepared in one of the working languages of the Organization. Final Reports can be sent in hard copy but preferably in electronic format. The Final Report shall be a public document in the interest of accident prevention.

1.7.2 Final Reports received by ICAO will be stored on the ICAO Electronic Library of Final Reports (e-Library) and posted on the AIG website, which is accessible through the ICAO public website at https://www.icao.int/safety/airnavigation/AIG/Pages/E-library-of-Final-Reports.aspx. In this way, safety lessons learned during investigations and information captured in Final Reports will be made available to a wide audience, including safety investigators, other safety officers and interested parties.

1.8 EXCHANGE OF FINAL REPORTS BETWEEN STATES

1.8.1 Aircraft accident prevention is dependent, in part, on information made available from accident investigations. The causes and/or contributing factors of accidents, especially those in which large aircraft are involved, are of interest to all States and, in particular, to those States operating similar aircraft types. Therefore, prompt dissemination to all States of the findings of aircraft accident investigations can be a major contribution to aviation safety. To facilitate the exchange of accident information, all States are encouraged to disseminate their Final Reports to other States. Use of the Internet can expedite such dissemination.

1.8.2 ICAO also encourages States to exchange information concerning any safety recommendations that were made before the completion of the Final Report.

1.8.3 The Final Reports of accidents and incidents submitted to ICAO are available in the e-library of Final Reports on the AIG website, which is accessible through the ICAO public website. However, as some Final Reports may not be available in the e-library, States that require information pertaining to these Final Reports should request a copy of these Final Reports from the accident investigation authority of the State which conducted the investigation. Appendix 2 to Chapter 4 of Part I of this manual lists the addresses and contact numbers of States' accident investigation authorities, as reported to ICAO. An up-to-date list can be found on the AIG website, which is accessible through the ICAO public website.

1.9 ICAO ADDRESS

Final Reports being sent to ICAO should be sent using one, or both, of the following addresses:

By mail: International Civil Aviation Organization
Attention: AIG Section
999 Robert-Bourassa Boulevard
Montréal, Quebec, Canada H3C 5H7

By email: ADREP@icao.int

Appendix 1 to Chapter 1

FORMAT AND CONTENT OF THE FINAL REPORT

To enable the Final Report to be presented in a convenient and uniform manner, a standardized format is contained in the Appendix to Annex 13. However, that format may be adapted to the circumstances of the accident or incident. Detailed guidance on completing each section of the Final Report is provided below.

INTRODUCTION (TITLE AND SYNOPSIS)

The title of the Final Report should contain the following information: name of the operator; manufacturer, model, nationality and registration marks of the aircraft; and place and date of the accident.

The introduction should contain brief information on the notification of the accident to national and foreign authorities, the identification of the accident investigation authority conducting the investigation, the accredited representation from other States and brief information on the organization of the investigation. The authority releasing the report, as well as the date of release, should also be given.

The introduction should contain a synopsis which briefly describes the accident. It should provide an overview of the accident flight, a statement of why the accident happened and a brief summary of the injuries and damage. The synopsis could be described in an executive summary to the Final Report and should usually not exceed one page in length.

The title page, or the inside cover, may contain a statement on the accident prevention objective of the investigation and the Final Report. It may also be stated that it is not the purpose of the investigation and the Final Report to apportion blame or liability. For example, the following text may be considered: “In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the prevention of accidents and incidents.”

The introduction may also contain a statement regarding the responsibility for implementing the safety recommendations. For example, the following text may be considered: “Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.”

The introduction should contain a reference to the time of day used in the report and the differential between local time and Coordinated Universal Time (UTC).

A table of contents, a list of abbreviations used in the report and a list of appendices will enhance the readability of the report.

1. FACTUAL INFORMATION

This part of the Final Report is descriptive in character and should be a comprehensive record of the facts and circumstances established in the investigation. When the investigation was conducted by groups, the report should

comprise a consolidation of the relevant information from the group reports. Supporting documents, such as photographs, diagrams, relevant parts of flight recorder readouts and technical reports, should be included or appended to the report. However, only those documents, or portions thereof, which are required to support the facts, analysis and conclusions shall be appended to the Final Report.

The collection of Human Factors information is an integral part of the investigation. Thus, the Human Factors information should be integrated into the appropriate areas of the factual part of the report, rather than being placed under a separate heading. Human Factors information should be presented in a language that is consistent with the presentation of the other factual information.

The factual information part of the Final Report should contain a description of all the events and circumstances directly related to the occurrence. The sequence should begin as far back in time as is necessary to include the significant events which preceded the accident. This part also contains all factual information, i.e. information resulting from direct verification, which is essential for the development of the analysis, conclusions and safety recommendations. The significance of the facts should not be explained in the factual information part. Such discussions should be presented in the analysis part.

1.1 History of the flight

1.1.1 The history of the flight describes the significant events which preceded the accident, in chronological order, when this is practicable. The information is usually obtained from sources such as flight records, flight data recorders, cockpit voice recorders, air traffic services records and recordings, and witness accounts. The information should be correlated to local time or UTC if the flight involved more than one time zone. The information presented in this section of the report should be based on established facts. Usually the flight number, the type of operator and operation, the crew briefing and flight planning, the departure point and time of departure, and the point of intended landing will be given, followed by a description of the events leading to the accident, including navigational details and relevant radio communications. It is important to give a description of the flight and the pertinent events as they occurred, including a reconstruction of the significant portion of the flight path, if appropriate. Evidence which facilitated the reconstruction of the sequence of events, such as witness accounts, cockpit voice recorder and air traffic services transcripts, should be mentioned.

1.1.2 In the history of the flight section, the objective is to enable the reader to understand how the accident happened but to avoid any analysis of why the accident occurred.

1.1.3 With regard to the location of the occurrence, include:

a) the latitude and longitude as well as a geographical reference to a well-known location (such as 75 km south of XYZ);

b) the elevation of the accident site;

c) the time of the occurrence in local time (and UTC if the flight crossed time zones); and

d) whether it was day, dawn, dusk or night.

1.2 Injuries to persons

1.2.1 Table IV-1-1 should be used to summarize injuries to persons. This table should be completed using numbers.

Table IV-1-1. Injuries to persons

Injuries	*Crew*	*Passengers*	*Total in the aircraft*	*Others*
Fatal				
Serious				
Minor				Not applicable
None				Not applicable
TOTAL				

1.2.2 Fatal injuries include all deaths determined to be a direct result of injuries sustained in the accident. Serious injury is defined in Chapter 1 of Annex 13. For statistical purposes, ICAO classifies a fatal injury as an injury which results in death within thirty days of the accident. The heading “Others” in the table refers to persons outside the aircraft who were injured in the accident. When the accident involves a collision between two aircraft, a separate table should be used for each aircraft.

1.2.3 Also, the nationalities of the passengers and the crew should be listed by stating the number of fatalities and serious injuries for each nationality.

1.3 Damage to aircraft

1.3.1 This section should contain a brief statement of the damage sustained by the aircraft in the accident (destroyed, substantially damaged, slightly damaged, or no damage). A detailed description of damage to relevant aircraft components and systems should be included in Section 1.12 — Wreckage and impact information.

1.3.2 Further guidance for the determination of aircraft damage is provided in Attachment E to Annex 13. In addition, an aircraft should/could be classified as “destroyed” when the main structural elements and/or systems are substantially damaged to the extent that it would be impractical to return the aircraft to an airworthy condition. Examples of damages that would merit classification as “destroyed” are as follows:

a) damage to an aircraft where the structure is deformed, crushed, demolished or consumed by fire to such an extent that the make and model is not readily distinguishable without viewing its written documents, data plate or insignia;

b) most of the parts are damaged and need to be replaced or repaired;

c) for large aircraft, keel beam damage that exceeds the structural repair manual (SRM);

d) fuselage broken in two or more sections;

e) multi-site damage locations that exceed the SRM, such as engine separation, wing separated or broken, or empennage separated or broken; and

f) aircraft is submerged in saltwater for 24 hours or longer.

Note 1.— A classification of "destroyed" is usually associated with a hull loss, meaning that the aircraft is damaged beyond economical repair. However, an aircraft may be repaired for other reasons, such as historical value. Therefore, a technical determination of damage classification "destroyed" is not to be affected by the decision of whether to repair or rebuild an accident aircraft.

Note 2.— Occurrence where the aircraft damage is coded as "destroyed" is to be classified as an "accident".

1.4 Other damage

Make a brief statement of damage sustained by objects other than the aircraft, such as buildings, vehicles, navigation facilities, aerodrome structures and installations, and any significant damage to the environment.

1.5 Personnel information

1.5.1 Provide a brief description of the qualifications, experience and history for each flight crew member (pilot, co-pilot and flight engineer) including age, type and validity of licences and ratings; flying experience (total hours), types flown and hours on the type; hours flown in the last 24 hours, 7 days and 90 days prior to the accident; results of recent training and mandatory and periodic checks; experience on route and aerodrome involved in the accident; relevant information on duty time and rest periods in the 48 hours prior to the accident; and significant medical history and medical checks. Also, state the position occupied by each flight crew member and identify who was flying the aircraft.

1.5.2 When relevant to the accident, give a brief statement of the duties and responsibilities of the cabin crew as well as their qualifications, experience, and training. These details would be relevant, for example, if the accident involved an evacuation of the aircraft.

1.5.3 When relevant to the accident, include a brief statement of the validity of licences and ratings as well as the qualifications and experience of air traffic services personnel, including age, position manned, total experience (in years), and details of experience specific to the position manned. Details of training and pertinent checks should be included as well as duty times and rest periods in the 48 hours prior to the occurrence.

1.5.4 When relevant to the accident, information on maintenance personnel and other personnel involved should include qualifications, experience, time on duty, shift work rosters, workload and the time of the day.

1.5.5 When relevant to the occurrence, this section would also include information on any personal or medical factors that could have influenced human performance.

1.5.6 Use subheadings, as appropriate, to organize the information in this section.

1.6 Aircraft information

1.6.1 When relevant to the accident, provide a brief statement of the airworthiness and maintenance of the aircraft including the following information:

a) *General information*: Aircraft manufacturer and model, serial number and year of manufacture; nationality and registration marks, validity of the Certificate of Registration; name of the owner and the operator; and validity of the Certificate of Airworthiness;

b) *Aircraft history*: Total flying hours since manufacture, since overhaul and since last periodic inspection. Include relevant information on maintenance log and maintenance documentation, compliance (or otherwise) with airworthiness directives, manufacturer service bulletins and aircraft modification status;

c) *Helicopters*: Main rotor and tail rotor types and serial numbers. When relevant, include total time, time since overhaul, time since inspection, and certificated time and cycle limits for relevant components;

d) *Engines and propellers*: Engine manufacturer and model, position on the aircraft and engine or engine module serial numbers; engine overhaul period if an engine failure occurred; and total hours, hours since overhaul and hours since last inspection, for each engine. If relevant, provide the same information for the propellers;

e) *Fuel*: Type of fuel used and type of fuel authorized. Also, state the amount of fuel on board and how it was determined, its specific gravity, and its distribution in the fuel tanks;

f) *Accessories*: In respect of any component which failed, give details of the manufacturer, type, model, part and serial number, certificated time and cycle limits, and operating time since manufacture and since overhaul;

g) *Defects*: List any technical defects in the aircraft, engine or accessories that were discovered during the investigation or recorded in the appropriate log and not cleared. Indicate whether the defects were recurring and whether the flight was permissible under the aircraft master minimum equipment list. If there were no defects, make a statement to that effect; and

h) *Aircraft load*: The maximum certificated take-off mass and landing mass, actual take-off mass and mass at the time of the occurrence should be given. Also, state the certificated limits for the centre of gravity of the aircraft, and the centre of gravity at take-off and at the time of the occurrence. Include a description of the operator's loading control system, the load distribution and its security, and how the details of the aircraft mass and centre of gravity were established.

1.6.2 Describe any aircraft part or system which had a bearing on the accident. Similarly, describe operational procedures, performance limitations and other aircraft-related circumstances which played a role in the accident. The objective is to enable the reader to fully understand how the accident happened.

1.6.3 The availability, serviceability and use of transponder, airborne collision avoidance system (ACAS) and traffic alert and collision avoidance system (TCAS), ground proximity warning system (GPWS) and terrain awareness warning system (TAWS) should be stated. The relevant systems should be discussed in detail for near-collisions, mid-air collisions, approach and landing accidents and controlled flight into terrain accidents.

1.7 Meteorological information

1.7.1 Provide a brief statement on the relevant meteorological conditions, including the forecast and actual weather, together with an appreciation of the weather in retrospect. When relevant to the occurrence, the following information should be included:

a) Describe when, where and how the pilot obtained weather information;

b) Weather forecast: Route and aerodrome forecasts available to the pilot, and details of any weather briefing obtained by the pilot prior to departure or received en-route;

c) Weather observations at the time and place of the occurrence including precipitation, ceiling, visibility, runway visual range, wind speed and direction, temperature and dew point;

d) Actual weather on the route of the flight including weather observations, SIGMETs, pilot reports and witness accounts;

e) A general view of the weather situation (synoptic weather);

f) Weather radar recordings, satellite photos, low-level wind shear alert system (LLWSAS) data, and other recorded meteorological information; and

g) Natural light conditions at the time of the accident, such as day (sunlight or overcast), twilight (dawn or dusk; when relevant, the time of sunrise or sunset at the applicable altitude should be included), night (dark or moonlight) and when relevant, the position of the sun relative to the direction of the flight.

1.7.2 The amount of meteorological information to be included in this section depends on the significance of the meteorological factors in the occurrence. A detailed description of the forecast and weather observations is appropriate for a weather-related occurrence whereas a brief summary of the weather is appropriate when the weather was not a factor.

1.8 Aids to navigation

1.8.1 Include relevant information on ground-based navigation and landing aids available, such as non-directional radio beacon (NDB), very high frequency omnidirectional radio range (VOR), distance measuring equipment (DME), instrument landing system (ILS), precision approach radar (PAR), and visual ground aids as well as their serviceability at the time of the accident.

1.8.2 When relevant, include pertinent information on equipment on board the aircraft, such as auto flight system, flight management system (FMS), global positioning system (GPS), inertial navigation system (INS), aircraft communication addressing and reporting system (ACARS), enhanced ground proximity warning system (EGPWS), TCAS and electronic flight bag (EFB), including their serviceability. Availability of relevant maps, charts, approach plates, pertinent air-based navigation (such as global navigation satellite system (GNSS)), surveillance data from primary and secondary radar equipment, automatic dependent surveillance — broadcast (ADS-B), automatic dependent surveillance — contract (ADS-C), satellite communication (SATCOM) and satellite data should also be discussed and included in, or attached to, the report. The information should include the effectiveness of the pertinent systems at the time.

1.9 Communications

Describe the communication facilities available to the flight crew and their effectiveness. Describe the communications with the air traffic services and other communications relevant to the flight, including reference to communication logs and transcripts of recordings. When essential to the analysis and understanding of the occurrence, pertinent extracts from the transcripts of air traffic services communications recordings should be included in this section or attached to the report.

1.10 Aerodrome information

1.10.1 When the occurrence took place during take-off or landing, include information concerning the aerodrome and its facilities. When relevant, include the following information:

a) Name of aerodrome, location indicator, reference point (latitude/longitude) and elevation;

b) Runway identification, runway markings, runway length and slope, length of overrun, and obstructions;

c) Runway conditions, such as pavement texture and grooving, rubber deposits, presence of water, slush, snow, ice, friction coefficient and braking action;

d) Lighting, such as runway, taxiway and stopway lighting; and visual aids, such as visual approach slope indicator system (VASIS) and precision approach path indicator (PAPI);

e) Runway inspection programmes and inspections carried out; and

f) Bird and wildlife programmes.

1.10.2 If the aircraft was taking off from, or landing on, an area other than an aerodrome, relevant information on the take-off or landing area should be given.

1.10.3 This section should be divided into departure aerodrome information and destination aerodrome information, if both aerodromes were pertinent to the occurrence.

1.11 Flight recorders

1.11.1 Provide the particulars for each flight recorder, such as manufacturer, model, number of parameters recorded, recording medium and duration of the recording. The recorders would include flight data recorders (FDRs), cockpit voice recorders (CVRs), flight crew-machine interface recordings (FCMIR), quick access recorders/direct access recorders (QARs/DARs), engine parameter recorders (such as electronic engine control (EEC)), health and usage monitoring systems (HUMS), airborne image recorders (AIRs), data link recorders, lightweight recorders, non-volatile memory chips in aircraft systems, other on-board data storage equipment, and communication and/or video storage devices, or ground-based recorders.

1.11.2 Describe the performance of the means for timely recovery of flight recorder data as required by Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, 6.3.6 *Flight recorder data recovery*. When applicable, describe the location and retrieval of automatic deployable flight recorders, including the performance of the emergency locator transmitter(s) (ELT(s)) for locating the recorder, or the recovery of any transmitted flight recorder data.

Note.— Guidance on approving the means to locate an aircraft in distress and make flight recorder data available in a timely manner is contained in the Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery *(Doc 10054).*

1.11.3 Describe the condition of the recorders on recovery, in particular their exposure to fire and impact forces. If the flight recorder(s) could not be recovered, the reasons should be explained. If data were not recorded or could not be extracted, describe the reasons for the malfunction or loss of data. Include techniques used to extract data and any problems encountered. If the recorders operated properly, a short statement to this effect should be made and the pertinent data presented.

1.11.4 In this section, provide information recorded by the flight recorders. Because of the length of a flight data recording read-out report, include here, or in an appendix to the Final Report, only those parts of the read-out reports which are pertinent to the analysis and findings.

1.11.5 Transcripts from the cockpit voice recordings shall be included in the Final Report or its appendices only when essential to the analysis and understanding of the occurrence. Parts of the recordings not essential to the analysis shall not be disclosed. Chapter 5 of Annex 13 contains provisions pertinent to transcribed voice recordings and should be taken into account when it is considered necessary to include such transcripts in the Final Report or its appendices.

1.11.6 If the aircraft was not required to be equipped with flight recorders, a statement along the following lines may be used: “The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by the relevant aviation regulations.”

1.11.7 When applicable, describe any techniques or processes used to recover data from other devices containing solid-state memory, including methods employed for the extraction (decoding) of operational and/or engineering units from the raw data set.

1.11.8 If the flight recorders installed did not comply with ICAO Standards or national regulations, or if the recorders did not function in accordance with specifications or were not properly maintained, these deficiencies should be noted in this section of the investigation report. When applicable, a statement as to the impact of these deficiencies on the investigation should be noted.

1.12 Wreckage and impact information

1.12.1 Provide a general description of the site of the accident and the distribution pattern of the wreckage, including the final portion of the flight path, the impact path, the impact sequence and the location of impact impressions on the ground, trees, buildings and other objects. The impact heading, aircraft attitude (pitch, roll and yaw) and aircraft configuration at impact should be given. When relevant, the terrain surrounding the site of the accident should be described. Relevant wreckage distribution diagrams, charts and photographs should be included in this section or appended to the report. The location and the state of the major parts of the wreckage should be presented. In case of an in-flight breakup of the aircraft, a detailed description of the wreckage distribution should be provided.

1.12.2 In major accident investigations, it might be necessary to present the examination of the wreckage and the technical investigations under appropriate subheadings in this section, such as structures, power plants, instruments, flight controls and systems. The descriptions under each subheading should embrace the significant facts determined by the group which was responsible for the detailed investigation. Under appropriate subheadings also include the relevant results of special technical investigations, examinations and laboratory tests and the significance of the results obtained (see also Section 1.16 — Tests and research). When relevant, the technical laboratory and test reports should be appended to the Final Report.

1.12.3 It is important to include all pertinent material failures and component malfunctions and to indicate whether they occurred prior to, or at, impact. It is essential that failed or malfunctioning components, which are deemed to be significant to the accident, be described. A detailed description of all wreckage components is not necessary; describe only components considered to be relevant or which required examination and analysis. The inclusion of drawings of components and photographs of specific failures will enhance the Final Report. Such drawings and photographs could be presented together with the appropriate text or as an appendix.

1.12.4 When relevant, describe the performance of the underwater locating device (ULD) operating at frequency of 8.8 kHz for locating the aircraft wreckage underwater and the ULD operating at frequency of 37.5 kHz attached to the fixed flight recorders.

1.12.5 When relevant, describe the performance of the distress tracking equipment of the aircraft, which should be compliant with Standard 6.18 of ICAO *Annex 6 — Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*.

1.13 Medical and pathological information

1.13.1 Describe the results of the medical and pathological investigations of the flight crew. Medical information related to flight crew licences should be included under Section 1.5 — Personnel information. When relevant to the accident, the medical investigation may also concern the cabin crew members, passengers and ground personnel.

1.13.2 The results of the pathological and toxicological examinations concerning injuries, detection of disease and factors which impaired human performance (such as carbon monoxide, oxygen deficiency, alcohol and other drugs) should be stated. If alcohol and drugs are detected, their effects on human performance, as determined by medical experts, should be presented in this section.

1.13.3 Describe the pathological evidence of significance to the survival investigation such as the relationship of injuries and pathological evidence to the deceleration forces, aircraft attitude at impact, seat design and attachments, seat belts (see also Section 1.15 — Survival aspects), break-up of the aircraft structure, smoke inhalation, decompression and any evidence of preparation for an emergency situation (such as forced landing, ditching and unlawful interference).

1.13.4 Given the provisions of Annex 13, Chapter 5, with regard to medical and private records, particular care should be taken that such information is disclosed in the Final Report only when pertinent to the analysis and conclusions of the accident. In some States, there is a requirement for the investigation authority to coordinate the release of such information with the appropriate authority for the administration of justice.

1.13.5 If the medical examinations indicate that the performance of flight crew members was not degraded, a sentence along the following lines may be used: “There was no evidence that physiological factors or incapacitation affected the performance of flight crew members.”

1.14 Fire

1.14.1 If a fire or an explosion occurred, give a brief description of whether the fire started in flight or after ground impact. For in-flight fires, describe the effectiveness of the aircraft fire warning systems and the aircraft fire extinguishing systems. The determination of the origin of a fire, source of ignition, fuel source, duration, severity and effects on the aircraft structure and the occupants usually requires an analysis of the facts and indications and should therefore be dealt with in the analysis part of the Final Report. This section should describe the factual information which was established in the investigation related to the fire and which should then be discussed and analysed in the analysis part.

1.14.2 For fires on the ground, describe the propagation and the extent of the fire damage. The response time of the rescue fire service, access to the accident site by the rescue fire service vehicles, the type of fire-fighting equipment used, the type of extinguishing agent and the amount that was used and its effectiveness should also be described.

1.14.3 The effect of the fire on the evacuation and survivability of the occupants should be described in Section 1.15 — Survival aspects.

1.14.4 If there was no fire, a sentence along the following lines may be used: “There was no evidence of fire in flight or after the impact.”

1.15 Survival aspects

1.15.1 Give a brief description of the search and rescue activities. When applicable, include information regarding the serviceability and effectiveness of the fixed and/or portable ELT(s) or the equipment enabling the location of the wreckage and potential survivors. Pertinent information on the aircraft tracking system, in particular the autonomous distress tracking (ADT) system(s), should also be documented.

1.15.2 The location of crew members and passengers in relation to injuries sustained should be stated. The failure of structures such as seats, seat belts and overhead bins should be described. Also, the use and effectiveness of safety equipment should be reported. Aspects pertinent to the crashworthiness of the aircraft should be addressed as well as occupant survivability in relation to impact forces and fire.

1.15.3 If an evacuation was conducted, a description of the following information is usually included:

a) first notification of an accident to the emergency services and the response time;

b) emergency lighting in the aircraft (installation, activation, functioning and failures);

c) communications;

d) passenger behaviour and carry-on baggage;

e) emergency exits (types of exits and their use);

f) evacuation slides (types of slides, activation and their use);

g) injuries sustained in the evacuation; and

h) post-evacuation events.

1.16 Tests and research

1.16.1 Describe the results of any tests and research undertaken in connection with the investigation. Flight tests, simulator tests and computer modelling of aircraft performance are examples of the type of information that should be included in this section. Relevant details of research that are used to support the analysis should also be included.

1.16.2 The results of examinations of aircraft and engine parts may alternatively be included in Sections 1.6 — Aircraft information, 1.12 — Wreckage and impact information, or 1.16 — Tests and research.

1.17 Organizational and management information

1.17.1 When relevant to the accident, provide pertinent information on any organization and its management whose activities may have directly or indirectly influenced the operation of the aircraft. The organizations to be addressed in this section could include:

a) operator;

b) maintenance organizations;

c) air traffic services;

d) aerodrome administration;

e) meteorological services;

f) aircraft manufacturer;

g) certification and licensing authority; and

h) regulatory authority.

1.17.2 When deficiencies in the organizational structure and functions had a bearing on the accident, the information could include, but need not be limited to, the following factors:

a) safety culture;

b) resources and financial viability;

c) management policies and practices;

d) internal and external communications; and

e) certification, safety oversight and regulatory framework.

1.17.3 When relevant, provide pertinent information concerning the operator, such as type and date of issuance of the air operator certificate, types of operations authorized, types and number of aircraft authorized for use, and authorized areas of operation and routes. Also, include information concerning any deficiencies found in the operator's company operations manual and other operator documentation, when the deficiencies had a bearing on the accident.

1.18 Additional information

Give relevant information and facts, not already included in Sections 1.1 to 1.17, which are essential to the development of the analysis and conclusions parts of the Final Report.

Note.— Ensure that the factual information part of the Final Report contains all the technical data which are essential to the analysis and conclusions parts of the report.

1.19 Useful or effective investigation techniques

When useful or effective investigation techniques have been used during the investigation, briefly describe the main features of these techniques and their pertinence to future investigations. However, the data and the results obtained, as they relate to the occurrence, should be included under the appropriate Sections 1.1 to 1.18 of the investigation report. The full report on the use of these techniques may be included as an appendix to the Final Report.

2. ANALYSIS

2.1 In the analysis part of the Final Report, the significance of the relevant facts and circumstances which were presented in the factual information part should be discussed and analysed in order to determine which events contributed to the accident. There might be a necessity to repeat the description of some of the evidence already presented in the factual information part; however, the analysis should not be a restatement of the facts. Also, no new facts should be introduced in the analysis part. The purpose of the analysis is to provide a logical link between the factual information and the conclusions that provide the answer to why the accident occurred.

2.2 The analysis part should contain an evaluation of the evidence presented in the factual information part and should discuss the circumstances and events that existed or may have existed. The reasoning must be logical and may lead to the formulation of hypotheses, which are then discussed and tested against the evidence. Any hypothesis which is not supported by the evidence should be eliminated; it is then important to clearly state the reasons why a particular hypothesis was rejected. When a hypothesis is not based on fact but is an expression of opinion, this should be clearly indicated. Additionally, the justification for sustaining the validity of a hypothesis should be stated and reference should be made to the supporting evidence. Contradictory evidence must be dealt with openly and effectively. Cause-related conditions and events should be identified and discussed. The discussion in the analysis should support the findings and the immediate and systemic causes and/or contributing factors of the accident.

2.3 Also, discuss and analyse any issue that came to light during the investigation which was identified as a safety deficiency, although such issue may not have contributed to the accident.

2.4 Because the Final Report is often drafted as the investigation progresses and several investigators (all the groups in a major investigation) will contribute to the analysis part of the report, the development of an outline and subheadings for the analysis part will ensure that the investigators know their drafting assignments. Such an outline will also indicate to the investigators how the subheadings will come together in forming the analysis part of the Final Report. An example of such an outline is provided in Table IV-1-2.

Table IV-1-2. Example outline for the analysis part

EXAMPLE OF SUBHEADINGS IN THE ANALYSIS PART

An aircraft impacts the ground short of the runway during an instrument approach in marginal weather. Some of the occupants are killed or injured. Based on these few facts, the investigator-in-charge can identify many of the areas to be investigated and analysed. At an early stage of the investigation, the investigator-in-charge is able to allocate drafting assignments to the investigators for tentative subheadings in the analysis part, as follows:

2.1 General

2.2 Flight operations

2.2.1 Crew qualifications
2.2.2 Operational procedures
2.2.3 Weather
2.2.4 Air traffic control
2.2.5 Communications
2.2.6 Aids to navigation
2.2.7 Aerodrome

2.3 Aircraft

2.3.1 Aircraft maintenance
2.3.2 Aircraft performance
2.3.3 Mass and balance
2.3.4 Aircraft instrumentation
2.3.5 Aircraft systems

2.4 Human Factors

2.4.1 Psychological and physiological factors affecting the personnel involved

2.5 Survivability

2.5.1 Rescue fire service response
2.5.2 Analysis of injuries and fatalities
2.5.3 Survival aspects

The tentative subheadings in the analysis part may require adjustments as the investigation progresses, but the list identifies the major areas that should be covered in the analysis. The list is a good starting point as it indicates to the investigators where each drafting assignment for the subheadings will fit into the analysis part as a whole.

3. CONCLUSIONS

This part should list the findings and the causes and/or contributing factors established in the investigation. The conclusions are drawn from the analysis. However, it is essential to maintain the same degree of certainty in a conclusion as was established in the analysis. For example, if the discussion in the analysis indicates that an event or circumstance was likely, then the finding should contain the same qualifier (likely).

3.1 Findings

3.1.1 The findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal or indicative of deficiencies. Some findings point out the conditions that pre-existed the accident sequence but they are usually essential to the understanding of the occurrence. The findings should be listed in a logical sequence, usually in a chronological order.

3.1.2 All findings must be supported by, and directly related to, the factual information and the analysis. No new factual information should be introduced in the findings.

3.1.3 It is customary to report on certain conditions in every investigation, such as the validity of licences, the training and experience of the flight crew members, the airworthiness and maintenance of the aircraft, the loading of the aircraft, and whether there was a pre-impact failure. The following findings are typical of what is usually included:

a) The flight crew members were licensed and qualified for the flight in accordance with existing regulations;

b) The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures;

c) The mass and centre of gravity of the aircraft were within the prescribed limits; and

d) There was no evidence of airframe failure or system malfunction prior to the accident.

3.1.4 Significant events and factors that were investigated in detail, but eliminated in the analysis, should also be stated in the findings. For example, findings such as “flight crew fatigue was not a factor in the accident” and “there was no malfunction of the elevator control system” should be considered when a comprehensive investigation was made into these aspects. Areas of ambiguity should be identified and stated, for example, “the investigation was unable to establish whether the pilot-in-command or the co-pilot was the pilot flying the aircraft at the time of the accident”.

3.1.5 Some States present the causes and/or contributing factors of the accident separately from the findings under their own heading. Other States indicate in the list of findings which of the findings were causes and which were contributing factors of the accident, for example by adding after such a finding “(causal factor)” or “(contributory factor)”.

3.1.6 Examples of findings commonly used in accident reports are listed in Appendix 5 to Chapter 1.

3.2 Causes/contributing factors

3.2.1 Causes are those events which alone, or in combination with others, resulted in injuries or damage. Causes are defined as actions, omissions, events, conditions, or a combination thereof, which led to the accident or incident. The identification of causes does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2.2 Contributing factors are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

Note.— States may use either “causes” or “contributing factors”, or both, in the conclusions.

3.2.3 The determination of causes and/or contributing factors should be based on a thorough, impartial and objective analysis of all the available evidence. Any condition, act or circumstance that was a causal factor in the accident should be clearly identified. Seen together, the causes should present a picture of all the reasons why the accident occurred. The list of causes should include both the immediate causes and the deeper or systemic causes. No new information should be introduced in the causes. The causes and/or contributing factors should be presented in a logical order, usually chronological, bearing in mind that it is essential that all the causes and/or contributing factors be presented. The causes and/or contributing factors should be formulated with preventive action in mind and linked to appropriate safety actions.

3.2.4 Some States list the causes and/or contributing factors, usually sequentially as they occurred, without attempting to prioritize them. Other States prioritize the causes/contributing factors by using terms such as “primary causes” and “contributing causes”.

3.2.5 When certain of a cause, a definite statement should be used; if reasonably sure of a cause, a qualifying word such as “probable” or “likely” should be used. The causes statement is usually a reiteration of statements made at, or near, the end of the analysis and in the findings. For example, if the analysis and the findings state that a cause-related event or circumstance was “probable”, then the causes statement should contain the same qualifier (probable).

3.2.6 When there is insufficient evidence to establish why an accident or an incident occurred, there should be no hesitation in stating that the causes remain undetermined. In many instances, the most likely scenario could be stated provided that a qualifier, such as “likely” or “probable”, is included. However, a list of possible causes should not be given.

3.2.7 The causes/contributing factors should be formulated in a way which, as much as practicable, minimizes the implication of blame or liability. Nevertheless, the accident investigation authority should not refrain from reporting a cause merely because blame or liability might be inferred from the statement of that cause. An example of a formulation of the causes/contributing factors is given in Table IV-1-3.

4. SAFETY RECOMMENDATIONS

4.1 In accordance with Annex 13, the sole objective of the investigation of an occurrence shall be the prevention of accidents and incidents. One very important tool to achieve this objective is the issuance of timely safety recommendations. A safety recommendation is defined as a proposal of an accident investigation authority based on information derived from an investigation. The intended purpose of a safety recommendation is the prevention of accidents or incidents and the reduction of the consequences of such occurrences. It, in no case, has the purpose of creating a presumption of blame or liability for an accident or incident.

4.2 Annex 13 further states that the State conducting the investigation, at any stage of the investigation of an accident or incident, shall recommend in a dated transmittal correspondence to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety.

Table IV-1-3. Example of causal statements

EXAMPLE OF FORMULATION OF CAUSES/CONTRIBUTING FACTORS	
One Accident — Same Causes/Contributing Factors:	
The causes/contributing factors of this accident were: • the failure of airport management to identify and correct poor runway drainage; • the failure of the air traffic controllers to inform the flight crew that there was standing water on the runway;	The causes/contributing factors of this accident were: • the known and uncorrected lack of runway drainage; • lack of communication between the ATC and the flight crew regarding the degenerated runway condition;

- the flight crew's mismanagement of the aircraft's airspeed; and
- the flight crew's mismanagement of thrust reversers.
- the aircraft crossing the threshold 16 knots above V_{ref}; and
- the late application of reverse thrust.

Note.— The statements to the left implicate three groups of persons — the flight crew, the airport management and the air traffic controllers. Since the formulation of causes and/or contributing factors should not be blame-setting in nature, the statements should focus on functions that, in the example case, were not performed at the level required for safe operation. Such a functional statement logically leads to corrective or preventive measures that should be recommended to prevent future accidents.

4.3 The safety recommendations section of the Final Report should contain the following: any safety recommendations made during the investigation; the preventive actions taken in response to these recommendations by the appropriate authorities and the industry; and the safety recommendations issued as part of the investigation Final Report. Publishing the preventive actions taken in the Final Report has significant accident prevention value for those involved in similar operations. Some States also include information regarding the acceptance and implementation of their recommendations in this section of the investigation report.

4.4 Accident investigations often reveal safety issues that did not contribute to the occurrence, but which nevertheless are safety deficiencies. These safety deficiencies should be addressed in the Final Report. Some States include safety recommendations not related to the causes and/or contributing factors of the occurrence in the safety recommendations part of the Final Report; other States have adopted means other than the Final Report to notify the appropriate authorities of safety deficiencies that are not related to the occurrence. The actions taken in response to these types of safety communications are usually included in the Final Report.

4.5 In order to ensure that appropriate action is taken, each safety recommendation should be issued to a specific addressee. This is usually the appropriate authority of the State that has the responsibility for the matters with which the safety recommendation is concerned.

4.6 The documentation supporting a safety recommendation should clearly describe the safety problem and provide justification for the recommended safety actions. The development of convincing recommendations must be based on validated factual information, sound analysis and logical conclusions so as to withstand challenges by those having divergent interests.

4.7 Consideration should be given to whether a safety recommendation should prescribe a specific solution to a problem or whether the recommendation should be flexible enough to allow the addressee latitude in determining how the objective of the recommendation can be achieved. This latter approach might be used for situations wherein all the salient facts are not available; wherein more research, examination and testing appear necessary; or, wherein the accident investigation authority may lack the detailed information and experience required to evaluate the financial, operational and policy impacts of a specific solution.

4.8 Preferably, a safety recommendation should be performance-based and should identify the safety objectives of the recommendation, in particular mitigating the risks underlying the recommendation. This approach to recommendations will also facilitate the evaluation, by both the safety investigation authority and the addressee of the recommendation, as to whether and to what degree the action taken or planned will mitigate the deficiency upon which the recommendation was made.

4.9 Both safety recommendations issued during the course of the investigation and safety recommendations made in Final Reports shall be sent in a dated transmittal correspondence to the appropriate authorities, notifying them of the safety recommendations for which they are responsible, and formally requesting the responsible authority to notify the authority making the recommendation, within 90 days, as to the preventive action taken or under consideration, the action taken if it differs from the action that was recommended, or the reasons why no action will be taken. If there is a significant change in the action taken or under consideration, the addressee of the recommendation should inform the authority making the recommendation of the changes, including reasons why the proposed action has changed.

4.10 States are required to inform the Accident Investigation Section of the ICAO Air Navigation Bureau in a dated transmittal correspondence of SRGCs issued as well as the responses received to these recommendations.

4.11 The ICAO central database of SRGC is publicly available.

4.12 Before considering if a safety recommendation is of global concern, the investigation authority should identify what the systemic deficiencies are from the available evidence, review any history behind the systemic deficiencies and then discuss these with the relevant organizations best able to address the deficiencies. The following criteria, which should be read in conjunction with the examples in Appendix 6, are not exhaustive and should be considered individually when classifying, and prior to issuing, an SRGC:

a) the deficiency underlying the safety recommendation is systemic, global and not solely a national issue; and mostly not isolated to an aircraft type, a manufacturer, an operator, and/or an air navigation services provider;

b) there is a probability of recurrence with significant adverse consequences at a global level;

c) the urgency for taking effective remedial safety action is high; and/or

d) the deficiency underlying the safety recommendation is related to the airworthiness, design and/or manufacture of the aircraft type(s).

4.13 The text of the report supporting an SRGC should clearly describe the systemic deficiencies, provide justification for the recommended safety actions and explain why the safety recommendation is of global concern.

Note.— Chapter 1, Section 1.6 of this manual contains more information on SRGCs.

4.14 In summary, the safety recommendations should include a convincing presentation of the safety problem, with the attendant safety risks deriving from it, as well as a recommended course of action for the responsible authority to take in order to eliminate the unsafe condition. The safety recommendations should identify what action is required but should leave considerable scope for the implementing authority to determine how the problem will be resolved.

Note.— Appendix 6 to this chapter contains more detailed guidelines on the identification, drafting and follow-up of safety recommendations.

5. APPENDICES

The appendices should include, as appropriate, any pertinent information considered necessary to understand the report, such as a glossary, supporting technical reports, accident site diagrams, photographs and flight recorder data. Graphics and diagrams should have a professional appearance and should show only the information required for understanding the report. The appendices should be numbered and listed in the table of contents. The following is a list of appendices commonly found in a Final Report:

a) communications transcripts;

b) flight data recorder readouts;

c) flight plan and load sheet;

d) technical investigation reports;

e) pertinent pages from manuals and handbooks;

f) pertinent maintenance records;

g) maps and diagrams; and

h) photographs.

Appendix 2 to Chapter 1

REPORT-WRITING CONVENTIONS

1. GENERAL GUIDELINES

The purpose of writing any report is to convey the facts of the subject of the report to its readers in a succinct, clear, unambiguous and well-organized manner. When drafting the Final Report, the writer should not assume that everyone who reads the report is familiar with the technical details. Therefore, information should not be omitted because it is obvious to the writer. The writer should remember that the readers have not visited the accident site, nor have they participated in the investigation. The writer's responsibility is to present the reader with a word picture of the accident and the investigation. The writer should assume that the reader is intelligent but uninformed and will analyse the facts presented in order to test the conclusions of the Final Report. For example, if it is obvious to the writer that the weather was not a factor in the accident, this should be clearly stated; nevertheless, the reader should be provided with enough weather information to substantiate the conclusion.

2. EDITORIAL STANDARDS

2.1 Convey an attitude of impartiality and write objectively

2.1.1 The report should not favour any party involved with the accident, e.g. the pilot, the operator, the aircraft manufacturer or special interest groups (such as advocates for noise abatement), nor should it reflect prejudice against any party.

2.1.2 The straightforward descriptive narrative, which avoids flowery descriptions and human-interest items, should be used. Clues to the investigator's personality or prejudices should not be apparent to the reader. The indiscriminate use of adjectives and adverbs is usually not acceptable in accident report writing.

2.1.3 The writer should write to express the facts, not to impress the reader. If the Final Report must delve into complicated areas such as aerodynamics, metallurgy, and the operation of aircraft systems, the subject should be explained in a way that is easy to understand. To maintain the readability of the body of the Final Report, complex subjects may be explained in an appendix to the Final Report.

2.1.4 Subjects of equal importance should be given equal coverage when describing the facts, conditions and circumstances.

2.2 Clarity

2.2.1 The use of an outline, such as that provided in the Appendix to Annex 13, is a common sense approach to the task of writing the Final Report.

2.2.2 Clarity in report writing can be enhanced by reporting sequentially. The *History of the Flight*, for example, should describe the flight in a logical sequence from start to finish. Placing events out of sequence tends to confuse the reader.

2.2.3 Each sentence should be a logical unit. The writer should keep the subject of the sentence and its verb close together. Long asides between the subject and the verb interrupt the flow of the sentence. The information should be organized logically within each section and grouped under an appropriate heading.

2.2.4 The writer should provide the reader with a lead-in and context for new information or ideas by first referring to any related information already presented.

2.2.5 Pronouns, especially “this”, “that” and “it” should be placed close to their antecedents to ensure clarity. A pronoun should refer to a specific antecedent rather than an implied antecedent.

2.2.6 Sentences should begin with the real subject of the sentence, rather than with subjects such as “It is ...” or “There are ...”.

2.2.7 The writer should select the words that best describe the situation. Vague terminology should be avoided. For example, “Damage to the aircraft *appeared* to be the result of impact loading” and “It was *presumed* that the aircraft started to cartwheel after striking the left wing tip”. Words such as *appeared, seemed* and *presumed* are not precise enough for the factual part of the report. The investigator must report evidence found and not that which *appeared, seemed* or was *presumed* to have been.

2.2.8 The findings and statements in the report must be unambiguous and subject to only one interpretation.

2.3 Conciseness

2.3.1 Long sentences might make it difficult for the reader to comprehend the point the writer is trying to make. This does not mean that the report should consist entirely of simple sentences. Long sentences are acceptable if understandable. Any sentence which must be re-read to be understood is too long.

2.3.2 The writer should avoid unnecessary repetition and extraneous and irrelevant data which might confuse the reader and may cloud his/her comprehension of the conclusions.

2.4 Consistency

The writer should verify that the terminology used is consistent throughout the report. The writer should use the same terms for the same things and should spell, hyphenate and abbreviate words consistently. When using abbreviations, the writer should spell out the words in full, followed by the short form in parentheses the first time they are used. Thereafter, the abbreviations should be used. All the abbreviations used should be included in a glossary.

2.5 Gender

Avoid gender stereotyping, such as referring to the investigator-in-charge or an engineer by using the pronoun “he”.

3. ACTIVE VERSUS PASSIVE VOICE

3.1 The choice of voice has a great effect on the force of the narrative. The active voice is more vigorous and less ambiguous than the passive. Use of the passive voice often leads to wordiness, fuzziness and sometimes grammatical errors. In most cases, the active voice is preferable. For example, “When the pilot detected a fuel leak ...” is preferable to “When a fuel leak was detected by the pilot ...”.

3.2 The passive voice is more appropriate in some cases, such as:

a) when the agent, or doer of the act, is unknown;

b) when a reference to the actor is inappropriate; and

c) when the agent is less important than the action, e.g. “The two survivors were rescued ...”.

3.3 The writer should recognize when each voice is appropriate and not overuse the passive voice.

4. READ AND REVISE

4.1 Revising is a part of writing. Few investigators can express clearly on the first attempt what they intend to convey. One means of improving clarity is through the write – read, re-write – re-read process. The writer should review what he/she has written and check if it needs further clarification, shortening, rearrangement or other changes. Experienced writers find advantage in setting the report aside for a day or more before making a critical review to ensure that it conveys the intended meaning. Soliciting comments from other investigators often pinpoints ambiguous areas of the report in which the writer should make improvements. Comments from other investigators should be accepted as constructive and not as personal criticism.

4.2 The writer should edit the report to ensure that it is logical and consistent. Some of the common traps in drafting a report are:

a) *Hasty generalization:* basing a conclusion on too few instances, e.g. “Three of the ten witnesses agreed that the pilot was flying too low”;

b) *Using absolute words such as “always” or “never”:* such words are seldom appropriate, e.g. “Mid-air collisions are always the result of pilot inattention”;

c) *Oversimplification:* linking two events as if one caused the other when the relationship between them is more complex, e.g. “This practice violated fundamental flying principles”;

d) *Asserted conclusion:* drawing conclusions from insufficient data, e.g. “Based on wide experience, the experts concluded that landing accidents are the result of unstable approaches”;

e) *Post hoc fallacy:* assuming that because one event follows another, the second event was caused by the first, e.g. “Inexperienced pilots are more susceptible to controlled flight into terrain (CFIT) accidents”;

f) *Either/or fallacy:* assuming that a complicated question has only two possible answers, e.g. “The choice was to fly the mission in accordance with the company directives or not to fly it at all”;

g) *Non sequitur*: drawing a conclusion that bears no logical relation to the facts presented, e.g. “Because of his position as Director of Flight Operations, he was fully qualified to assess the qualifications of his pilots”; and

h) *False analogy:* suggesting that because two things or situations share some similarities, they must be alike in other ways, e.g. “Flying an aircraft at night is no different to flying it during the day in IMC”.

5. TONE OF EXPRESSION

5.1 Blame or liability

5.1.1 Annex 13 states that it is not the purpose of the investigation to apportion blame or liability. Nevertheless, blame or liability might sometimes be inferred from the findings. When such is the case, it is essential that all the causes and/or contributing factors established be clearly presented in the report. To do otherwise would jeopardize the objective of the investigation, which is the prevention of accidents and incidents.

5.1.2 Avoid words or phrases that have connotations of blame. For instance, use the statement “The operator *did not* notify ...” rather than “The operator *failed* to notify ...”. An investigator should not write from the perspective of a regulator who is concerned about non-compliance with rules and regulations or from the perspective of a manager in a company where determination of support for disciplinary or legal action may be an objective.

5.2 Contravention of regulations and orders

5.2.1 Deviations from the accepted norms of compliance with regulations and procedures should be clearly identified when relevant to the accident. The nature of the regulation and the extent of the deviation should be described in sufficient detail in order to explain the safety implications of the deviation. The analysis should explain the reasons why the deviation created a hazard.

5.2.2 For a contravention to be included as a cause and/or contributing factor, it should be clear that complying with the regulation or procedure could have prevented the accident or lessened the consequences of the accident.

5.3 Human suffering

The writer must recognize the human suffering that is associated with an accident by using respectful and discreet language in the report. If sensitive information must be reported because it pertains to the causes and/or contributing factors or safety deficiencies, it should be reported with due sensitivity.

6. COMMONLY USED LANGUAGE

Many accident investigation authorities employ standardized phraseology for the details which are recorded in any Final Report on an accident, such as crew qualifications and aircraft serviceability. Refer to Appendix 5 to Chapter 1 — Commonly used findings.

7. GLOSSARY

A glossary should be appended to the Final Report. Only the abbreviations used in the report should appear in the glossary.

Appendix 3 to Chapter 1

SYMBOLS AND ABBREVIATIONS

1. INTRODUCTION

1.1 This appendix presents a list of symbols and abbreviations which might be used in a Final Report. Note that symbols which are comprised of letters are presented among the abbreviations.

1.2 When compiling a glossary of abbreviations for an accident report, include only those abbreviations used in the report.

2. SYMBOLS

°	Degree (examples °C (temperature) and 1° (angle))
%	Per cent (example 95% fan speed (N1))
'	Minute
”	Second

3. ABBREVIATIONS

A

AC	Alternating current/Advisory circular
ACARS	Aircraft communication addressing and reporting system
ACAS	Airborne collision avoidance system
ACC	Area control centre
AD	Airworthiness directive
ADF	Automatic direction-finder
ADFR	Automatic deployable flight recorder
ADI	Attitude direction indicator
ADIZ	Air defence identification zone
ADREP	Accident and incident data reporting
ADS-B	Automatic dependent surveillance — broadcast
ADS-C	Automatic dependent surveillance — contract
ADT	Autonomous distress tracking
AFCS	Automatic flight control system
AFIS	Aerodrome flight information service
AFTN	Aeronautical fixed telecommunication network
AGL	Above ground level
AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIR	Airborne image recorder
AIREP	Air-report
AMSL	Above mean sea level
ANO	Air navigation order

AOA	Angle of attack
AOC	Air operator certificate
AOM	Aircraft operating manual
APP	Approach control office/Approach control/Approach control service
APU	Auxiliary power-unit
ARTCC	Air route traffic control centre
ASI	Airspeed indicator
ASR	Airport surveillance radar, *also* “air safety report”
ASRS	Aviation safety reporting system
ATC	Air traffic control
ATCC	Air traffic control centre
ATFM	Air traffic flow management
ATIS	Automatic terminal information service
ATPL	Airline transport pilot licence
ATS	Air traffic services
AVASIS	Abbreviated visual approach slope indicator system

B

C

C	Degrees Celsius (Centigrade)/ Centre (runway identification)
CAA	Civil aviation authority
CADC	Central air data computer
CAM	Cockpit area microphone
CAS	Calibrated airspeed
CAT	Clear air turbulence/Category
CAVOK	Visibility, cloud and present weather better than prescribed values and conditions (cloud and visibility OK)
CFIT	Controlled flight into terrain
CG	Centre of gravity
cm	Centimetre(s)
C of A	Certificate of airworthiness
CPL	Commercial pilot licence
CRM	Crew resource management
CRT	Cathode-ray tube
CTA	Control area
CVR	Cockpit voice recorder

D

DA	Decision altitude
DA/H	Decision altitude/height
DAR	Direct access recorder
DC	Direct current
DFDR	Digital flight data recorder
DH	Decision height
DME	Distance measuring equipment

E

E	East/Eastern longitude
EAS	Equivalent airspeed
ECAM	Electronic centralized aircraft monitor
EEC	Electronic engine control
EFB	Electronic flight bag
EFIS	Electronic flight instrument system
EGPWS	Enhanced ground proximity warning system
EGT	Exhaust gas temperature
EICAS	Engine indication and crew alerting system
ELT	Emergency locator transmitter
EMI	Electromagnetic interference
EPR	Engine pressure ratio
ETA	Estimated time of arrival/Estimating arrival
ETD	Estimated time of departure/Estimating departure

F

FAF	Final approach fix
FAP	Final approach point
FAR	Federal Aviation Regulations
FCOM	Flight Crew Operations Manual (or Operating Manual)
FCMIR	Flight crew-machine interface recordings
FD	Flight director
FDAU	Flight data acquisition unit
FDM	Flight deck management
FDR	Flight data recorder
FIR	Flight information region
FIS	Flight information service
FL	Flight level
FMC	Flight management computer
FMS	Flight management system
FOD	Foreign object damage (also the object)
FSS	Flight service station
ft	Foot (feet)
ft/min	Feet per minute

G

g	Normal acceleration
GNSS	Global navigation satellite system
GPS	Global positioning system
GPWS	Ground proximity warning system

H

h	Hour(s)
HF	High frequency (3 000 to 30 000 kHz)

Hg	Mercury
hPa	Hectopascal
HSI	Horizontal situation indicator
HUD	Head-up display
HUMS	Health and usage monitoring systems
Hz	Hertz (cycle per second)

I

IAF	Initial approach fix
IAS	Indicated airspeed
IFR	Instrument flight rules
IIC	Investigator-in-charge
ILS	Instrument landing system
IMC	Instrument meteorological conditions
INS	Inertial navigation system
IRS	Inertial reference system
ISA	International standard atmosphere

J

JAR	Joint Aviation Requirements

K

kg	Kilogram(s)
kHz	Kilohertz
km	Kilometre(s)
km/h	Kilometres per hour
kN	Kilonewton
kt	Knot(s)

L

L	Litre(s)/Left (runway identification)
LDA	Landing distance available
LED	Light emitting diode
LF	Low frequency (30 to 300 kHz)
LLWS	Low-level wind shear
LLWSAS	Low-level wind shear alert system
LOFT	Line-oriented flight training
LORAN	Long range air navigation system

M

m	Metre(s)
M	Mach number

MAC	Mean aerodynamic cord
MDA	Minimum descent altitude
MDA/H	Minimum descent altitude/height
MDH	Minimum descent height
MEL	Minimum equipment list
MET	Meteorological/Meteorology/Meteorological services
MHz	Megahertz
min	Minute(s)
MLS	Microwave landing system
mm	Millimetre(s)
MMEL	Master minimum equipment list
MOC	Minimum obstacle clearance (required)
MOPS	Minimum operational performance standards
MSA	Minimum sector altitude
MSL	Mean sea level
μ[mu]	Coefficient of sliding friction

N

N	North/Northern latitude/Newton
N_1	Low pressure compressor speed (two-stage compressor); fan speed (three-stage compressor)
N_2	High pressure compressor speed (two-stage compressor); intermediate pressure compressor speed (three-stage compressor)
N_3	High pressure compressor speed (three-stage compressor)
NDB	Non-directional radio beacon
NDT	Non-destructive testing
NOTAM	Notice to airmen (a notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations)
NM	Nautical mile(s)

O

OAT	Outside air temperature
OCA	Obstacle clearance altitude
OCH	Obstacle clearance height
OCL	Obstacle clearance limit
OCS	Obstacle clearance surface
OPS	Operations

P

PA	Public Address system
PANS	Procedures for Air Navigation Services
PAPI	Precision approach path indicator
PAR	Precision approach radar
PCU	Power control unit
PIC	Pilot-in-command
PIREP	Pilot report

P/N	Part number

Q

QA	Quality assurance
QAR	Quick access recorder
QFE	Atmospheric pressure at aerodrome elevation (or at runway threshold) (pressure setting to indicate height above aerodrome)
QNH	Altimeter sub-scale setting to obtain elevation when on the ground (pressure setting to indicate elevation above mean sea level)

R

RA	Radio altimeter/Resolution advisory
RCC	Rescue coordination centre
RESA	Runway end safety area
RF	Radio frequency
RFFS	Rescue and fire fighting service
RMI	Radio magnetic indicator
RNAV	Area navigation
RPM	Revolutions per minute
RTF	Radiotelephony
RVR	Runway visual range

S

SATCOM	Satellite communication
s	Second(s)
S	South/Southern latitude
SAR	Search and rescue
SAS	Stability augmentation system
SB	Service bulletin
SCAS	Stability and control augmentation system
SDR	Service difficulty report
SEM	Scanning electron microscope
SI	International system of units
SID	Standard instrument departure
SIGMET	Significant meteorological information (information concerning en-route weather and other phenomena in the atmosphere that may affect the safety of aircraft operations)
SL	Service letter
SMC	Surface movement control
SMR	Surface movement radar
S/N	Serial number
SPECI	Aerodrome special meteorological report
SRA	Surveillance radar approach
SRGC	Safety recommendation of global concern
SRM	Structural repair manual
SSR	Secondary surveillance radar
STAR	Standard instrument arrival

STOL	Short take-off and landing
SVR	Slant visual range

T

t	Tonne
TAF	Terminal aerodrome forecast
TAR	Terminal area surveillance radar
TAS	True airspeed
TAWS	Terrain awareness and warning system
TCAS	Traffic alert and collision avoidance system
TCH	Threshold crossing height
TDP	Take-off decision point
TDZ	Touchdown zone
TMA	Terminal control area
TODA	Take-off distance available
TORA	Take-off run available
TRACON	Terminal radar approach control
TWR	Aerodrome control tower/Aerodrome control

U

UAC	Upper area control centre
UAR	Upper air route
UHF	Ultra-high frequency (300 to 3 000 MHz)
ULD	Underwater locating device
UTC	Coordinated Universal Time

V

VASIS	Visual approach slope indicator system
VFR	Visual flight rules
VHF	Very high frequency (30 to 300 MHz)
VMC	Visual meteorological conditions
VOR	VHF omnidirectional radio range
VSI	Vertical speed indicator
VTOL	Vertical take-off and landing

V SPEEDS

V_1	Decision speed
V_2	Take-off safety speed
V_{MCA}	Minimum control speed in the air
V_{MCL}	Minimum control speed during landing approach with all engines operating
$V_{MO}/_{MMO}$	Maximum permissible operating speed or maximum permissible operating Mach number
V_{NE}	Never exceed airspeed
V_R	Rotation speed
V_{REF}	Reference landing approach speed, all engines operating
V_S	Minimum calibrated speed in flight during normal stall manoeuvre

V_{S1}	Stalling speed (“clean” configuration)
W	
W	West/Western longitude
X	
Y	
Z	

Appendix 4 to Chapter 1

AVIATION TERMINOLOGY

INTRODUCTION

This appendix comprises two sections. The first section is titled descriptive technical terms and lists technical terms which have a specific meaning and an explanatory definition. The second section presents some commonly used Human Factors terms.

1. DESCRIPTIVE TECHNICAL TERMS

Arcing. Visible effects (burn spots, fused metal) of an electrical discharge between two electrical connections. Also: flash over.

Battered. Damaged by repeated blows or impacts.

Bent. Deviated from original line or plane usually caused by lateral force. Also: creased, folded, kinked.

Binding. Restricting movement, such as tightened or sticking condition, may result from high or low temperature or a foreign object jammed in mechanism. Also: sticking, tight.

Bowed. Curved or gradually deviated from original line or plane often caused by lateral force or heat.

Brinelling. Circular surface indenting of bearing races, usually caused by repeated shock loading of the bearing. False brinelling is wear caused by bearing rollers sliding back and forth across a stationary race, while true brinelling is plastic displacement of material.

Broken. Separated by force into two or more pieces. Also: fractured.

Bulged. Swollen outward locally. Usually caused by excessive local heating or differential pressure. Also: ballooned, swelling.

Burned. Oxidized destructively. Usually caused by higher temperature than the parent material can withstand.

Burrs. A rough edge or a sharp projection on the edge or surface of the parent material.

Carboned. Covered by an accumulation of carbon deposits. Also: carbon-covered, carbon-tracked, coked.

Chaffed. Worn by frictional damage. Usually caused by two parts rubbing together with limited motion.

Checked. Cracked on the surface. Usually caused by heat.

Chipped. Broken away at the edge, corner or surface of the parent material. Usually caused by heavy impact; not flaking.

Collapsed. Inwardly deformed original contour of a part. Usually due to high pressure differentials.

Corroded. Gradually destroyed by chemical action. Often evidenced by oxide build-up on the surface of the parent material. Also: rusted, oxidized.

Crack. Visible partial separation of material.

Crossed. Damaged parent material of parts due to improper assembly (as in the case of crossed threads) or parts rendered inoperative (as in the case of crossed wires).

Curl. A condition where the tip(s) of compressor or turbine blades have been curled over due to rubbing against engine casings.

Dented. Damage by impact of a foreign object resulting in a surface indentation with rounded bottom. Parent material is displaced, but seldom separated. Also: peened.

Deposits. A build-up of material on a part either from foreign material or from another part not in direct contact. Also: metalizing.

Disintegrated. Separated or decomposed into fragments. Excessive degree of fracturing (breaking) as with disintegrated bearings. Complete loss of original form. Also: shattered.

Distortion. Extensive deformation of the original contour of a part usually due to impact of a foreign object, structural stress, excessive localized heating or any combination of these. Also: buckled, depressed, twisted, warped.

Eccentricity. Part(s) wherein the intended common centre is displaced. Also: non-concentric.

Electrical circuits — grounded. Circuits in which the current has a path to ground.

Electrical circuits — open. Incomplete electrical circuit due to separation at or between electrical connections.

Electrical circuits — shorted. Circuits in which the current has an undesired path between leads or circuits that are normally at different electrical potentials.

Eroded. Component from which material has been carried away by flow of fluids or gases; may be accelerated by heat or grit.

Fatigue. The progressive failure of a part under repeated loading.

Flattened out. Permanent loss of curvature beyond tolerance limits. Usually caused by compression.

Frayed. Worn into shreds by rubbing action.

Fretting. Removal of material by rubbing.

Fusing. Joining together of two materials. Usually caused by heat, friction or electrical current flow.

Galling. Chafing or severe fretting caused by relative movement of two surfaces under high contact pressure.

Glazing. Undesirable development of a hard, glossy surface due to rubbing action, heat or varnish.

Gouging. Scooping out of material usually caused by a foreign object. Also: furrowed.

Groove(s). Smooth, rounded furrow or furrows of wear, usually wider than scoring, with rounded corners and a smooth groove bottom.

Hot-spot. Result of subjection to excessive temperature usually evidenced by change in colour and appearance of part. Also: heat discoloured, overheated.

Melted. Deformed from the original configuration due to heat, friction or pressure.

Mismatch. Improper association of two or more parts.

Mis-positioned. Improperly installed part which may damage the installed part or two associated parts. Also: misaligned, reversed.

Nick. A sharp surface indentation caused by impact of a foreign object. Parent material is displaced, seldom separated.

Out-of-round. Part with inconsistent diameter.

Out-of-square. Part with deformation of right angle relationship between part surfaces.

Peeling. A breaking away of surface finishes such as coatings and plating. Peeling would be flaking of large pieces. A blistered condition usually precedes or accompanies peeling. Also: blistered, flaked.

Pick-up. A transfer of metal from one surface to another. Usually the result of rubbing two surfaces together without sufficient lubrication.

Pit. A small irregular-shaped cavity in the surface of the parent material usually caused by corrosion, chipping or electrical discharge.

Plugged. Totally or partially blocked pipe, hoses, tubing, channelling or internal passages. Also: clogged, obstructed, restricted.

Porous. State of material caused by internal voids. Usually applied to cast material or welds.

Rolling-over. Lipping or rounding of a metal edge. Also: lipped, turned.

Rubbed. Moved with pressure or friction against another part.

Rupturing. Excessive breaking apart of material usually caused by high stresses, differential pressure, locally applied force or any combination of these. Also: blown, burst, split.

Score(s). A deep scratch or scratches made by sharp edges of foreign matter.

Scratches. Light, narrow, shallow mark or marks caused by movement of a sharp object or particle across a surface. Material is displaced, not removed.

Seized. Parts bound together. May be due to expansion or contraction due to high or low temperature, foreign object jammed in mechanism or lack of lubricant. Also: frozen, jammed, stuck.

Sheared. Body divided by cutting action. Also: cut.

Spalled. Sharply roughened area characterized by progressive chipping-away of surface material. Not to be confused with flaking.

Stretching. Enlargement of a part. May result from exposure to operating conditions or excessive force. Also: growth.

Stripping. A condition usually associated with fastener threads or electrical insulation. Involves removal of material by force.

Torn. Separated by pulling apart.

Worn. Consumption of material of a part as a result of use.

2. HUMAN FACTORS TERMS

This section presents a selection of Human Factors terms which are likely to be encountered when writing the Final Report on an accident. Knowledge of these terms will facilitate the identification and formulation of the Human Factors aspects which were present in the accident.

Acute fatigue. The result of excessive physical and/or mental activity during a short period. A temporary condition that may be reversed by adequate rest.

Channelized attention. A mental state which exists when a person's full attention is focused on one stimulus to the exclusion of all others. This becomes a problem when the person fails to perform a task or process information of a higher priority and thus fails to notice or has no time to respond to cues requiring immediate attention.

Chronic fatigue. The result of long exposure to successive periods of acute fatigue, over many days or weeks, without adequate rest periods for recovery.

Cockpit authority gradient. The relative skills and experience in a particular environment that are factors in determining the extent of the pilot's authority.

Cognitive saturation. The information to be processed exceeds an individual's span of attention.

Complacency. A state of reduced conscious attention caused by a sense of security and self-confidence. Behaviour characteristics of complacency include overconfidence and boredom, both of which can significantly degrade performance.

Confirmation bias. An expectation of an event may diminish an individual's ability to recognize evidence that events are not developing as anticipated.

Distraction. The interruption and redirection of attention by environmental cues or mental processes.

Fascination. An attention anomaly in which a person observes environmental cues, but fails to respond to them.

Fatigue. The progressive decrease in performance due to prolonged or extreme mental or physical activity, sleep deprivation, disrupted diurnal cycles, or life-event stress.

Habit pattern interference. Behaviour in which the subject reverts to previously learned response patterns which are inappropriate to the task at hand.

Illusion. An erroneous perception of reality due to limitations of sensory receptors and/or the manner in which the information is presented or interpreted.

Inattention. Inattention is usually due to a sense of security, self-confidence or perceived absence of threat. Boredom is a form of inattention due to an uninteresting and undemanding environment. Complacency is another form due to an attitude of overconfidence, laxity or lack of motivation.

Pressure. A type of stress resulting from the demands of management, peers, self-induced goals, time, environmental factors or man-machine relationship.

Situational awareness. The ability to keep track of the prioritized significant events and conditions in the environment of the subject.

Spatial disorientation. Unrecognized, incorrect orientation in space.

Stress. Mental or physical demand requiring some action or adjustment.

Vigilance. Maintenance of the appropriate level of conscious attention for the assigned task. Lapses in attention may occur after a person has been at a monitoring task for a period of time.

Appendix 5 to Chapter 1

COMMONLY USED FINDINGS

The following findings might be used in aviation accident reports and are presented here as examples only. The investigator-in-charge must ensure that each finding in an accident report is pertinent, valid and in the proper context.

1. AIRCRAFT

a) The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures.

b) The aircraft had a valid Certificate of Airworthiness and had been maintained in compliance with the regulations.

c) The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

d) The aircraft was airworthy when dispatched for the flight.

e) The mass and the centre of gravity of the aircraft were within the prescribed limits.

f) There was no evidence of any defect or malfunction in the aircraft that could have contributed to the accident.

g) There was no evidence of airframe failure or system malfunction prior to the accident.

h) The aircraft was structurally intact prior to impact.

i) All control surfaces were accounted for and all damage to the aircraft was attributable to the severe impact forces.

j) The aircraft was destroyed by impact forces and a post-impact fire.

k) Due to the destruction of the aircraft by the impact and fire, it could not be determined whether any pre-impact failure or system malfunction contributed to this accident.

l) The destruction of the aircraft by impact and fire precluded determination of any material failure or system malfunction.

m) The position of the fuel selectors could not be determined due to the extensive fire damage.

n) The fuel sampled was of the proper grade and quality and contained no contamination.

o) The fuel that remained in the aircraft fuel tanks was uncontaminated and of the recommended grade.

p) The engine(s) stopped from fuel exhaustion (no usable fuel on board).

q) The engine(s) stopped from fuel starvation (usable fuel on board).

r) The intercom system, flight deck lighting and other standby electrical services failed some four minutes before impact as a result of a rapid decay in battery power, for which no explanation was found.

s) The obsolescent design of the aircraft's primary flight instruments and radio navigation systems contributed to the loss of situational awareness of the crew at a time of high crew workload.

t) The worn condition of the left tire reduced braking effectiveness in the wet runway conditions.

u) Propeller blade damage and twist was consistent with the engine producing power at impact.

v) The propeller(s) exhibited chord-wise scratching and torsional damage indicative of the engine producing power at impact.

2. CREW/PILOT

a) The flight crew/pilot/co-pilot was licensed and qualified for the flight in accordance with existing regulations.

b) The flight crew/pilot/co-pilot was properly licensed, medically fit and adequately rested to operate the flight.

c) The flight crew/pilot/co-pilot was in compliance with the flight and duty time regulations.

d) Although the aircraft was equipped for instrument flight, the pilot was not qualified for IFR flight.

e) The pilot's degraded performance was consistent with the effects of fatigue, but there was insufficient evidence to determine if the pilot's degraded performance contributed to the accident.

f) Although the pre-flight rest period was adequate and the flight duty time was within the company flight time limitations, the two-hour turnaround in the middle of the night may have reduced the alertness levels of the two pilots.

g) The pilot's actions and statements indicated that his/her knowledge and understanding of the aircraft systems was adequate/inadequate.

3. FLIGHT OPERATIONS

a) The flight was conducted in accordance with the procedures in the company Operations Manual.

b) The flight crew carried out normal radio communications with the relevant ATC units.

c) The pilot attempted to continue visual flight in instrument meteorological conditions.

d) There was insufficient height available to effect a recovery from the stall.

e) During (phase of flight), the aircraft began an uncommanded turn to the right/left.

f) During flare for touchdown, the pilot lost control of the aircraft in a strong gust of wind.

g) The aircraft was fitted with a radio altimeter, but the operator's procedures did not require reference to it during non-precision approaches.

h) The wind conditions in which the pilot landed the aircraft were outside the limits detailed in the Flight Manual and the Operations Manual.

i) Braking performance analysis indicated that, in the conditions existing at the time of the accident, the aircraft could not have stopped on the runway available.

j) The incorrect handling of the airframe de-icing system resulted in a considerable accretion of ice or snow during the descent.

k) The continuation of the landing with the airspeed above the calculated threshold speed resulted in touchdown beyond the normal touchdown point.

l) The pilot made an early decision to divert towards a suitable aerodrome while attempting to determine the extent of the emergency.

4. OPERATOR

a) The presentation of the operator's Emergency Checklist was inadequate for use under conditions of stress.

b) The Standard Operating Procedure for the non-handling pilot to monitor the progress of the approach was not effective in preventing the pilot flying the aircraft from descending below the published approach profile.

c) The operator's Quality Assurance system had not identified frequent deviations from the requirements of the Aircraft Maintenance Manual over a considerable period of time.

d) The crew resource management training arranged by the operator did not promote good flight deck communication.

5. AIR TRAFFIC SERVICES AND AIRPORT FACILITIES

a) The approach/approach radar controllers were properly licensed, medically fit and correctly rated to provide the service.

b) The number of air traffic controllers on duty in the tower was/was not in accordance with the regulations.

c) The air traffic controller's workload was assessed as low/moderate/high with normal complexity.

d) The air traffic controller gave conflicting clearances to the two aircraft.

e) The air traffic controller issued a clearance to ... (flt #) which caused a loss of separation to another aircraft ... (flt #).

f) The air traffic controller requested ... (flt #) to turn/ climb/descend immediately to avoid traffic.

g) ATC provided prompt and effective assistance to the flight crew.

h) Use of incorrect RTF terminology by the flight crew when declaring the emergency negated an effective response from ATC.

i) All aerodrome approach aids and lighting facilities were operating normally at the time of the accident.

j) The airport was not equipped with a facility to record the secondary surveillance radar. The lack of data significantly impaired the reconstruction of the aircraft's descent profiles, given the limited information available from the FDR fitted to the aircraft.

6. FLIGHT RECORDERS

a) The aircraft was not equipped with an FDR or a CVR; neither was required by regulation.

b) The 30-minute closed-loop cockpit voice recorder tape was of inadequate duration to be helpful in the investigation of this accident.

c) The lack of a CVR recording covering the period of the incident prevented some details of the events from being resolved.

7. MEDICAL

a) There was no evidence that incapacitation or physiological factors affected the flight crew performance.

b) There was no evidence that the pilot suffered any sudden illness or incapacity which might have affected his/her ability to control the aircraft.

c) Toxicological tests for common drugs/carbon monoxide/hydrogen cyanide were negative/positive.

d) Based on the autopsy, toxicology and medical reports, there was no evidence to indicate that the pilot's performance was degraded by physiological factors.

e) A post-mortem examination of the pilot showed that the cause of death was a coronary atherosclerosis/hypertensive heart disease. Toxicological results were negative for carbon monoxide, cyanide, volatiles and tested drugs.

f) The flight crew was diagnosed as suffering from carbon monoxide (CO) exposure.

g) A toxicology report revealed 0.180 per cent alcohol in the pilot's blood. The specimen was taken one hour and twelve minutes after the accident.

8. SURVIVABILITY

a) The accident was not survivable due to the magnitude of the deceleration forces and the severity of the post-impact fire.

b) The occupants succumbed to the effects of the post-impact fire.

c) Although a shoulder harness was available, the pilot did not wear it.

d) The fatal injuries sustained by the occupants might have been prevented had they worn shoulder harnesses.

9. SAFETY OVERSIGHT

a) The civil aviation authority's safety oversight of the operator's procedures and operations was adequate/inadequate.

b) The civil aviation authority's safety oversight programme had not addressed the subject of the diverse nature of the operator's fleet of aircraft, in terms of the primary flight instruments, navigation equipment, flight deck layout and its suitability for public transport operations.

c) The safety oversight programme conducted by the civil aviation authority on this operator had identified deficiencies in the crew resource management aspects of the company's operations. However, the oversight programme was ineffective in producing sufficient and timely improvement.

d) The civil aviation authority's monitoring system had been ineffective in identifying and making the operator correct the procedural lapses.

Appendix 6 to Chapter 1

GUIDELINES ON THE IDENTIFICATION, DRAFTING AND FOLLOW-UP OF SAFETY RECOMMENDATIONS

TABLE OF CONTENTS

1. PRINCIPLES OF SAFETY COMMUNICATION

1.1 General

1.1.1 The purpose of accident and incident investigations is to advance safety by identifying safety issues, deficiencies and underlying/contributing factors that pose a risk to future operations. The State conducting the investigation, at any stage of the investigation of an accident or incident, shall recommend any preventive action that it considers necessary to be taken promptly to enhance aviation safety.

1.1.2 The purpose of safety communication is to ensure that identified risks are communicated to those entities or organizations best able to effect change and to convince them to take remedial safety action. Safety communication can be formal, semi-formal or informal and may take many forms, such as investigation team discussions, briefings, written interim statements and safety advisories, and formal safety recommendations. The form and timing of safety communication is influenced by the degree of risk associated with the underlying safety issue.

1.1.3 The openness of Annex 13 investigations and the involvement of stakeholders in the investigation process should encourage the involved organizations/stakeholders to take action before a recommendation is made. In fact, some investigation authorities view having to resort to formal recommendations as being a failure of less formal communications to produce change.

1.1.4 The failure to take immediate actions may be an indicator that the involved organizations/stakeholders are not convinced that action is required or that the changes required are, or are viewed to be, very difficult to achieve. Therefore, the investigation authority's recommendations must be close to perfect to achieve positive results.

1.1.5 A formal safety recommendation would be the appropriate type of safety communication for safety issues/ deficiencies assessed as posing a high risk to the conduct of air operations.

1.1.6 The remainder of this document will concentrate on guidelines on the identification, drafting and follow-up of safety recommendations.

2. VALIDATION OF A SAFETY ISSUE/DEFICIENCY

2.1 General

2.1.1 The following are steps that would assist in determining the requirement and bases for a safety recommendation:

a) Using the information determined by the investigation, determine the history of the flight of the aircraft and the pre-flight, in-flight and post-flight events that contributed to the adverse consequences related to the occurrence;[1]

b) From the list of events, determine the safety significant events. Safety significant events would include but not be limited to events:

— that are undesirable from a risk perspective;

1. An event describes a happening or an action step in a sequence of actions that lead to or could lead to an occurrence.

— that are potentially linked as an antecedent to another undesirable event;

— that are non-standard or unusual; or

— where one or more alternative actions or options are available;

c) For the safety significant event of interest, determine the underlying factors that contributed to or facilitated the event;

d) For the underlying factor of interest, determine the level of risk. Risk can be defined in terms of two components: the probability that the underlying factor will lead to an adverse consequence and the severity of that adverse consequence;[2]

e) For the underlying factor of interest, determine the availability and the effectiveness of physical or administrative defences needed to limit, reduce or prevent unwanted consequences;

f) For the underlying factor of interest, validate the safety deficiency. This validation is based on the results of risk analysis and defence analysis above. A safety deficiency is an underlying factor with risks for which the defences are less than adequate;

g) For each safety deficiency, determine possible risk-control options that have the potential to mitigate the risk of the safety deficiency contributing to a future occurrence. Each risk-control option must be critically evaluated to determine the benefits that would result from the control option, the administrative and financial feasibility and the reasonableness of the control option; and

h) Based on the preceding analyses, determine the risk-control option that has the best potential for mitigating the risk associated with the validated safety deficiency.

2.1.2 In summary, a safety recommendation would be warranted if the analysis of the investigation information determines the existence of an underlying factor(s) with high risks and for which the defences are less than adequate. A safety recommendation would be issued at any time during the investigation whenever it is assessed that there is an immediate risk to the conduct of air operations and an urgent need for immediate formal communications with the action addressee responsible for the matter. A safety recommendation would be made in the Final Report of the investigation in situations wherein immediate action is not needed or wherein the deficiency is not clearly defined and justified until the Final Report stage. See Figure IV-1-6-1 for a flow diagram of the steps to determine the requirement and bases for a safety recommendation.

3. SAFETY RECOMMENDATION ADDRESSEES

3.1 Safety recommendation action addressees

3.1.1 Safety recommendations must be communicated to the entity or organization that is best able to take action to mitigate the risks, has the authority and responsibility to take remedial action and has the mandate to take action that will have the broadest impact.

2. ICAO *Safety Management Manual* (Doc 9859) provides guidance on the risk assessment process.

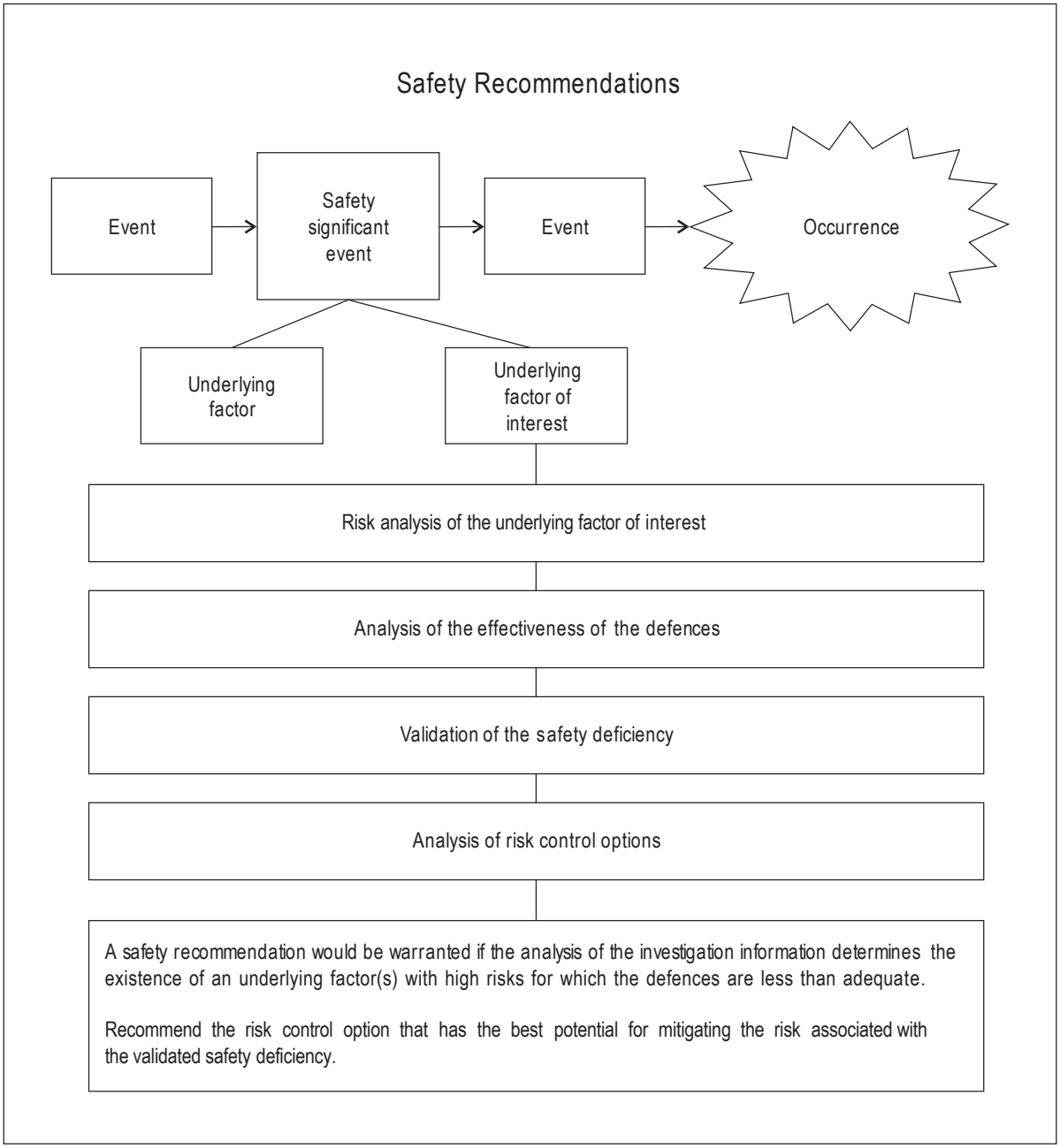

Figure IV-1-6-1. Steps to determine the requirement and bases for a safety recommendation

3.1.2 There should only be one principal action addressee for each recommendation. Having multiple addressees will result in a situation where there could be uncertainty as to what addressee is responsible for taking safety action. Having multiple principal action addressees also will make it difficult to track and evaluate action taken in response to the recommendation. In such situations, it would be preferable to send the recommendation independently to each addressee. Alternatively, one addressee could be designated as the lead action addressee and the other addressees designated as support action addressees.

3.1.3 For SRGCs, the action addressee normally would be the State civil aviation authority responsible for the certification and oversight, in part, of the design, manufacture, maintenance and/or operations of the aircraft or facilities involved in the occurrence. For other safety recommendations, the action addressee could be, but not be limited to, the air operator, manufacturer, maintenance organization, air traffic services provider and airport operator. ICAO would be the action addressee for recommendations related to the international Standards and Recommended Practices contained in the Annexes to the Convention on International Civil Aviation and perceived deficiencies in ICAO guidance material.

3.2 Safety recommendation information addressees

For the purpose of advancing the safety of operations, copies of the safety recommendation also should be sent to those persons or organizations of the aviation community that have a direct interest in the safety issue or who would benefit from the information that was the basis for the safety recommendation. Information addressees could be, but is not limited to, the following: involved government departments; involved States and accident investigation authorities; and involved stakeholders, such as the airline, maintenance organization, manufacturer, air traffic services provider, and airport operator.

4. WRITING SAFETY RECOMMENDATIONS

4.1 Framework of a safety recommendation

To be effective, a safety recommendation must present a compelling argument for safety action to mitigate the risks identified by the investigation. A clear, succinct and well-structured safety communication would facilitate this objective. The following is a suggested framework for a safety recommendation, including guidelines as to the type of information that should be included:

a) The background section should include the following:

— A summary of the occurrence, including the date, aircraft type and location of the occurrence. This summary should describe what happened, not why it happened. This section should also identify the investigation authority, the investigation number and the status of the investigation;

— The safety significant event associated with the safety issue, along with the adverse consequence(s) that resulted from the associated unsafe condition;

— The associated safety deficiency(ies), if any; and

— The immediate circumstances that led to the adverse consequence.

b) The supporting information section should include the following:

— Historical evidence of the risks and consequences, by referring to other occurrences where similar circumstances resulted in adverse consequences, to demonstrate that this was not just an isolated occurrence;

— Information as to how the number of such accidents has varied over time, by geographic area, by aircraft type and by type of operation. This section should also include a description of the adverse consequences associated with the occurrences. This information establishes the probability of adverse consequences, and the severity of the consequences in terms of historical evidence; and

— The risk control options currently in use and the effectiveness of these options, if applicable.

c) The deficiency analysis section should include the following:

— The unsafe condition/factor underlying the safety significant event;

— The shortcomings of prior actions taken, if any;

— The inadequacies of existing defences; and

— The residual risk.

d) The safety recommendation section should include the following:

— A summary of the safety deficiency statement, including the unsafe condition, inadequacies of defences, and the residual risk (of adverse consequences) if no action is taken; and

— The recommended safety action (risk-control options), including the performance expectations.

e) Attachments supporting the integrity of the factual information and argument for change could be appended to the recommendation document, such as, but not limited to, statistics, lists of similar previous occurrences, technical and scientific analyses, and flight data recorder printouts and analyses.

Note.— For safety recommendations issued in Final Reports, the above information should be included in the factual information, analysis, conclusions, recommendations and attachments sections of the Final Report.

4.2 Covering letter for safety recommendations

The covering letter for the safety recommendation should include the following information:

a) The specific addressee, who should be the head official of the organization and who is best suited to implement the required safety action. This could be, but is not limited to, the following: the government minister, director general, secretary general or chief executive officer;

b) The date;

c) The occurrence summary (see framework section);

d) The purpose of the safety recommendation;

e) The safety deficiency statement;

f) The recommended safety action(s); and

g) The requirement to respond within 90 days regarding:

— actions taken;
— actions planned, including alternative actions, if applicable; or
— reasons why no action will be taken.

Note.— For safety recommendations issued in the Final Report, a separate cover letter should be sent to each head official deemed responsible for taking action on a safety recommendation.

4.3 Distribution of safety recommendations

4.3.1 Copies of the safety recommendation should be sent to persons or organizations in the aviation community that have a direct interest in the safety issue which was the basis for the safety recommendation, as well as to other members of the aviation community who would benefit from the information, including but not limited to, the following:

a) The safety recommendation action addressee;

b) Involved government departments;

c) Involved States and accident investigation authorities;

d) Involved stakeholders, such as, but not limited to, the airline, maintenance organization, manufacturer, air traffic services provider and airport operator; and

e) Others who may benefit from lessons learned.

4.3.2 The ICAO Accident Investigation Section must be provided with a copy of each SRGC.

4.3.3 Some accident investigation authorities post their safety recommendations on a website.

5. MEASURING THE SUCCESS OF THE RECOMMENDATIONS

5.1 General

The purpose of a safety recommendation is to ensure that identified risks are communicated to those entities or organizations best able to effect change and to convince them to take remedial safety action. In this regard, the issuance of safety recommendations by the investigation authority can be viewed as the most important output of the investigation. The full potential of recommendations to prevent future accidents and incidents cannot be realized until appropriate safety action to mitigate the risks underlying the recommendation is taken by the entity to which the recommendation was issued. Measuring the effectiveness of safety recommendations to achieve positive changes requires an evaluation of the actions taken against the performance expectations of the safety recommendation. Refer to Figure IV-1-6-2 for a flow diagram for tracking safety recommendations.

5.2 Mandating responses to safety recommendations

5.2.1 ICAO Annex 13 requires that a State that receives safety recommendations shall inform the proposing State, within 90 days of the date of the dated transmittal correspondence, of the preventive action taken or under consideration, or the reasons why no action will be taken. In most States, the State civil aviation authority is responsible for ensuring compliance with this Standard; in other States the State accident investigation authority is the entity responsible.

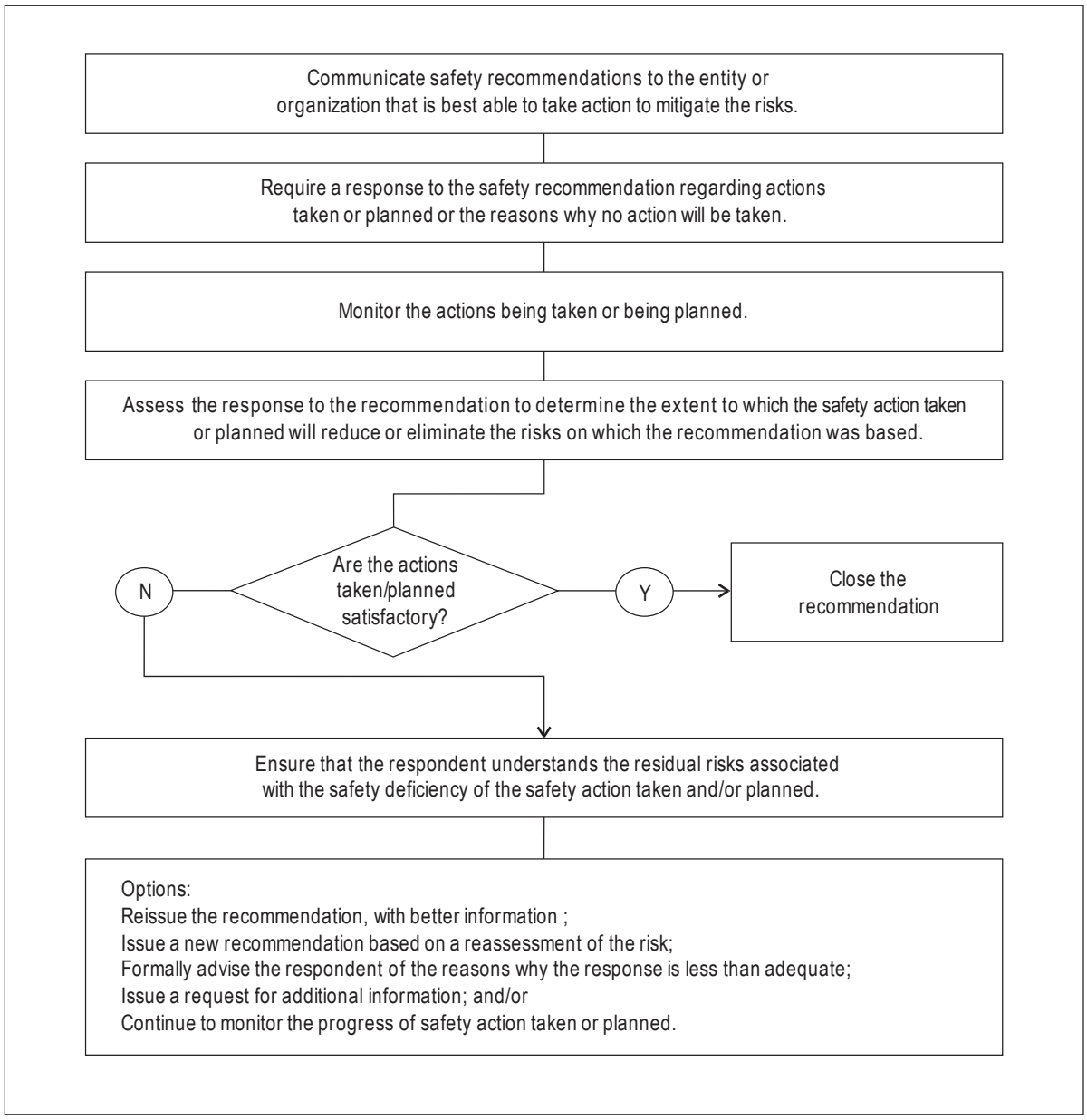

Figure IV-1-6-2. Flow diagram for tracking safety recommendations

5.2.2 Some accident investigation authorities post the responses to safety recommendations on a website.

5.3 Monitoring the progress of action taken

5.3.1 Annex 13 states that a State that receives a safety recommendation shall implement procedures to monitor the progress of the action taken in response to that safety recommendation. Annex 13 also states that a State

conducting the investigation, or any other State issuing a safety recommendation, shall implement procedures to record the responses to the safety recommendation issued. In some States, the State accident investigation authority is responsible for ensuring compliance with these Standards; in other States, the State civil aviation authority is the entity responsible.

5.3.2 Notwithstanding the Annex 13 provisions, it would be prudent for the accident investigation authority that issued the safety recommendation to establish a direct staff-level liaison with the accident investigation authority of the State responsible for responding to the recommendation in order to arrange for routine updates as to the status of the action taken and/or action planned.

5.3.3 For situations where a response is not received within the prescribed 90 days, it would be prudent for the State that issued the recommendation to formally request a status report from the action addressee to which the safety recommendation was made. If there is a significant change in the action taken or under consideration, the addressee of the recommendation should inform the authority making the recommendation of the changes, including reasons why the proposed action has changed.

5.3.4 Some accident investigation authorities post the responses to recommendations on a website.

5.4 Assessing responses and action taken

5.4.1 It would be prudent for the accident investigation authority that issued the recommendation to have a process and guidelines for assessing responses to recommendations. The purpose of evaluating the safety action taken and/or planned is simply to determine whether further safety action is required.

5.4.2 The following is a suggested process for assessing responses to recommendations:

a) Review the recommendation to confirm the performance expectations of the recommendation;

b) Review the response to the recommendation to determine the extent to which the addressee has accepted the existence of the safety deficiency underlying the recommendation;

c) Assess the extent to which the safety action taken, or planned, will reduce or eliminate the risks on which the recommendation is based;

d) Reassess the residual risks associated with the safety deficiency, taking into account the safety action taken and/or planned; and

e) Categorize the response in terms of risk mitigation.

5.4.3 Some accident investigation authorities assign category of risk mitigation to the responses to safety recommendations, such as “satisfactory”, “partly satisfactory” or “unsatisfactory”. Some accident investigation authorities post the category of risk mitigation on a website.

5.4.4 Some accident investigation authorities assign a status to each recommendation, such as “open” or “closed”. Some accident investigation authorities post the status of their recommendations on a website.

5.4.5 Some accident investigation authorities inform the State responding to a recommendation, in writing, of their assessment of the response. Some accident investigation authorities post the assessments of the responses to their recommendations on a website.

Note.— Prior to making public its assessment of responses to its recommendations, it would be prudent for the accident investigation authority to provide advance notice to the State responding to the recommendation of its intent to do so. (Additional guidance can be found in the next section regarding the follow-up to situations wherein the action taken/planned in response to a recommendation is less than adequate.)

5.4.6 For each SRGC, the State that issued the recommendation should provide the ICAO Accident Investigation Section with a copy of the responses to its recommendation, the State's assigned category of risk mitigation of the action taken, and the status of the recommendation.

5.5 Follow-up to less-than-adequate action taken/planned

5.5.1 If it is assessed that a response to a safety recommendation is less than adequate, it would be prudent for the investigation authority to contact the authority responsible for taking action on the recommendation to ensure that:

a) the recipient of the recommendation understands the recommendation and the risk level associated with the safety deficiency;

b) the accident investigation authority that issued the recommendation understands the substance of the response to the recommendation, including the potential of the action taken and/or action planned to mitigate risk; and

c) the recipient of the recommendation understands the residual risks associated with the safety deficiency, taking into account the safety action taken and/or planned.

5.5.2 The follow-up options to a less-than-adequate response would vary based on the level of residual risk and the urgency for additional safety action. The following are some options that should be considered:

a) Reissue the recommendation, with changes, additional clarification and/or better information;

b) Issue a new recommendation based on a reassessment of the risk of the underlying deficiency;

c) Formally advise the action addressee of the recommendation as to the investigation authority's assessment of the response, including the reasons why the response is less than adequate;

d) If appropriate, inform ICAO and/or other States about a less-than-adequate response to a recommendation;

e) Issue a request for additional information from the safety recommendation action addressee; and/or

f) Continue to monitor the progress of the safety action taken or planned.

6. ADDITIONAL GUIDANCE ON SAFETY RECOMMENDATIONS

6.1 Qualities of a good safety recommendation

The following are some qualities of a good safety recommendation:

a) There is a clear and positive link to a safety significant event:

— The challenge is to convince the unconvinced;

— The potential for a safety recommendation to achieve change will be adversely affected if the underlying factor is not directly linked to the safety significant event; and

— The logic of the argument to achieve change must be concise and clear.

b) Data are accurate and indisputable:

— All data must be validated and carefully scrutinized.

c) The analysis is sound:

— Use of assumptions or stretching data weakens the safety recommendation and reduces the chances that appropriate action will be taken.

d) The safety recommendation is addressed to the entity best able to take the corrective action.

e) The recommendation is achievable:

— It will be a waste of effort to produce an unachievable recommendation;

— An unachievable recommendation will diminish the credibility of the accident investigation authority; and

— It is inadvisable to shy away from issuing recommendations on difficult issues.

f) There is a significant risk in being too prescriptive:

— The action addressee is likely in a better situation to determine the most appropriate method to mitigate the risk; and

— The credibility of the accident investigation authority may be at risk.

g) A performance-based recommendation will make the action taken in response to a recommendation more measurable by both the accident investigation authority and the safety recommendation action addressee.

h) A good recommendation is one that is written in a way that clearly states:

— The deficiency (underlying factor and residual risk);

— The action required to mitigate the risk (or to make the risk tolerable); and

— The expected result of action being taken.

6.2 Characteristics of a weak recommendation

The following are some characteristics of a weak safety recommendation:

a) The action addressee is not identified:

— There will be uncertainty as to who is responsible for taking the recommended safety action; and

— There is a risk that no one will take on this responsibility and no action will be taken.

b) Too many action addressees:

— There will be uncertainty as to who is responsible for taking the recommended safety action and/or who will take the lead in coordinating the safety action to be taken.

c) The action addressee does not have the mandate to mitigate the identified deficiency:

— There is significant risk that safety action will not be taken.

d) The addressee is not the one that can correct the deficiency on a systemic level:

— There is significant risk that safety action will not be taken at the systemic level.

e) The factual information is incorrect or inappropriately skewed:

— The recommendation will lack credibility and no one will take action.

f) The logic linking facts, analysis and conclusions is flawed:

— The recommendation will lack credibility and no one will take action.

g) The risk or consequences are exaggerated:

— The recommendation will lack credibility and no one will take action.

h) The recommendation is not based on a finding or a cause/contributing factor:

— The recommendation will be interpreted as having a low priority; and

— The safety action will be delayed or not taken at all.

i) The recommendation is too specific:

— The recommended safety action might not be the best option available to correct a systemic deficiency.

j) The recommendation is too broad:

— It will be difficult to determine the best option to mitigate the risk; and

— Assessing the suitability of the safety action taken will be more difficult.

k) The recommended action is not achievable:

— The recommendation will lack credibility and no one will take action; and

— The credibility of future recommendations by the accident investigation authority could be at risk.

l) The performance expectations of the recommendation are unclear:

— It will be more difficult to determine the best option to mitigate the risk; and

— It will be more difficult to assess whether the safety action taken meets the expectations of the recommendation.

m) Too many recommendations in a report:

— Having too many recommendations will possibly dilute their overall importance.

n) Recommendations made on low-risk issues:

— The recommendations collectively will be deemed to be of low priority; and

— The credibility of future recommendations by the accident investigation authority could be at risk.

o) A recommendation based on a single, local event:

— The recommendation will be deemed as being low priority; and

— The safety action will be delayed or not taken at all.

p) The recommendation is not clearly identified as such:

— There is a risk that such recommendations will be overlooked; and

— There is a risk that no safety action will be taken.

7. EXAMPLES OF SAFETY RECOMMENDATIONS OF GLOBAL CONCERN

1. United Kingdom Air Accidents Investigation Branch (AAIB) Safety Recommendation 2009-029

1.1 B 777-236ER, Engine rollback, Heathrow, 17 January 2008, 152 on board

While the aircraft was on final approach at 720 ft agl, the right engine suffered an uncommanded reduction in engine power to 1.03 EPR, and seven seconds later, the left engine suffered an uncommanded reduction in engine power to 1.02 EPR. The investigation identified that the following probable causal factors led to the fuel flow restrictions:

- Accreted ice from within the fuel system released, causing a restriction to the engine fuel flow at the face of the fuel oil heat exchanger, on both of the engines; and

- Certification requirements, with which the aircraft and engine fuel systems had to comply, did not take account of this phenomenon as the risk was unrecognized at that time.

Several recommendations were raised that are of global concern. The safety issues are related to systemic deficiencies in fuel system design and crashworthiness, which had already been evident in previous accidents on other types. The issue was wide ranging and affected all aircraft and engines; in addition, the crashworthiness was significant for all types

as well. Timely action was needed to prevent recurrence. The safety recommendations were as follows:

Safety Recommendation 2008-049: It is recommended that the Federal Aviation Administration and the European Aviation Safety Agency review the current certification requirements to ensure that aircraft and engine fuel systems are tolerant to the potential build up and sudden release of ice in the fuel feed systems.

Safety Recommendation 2009-096: It is recommended that the Federal Aviation Administration, in conjunction with the European Aviation Safety Agency review the requirements for landing gear failures to include the effects of landing on different types of surface.

Safety Recommendation 2009-098: It is recommended that the Federal Aviation Administration and the European Aviation Safety Agency, review the qualification testing requirements applied by manufacturers to cabin fittings, to allow for dynamic flexing of fuselage and cabin structure.

Safety Recommendation 2009-031: It is recommended that the Federal Aviation Administration and the European Aviation Safety Agency jointly conduct research into ice formation in aviation turbine fuels.

Safety Recommendation 2009-030: It is recommended that the Federal Aviation Administration and the European Aviation Safety Agency conduct a study into the feasibility of expanding the use of anti ice additives in aviation turbine fuel on civil aircraft.

Safety Recommendation 2009-032: It is recommended that the Federal Aviation Administration and the European Aviation Safety Agency jointly conduct research into ice accumulation and subsequent release mechanisms within aircraft and engine fuel systems.

1.2 Boeing 737-86J, took off with insufficient thrust for the environmental conditions and struck an obstacle after lift-off, 21 July 2017.

The Boeing 737-800 took off with insufficient power to meet regulated performance requirements. The aircraft struck a supplementary runway approach light, which was 36 cm tall and 29 m beyond the end of the take-off runway.

The investigation found the following causal factors for this serious incident:

- An incorrect OAT was entered into the FMC, which caused the FMC to calculate an N_1 setting for take-off which was significantly below that required for the aircraft weight and environmental conditions.
- The incorrect OAT was not identified subsequently by the operating crew.
- The abnormal acceleration during the take-off run was not identified until the aircraft was rapidly approaching the end of the runway, and no action was taken to either reject the take-off or increase engine thrust.

The investigation found the following contributory factors for this serious incident:

- The aircraft's FMC did not have the capability to alert the flight crew to the fact that they had entered the incorrect OAT into the FMC, although this capability existed in a later FMC software standard available at the time.
- The Electronic Flight Bags (EFB) did not display N_1 on their performance application (some applications do), which meant that the crew could not verify the FMC-calculated N_1 against an independently-calculated value.

The investigation identified other examples of accidents or serious incidents where there was a gross failure of an aircraft to achieve its expected take-off performance, and found that technical solutions to address this serious safety issue are now feasible.

Some recommendations were made that are of global concern as the issues were due to systemic deficiencies related to take-off performance which was endemic, it was also clear that other AIAs had raised similar issues with other investigations, so the need for timely action is evident. These recommendations focused on take-off acceleration monitoring.

Safety Recommendation 2018-014: It is recommended that the European Aviation Safety Agency, in conjunction with the Federal Aviation Administration, sponsor the development of technical specifications and, subsequently, develop certification standards for a Take-off Acceleration Monitoring System which will alert the crew of an aircraft to abnormally low acceleration during take-off.

Safety Recommendation 2018-015: It is recommended that the International Civil Aviation Organization note the conclusions of this report and introduce provisions addressing Take-off Acceleration Monitoring Systems.

2. Australian Transport Safety Bureau (ATSB) safety recommendation

2.1 B-747-438 Water leak, Bangkok, 7 January 2008, 346 passengers, 19 crew

Significant safety issue: The United States Federal Aviation Administration regulations and associated guidance material did not fully address the potential harm to flight safety posed by liquid contamination of electrical system units in transport category aircraft.

The ATSB considers that the risk of ongoing or emerging design, operation and maintenance issues with the potential to result in liquid contamination of electrical system units in transport category aircraft could be significantly reduced over time by improved regulatory guidance and oversight. For example, existing designs and processes should be monitored for continuing effectiveness while consideration of alternative design principles may be applied to new aircraft designs.

ATSB Recommendation issued to: U.S. Federal Aviation Administration.

The Australian Transport Safety Bureau recommends that the U.S. FAA take safety action to address this safety issue.

2.2 Runway excursion involving Boeing 737, Darwin Airport, Northern Territory, 6 December 2016

Background: The flight crew established and maintained clear visual reference to the 60 m wide runway and surrounds until they encountered heavy rain shortly before reaching the runway threshold. Under the influence of a light but increasing crosswind, the aircraft drifted right without the flight crew being able to discern the extent of the drift. The aircraft landed 21 m to the right of the runway centre line and, shortly after touchdown, the right landing gear departed the sealed surface of the runway, destroying six runway lights before the aircraft returned to the runway. The aircraft incurred minor damage from ground debris and there were no injuries.

Significant safety issue: Category I runways that are wider than 50 m and without centre line lighting are over-represented in veer-off occurrences involving transport category aircraft landing in low visibility conditions. The installation of centre line lighting on wider Category I runways is recommended but not mandated by the International Civil Aviation Organization Annex 14.

Recommendation to ICAO: The Australian Transport Safety Bureau recommends that the International Civil Aviation Organization review the effectiveness of Annex 14, recommendation 5.3.12.2 (for the installation of runway centre line lighting on Category I runways that are wider than 50 m), given that Category I runways that are wider than 50 m and without centre line lighting are over-represented in veer-off occurrences involving transport category aircraft landing in low visibility conditions.

Reason why this is an SRGC: This recommendation affects all runways throughout the world greater than 50 m wide and Cat 1 without centre line lighting. There have been a number of accidents and serious incidents that have been a result of this safety issue in various countries, and there is a high risk of reoccurrence.

3. French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA)

Impact Assessment on the safety benefit of detection and warning systems of gross errors (SRGC Local reference FRAN-2018-0023)

Over the last 15 years, several safety investigations and safety studies have been conducted worldwide on the use of erroneous parameters at take-off. With reference to this subject, several safety recommendations were issued concerning On-Board Weight and Balance Systems (OBWBS), Take-Off Performance Monitoring Systems (TOPMS) or gross error detection/warning systems.

Consequently, the BEA recommends that: EASA, with relation to updating its impact assessment, assess the safety benefit of gross error detection/warning systems, in particular taking into account existing systems (Airbus TOS, Boeing FMS/EFB messages and protections, Lufthansa Systems LINTOP, etc.).

Reason why this is an SRGC: The BEA considered this safety recommendation a SRGC due to the systemic deficiency, having a probability of recurrence, with significant consequences on the safe conduct of the flight.

4. German Federal Bureau of Aircraft Accident Investigation (BFU)

The following is an example of a recommendation that might be considered to be a Safety Recommendation of Global Concern. The following two examples of recommendations are issued as outcomes of different investigations by the BFU: Similarities of the safety recommendations are systemic deficiencies having a probability of recurrence with significant consequences at a global level.

4.1 BFU SRGC: 06/2010 BFU-Report: File 5X003-0/08

An Airbus A320 landed at Hamburg Airport, during the course of which the left wingtip touched the ground. During the cruise phase of the flight the crew monitored the ATIS weather information, which reported the wind in Hamburg as 23 kt from 280°, gusting 37 kt, and decided to make an approach and landing on Runway 23 which was then in use. During the approach to land, the Air Traffic Controller gave several wind updates. Immediately prior to touchdown, the wind was reported as 300°/33 kt, gusting up to 47 kt.

Investigation into this serious incident revealed that the Airbus A320 crew had a considerable problem with the values quoted for wind speed and direction and interpretation of the gust information. The crew did not interpret the value quoted for maximum crosswind demonstrated for landing in an Operating Manual B (OM/B) Chapter Limitations as a prescribed limitation or operational threshold. The crew was not aware that in general no direction is given for gusts. The existing definition of gusts and the measuring method described in ICAO Annex 3, did not allow stating the gust direction.

A survey of more than 80 pilots revealed that about half regarded the numerical value of the maximum demonstrated crosswind stated OM/B as a limit, while the other half regarded the numerical value as a guide; this indicates to the BFU that there is a need for clarification. Likewise, the distribution of answers to question three, as to whether a landing should be allowed in the presence of a 40 kt gust report, highlights pilot uncertainty about the application and interpretation of the numerical value of the maximum demonstrated crosswind in conjunction with the value stated for wind vector and gusts.

The BFU was of the opinion that the measuring and handling of gusts wind values in everyday operations was neither sufficiently clear, nor adequately processed for flight crews.

BFU Safety Recommendation 06/2010:

EASA should place a contract with a suitable research institute (DLR, University or similar) to determine what measuring systems are suitable to detect the presence of near-surface gusts on airports, and how the resulting gust data and wind direction information should be processed and communicated to pilots. The results should lead to a process through which the information so obtained can be standardized and incorporated into the regulations governing air operations.

4.2 BFU SRGC No. 07/2017 BFU-Report: File No. 16-0055-EX

An Airbus A320 with 110 passengers on board collided with two de-icing vehicles as it began taxiing from the De-icing Area (DA) 14 in front of runway 26L of Munich Airport. The airplane's wings' transition zones with the sharklets had collided with the booms of the de-icing vehicles. The drivers' cabs of the de-icing vehicles stood abeam of the corresponding edge marking of the taxiway. The vehicles had tipped by about 20° and therefore they stood on their left or right wheels, respectively. At the time of the occurrence the operators of the two de-icing vehicles had been in their respective cubicles at the end of the vehicles' booms. The cubicles had been in approximately 6 m above ground. Initially the fire brigade secured the de-icing vehicles with steel cables. Then the two operators were rescued. Due to the tilted position of the de-icing vehicles, a great risk of a severe accident occurring had developed for the de-icing personnel.

The BFU came to the conclusion that a misinterpretation in the communication regarding the finalization of the de-icing procedure occurred between the flight crew and the team leader of the de-icing crew. Neither of the two pilots checked for obstacle clearance before taxiing. The missing standardized phraseology for pilots and de-icing personnel contributed to the serious incident.

Neither the phraseology of the de-icing plan nor the SAE document ARP6257TM contained precise stipulations for the communication if the de-icing procedure had to be aborted. This case shows that neither the pilots nor the team leader had used the wrong wording. Still both did not fully understand the other's information; instead they understood what fit their mental image of the situation. De-icing companies and operators have recognized the importance of standardized communications and accepted their application, but there was no extensive ICAO standard phraseology in place for the de-icing process, which would apply for pilots and de-icing personnel. Therefore the possibility for miscommunication was increased.

BFU Safety Recommendation No. 07/2017:

The Society of Automotive Engineers (SAE International) should amend the document Aircraft Ground De/Anti-Icing Communication Phraseology for Flight and Ground Crews (ARP6257TM) to mitigate the risk of miscommunication. Section 3.2.2 Abnormal Operations should include recommendations for standardized phraseology for pilots and de-icing personnel in regard to biunique communication in case the de-icing procedure has to be aborted.

5. Brazilian Aeronautical Accidents Investigation and Prevention Center (CENIPA)

5.1 System/component failure or malfunction involving a helicopter model S-76A, Pampulha Airport, Belo Horizonte – MG, 20 September 2007.

Background: During the taxi, the pilots perceived an abnormal noise and interpreted it as characteristic of a compressor "stall". Number two engine parameters were abnormal, with the temperature rising rapidly, reaching the red belt, and the "fuel press low light" lit for engine one. The commander cut engine number two and simultaneously found that engine number one had been cut without command. One of the passengers reported the smell of smoke. Passenger disembarkation was carried out and then there was fire in the area between the main gear box and the engines. The pilots triggered the fire extinguishers of the engines, but they were not efficient. The firefighters of the airfield were immediately called and the fire was extinguished. The two crewmen and the five passengers were unharmed. The aircraft suffered serious damage.

Significant safety issue: To the Federal Aviation Administration it is recommended:
RSO (A) 43/2009 - CENIPA Issued on 27 April 2009
To determine to the operators of the S-76A aircraft model, TCDS No. H1NE, manufactured by Sikorsky Aircraft Corporation, equipped with the electrical/hydraulic rotor brake system, the deactivation of such a system, in accordance with the Maintenance Manual SA 4047-76-2, ATA 66-50-00, page 206, revision date 15 FEB 1986, until the incorporation of the ASB 76-66-48 of Sikorsky Aircraft Corporation, dated 11 SEP 2007.

Reason why this is an SRGC: This recommendation affects all operators of model S-76A around the world. There was more occurrences involving the system. There is a risk of reoccurrence until the incorporation of the ASB 76-66-48 of Sikorsky Aircraft Corporation.

6. Indonesia National Transport Safety Committee (KNKT), SRGC related to Boeing 737-8 (MAX)

On 29 October 2018, at about 06:32 Local Time, a Lion Air Boeing 737-8 (MAX) aircraft registered PK-LQP, was being operated as a scheduled passenger flight from Soekarno-Hatta International Airport (WIII), Jakarta to Depati Amir Airport (WIPK), Pangkal Pinang, when the aircraft disappeared from radar after informing flight control, altitude and airspeed issues. The multiple alerts, repetitive activations of the of the Maneuvering Characteristics Augmentation System (MCAS) and numerous ATC communications contributed to the flight crew difficulties to control the aircraft. The aircraft impacted the water in Tanjung Karawang, West Java. All persons on board perished and the aircraft was destroyed.

The MCAS was a new feature introduced on the Boeing 737-8 (MAX) to enhance pitch characteristics during manual flight in elevated angles of attack (AOA). The investigation considered that the design and certification of the MCAS was inadequate. The aircraft flight manual and flight crew training did not include information about MCAS. On 10 March 2019, a similar accident occurred in Ethiopia involving a Boeing 737-8 (MAX) experiencing erroneous AOA inputs.

The investigation concluded with a number of contributing factors, with the following being associated with the aircraft certification process:

- During the design and certification of the Boeing 737-8 (MAX), assumptions were made about flight crew response to malfunctions which, even though consistent with current industry guidelines, turned out to be incorrect.
- Reliance of MCAS on a single sensor was deemed appropriate and met all certification requirements.
- MCAS was designed to rely on a single AOA sensor, making it vulnerable to erroneous input from that sensor.

- The absence of guidance on MCAS or more detailed use of trim in the flight manuals and in crew training made it more difficult for flight crews to properly respond to un-commanded MCAS.

- The AOA DISAGREE alert was not correctly enabled during the Boeing 737-8 (MAX) development. As a result, it did not appear during flight with the miscalibrated AOA sensor; could not be documented by the flight crew; and was therefore not available to help maintenance personnel identify the miscalibrated AOA sensor.

KNKT of Indonesia issued safety recommendations to, among others, Boeing Company and the Federal Aviation Administration (FAA). Some of those recommendations were as follows:

6.1 To Boeing Company

Safety recommendation 04.M-2018-35.11

During the accident, multiple alerts and indications occurred which increased flight crew's workload. This obscured the problem and the flight crew could not arrive at a solution during the initial or subsequent automatic and stabilizer trim input, such as performing the runaway stabilizer procedure or continuing to use electric trim to reduce column forces and maintain level flight.

Therefore, KNKT recommends that the aircraft manufacturer consider the effect of all possible flight deck alerts and indications on flight crew recognition and response; and incorporate design, flight crew procedures, and/or training requirements where needed to minimize the potential for flight crew actions that are inconsistent with manufacturer assumptions.

Safety recommendation 04.M-2018-35.14

The flight crew should have been provided with information and alerts to help them understand the system and know how to resolve potential issues. Flight crew procedures and training should be appropriate. Therefore, KNKT recommends that Boeing develop guidance for the criteria of information which should be included in flight crew and engineer's manuals.

6.2 To the Federal Aviation Administration (FAA)

Safety recommendation 04.R-2018-35.21

In the accident flight, the system malfunction led to a series of aircraft and flight crew interactions which the flight crew did not understand or knew how to resolve them. It was the flight crew response assumptions in the initial design process which, coupled with the repetitive MCAS activations, turned out to be incorrect and inconsistent with the Functional Hazard Assessment (FHA) classification of Major.

Therefore, the KNKT recommends that the FAA review the processes for determining the FAA's level of involvement (degree of delegation) and how changes in the design are communicated to the FAA to ensure an appropriate level of review.

Safety recommendation 04.R-2018-35.24

During the accident and previous flights, the flight crew initially responded in the same way by pulling back on the control column. However, they did not consistently trim out the resulting column forces as had been assumed. As a result, Boeing assumption was different from the flight crew behaviour and reaction time in responding to MCAS activation.

Therefore, the KNKT recommends that the FAA work with international regulatory authorities to review assumptions on flight crew behaviour used during design, and revise certification processes to ensure assumptions used during the design process are validated.

Safety recommendation 04.R-2018-35.25

The flight crew should have been provided with information and alerts to help them understand the system and know how to resolve potential issues. Flight crew procedures and training should be appropriate.

Therefore, KNKT recommends that the FAA work with international regulatory authorities to review the guidance for the criteria of information which should be included in flight crew and engineer's manuals.

Safety recommendation 04.R-2018-35.27

The aircraft was equipped with an airframe-mounted low frequency underwater locator beacon (ULB) which operated at a frequency of 8.8 kHz. The beacon is included in ICAO Standards. The purpose of the beacon is to aid in the location of submerged aircraft. During the search phase, multiple surveys were conducted to detect a signal at 8.8 kHz, however no such signals were detected in the area where the wreckage was recovered. The beacon was mounted on the forward side of the nose pressure bulkhead. Most of the preferred installation locations could not be used because they proved to be incompatible with EASA and FAA Non-Rechargeable Lithium Battery certification requirements, or they did not meet the ICAO empennage and wings exclusion.

Therefore, KNKT recommends that the FAA work with international regulatory authorities to review the requirements for installation of Non-Rechargeable Lithium Battery certification requirements.

6.3 Safety recommendations from the U.S. National Transportation Safety Board (NTSB)

The NTSB participated in the investigation and, on 19 September 2019, issued a Safety Recommendation Report titled: *Assumptions Used in the Safety Assessment Process and the Effects of Multiple Alerts and Indications on Pilot Performance*.

The NTSB recommendations to the FAA were as follows:

a) *Require that Boeing:*

1) Ensure that system safety assessments for the 737 MAX in which it assumed immediate and appropriate pilot corrective actions in response to un-commanded flight control inputs, from systems such as the Maneuvering Characteristics Augmentation System (MCAS), consider the effect of all possible flight deck alerts and indications on pilot recognition and response; and

2) Incorporate design enhancements (including flight deck alerts and indications), pilot procedures, and/or training requirements, where needed, to minimize the potential for and safety impact of pilot actions that are inconsistent with manufacturer assumptions. (A-19-10)

b) *Require that for all other US type-certificated transport-category airplanes, manufacturers*

1) Ensure that system safety assessments for which they assumed immediate and appropriate pilot corrective actions in response to un-commanded flight control inputs consider the effect of all possible flight deck alerts and indications on pilot recognition and response; and

2) Incorporate design enhancements (including flight deck alerts and indications), pilot procedures, and/or training requirements, where needed, to minimize the potential for and safety impact of pilot actions that are inconsistent with manufacturer assumptions. *(A-19-11)*

c) Notify other international regulators that certify transport-category airplane type designs (for example, the European Union Aviation Safety Agency, Transport Canada, the National Civil Aviation Agency-Brazil, the Civil Aviation Administration of China, and the Russian Federal Air Transport Agency) of Recommendation A-19-11 and encourage them to evaluate its relevance to their processes and address any changes, if applicable. *(A-19-12)*

d) Develop robust tools and methods, with the input of industry and human factors experts, for use in validating assumptions about pilot recognition and response to safety-significant failure conditions as part of the design certification process. *(A-19-13)*

e) Once the tools and methods have been developed as recommended in Recommendation A-19-13, revise existing Federal Aviation Administration (FAA) regulations and guidance to incorporate their use and documentation as part of the design certification process, including re-examining the validity of pilot recognition and response assumptions permitted in existing FAA guidance. *(A-19-14)*

f) Develop design standards, with the input of industry and human factors experts, for aircraft system diagnostic tools that improve the prioritization and clarity of failure indications (direct and indirect) presented to pilots to improve the timeliness and effectiveness of their response. *(A-19-15)*

g) Once the design standards have been developed as recommended in Recommendation A-19-15, require implementation of system diagnostic tools on transport-category aircraft to improve the timeliness and effectiveness of pilots' response when multiple flight deck alerts and indications are present. *(A-19-16)*

8. EXAMPLE OF SAFETY RECOMMENDATION "NOT" OF GLOBAL CONCERN

Transportation Safety Board of Canada (TSBC) safety recommendation

The following is submitted as an example of a recommendation that might not be considered to be a Safety Recommendation of Global Concern. This recommendation comes from a recently released Safety Issues Investigation (A17O0038) into runway incursions at Toronto's Lester B. Pearson International Airport (CYYZ).

This particular recommendation (A18-07) is addressed to a specific airport operator, and focuses on the layout and characteristics of a particular part of the airport complex. The combination of several uncommon characteristics on these rapid exit taxiways, including direct-access, short distance, a curve, and the type and placement of the runway holding positions and the associated visual cues, make the incursion hazard at these locations unique. This combination is not known to occur elsewhere.

As the standards, both locally and internationally, were not found to be deficient, the TSB addressed the recommendation directly to the airport operator (the Greater Toronto Airports Authority) to recommend that they make physical changes to address this unique hazard.

Recommendation A18-07 – Taxiway layout and conspicuity

The taxiway layout between the closely spaced parallel runways at Toronto/Lester B. Pearson International Airport (CYYZ) has several characteristics that are uncommon when compared with those at other airports, both within North America and globally. The runways are spaced a relatively short distance apart, and the rapid exit taxiways provide direct access to the adjacent runway without first progressing to another transitional surface. The runway holding positions are located immediately following a 65° curve and are situated at greater distances from the protected inner runway than is seen elsewhere.

These uncommon characteristics, and the short distance between the runways, present significant challenges for flight crews. When exiting the landing runway, crews are normally occupied with other tasks and, because they are using a rapid exit taxiway, the aircraft is usually travelling at taxi speeds that are faster than typical. A flight crew's unfamiliarity with these uncommon characteristics, the short amount of time and distance available, and distraction due to other tasks reduces their ability to identify the runway holding positions. As demonstrated by the occurrences covered in this investigation, if these positions are not identified, aircraft can incur on the other active runway and potentially collide with another aircraft.

International guidance recommends many strategies to address runway incursions. All but one of these has been implemented on the south complex at CYYZ; the remaining strategy is to make physical changes to the taxiway layout.

A change of this scale may be required to increase the distance and taxiing time between runway holding positions, to reduce the taxiing speeds of aircraft approaching the hold-short line, to prevent direct access to adjacent runways from rapid exit taxiways, and to re-situate visual cues in common locations. Among the possible reconfigurations that may address these factors is the inclusion of an intermediate parallel taxiway between the runways, as found at numerous other airports with parallel runways.

It is recognized, however, that a change this significant cannot be made overnight, and simpler incursion mitigation strategies may need to be implemented, or current strategies improved, in the meantime. Although much has been done over the past few years to improve the conspicuity of the runway holding positions, options still remain, such as altering the type, amount, or intensity of the runway holding position lighting, which may further improve the likelihood that flight crews identify the cues and stop before incurring on the runway.

Therefore, the Board recommends that the Greater Toronto Airports Authority make physical changes to the taxiway layout to address the risk of incursions between the parallel runways and, until these changes can be made, make further improvements to increase the conspicuity of the runway holding positions.

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Chapter 2

FORMAT AND CONTENT OF WRITTEN PRELIMINARY REPORT AND INTERIM STATEMENT

Note.— Annex 13 contains requirements for the accident and incident data reporting (ADREP) Preliminary Report. The guidance in this Chapter is for the written Preliminary Report and the interim statement. The written Preliminary Report serves a different purpose, in principle, and may be used at the discretion of the State conducting the investigation. The same applies to the interim statement.

2.1 WRITTEN PRELIMINARY REPORT

2.1.1 The Preliminary Report, like the notification and the Final Report, represents an important milestone in the investigation process and it may serve an important function in the public domain. The Preliminary Report also provides an update of the occurrence with pertinent additional information to that made available in the notification. The accident investigation authority may decide to publish the Preliminary Report, inter alia, to inform the victims and the families of the victims, the media and/or the public in general.

2.1.2 For the written Preliminary Report, the format of the factual information in the Final Report may be used. The concept to adapt the Final Report to the circumstances of the accident or incident (Annex 13, 6.1 refers) should also be applicable for the written Preliminary Report. The Preliminary Report is concluded within thirty days of the date of the accident and should provide a brief description of the occurrence, including emergency circumstances, significant facts and other relevant information. It should also include any corrective action taken or under consideration if this is known at the early stage of the investigation.

2.1.3 Publication of Preliminary Reports must be subject to the protection of accident and incident investigation records afforded by Annex 13, 5.12.

2.2 INTERIM STATEMENT

2.2.1 As per Annex 13, 6.6, if the Final Report cannot be made publicly available within twelve months, the State conducting the investigation shall make an interim statement, publicly available on each anniversary of the occurrence, detailing the progress of the investigation and any safety issues raised. The interim statement also provides an update of the occurrence with pertinent additional information to that made available in the notification and the Preliminary Report.

2.2.2 The format and content of the interim statement are, in principle, short in order not to increase the workload of States conducting the investigation. However, States may consider making a more detailed update to the relevant stakeholders using the format of the written Preliminary Report with additional information, such as safety actions taken or safety recommendations issued.

Chapter 3

THE ACCIDENT/INCIDENT DATA REPORTING (ADREP) SYSTEM

3.1 ADREP REPORTING SYSTEM — GENERAL

3.1.1 In accordance with Annex 13, States report to ICAO information on all aircraft accidents which involve aircraft of a maximum certificated take-off mass of over 2 250 kg. ICAO also gathers information on aircraft incidents considered important for safety and accident prevention. Thorough accident and incident investigations identify safety issues in the aviation system, both at the airline level and at the national level. However, it is sometimes difficult to differentiate between isolated manifestations of a problem and systemic unsafe conditions with a potential for loss of life or property damage. Such safety issues must be validated; in part, this is done by comparing the accident and incident experience in question with the broader experience of the airline, the State and other States. This type of comparative analysis requires reliable and complete data. The ADREP System operated by ICAO provides States with the data that will assist them in validating safety issues. Based on this validation process with its attendant assessment of risk, accident investigation authorities can offer meaningful recommendations for correcting unsafe conditions in the aviation system.

3.1.2 Detailed information concerning the reporting of accidents and incidents to the ADREP system is contained in Appendix 1 to this Chapter. ADREP reports can be sent in an ADREP compatible format, such as the European Coordination Centre for Accident and Incident Reporting System (ECCAIRS).

Note.— Chapter 7 of ICAO Annex 13 contains the Standards and Recommended Practices for ADREP reporting.

3.2 ADREP INFORMATION AVAILABLE TO STATES

3.2.1 When ADREP reports are received from States, the information is checked and stored in a database. The stored reports constitute a database of worldwide occurrences in order to provide States with the following services:

a) annual safety reports, presenting statistical information under broad categories, such as the types of events which took place and the phases of operation in which they occurred;

b) replies to States' requests for specific information. States wanting information on specific safety problems should forward their requests to ICAO at ADREP@icao.int. Replies will be sent via email; and

c) a record for individual States. ICAO may provide any State, upon request, with the complete record of accidents and incidents reported by that State to ICAO, and thus serve as an occurrence database for States that wish to take advantage of this service.

3.2.2 The ICAO ADREP database of accident and incident information is used to provide States with flight safety information. States' administrations are encouraged to request ADREP information from ICAO in order to assist them in their accident or incident investigation and prevention efforts. For example, if it is suspected in an investigation that a specific malfunction or failure has occurred, information on similar occurrences may be helpful in the investigation.

ADREP information is also used by States for accident prevention studies, including those prompted by operators, manufacturers and safety organizations. This safety information is provided by ICAO with the understanding that the ADREP information will be used for accident prevention only.

3.3 DATA VALIDITY

The validity of the safety information which ICAO provides to States depends on the detail and care with which accidents and incidents have been investigated and reported to ICAO. Thus, it is in the interest of all States to accurately report all investigated occurrences in accordance with Annex 13. Only then can ICAO provide valid and complete information required for accident prevention.

3.4 ADREP PRELIMINARY REPORT

3.4.1 Basic factual and circumstantial information on an accident is usually available within the first two to four weeks of the investigation. The ADREP Preliminary Report form is a simple and standard method for reporting such preliminary information. Although the Preliminary Report is not compulsory for incidents, States are encouraged to use the Preliminary Report for investigations conducted into serious incidents.

3.4.2 In accordance with Annex 13, Chapter 7, 7.1 and 7.2, an ADREP Preliminary Report is required, as follows:

Accidents to aircraft over 2 250 kg

7.1 When the aircraft involved in an accident is of a maximum mass of over 2 250 kg, the State conducting the investigation shall send the Preliminary Report to:

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Design;

d) the State of Manufacture;

e) any State which provided relevant information, significant facilities or experts; and

f) the International Civil Aviation Organization.

Accidents to aircraft of 2 250 kg or less

7.2 When an aircraft, not covered by 7.1, is involved in an accident, and when airworthiness or matters considered to be of interest to other States are involved, the State conducting the investigation shall forward the Preliminary Report to:

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Design;

d) the State of Manufacture; and

e) any State which provided relevant information, significant facilities or experts.

3.4.3 The Preliminary Report shall be sent using the ICAO online secure portal or by facsimile, email or airmail within thirty days of the date of the accident unless the Accident/Incident Data Report has been sent by that time. When matters directly affecting safety are involved, it shall be sent as soon as the information is available and by the most suitable and quickest means available.

3.5 ADREP ACCIDENT/INCIDENT DATA REPORT

3.5.1 When the investigation has been completed and the Final Report has been released, the Accident/Incident Data Report has to be compiled. The purpose of the Data Report is to provide accurate and complete information in a standard format.

3.5.2 In accordance with Annex 13, Chapter 7, 7.5 and 7.7, the Accident/Incident Data Report is to be sent as follows:

Accidents to aircraft over 2 250 kg

7.5 When the aircraft involved in an accident is of a maximum mass of over 2 250 kg, the State conducting the investigation shall send, as soon as practicable after the investigation, the Accident Data Report to the International Civil Aviation Organization.

. . .

Incidents to aircraft over 5 700 kg

7.7 If a State conducts an investigation into an incident to an aircraft of a maximum mass of over 5 700 kg, that State shall send, as soon as is practicable after the investigation, the Incident Data Report to the International Civil Aviation Organization."

3.5.3 The ADREP Data Report shall be sent to ICAO using the ICAO online secure portal or by facsimile, e-mail, or airmail as soon as possible after the release of the Final Report on the investigation. The State conducting the investigation should, upon request and as appropriate, provide other States with pertinent information additional to that made available in the Accident/Incident Data Report.

3.5.4 If, at the end of the investigation, it is established that some of the data in the Preliminary Report was not correct or was incomplete, this should be reflected in the Accident/Incident Data Report and ICAO be informed accordingly. Similarly, if a State reopens an investigation, the information previously reported should be amended by a new report.

3.5.5 If an accident/incident investigation has been completed and the Accident/Incident Data Report can be compiled within thirty days of the date of the accident, the State conducting the investigation should send an Accident/Incident Data Report to ICAO, instead of a Preliminary Report. In such cases, this State should also send the Data Report to the States which normally would have received the Preliminary Report.

3.6 CONSTRAINTS ON INCIDENT DATA REPORTS

Considering the sensitivity related to the dissemination of incident information, the following constraints are placed upon the use of incident data by ICAO:

a) ICAO will use incident information for the purpose of accident prevention only;

b) when ICAO conducts analyses based on incident information, it will be identified as such; and

c) ICAO will de-identify incident reports before their dissemination upon request, by deletion of the State of Registry, the nationality and registration marks, and the name of the owner and operator.

Appendix 1 to Chapter 3

GUIDANCE ON ADREP REPORTING

1. INTRODUCTION

Annex 13 — *Aircraft Accident and Incident Investigation*, requires States to report data obtained during the early stages of an investigation of an accident. ICAO also gathers information on aircraft incidents for safety and accident prevention. For ease of reference, the term “occurrence” refers to accidents, serious incidents and incidents.

2. ACCIDENTS AND INCIDENTS DATA REPORTING (ADREP) REPORTS

2.1 General

2.1.1 The ICAO ADREP system collects data from States in order to enhance safety by means of analysis, which is accomplished either by validation of known safety issues or identification of emerging safety trends, leading to recommendations for accident prevention purposes.

2.1.2 There are two different stages when an ADREP report to ICAO is required after an occurrence. These are:

a) ADREP Preliminary Report; and

b) Data Report.

2.1.3 These ADREP Reports are discussed further in Sections 2.2 and 2.3, and Table 4-A6-1 depicts a sequential summary of a notification and reporting checklist in accordance with Annex 13, Attachment B.

2.2 Preliminary Report

2.2.1 The Preliminary Report is one of the primary means of communication for the dissemination of data obtained during the early stages of the investigation. It is an interim report that contains additional information that was not known or available at the time of the notification. Although the Preliminary Report is not compulsory for incidents, States are encouraged to consider using the Preliminary Report for investigations conducted into serious incidents.

2.2.2 Annex 13, 7.1 requires, when the aircraft involved in an accident is of a maximum mass of over 2 250 kg, that the State conducting the investigation send the Preliminary Report to: the State of Registry or the State of Occurrence, as appropriate; the State of the Operator; the State of Design; the State of Manufacturer; any State that provided relevant information, significant facilities or experts; and ICAO. Annex 13, 7.2 is for accidents to aircraft of 2 250 kg or less and when airworthiness, or matters considered to be of interest to other States, are involved. The State conducting the investigation shall forward the Preliminary Report to all the States, as in 7.1, with the exception of ICAO.

2.2.3 Annex 13, 7.4 requires the Preliminary Report to be sent by facsimile, email, or airmail within thirty days of the date of the accident unless the Accident/Incident Data Report has been sent by that time. When matters directly affecting safety are involved, the Preliminary Report shall be sent as soon as the information is available and by the most suitable and quickest means available.

2.2.4 In case of a high profile investigation of a major accident, the State conducting the investigation is encouraged to consider publishing a *written* Preliminary Report, in addition to the ADREP Preliminary Report, and release investigative information such as media briefings within 30 days of the accident, noting the guidance in Chapter 2 of this document. For major or complex accident investigations, consideration should also be given to making the content of the ADREP Preliminary Report public within 30 days.

2.2.5 Publication of Preliminary Reports must be subject to the protection of accident and incident investigation records afforded by Annex 13, 5.12.

2.3 Accident/Incident Data Report

2.3.1 When the investigation has been completed and the Final Report has been released, the Accident/Incident Data Report has to be compiled. If an investigation is reopened, the information previously reported should be amended as appropriate. The purpose of the Data Report is to provide accurate and complete information in a standard format.

2.3.2 For accidents involving aircraft of a maximum mass over 2 250 kg, Annex 13, 7.5 requires that the State conducting the investigation shall send, as soon as practicable after the investigation, the Accident Data Report to the International Civil Aviation Organization.

3. GENERAL INSTRUCTIONS FOR COMPILING

3.1 Basic rules

States should report accurate and complete data in accordance with Annex 13 and the guidance in this manual. Some basic rules to observe when reporting occurrences in ADREP-compatible format (e.g. ECCAIRS format) are as follows:

a) Determine the appropriate occurrence classification, i.e. whether it is an accident, serious incident or incident, based on injury level, aircraft damage and other information available.

b) Complete the basic data such as date, time, State and location of occurrence, airport (if relevant), severity, aircraft type, operator, operation type and flight phase.

c) Choose the appropriate units for the attributes before entering values, e.g. ft, MSL or FL for altitude.

d) If more than one aircraft is involved in an occurrence, provide the information about the other aircraft. When entering event types for more than one aircraft, be sure to select the appropriate aircraft (1 or 2). All events must be in time sequence and care should be taken not to exclude vital events.

e) Align events with occurrence category(ies).

f) Use “Unknown” entries only if it is established after investigating that no information was found.

g) Use “Blank” entries to indicate that the investigation is ongoing to find information that is currently not available.

3.2 ADREP taxonomy

The ADREP taxonomy was developed by ICAO and contains definitions and terminology for aviation accident and incident reporting systems.

3.3 Dispatch of the reports

3.3.1 When information on the occurrence is available in an ADREP-compatible format (e.g. ECCAIRS format), a copy of the electronic file (e.g. .E5F) should be attached to the notification e-mail and sent to adrep@icao.int.

3.3.2 Reports that are completed on paper forms are to be sent to ICAO at adrep@icao.int in .pdf file format or to the following address:

International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec H3C 5H7
Canada

4. SPECIAL INSTRUCTIONS FOR COMPILING

4.1 Occurrence category coding

4.1.1 The ADREP occurrence category taxonomy is part of ICAO's accident and incident reporting system. The occurrence categories are a set of terms used by ICAO to categorize accidents and incidents in order to conduct safety trend analysis. The goal of such analysis is to take pre-emptive action to prevent recurrence of similar accidents or incidents.

4.1.2 Most accident and incident sequences involve multiple events. Therefore, strictly coding an accident or incident under a single category can be difficult. For instance, abrupt manoeuvring (AMAN) may also result in a loss of control in flight (LOC-I). In this case, the event is coded under both categories, AMAN and LOC-I. ICAO's occurrence category coding philosophy allows the reporter to code multiple categories for a single accident or incident in order to consider or study all events that led to the accident or incident.

4.2 Event type coding

4.2.1 In order to determine why an accident or incident happened, it is critical to study factors leading up to, during and after the occurrence. It is therefore vital that all event data known at the time of reporting is accurately included.

4.2.2 To further describe an event, "descriptive factors" can be entered for each event. Descriptive factors describe, in detail, what happened during an event by listing all phenomena present. If possible, the descriptive factors should be coded in chronological order below each event type.

4.2.3 To explain an event, "explanatory factors" can be entered for each descriptive factor. These factors explain why the event happened and include the human factor aspects in the coding of events. They are used to determine what preventive action may be required. The complete set of event types and descriptive and explanatory factors, with their detailed descriptions, can be found on the ICAO ADREP taxonomy webpage.

4.2.4 General considerations when reporting events include the following.

a) Be as specific as possible; for example, if the nose landing gear did not extend, use the event "nose/tail landing gear-related event" and not "landing gear-related event".

b) Align occurrence categories with events; for example, if the occurrence category is System or Component Failure – Non-Powerplant (SCF-NP), then there must be an event of failure of a non-powerplant component/system.

c) Align events and descriptive factors: events and descriptive factors describe what went wrong, what did not work, what was out of the ordinary and what contributed to the occurrence; for example, the event "central warning-related event" can be used for events where the system malfunctioned, and the descriptive factor "central computers" can be used to specify the event.

d) Complete the sequence of events in chronological order: an occurrence must be described by the way it is coded. In essence, the event coding should provide a similar image of the occurrence sequence, as is found in the narrative.

4.3 Narratives

4.3.1 The narrative provides a brief description of the occurrence, including emergency circumstances, significant facts and other relevant information. The narrative shall not exceed 200 words. It is important that events be described in chronological (time) order and be brief and specific.

4.3.2 The study and analysis of the sequence of events that led to the occurrence can help to better understand the nature of the occurrence. Therefore, narratives should include a concise summary of all events in order to provide information regarding the events that led to the occurrence. The information provided in a Preliminary Report narrative need not necessarily be repeated in a Data Report. However, any new information obtained subsequent to the Preliminary Report submission must be included in the Data Report. Seen together, the two narratives should provide the complete history of the flight and conclusions of the investigation.

4.3.3 When a Preliminary Report has not been submitted (either in the case of an incident or when an accident investigation has been completed within 30 days), the narrative in the Data Report must provide the history of the flight (and the description and analysis of how and why the event occurred), conclusions of the investigation, and findings and causes/contributing factors. In such cases, ideally a total of up to 400 words may be used in the narrative of the Data Report submitted.

4.4 Safety recommendations

4.4.1 The reporter should correlate safety recommendations, including safety recommendations of global concern, and actions to the relevant findings, as applicable. The safety recommendation attributes on the Data Report should include any corrective action taken or under consideration. If possible, the safety recommendation should specify how this corrective action would resolve the identified safety problem. Include a summary of preventive action already taken.

Table 4-A6-1. Notification and reporting checklist

In this checklist, the following terms have the meanings indicated below:

International occurrences. Accidents and serious incidents occurring in the territory of a Contracting State to aircraft registered in another Contracting State.

Domestic occurrences. Accidents and serious incidents occurring in the territory of the State of Registry.

Other occurrences. Accidents and serious incidents occurring in the territory of a non-Contracting State, or outside the territory of any State.

ADREP Preliminary Report

<table>
<tr><th>From</th><th>Category</th><th>Report</th><th>To</th><th>For</th><th>By</th></tr>
<tr><td rowspan="3">State conducting the investigation</td><td rowspan="2">Accident</td><td rowspan="2">Preliminary</td><td>- State of Registry
- State of Occurrence
- State of the Operator
- State of Design
- State of Manufacturer
- Any State providing relevant information, significant facilities or experts.
- ICAO</td><td>Aircraft over 2 250 kg</td><td>Within 30 days of the date of the accident*</td></tr>
<tr><td>Same as above, except ICAO</td><td>Accidents to aircraft of 2 250 kg or less if airworthiness or matters of interest are involved</td><td>Within 30 days of the date of the accident*</td></tr>
<tr><td>Incident</td><td>Preliminary</td><td colspan="3">Not required</td></tr>
<tr><td colspan="6">* If, within 30 days, the accident Data Report has been compiled and sent to ICAO, no Preliminary Report is required.</td></tr>
</table>

ADREP Data Report

From	*Category*	*Report*	*To*	*For*	*By*
State conducting the investigation	Accident	Data	ICAO	Aircraft over 2 250 kg	When the investigation has been completed and Final Report issued
	Incident			Aircraft over 5 700 kg	

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