Safety Investigation Procedure Manual

Second Edition

December, 2021

Civil Aviation Authority of Nepal

Approved for publication by the Director General, Civil Aviation Authority of Nepal, under Article 82 of the Civil Aviation Rules, 2058 BS.

Safety Management Division

Aviation Safety and Security Regulation Directorate

Civil Aviation Authority of Nepal

First Edition – July 2011

Second Edition – December 2021

This manual is available at www.caanepal.gov.np

Foreword

This second edition of Safety Investigation Procedure Manual has been developed by Civil Aviation Authority of Nepal in order to provide the guidance while conducting safety investigations by civil aviation authority. This edition of manual has been issued by the Director General pursuant to the rule of 83 (b) of Civil Aviation Regulations, 2002.

The importance of safety investigations for the prevention of future accident, Incidents and establishing just culture cannot be simply overstated. The core objective of safety investigation is to identify direct and systemic causes of accident or incident and take remedial actions to eliminate such deficiencies in the future.

This Manual outlines the responsibilities and provides guidelines to Authority - appointed investigators for any safety investigation. Contents in the Manual are formulated in a manner to help investigators to easily identify, consider and apply various aspects when conducting any type of safety investigation. This manual will not only be a document for any Aircraft Incident Investigation Committee, the Chief Investigator, other Investigators and any other officer, appointed by the Civil Aviation Authority of Nepal or others involved in any such capacity in an investigation to follow but also will serve as valuable information guidance to all concerned.

Safety investigations also help ensure the just culture in the organization. Therefore, this manual identifies the areas like: reports, occurrences, suspected and detected violations, negative trending of hazards to conduct safety investigations. This manual also explains various tools like root cause analysis, human factors analysis and organizational factors analysis. Another important aspect of this manual is the introduction of Human Culpability Evaluation Tools (popularly known as Decision Tree) to evaluate the degree of culpability of individuals involved in the matter being investigated.

Any Comments or suggestions for the improvement of this manual are appreciated and such comments and suggestions may be forwarded to Safety Management Division. It is the onus of the Civil Aviation Authority of Nepal to update this Manual as and when necessary.

This manual shall come into implementation with immediate effect.

Director General

December, 2021

RECORD OF AMENDMENTS

Revision No.	Date	Entered By
1	December 2021	Signed

ABBREVIATIONS

AIP -	Aeronautical Information Publication
AIS -	Aeronautical Information Services
AIU-	Aircraft Interface Unit
AMM-	Aircraft Maintenance Manual
ANSSSD –	Air Navigation Services Safety Standards Department
ASSD -	Aerodrome Safety Standards Department
ATC-	Air Traffic Controller
ATS-	Air Traffic Services
ATSEP -	Air Traffic Services Electronic Personnel
CAAN-	Civil aviation Authority of Nepal
CMM-	Component Maintenance Manual
CRS-	Child Restraint System
CVR-	Cockpit Voice Recorder
ELT -	Emergency Location Transmission
FDAP-	Flight Data Analysis Programme.
FDR-	Flight Data Recorder
FRMS -	Fatigue Risk Management System
FSSD -	Flight Safety Standards Department
FTA-	Fault Tree Analysis
GFTs-	General Failure Types
HBIg-	Hepatitis B Immune globulin
HBV-	Hepatitis B Virus
HF -	High Frequency
HFACS-	Human Factors Analysis and Classification System
HIV-	Human Immunodeficiency Virus

ILS -	Instruction Landing System
LAMT-	Licensed Aircraft Maintenance Technician
MFA-	Minimum Flight Altitude
NDB -	Non Directional Beacon
NOTAM-	Notice to Airmen
NTSB-	National Transportation Safety Board
OFA-	Organizational Factor Analysis
OH and S-	Occupational Health and Safety
PA-	Passenger Announcement
PAPI -	Precision Approach Path Indicator
PBE -	Protective Breathing equipment
PIB -	Preflight Information Bulletin
QAR-	Quick Access Recorder
RCA-	Root Cause Analysis
RT-	Radio Telephony
SCBA-	Self Contained Breathing Apparatus
TSB-	Transportation Safety Board
TSO-	Technical Standards Order
TOR-	Terms of Rference
ULB-	Underwater Locator Beacon
VHF -	Very High Frequency
VOR/DME-	VHF Omnidirectional Range/ Distance Measuring Equipment

TABLE OF CONTENTS

Definitions

Accident- An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

a) a person is fatally or seriously injured as a result of:
   - being in the aircraft, or
   - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
   - direct exposure to jet blast,

   except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

b) the aircraft sustains damage or structural failure which:
   - adversely affects the structural strength, performance or flight characteristics of the aircraft, and
   - would normally require major repair or replacement of the affected component,
   - except for engine failure or damage, when the damage is limited to a single engine (including its cowling or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes), or for minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

c) the aircraft is missing or is completely inaccessible

Aircraft - Any machine that can derive support in the atmosphere from the aerodynamic reactions of the air other than the reactions of the air against the earth's surface.

Authority - The Civil Aviation Authority of Nepal, established by the Civil Aviation Authority of Nepal Act 1996.

Causes - Actions, omissions, events, conditions, or a combination thereof, which led to the Incident. The identification of causes does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

Chief Investigator - A person appointed by the Civil Aviation Authority of Nepal on the basis of his or her qualifications, and charged with the responsibility for the organization, conduct and control of an investigation.

Contributing factors - 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

Fatal injury - An injury resulting in death within thirty (30) days of the date of the Incident.

Flight recorder - Any type of recorder installed in the aircraft for the purpose of complementing Incident investigation.

Incident - An occurrence, associated with the operation of an aircraft other than an Incident, which affects or could affect the safety of operation.

Investigation - A process conducted for the purpose of Incident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of causes and/or contributing factors and, when appropriate, the making of safety recommendations.

Investigator - A member of the Aircraft Incident Investigation Committee appointed by the Authority.

Maximum mass- Maximum certificated take-off mass

Safety recommendation - A proposal of an Incident investigation authority based on information derived from an investigation, made with the intention of preventing Incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from Incident investigations, safety recommendations may result from diverse sources, including safety studies.

Serious incident - An incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.

Serious injury - An injury which is sustained by a person in an Incident and which:

a. requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or
b. results in a fracture of any bone (except simple fractures of fingers, toes or nose); or
c. involves lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or
d. involves injury to any internal organ; or
e. involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or
f. involves verified exposure to infectious substances or injurious radiation.

Chapter-1

General

1.1 Safety Investigation

The purpose of developing and implementing a Safety Management is to reduce the risk of accidents, incidents and occurrences. However, complete elimination of risk is not always possible, and there are likely to be occasions when 'things go wrong'. A process for determining what went wrong, why, and how to prevent a recurrence, is an integral component of the Safety Management. An accident and incident investigation program is a safety management tool used to identify the contributing factors and causes of an occurrence in order to eliminate or mitigate these factors and ensure that similar accidents are not repeated.

The purpose of a safety investigation is to:

a. Analyse the available facts and information;
b. Identify contributing and (or) causal factors;
c. Develop findings and recommendations;
d. Communicate findings and recommendations to avoid a repetition of the occurrence;
e. Communicate lessons learned from the investigations.

The safety investigation process shall not be focused on apportion blame to the individuals but the gross negligence and willful deviation shall not be tolerated.

Safety investigations are conducted in response to an accident or incident (e.g. reactive), suspected violations detected from surveillance or other activities and more in-depth follow up is required, as well as adverse trending of hazards and risks (e.g. proactive).

1. 2 Triggers of a safety investigation and formation of team

1.2.1 Triggers of a safety investigation

a. When a safety reporting is received, its initial level of risk is determined. If the determined level of risk is significant and demands an investigation then investigation process is initiated or,
b. an occurrence (accident or serious incident or incident) occurs and the involved level of risk is considered as significant then investigation process is initiated or,
c. a suspected violation detected from surveillance or other activities and more in-depth follow up is required, then a safety investigation process is initiated or,
d. adverse trending of hazards is observed and the involved level of risk is significant, then an investigation process is initiated.

1.2.2 Formation of an investigation team

Priority for investigation shall be determined based on the severity of the consequence of the occurrence or safety issue. While determining severity of the consequence of occurrence, following impact areas are considered:

(highest importance is given to 'a' and lowest importance is given to 'g'):

a. Passenger/Public (Safety): Extent to which Consequence compromise/ impact people or passenger safety;
b. Employee/Worker (Safety): Extent to which Consequence compromise/ impact employee or worker safety;
c. Product/Service (Quality): Extent to which Consequence compromise/ impact service or product quality;
d. Asset/Financial (Loss): Extent to which Consequence result in loss of financial/ physical assets
e. Reputation (Loss): Extent to which Consequence result in loss of organizational or national reputation
f. Aviation Security (Breach): Extent to which Consequence compromise/ breach aviation or company security
g. Environmental (Damage): Extent to which Consequence result in damage to environment

The Chief of regulatory Departments/Divisions shall assign an investigation priority level based on above mentioned safety impacts and accordingly determine whether to conduct investigation himself or request the Director General for the formation of investigation team.

If the chief of regulatory domains (Flight Safety Standards Department, Air Navigation Services Standards Department, Aerodrome Safety Standards Department and Safety Management Division), first having knowledge of the safety issue, considers the issue is investigable, the domain chief shall request the Director General (DG) for formation of an investigation team. DG shall form such team along with TOR and timeframe and the domain chief shall notify the investigation team members.

If the chief of regulatory domain, first having knowledge of the safety issue, considers the initial level of risk is not significant and all the possible risks of the issue lie within the regulatory domain and inter domain coordination and collaboration is not required, then the regulatory domain chief can form an investigation team along with TOR and timeframe and initiate the investigation.

1.3 Consideration for conducting safety investigations

The duties and responsibilities for the management of such safety investigations shall be documented with consideration of:

a. Nature of occurrence, i.e, whether the occurrence is an accident, serious incident or incident;

b. the scope of the investigation and factor that triggered the investigation;
c. Extent of damage, or its possibility as indicated by the risk index of probability and severity, in terms of life and property;
d. the composition of the investigation team, including specialist assistance if required
e. timeframe for completion.

The role of the investigator is to identify where corrective or preventive actions are necessary using appropriate causal analysis methodologies. It is for the organisation's management to decide what those actions should be and to implement them.

1. 4 Selecting safety investigators

Safety investigations shall be conducted by trained and competent personnel who, where practicable, are independent of the operation. Whilst it is preferable that investigators have received formal training in aviation incident and accident investigation. The following are the typical knowledge, experience and skill requirements of a safety and / or occurrence investigator:

a. having at least 7 years of aviation experience and trained in accident and incident investigation techniques;
b. technically competent and have experience in interpreting occurrence information to determine causal factors.
c. having knowledge and experience of analysis of facts and information to determine root cause of the occurrence;
d. proficient in written and verbal communication skills;
e. having high level of integrity
f. be able to act independently
g. be able to present reports which are a clear representation of the facts and causes

Note: Investigator role is not necessarily required on a full time basis, (either amongst existing personnel/ crew or externally).

1.5 Powers to Investigators

The Investigators shall have unhampered access and control over the scene of the Incident, wreckage and all relevant material/evidence, documents including flight recorders and air traffic service (ATS) records.

In case of an ongoing parallel investigation in accordance to Annex 13, cooperation must be ensured between the investigation Commission and the committee formed by CAAN, especially at accident site and gathering other factual information.

Cooperation may be achieved by legislation, protocols, agreements or other arrangements, and may cover the following subjects: access to the site of the accident; preservation of and access to evidence; initial and ongoing debriefings of the status of each process; exchange of information; appropriate use of safety information; and resolution of conflicts.

a. The Chief Investigator shall assume responsibility for liaison with all related stakeholders.

The investigators, during the course of safety investigation, shall have the power to:

b. summon and call before it and examine all such persons whom it considers necessary;
c. require any person summoned to answer any question or furnish any information or produce any books, papers, documents or articles which the team may consider relevant, and to retain any such books, papers, documents and articles, until the completion of the investigations;
d. take statements from all such persons as it considers necessary and to require any such person to make and sign a declaration relating to the truth of the statement made by him;
e. have access to examine documentation, facility, an aircraft etc. involved in the Incident and the place where the Incident occurred, and for that purpose to require any such aircraft or any part of equipment thereof to be preserved unaltered, pending examination;
f. examine, remove, test, take measures for the preservation of, and otherwise deal with the aircraft or any part thereof or anything contained therein;
g. enter and inspect any place or building where it appears to be requisite for the purposes of the investigation; and
h. take all measures necessary for the preservation of evidence.
i. Carry out detailed examination of relevant material/evidence.

1.6 Non - disclosure

Any member of the investigation, or any other officer related to the investigation shall not make the following records available for purposes other than Incident investigation, unless the appropriate authority for administration of justice determines that their disclosure outweighs the adverse domestic and international impact such action may have on the investigation or any future investigations;

a. all statements taken from persons by the investigation Committee in the course of their investigation;
b. all communications between persons having been involved in the operation of the aircraft;
c. medical or private information regarding persons involved in the Incident;
d. Cockpit Voice Recorder(CVR) recordings, flight data recordings, recordings from air traffic control units and transcripts from such recordings; and

e. Opinions expressed in the analysis of information, including flight recorder information.
f. Any record not relevant to the analysis of the Incident.

These records shall be included in the final report or its appendices only when pertinent to the analysis of the Incident. Parts of the records not relevant to the analysis shall not be disclosed.

1.7 Defining the scope of a safety investigation

Not all occurrences or hazards shall be investigated; the decision to conduct an investigation and its depth shall depend on the actual or potential consequences of the occurrence or hazard. Investigations into occurrences and hazards considered to have a high-risk potential are more likely to be instigated and shall be investigated in greater depth than those with lower risk potential. CAAN shall use a structured decision-making approach with defined trigger points. These will guide the safety investigation decisions: what to investigate and the scope of the investigation.

This could include:

a. the severity or potential severity of the outcome;
b. regulatory or organisational requirements to carry out an investigation;
c. safety value to be gained;
d. opportunity for safety action to be taken;
e. risks associated with not investigating;
f. contribution to targeted safety programmes;
g. identified trends;
h. training benefit
i. resources availability

The extent of the investigation will depend on the actual and potential consequences of the event or risk level associated with a hazard. This can be determined through an initial risk assessment of the actual outcome(s) or potential outcome(s).

Since the level of risk is the product of consequence and likelihood, trying to assign a risk level to an event that has occurred provides little value; the likelihood is irrelevant – it has happened and past events cannot be managed.

However, when deciding whether to investigate an event and to what extent, consideration should be given to the other potential outcomes in the same contextual setting. By considering alternative, credible outcomes and considering the effectiveness of existing risk treatments or controls, it is possible to assign a risk level to this and similar events.

While the majority of investigations shall focus on cause and effect, the application of a deeper systemic and thematic safety investigation will also complement safety management implementation. Thematic and systemic investigations require a more holistic perspective of how a whole system is performing, to identify potential weaknesses or emerging risks within the system. Typically, the output from this type of safety investigation is information on emerging or potential risks, specifically, information on the characteristics, structure, weaknesses and strengths of the system. Ideally, a systemic and thematic safety investigation will identify the resilience of the system, allowing the level of safety within the system to be measured.

1.8 Repository of Investigation documentations

Safety Management Division shall work as repository for all safety investigation documentations. The division shall also analyse the reports and take necessary actions for future improvement of safety management in the State. The data protection and confidentiality shall be maintained in accordance with the prevailing rules and regulations.

1.9 Gathering evidence

The first step in the investigation process is to gather all factual information about the occurrence. Factual information can come from a number of different sources, depending on the nature of the occurrence. Some of the most common sources in the context of aviation-related occurrences include the following:

- interviews with involved personnel and witnesses
- different, e.g. FDR, CVR, FDAP, ATC communication and surveillance records etc.
- records and documentation, e.g., maintenance logs, manuals, notices and other correspondence, personnel records such as license, authorization, validation, certification etc.

Chapter – 2

Occupational Health and Safety

2.1 Purpose

CAAN acknowledges its responsibilities with regards to the health and safety of its employees engaged in aviation Incident investigation and wreckage examination. CAAN shall make reasonable arrangements to ensure compliance with occupational health and safety legislation of Nepal or universal safety precautions issued by WHO during the investigation process and maintain a working environment for Investigators, which is safe, and without risk to health. The Authority shall provide investigators with protective equipment and guidelines to address biological hazards and other hazards at Incident sites.

These guidelines apply to all employees who are likely to face exposure to potentially infectious or injurious substances or objects when conducting Incident investigations. Each employee has a responsibility to ensure that he or she works safely, and also protect others in the work place. Adherence to the work practices described, together with the use of appropriate personal protective equipment, will reduce on-job risk for all staff exposed to Incident site hazards. All Investigators and support staff are strongly advised to follow guidelines given in this Chapter to avoid possible exposure to conditions that may pose a safety and health hazard.

2.2 Pathological Hazards

Contact with human and animal remains and body fluids is serious health hazard because of the risks of bacterial viral and fungal contamination. Exposures to pathogens are unpredictable and since infection can be transmitted through direct contact with the eyes, nose and mouth, an open cut, dermatitis rash/chafed skin, or open skin sore. The preventive measure requires that all Investigators while working on-site take Universal Safety Precautions where the potential for exposure exists. Universal Safety Precautions is an approach to infection control, which assumes that all human blood and certain human body fluids are known to be infectious for HIV, HBV and other blood-borne pathogens and are handled accordingly. See guidelines given below under universal safety precautions.

2.3 Bio Hazards

Bio hazards are blood-borne pathogens that cause disease in humans. The precautions that should be taken against them are described below. Blood-borne pathogens are microorganisms which, when they enter human blood, can cause disease in humans. Infectious pathogens can be found in fatally injured persons as well as injured survivors. These pathogens include, but are not limited to:

a) Hepatitis B Virus (HBV)
b) Human Immunodeficiency Virus (HIV)
c) Malaria

d) Syphilis
e) Tetanus

The same universal and workplace infection control procedures apply to both HBV and HIV. Infection transmissions of other pathogens are interrupted by the procedures adopted for HBV/HIV.

HIV –
HIV affects the immune system, weakening it to the point where the individual becomes more susceptible to other infections - for example, pneumonia, tuberculosis or cancers. In the early and mid-1980s, it was generally believed that the HIV virus would not survive long outside the body. Recent studies have changed this thinking. In some cases, dried plasma held at room temperature retained infective virus for more than three days. In aqueous preparations held at 23-270C, just above room temperature, infective virus was retained after 15 days. Temperatures above 56^{0}C shorten the survival time of HIV virus to less than three hours. No cases of insect transmission are presently known. A vaccination against HIV infection is not available to date.

HBV –
Hepatitis B Virus causes inflammation of the liver, and may result in an individual becoming an HBV carrier with the potential to infect others. Liver failure and death can follow infection. HBV can remain viable outside the human body for some days and can exist in dried blood/body fluids. The disease, because of its abundance in a given infected blood sample, relative to HIV, is potentially many times more infective and therefore the greater site risk. The best defense against Hepatitis B infection is vaccination. Should a known exposure occur it is usual medical practice to give a Hepatitis B Immuno Globulin (HBIG) injection within 24 hours.

Malaria –
Except for one strain of malaria, human malarias are generally not life threatening, but produce a repetitive series of shaking chills and rapidly rising temperatures followed by profuse sweating over several days. Relapses may occur at irregular intervals and infection may persist for upwards of 50 years. Transmission is by the bite of an infective mosquito. Personal protection on the worksite will be achieved by regular use of an insect repellent in addition to wearing the protective clothing provided.

Syphilis –
This disease can occur concurrently with HIV infection and is spread in a similar way, namely through contact with infectious body fluids and secretions. Syphilis is characterized by skin lesions and a rash involving the palms and soles. As the disease

develops it attacks the central nervous system and cardiovascular system. Transmission of infection will be interrupted by procedures adopted for HIV protection.

Tetanus –
An acute disease characterized by painful muscular contractions primarily around the jaw and neck followed by contractions of the trunk muscles. Around the world, case fatality rates range between 30% and 90%. The disease is introduced into the body through a puncture wound contaminated with soil, street dust or animal/human faeces. Often the wound is unnoticed or too trivial for medical consultation. Active immunity can be obtained from an immunization, which lasts nominally 8 to 10 years. Tetanus control is best achieved by active immunization since it is rarely possible to recover and identify the organism at an infection site.

2.4 Universal Safety Precautions

Universal Safety Precautions shall be observed to minimize exposure to infectious materials. Risk reduction precautions shall include the following;

a. Investigators shall avoid direct contact with any potentially infected wreckage or soil.
b. Until properly protected, Investigators shall avoid any investigative, procedure on potentially infected wreckage or soil which might tend to splash, spray, generate droplets or otherwise dispense contaminated particulate matter
c. Investigators shall not eat, drink, smoke, apply lip balm or skin cream or handle contact lenses while in potential biohazard areas.
d. Each Investigator shall use antiseptic hand towelettes, or equivalent means of cleaning, immediately after leaving the biohazard area and removing personal protective equipment.
e. Investigators shall wash their hands with antiseptic soap and running water as soon as possible after using the antiseptic towelettes.
f. Any personal investigative equipment (Cameras, notebooks etc.), which may become contaminated with infectious materials, shall be examined and either decontaminated or disposed of as appropriate, prior to removal from the biohazard area.
g. Decontamination shall be with antiseptic towelettes or by a 10% solution of household bleach in water (10 minute minimum contact).
h. Investigators shall wash their skin or flush mucous membranes with water as soon as feasible following contact of their body areas with potentially infectious materials.
i. No staff members with a pre-existing condition that would facilitate the spread of a bloodborne pathogen for example open hand or facial cuts, skin rashes, open sores-will be permitted access to the bio-hazard area.

2.5 Vaccinations/Immunizations

The Authority strongly advise all participating investigators and support staff to take the Hepatitis B vaccination series including the antibody check two months after the test vaccination. All must take tetanus toxin immunization. The Authority recommends and encourages all investigators to complete the HBV series and that their tetanus immunization is current. Investigators must also take the routine booster vaccinations as required. Investigations in regions affected with known infective diseases may require inoculations against such diseases. Investigators are advised to seek medical advice regarding protections to visit such sites.

2.6 Work Practice Controls

2.6.1 General

All investigators shall treat all Incident sites as potentially hazardous areas and control entry to the site in accordance with the provisions of this Manual. Control may be revised once the potential hazards have been eliminated.

From time to time the Committee will require the use of laboratory facilities with outside contractors. Many of hazards found at an Incident site, whilst minimized prior to transport, may still be present or further exposed during laboratory testing.

The relevant workplace risk minimization procedures set out for an Incident site shall continue to be applied in the laboratory setting.

2.6.2 On-site Occupational Health and Safety Responsibility

An Incident site presents a number of potential hazards, each of which requires that appropriate procedures be established and followed. Terrain, environmental conditions, wreckage, and hazardous materials such as chemical, explosive, biological and radioactive items all have considerable potential to cause serious physical injury. In addition, critical incident stress has the potential to cause both emotional and physical damage to individuals during and following an Incident site visit.

For the purpose of Occupational Health & Safety (OH & S) issues it could be considered that the wreckage includes that area of ground encompassing all parts of aircraft wreckage and including an additional buffer zone of a further 50% of the actual wreckage area.

The Committee will only have responsibility for an occurrence site once it has been handed over by the emergency responder's site commander. This may be the site Commander from authority or airport authority or the local Police, The Chief Investigator of Incident should seek the site Commander's advice on occupational health and safety matters prior to hand over.

In a less severe Incident, committee will probably have immediate responsibility for the wreckage and, consequently OH & S responsibility. This responsibility includes the entire area encompassing the wreckage.

In the event of an occurrence on airport land & premises the airport authority and the site Commander will have joint responsibility for OH & S until control of the site is handed over to the Committee Chief Investigator. Once the site is handed over, the Airport Authority will maintain the responsibility for the property around the Incident site and will therefore control all access to the site.

The Authority recommends and encourages all investigators to complete the HBV series and that their tetanus immunization is current. Investigators must also take the routine booster vaccinations as required. Investigations in regions affected with known infective diseases may require inoculations against such diseases. Investigators are advised to seek medical advice regarding protections to visit such sites.

The Chief Investigator is responsible for OH & S activities of the investigation Committee while the members are under the Chief Investigator's direct control whether at the Incident site or not. The support of the fire department and the dangerous goods specialized should be enlisted, as necessary, to evaluate existing and potential hazards and to brief the investigation team, as appropriate. It should be noted that the role of investigators is to investigate the Incident, not to fight fires or remove hazardous materials.

2.6.3 Personnel on Site

To limit exposure to potentially hazardous situations, only personnel who have a need to be on-site as part of the investigation team should be allowed access to the Incident site and that too, only for the minimum possible period.

The aircraft Manufacturer and Operator may be requested to advice the Chief Investigator on possible hazards associated with the aircraft or its cargo. As part of the on-site safety process, the Chief Investigator may conduct pre-entry briefings as necessary for all personnel entering the Incident site. The intent of these briefings from a safety point of view is to inform all the Investigators, the Authority staff and approved visitors of potential hazards and ways of avoiding or combating them, including wearing of minimum protective clothing.

If any Investigator suffers from exposure to any hazard, the Chief Investigator must take appropriate action immediately after the on-site phase.

2.7 Site Precautions

2.7.1 General

Personal Safety at the Incident site is a combination of common sense and proper procedures. Although the Chief Investigator of Incident is ultimately responsible for the safety of personnel assigned to the investigation committee, all Investigators must be familiar with the OH & S regulations and guidelines and established safety procedures. Each Investigator must take every precaution to prevent personal injury. Investigators must exercise caution and use all appropriate protective devices when working at the Incident site. An Investigator should not work alone at an Incident site unless the site location and circumstance adequately provide for his or her personal safety.

2.7.2 Hazardous Sites

Entry and exit must always be via the controlled entry point. The Chief Investigator must ensure that a log is kept indicating when personnel enter and leave the site. Entry requires appropriate protective equipment; exit requires leaving contaminated outerwear in designated receptacles.

2.7.3 Isolated Sites

Investigators should not normally work alone at an isolated occurrence site. An isolated site is defined as one, which would involve more than two hours travel time to an appropriate medical facility or which would otherwise present difficulties if immediate removal of an Investigator were necessary.

2.7.4 Precautions against fire

There should be no smoking permitted within the guarded area and the fire-fighting equipment should be readily available while a high fire risk remains. Aircraft batteries should be disconnected as soon as possible and if aircraft fuel tanks are still intact, they should be emptied. The quantity of fuel removed from each tank should be measured and recorded. If there has been a large spillage of fuel, the investigators must control any activity that could increase the possibility of ignition. Care should be exercised to control possible sources of ignition. The operation of radio or electrical equipment or the use of salvage equipment should be avoided until the fire risk has been assessed and eliminated.

2.7.5 Precautions to dangerous cargo

The Committee should ascertain whether or not dangerous goods were carried aboard the aircraft. A preliminary check of the freight manifest and an inquiry to the operator should resolve this question. Dangerous goods may include such items as radioactive consignments, explosives, ammunition, corrosive liquids, liquid or solid poisons or bacterial cultures. If radioactive materials are carried, steps must immediately be taken to have them removed by qualified personnel before any harm is caused to persons working in close proximity to the wreckage. Limitations on the quantity of radioactive material, authorized to be carried on-board an aircraft, the strength of its packaging and shielding will minimize the possibility of container damage in an aircraft Incident. However, a postimpact fire could damage the packaging and shielding, and the ensuing heat may cause the radioactive material to change into gaseous form, in which case radiation may spread. In such cases, all participants in the rescue and fire-fighting operations should be checked, decontaminated and placed under medical observation, as necessary. No examination of the wreckage should be initiated until the level of radiation has been measured and the site declared safe.

2.7.6 Physical Conditions

Investigators are responsible for ensuring that they are fit enough to endure the sometimes arduous conditions found at an Incident site. Each Investigator should be aware of the effects of fatigue long before Exhaustion sets in.

In addition to being aware of the current condition of the site, the Chief Investigator needs to be aware of the condition of the participants in the investigation. The Chief Investigator should ask all participants if they are aware of any medical (including psychological) or physical reason why they should not be assigned normal on-site workload.

Precautions should be taken against the possibility of dehydration, heat stroke and sunburn. Early symptoms of dehydration are thirst, lack of appetite, slow reactions, nausea, drowsiness and high body temperature. Further symptoms are dizziness, headache, difficulty in breathing, tingling in the arms and legs, indistinct speech and an inability to walk. Dehydration can be fatal. Drink plenty of water to prevent dehydration - even if not really thirsty.

The symptoms of heat exhaustion are a pale face, cold sweat and shallow breathing. Heat exhaustion is considered to be shock from exposure to heat. Place the individual on their back in a shady spot elevate their feet and loosen tight clothing. Apply cool, wet cloths.

Symptoms of heatstroke are red, hot, dry skin, high body temperature, rapid pulse, slow and noisy breathing, confusion or unconsciousness. This condition is serious and must be treated immediately. Seek shade; place the individual on their back and undress. It is especially important to cool the head. Have the individual drink fluids and rest.

To protect Investigators exposed to the effects of UV radiation and windburn, sunscreen lotion should be applied generously and frequently before going out in the sun. A sun-blocking product, for example, zinc cream-should be applied to the nose, lips and ears.

Sunburn can be caused even on hazy or cloudy days. Investigators should observe the precaution of wearing long sleeves and a broad brimmed hat.

When temperatures drop, be on guard against hypothermia. If an individual becomes exhausted, is wet, exposed to strong winds, and the temperature drops to between 50 C to 100 C, hypothermia can set in, resulting in coma and possible death. Be alert to symptoms such as irritability, slow breathing, casual attitude and slow movements. In freezing conditions do not touch metal parts with bare hands as your skin might stick to the part.

2.7.7 Hazardous Material

Hazardous materials (Hazmats) jeopardize the health and safety of all personnel at the Incident site and are found in various forms: toxic, flammable corrosive, radioactive, biological and other substances.

When expert advice is needed on dangerous goods at the Incident site, contact the state organization responsible for the provision of support. They can provide advice on chemicals, drugs and insect or other bites.

Adhere to the following guidelines:

a. Assume that hazardous materials are present at the Incident site. Suspect all freight, mail and passenger baggage until positively identified.
b. Always assume that pressure vessels are explosive until rendered inert.
c. Before examining any wreckage, perform a personal site-safety check
d. If a danger has not or cannot be neutralized, use alternative methods for gathering evidence such as photography, or witnesses.
e. Aircraft always contain hazardous materials such as fuel, oil and hydraulic fluid. When possible, clean any serious contamination of fuel and lubricant from the wreckage using a detergent wash and rinse, and when necessary, an approved absorbent. Be aware of the ever-present danger of fire and explosion when cleaning contaminated wreckage.
f. Burning or smoldering aircraft interiors and modern composite materials emit noxious and highly toxic gases and possible carcinogenic particles. While the aircraft wreckage is still burning or smoking, only fire fighters and rescue personnel equipped with Self Contained Breathing Apparatus (SCBA) should enter the wreckage. If it is essential for an Investigator or any other person to enter such an environment, SCBA equipment must be worn and, in case of difficulties, one or more assistants who are similarly equipped and ready to evacuate must assist the person

Chapter- 3

Investigation

3.1 Commencing a safety investigation

The following steps shall be considered when launching a safety investigation:

The investigation team formed as per 1.2 shall:

- notify personnel and companies involved;
- Establish a repository of all information relating to the investigation (e.g. a file in the safety reporting dataset).

3.2 **Medical**

In the event of a fatal accident, ensure that arrangements have been made for complete autopsy examination of fatally injured flight crew and subject to the particular circumstances, of fatally injured passengers and cabin attendants, by a pathologist, preferably experienced in accident investigation. The examinations shall be expeditious and complete. When appropriate, the Committee will make arrangements for expeditious medical examination of the crew, passengers and involved aviation personnel, by a physician, preferably experienced in Incident investigation. Such examinations should be expeditious and may also determine whether the level of physical and psychological fitness of flight crew and other personnel directly involved in the Incident is sufficient for them to contribute to the investigation.

3.3 Legal

The Chief Investigator shall coordinate with judicial authorities, as necessary; with particular attention to evidence that requires prompt recording and analysis. If in the course of an investigation it becomes evident, or it is suspected, that an unlawful interference was involved, the Chief Investigator shall immediately inform the Authority and when required Police or initiate action to inform relevant security authorities to deter the security threats and bring back the safety of the flight, equipment and personnel. In this regard the Committee will seek the assistance of government departments, airport administrations and tenants who are responsible for preparing individual contingency plans applicable to their organizations wherein such plans are usually coordinated amongst the organizations for cohesive implementation by issuing staff instructions, installing communications systems and undertaking training, in order to respond to such act of unlawful interference.

3.4 Site considerations

On- site investigation is to collect as much evidence as possible before the wreckage has been disturbed. Sometimes the time available for an on-site investigation may be limited by factors outside the Investigator's control, such as weather, or a hazardous location. Therefore, it is required to concentrate on collecting relevant evidence rather than trying to analyze the Incident on-site.

The Chief Investigator should contact the local police or Airport security as applicable to ensure the security of the wreckage until their arrival. The Investigator must ensure that the security or police is aware of site security requirements including the possibility of hazards from dangerous cargo.

3.4.1 At the Site

The Chief Investigator must attend to the following, immediately on arrival. Establish who has control of the crash area. Check with them whether there has been any disturbance of the wreckage during any rescue operations and record the extent of the disturbance. Make arrangement for the medical examination of crew, passengers and involved aviation personnel by a physician, preferably experienced in Incident investigation. It is required that persons, such as the landowner or local authority agencies, do not disturb the site. Be mindful of the normal functional use of the Incident site. Review arrangements for guarding the site and impress on any guards the importance of their duties, in order to;

1. Prevent disturbance of the wreckage.

2. Protect and preserve, where possible, any impact marks made by the aircraft.

3. Admit only those persons or vehicles authorized.

3.4.2 Precautionary Measures

Observe the availability of following precautionary measures.

There should be attendance (?) of emergency services and assurance that any fire has been extinguished. Precautions must be taken to prevent an outbreak of fire. In particular the investigator should check that electrical power is not still applied to any system.

If residual fuel has to be drained from the aircraft as a precautionary measure, the quantity removed and from which tank(s) it was removed must be recorded.

During subsequent examination of the wreckage beware of causing further fire/explosion hazard by rupturing any system component- for example, oxygen supply lines.

Other hazards, which may be present at the site, particularly after a fire has occurred, are associated with the following.

1. Inflated tyres
2. Compressed springs
3. Hydraulics/Pneumatics
4. Oleos
5. Igniters

6. Oxygen system- fixed and portable
7. Fire extinguishers
8. Evacuation chutes
9. Life rafts and jackets
10. Composite materials

Dangerous cargo may have been in the aircraft. The aircraft operator may confirm this. In this case, examination of the wreckage must not commence until there is confirmation by an expert that the site is safe for personnel to work in. This applies particularly to radioactive or biological cargo.

3.4.3 Initial Site Survey

The primary consideration is to establish;

1) A probable flight path
2) Impact angle
3) Impact speeds
4) Whether or not the aircraft was under control
5) Whether structural failure occurred prior to impact

The Investigator is not required to attempt a detailed examination at this stage. The initial aim is to obtain as complete and clear a picture as possible of the circumstances under which the accident occurred.

This is needed to establish a reference point, and then follow the subsequent path of the aircraft by searching for marks or scars on ground, on buildings, trees, shrubs, rocks, etc.

General survey of the wreckage and the knowledge gained of the terrain will assist the Chief Investigator in planning the investigation and assessing priorities in the work to be undertaken.

3.4.4 Preservation of Evidences and Records

a. All physical evidence and deductions made by Investigators or groups responsible for various aspects must be recorded. As a guide, a pocket-sized notebook will be convenient for recording details at the Incident site.
b. Determine and record the precise location of the Incident site. In difficult terrain this could be done using a Global Positioning System.
c. Determine the site elevation and significant terrain gradient, as both may be relevant to the Incident.
d. Preservation of impact marks is very important, careful note should be made of all ground marks so that guard arrangements may be amended where necessary to provide additional security.
e. Ensure that all aspects of the wreckage trail are preserved, photographed and their description and location have been recorded.
f. Ensure that flight recorders are left in place until specialists' advice on their removal is obtained. Special handling and preservation precautions are needed if the recorders are recovered from the water.

The officers should pay special attention to handle various articles, which may be required as evidence. These articles may consist of documents or aircraft components or material. Investigators must therefore:

a. Ensure that the integrity of these potential exhibits is preserved
b. Try to handle evidence as little as possible.
c. Retain the item as closely as possible in its original condition.
d. Make immediate arrangements for appropriate preservation and safe storage. This may include oiling, greasing, wrapping or sealing.

3.4.5 Collection and Handling of Fluid Samples

If there is any likelihood of the fluid samples, including fuel and oil, being required as evidence, they should be obtained in accordance with the following procedures;

i. At least three samples in the presence of the person giving permission and are sealed securely.
ii. Each fuel sample should be at sufficient amount.
iii. Each bottle should be marked with the source, date, time and place of the taking of the sample and should be signed by the officer concerned.
iv. The three sample bottles should then be distributed as follows;
    a. One to the owner or, with the owner's permission to pilot or any other as applicable
    b. One for analysis.
    c. One to be retained with the Investigator as control
    d. The three sample bottles should then be distributed as follows;
        II. One to the owner or, with the owner's permission to pilot or any other as applicable
        III. One for analysis.
        IV. One to be retained with the Investigator as control

Note: When on-site investigation has been completed the Chief Investigator will hand over the aircraft wreckage to the owner or their representative so that salvage/clean-up operations can commence. It is requested to record the movement of the evidences. Record the position of personal effects found at the site of an occurrence. Hand them to police, obtaining a receipt for significant items.

3.4.6 Task Allocation

The importance of timely discussion with other members of the team, when key evidence is discovered, should be emphasized. Additionally, regular meetings of the team should be held to review the progress of work and to permit a free interchange of ideas and information by team members. The team members assigned to the groups depending on their special qualifications. All investigators should be permitted reasonable rest periods and their welfare must be looked after. The Chief Investigator should impose on realistic targets.

3.4.7 Photographing

Photographs need to be taken as soon as possible before removal of evidences from the occurrence site. Photograph impact marks as a first priority as these may be obliterated by later activity at the Incident site. Since many photographs will be taken, it is essential that they are labelled and indexed in some way to assist later analysis. A simple title-board written with a felt pen and sheet of paper can be used to identify closeup photographs.

Free use of digital photography is recommended for ease of duplication, transfer and preservation in a computer. Good quality of photograph should be ensured by examining the results before disturbing the evidence. More than one camera should invariably be used for safety of photographs. Photographs should cover general views of the scene from four directions.

A good coverage of the wreckage in the condition in which it is found and before it is disturbed is essential. Record the location and direction of each photograph, paying particular attention to the following:

a. Engine(s), before anything is moved, showing details of condition and damage from all
   I. Engine control lever positions at the engine
   II. Engine components, and accessories
   III. Engine instrument readings and positions of control levers and switches
   IV. Nature of damage to engine compressor and turbine blades indicating FOD or blade material failure
   V. Nature of damage to propeller blades indicating rotation at the time of impact

b. Instrument settings and readings

c. Position of controls in the cockpit

   I. Radio settings
   II. Autopilot setting
   III. Fuel selectors
   IV. Switch positions
   V. Undercarriage and flap selector positions
      a. Control surface positions

      b. Trim tab settings

d. Suspicious breakages or bends

e. Propeller/rotor blades showing pitch positions

f. Fire damage

g. Impact marks

h. Seats and seat belts

Consideration should be given to the use of overlapping photographs, which are sometimes of particular value for both aerial and close photography. Consider also any photographs or video imagery taken by witnesses.

3.4.8 Wreckage Distribution Chart

After the initial study of the general scene of the Incident and photographs taken, one of the steps is to plot the distribution of the wreckage from a convenient datum. This task must be carried out carefully and accurately, as the study of the completed chart may later suggest possible failure patterns or sequences. This data can be referred frequently during the investigation and it will supplement the written report. While preparing the chart pay attention to any components such as control surfaces, wheels, this may be conspicuous by their absence. In most Incidents the chart should record the following:

a. Location of all major components, parts and accessories
b. Freight
c. Location at which any Incident victims were found
d. The initial contact markings and other ground markings, with suitable reference to identify the part of the aircraft or component responsible for the markings
e. Pertinent dimensions, descriptive notes and also the locations from which photographs were taken add to the completeness of the chart.

3.4.9 Examination of Impact Marks and Debris

Determine which part of the aircraft impacted first. This can usually be done by locating the marks of the first impact of the aircraft, and examining the distribution of the wreckage. From these marks it is usually possible to form a preliminary picture of:

a) The direction, angle and speed of descent

b) Whether it was a controlled or uncontrolled descent

c) Whether the engines were powered at the time of impact

d) Whether the aircraft was structurally intact at the point of first impact

3.4.10 Wreckage in the Water

3.4.10.1 General

Wreckage in salt water can deteriorate quickly, particularly magnesium and, to a lesser extent, aluminum. As this process accelerates on exposure to air, wreckage collected from salt water must be washed thoroughly with fresh water as soon as it is raised. Further preservation action will be required for any components that must be subjected to metallurgical examination. Water displacing fluid, oil or inhibited fluid may be used as an interim preservative solution. Components such as CVR and FDR should not be dried but kept in fresh water until a specialist can assume responsibility.

3.4.10.2 Locating the wreckage

For aircraft crash at SEA, the chief investigator should try to obtain the best technical expertise available. Incident investigation of other States known to have experience in this field (e.g. US NTSB, UK AIU, and Canada TSB) should be consulted. Advice may also be obtained from people (e.g. fishermen) with local knowledge of sea beds and currents, etc.

The first step is to ascertain the most probable point of impact basing on floating wreckage, witness reports, search and rescue reports and radar recordings. Buoys should be positioned at the estimated point of impact.

If the water is shallow (less than 60 m), search methods using divers can be effective. If the wreckage is located in deeper water, or conditions make it difficult to use divers, use of the following equipment should be considered:

Underwater equipment used to locate underwater locating devices on the flight recorders.

- Underwater videos and cameras.

- Side-scan sonar equipment.

- Manned or unmanned submersibles.

3.4.10.3 Decision to recover the wreckage

The circumstances and location of an Incident will determine whether salvage of the wreckage is practicable. In most cases, wreckage should be recovered if it is considered that the evidence it might provide would justify the expense and effort of a salvage operation. A decision to discontinue recovery operation should be made in consultation with the parties concerned (the Incident airline in particular).

3.4.10.4 Wreckage distribution

Once the wreckage has been located, a chart plotting the wreckage distribution should be prepared. In shallow waters, this can be achieved by divers. In deep waters, underwater video cameras from remotely controlled submersibles may be used. The state of the various pieces of wreckage, their connection by cables or pipes, the cutting of these connections for the salvage operations, etc., should be recorded before lifting the various pieces of wreckage from the bottom. As divers will not be experienced in Incident investigation, they will need detailed briefings.

3.4.10.5 Preservation of the wreckage

The rates at which various metals react with salt water vary considerably. Magnesium components react quite violently and, unless recovered within the first few days, may be completely dissolved. Aluminium and most other metals are less affected by immersion in salt water. However, corrosion will rapidly accelerate once the component is removed from the water, unless steps are taken to prevent it. Once the wreckage has been recovered, its components should be thoroughly rinsed with fresh water. It may be convenient to hose the wreckage as it is raised out of the water prior to it being lowered onto the salvage vessel. Freshwater rinsing does not stop all corrosion action. When large aircraft are involved, it may not be practicable to take further anti-corrosion action on large structural parts. However, all components that require metallurgical examination will require further preservation. The application of a water-displacing fluid will provide additional corrosion protection; fracture surfaces should then be given a coat of corrosion preventives such as oil or inhibited lanolin. When organic deposits, such as soot deposits or stains, require analysis, organic protective substances should not be used. Freshwater rinsing should be employed followed by air drying. When the component is completely dry, it should be sealed in a plastic bag with an inert desiccant such as silica gel. Flight recorders should not be dried but should be kept immersed in fresh water until the assigned flight recorder specialist assumes responsibility for them.

3.4.10.6 Precautionary measures

When recovering the wreckage, consideration should be given to deflating tyres and pressure containers as early as possible. Corrosion of magnesium wheel assemblies can progress rapidly to the extent that the wheel assemblies become safety hazards.

Other pressure containers should be discharged as soon as their contents have been evaluated. The operation of recovery equipment and the supervision of salvage personnel should be left to the salvage contractor. The investigator may provide advice on how to attach cables, hooks, etc., to the wreckage to ensure that it is not unnecessarily damaged during the recovery. When salvage barges, which are equipped with large machinery, hoists, cables, nets, rigging equipment, etc., are used, investigators should exercise caution and, in particular, should remain clear of equipment and sling loads.

3.4.10.7 Debris tagging and documentation

3.4.10.7.1. Debris data system

Proper records should be kept of the items found from the recovery operation. The records should contain details related to each piece, such as recovery location, extent and type of damage, photographs, sketches, and the manufacturer’s engineering drawings showing the part’s location on the aircraft. A debris data management team should be set up to systematically record all the wreckage pieces recovered. The team should be headed by an investigator or a member of the Structures group. The team should comprise or be supported by members of the Structures group, who will examine the debris items to try to identify the portions of the aircraft where they may have come from.

3.4.10.7.2. Tagging of wreckage pieces

All large and small wreckage items recovered from the sea that are identifiable and considered significant should be tagged for reference. The tag should carry a reference number and the following information:

a) Location where the wreckage piece was found

b) Date/time of the recovery

c) The recovery team involved

If necessary, color-coded tags may be used to readily identify the different zones of the debris field from which the items have been recovered. For example, the debris fields may be divided into the Red, Green and Yellow Zones and red, green and yellow tags are then used respectively for the items recovered from these zones.

Tags are usually attached to the items promptly upon recovery and before the items are transported to the shore or storage area. Nevertheless, items found and brought in by other parties (e.g. volunteers) may not carry any tags.

3.4.10.7.3. Logging into a debris database

After the specialists of the data management team has examined the items and identified the portions of the aircraft where they have come from, the items are assigned a log number for input into a debris database together with any other details and sketches or photographs. The log number is written on the wreckage piece itself and on a separate tag that is to be attached to the piece.

It is possible that one tagged item may spawn many more log numbered items. For example, during salvage and reconstruction efforts it may occasionally become necessary to cut or separate objects (previously tagged as a whole) into more than one piece; some objects may have been extracted from an entangled group of debris (recovered and tagged as a unit); pieces may have been received in a bag, net or box full of other items with one tag assigned to the container; or some parts may have broken during handling and transport. In all of these situations, the recovery position information on the original tag must be transferred to the log numbered tags assigned to the separated objects.

For easier referencing, a classification system for the log numbers may be created. For example, the following nomenclature was used by NTSB for the TWA 800 wreckage (XX denotes the number assigned to an individual piece):

- LF-XX Left fuselage
- RF-XX Right fuselage
- LW-XX Left wing
- RW-XX Right wing
- H-XX Horizontal stabilizer (both sides)
- LE-XX Left elevator
- RE-XX Right elevator
- V-XX Vertical stabilizer
- R-XX Rudder
- CW-1XX Wing centre section - upper skin
- CW-2XX Wing centre section - lower skin
- CWS-10XX Wing centre section - rear spar
- CWS-11XX Wing centre section - butt line zero rib
- FBM-XX Floor beam
- LG-XX Landing gear

Chapter- 4
Analysis of facts

4.1 General

Once the evidence is gathered, all the facts and information shall be analysed to identify 'what' happened and, more importantly, 'why' it happened. It is often easy to identify 'what' happened; the factual information should reveal this. The 'why' it happened can be challenging, but this is where the real lessons and safety benefits are. There are a number of well-known tools available to dig deep to identify the root cause (s) of the Occurrence or hazard. Such tools are: Bow-Tie Analysis (BTA), 5-why analysis, Ishikawa or 'fishbone' Analysis, Fault Tree Analysis (FTA) etc. Investigators can use any one or combination of them in the investigation process.

While investigating the occurrence, investigators shall also conduct the Human Factor Analysis (HFA) to determine the level of human factor contribution to the occurrence. For the purpose of HFA, investigators can use human factor analytical methodologies like Human Factors Analysis and Classification System (HFACS), SHELL model etc. Sometimes, human factors analysis can also be conducted through the RCA tools as a component of analysis while analyzing the causes of occurrence.

The investigators shall also conduct the Organizational Factor Analysis (OFA) to determine the level of organizational factor contribution to the occurrence. For the purpose of OFA, investigators can use separate OFA tools or human factor analysis tools which also help to determine the organizational factor contribution to the occurrence.

It is often worthwhile to use pre-established and proven analytical methodologies to help identify and organise the causal links of an occurrence. This will help to avoid bias, misidentification, or misinterpretation.

See Appendix-2 and 3 for details about tools for Root Cause Analysis and Human and Organziational Factor analysis.

4.2 Human Factors Analysis

4.2.1 Objective

In all type of investigations, the human factors analysis shall be conducted. The prime object of the Human Factors analysis is to obtain evidence through an examination, if any such evidence exists, of abnormal behaviors or fatigue of the operating crew, the cabin attendants and passengers, air traffic controllers, maintenance personnel and other ground staff, which may have caused or contributed to the occurrence.

4.2.2 Analysis

Human factors involved in the occurrence should be fully explored during the investigation. These aspects can then be discussed further with the appropriate specialist if necessary. The focus on human performance can be directed toward any individual involved in the occurrence, but usually includes cockpit crewmembers, air traffic controllers or maintenance personnel. It may also be directed at larger system issues, such as company policy, training and design.

Normally following elements are covered in the human factor analysis

a. Behavioural
b. Medical
c. Operational
d. Tasks
e. Equipment design
f. Environmental
g. Organizational culture

Behavioral

72-hour history. A critical part of the human performance investigation is to trace the activities for at least 72 hours prior to the occurrence, of all individuals of importance to the occurrence, in order to determine:

i. Sleeping history
ii. Eating history
iii. Drinking history
iv. Purpose of the flight
v. Preparation for the flight
vi. Unusual activities or events
vii. Mood of the crew
viii. Interaction between the crew
ix. Any other information that could prove critical to understanding the occurrence

Information related to the 72-hour history is considered ‘perishable’ since memory tends to become less accurate and less detailed over time. Persons who should be interviewed are those who have had close contact with the personnel involved during that period. Even evidence from these witnesses to the effect that everything seemed routine can be of considerable value to the investigation.

Medical

The medical records of the personnel involved may indicate whether any condition was known to exist which might have precluded the successful completion of any task demanded of them under the prevailing circumstances. Aviation Medicine may, on request, provide this information.

Particular attention should be given to any condition likely to have led to incapacitation inflight or to deterioration in fitness and performance. Toxicological factors must also be considered, but to be conclusive, samples, must be obtained from the person as soon as possible after the event. Other specific areas, which should be considered, are sensory acuity, drug/alcohol ingestion and fatigue.

In the event of actions and behavior of the crew being required to be examined further, it is imperative that the crew medical examination is conducted immediately after the Incident. The crew's medical examination should be conducted at a CAAN approved facility or hospital and must include blood and urine samples testing for presence of alcohol or any other stimulants which may have an effect on crew's faculties.

Operational

Specific areas relative to human performance are training, operating procedures, experience, familiarity, habit patterns, and company policy. Records should be obtained from the training school and/or company.

Task

Excessive workload at the time of the occurrence is a common cause of human failure. Although this may be related to training and competence, other factors such as task information, task components, task-time relationship and workload require investigation.

Equipment Design

Equipment design may apply to an aircraft cockpit, maintenance workshop or air traffic control console. The aspects that should be investigated are the human/equipment interface, display or instrument panel design, control design and even seat design and configuration.

Environmental

Environmental factors are often beyond the control of the individual involved. Aspects such as excessive noise/vibration/motion, extraneous or insufficient illumination and weather producing reduced visibility or turbulence, warrant examination.

Checklist of Human Performance Questions

This short checklist (see below) may be used selectively to interview individual witnesses. Additional questions often are suggested by the details of the specific occurrence. By listening closely to witness descriptions, and by asking simple questions to reach a "common-sense' understanding of the occurrence, the investigator can often generate additional areas for greater human performance understanding.

Human performance interviews normally begin with very general questions that allow witnesses to describe what they know at length and without influence from the interviewer. As the interview progresses, more pointed questions are normally asked to focus the witness on topics that have not been fully addressed.

Human Performance Questions

a. Activities in the Last 72 Hours

I. When was the last time you (pilot, Air Traffic Controller, LAMT) worked before the occurrence? When did you work during the previous three days? What were your other activities during this period?

II. When did you go to sleep the previous night (or previous three nights)? When did you wake up? Did you feel well rested?
III. What is your normal work schedule? When are your days off, holidays? When was your last holiday?
IV. Describe your activities on the day of the occurrence up until it occurred. When/what did you eat? Any rest breaks?
V. Was this an unusual schedule?
VI. How is your level of experience with this particular type of aircraft?

b. Occurrence History

I. Have you been involved in any previous occurrences?
II. Have you been disciplined for your performance/have you been commended for your performance?

c. Life Changes in the Past Year

I. Have you had major changes in your health (good or bad)
II. ii. Have there been major changes in your financial situation (good or bad)
III. iii. Have there been major changes in your personal life (for example, separation, divorce, birth, death, etc.)

d. Medical/drugs

I. How is your health?
II. What is the name of your personal doctor?
III. How is your vision? Do you wear corrective lenses? Name of Eye doctor? Prescription?
IV. How is your hearing? Do you wear a hearing aid? Name of doctor?
V. Do you take prescription medicine? What, how often? When was the last time you took it before the occurrence?
VI. Do you drink alcohol? When/what was your last drink before the occurrence? How many drinks did you have?
VII. Do you smoke tobacco? Last use before the occurrence?
VIII. Do you use illicit drugs?
IX. In the 72 hours before the occurrence did you take any drugs, prescription or non-prescription that might have affected your performance?

a. Workload

- How was your workload on the day of the occurrence? Was your workload affected by the weather?

b. Environmental

- Any problems with the aircraft/vehicle?
- Any problem with noise, vibration, temperature?
- Any problems with visibility (instruments, signals, etc.)?

c. Mood

- What was the mood of the other crewmembers before the occurrence? During the occurrence? After the occurrence?
- Had the crewmembers flown together before?
- Did the crewmembers get along personally? Did they see each other socially? What did they talk about?
- How did the pilots get along with passengers/flight attendants?
- Are pilots having family issues, like going through the bad time financially or emotionally?

d. Background - Other Sources

- What was the subject like personally?
- Was the subject married? Any children? What were the subject's living arrangements? - What level of education did the subject complete?
- How did the pilot get interested in aviation? Where did the pilot train? What were his/her previous jobs?
- What did the pilot like about flying? About this job? About the aircraft?
- How familiar was the pilot with the route? With the airport?
- What was the deadline for completing the trip?
- What were the pilot's greatest strengths as a pilot? Were there areas in which the pilot could have improved?
- Did anyone ever complain about flying with this pilot?
- Did the pilot ever complain about the company or equipment?
- Did the pilot experience any emergency, incident or problem during a previous flight? What happened? - Did the pilot receive training in Crew Resource Management?

See Appendix 3 for Human factors analysis tools

4.3 Organizational Factors Analysis

In all type of investigations organizational factors analysis shall be conducted to find the possible involvement of organizational factors in contributing the incidents or accident. It is argued that modern aircraft Incidents occur, for the most part, as the result of complex interactions between many causal factors - for example:

a. Active failures committed by those at the 'sharp end' (cockpit, flight line), having immediate impact upon the integrity of the aircraft.
b. Local triggering factors
c. Latent failures, originating in the managerial and Organizational spheres, whose consequences may lie dormant for long periods. These factors would eventually lead to committing of unsafe acts.

4.3.1 Unsafe Acts

Unsafe acts, as described by Professor Reason 1991, can be categorized into two distinct groups:

a. Errors

b. Violations

All involve deviations from rules and standards, but they differ with regard to the nature of the deviation. Here we discuss the psychological varieties of unsafe acts.

4.3.1.1 Errors

Errors may be of two kinds:

a. Slips in attention and memory lapses, involving the unintended deviation of actions from what may be a perfectly good plan.
b. Mistakes, where the actions follow the plan but the plan deviates from some adequate path to the desired goal.

Mistakes

Mistakes fall into two groups:

1. Rule-based mistake, in which the individual encounters some relatively familiar problem, but applies the wrong pre-packed solution.
2. Knowledge-based mistakes, in which the individual encounters a novel situation for which his/her training has not provided some rule-based solution and he/she has to use on-line reasoning based upon some (usually) incomplete or incorrect mental model of the problem situation.

4.3.1.2 Violations

Violations involve deliberate deviations standards and procedures. There are generally three types of violations.

1. Routine violations, involving short cuts between task-related points
2. Optimizing violations, in which the individual seeks to optimize some goal other than safety.
3. Exceptional violations, one-off breaches of regulations seemingly dictated by unusual circumstances. Not all violations are necessarily bad or cause Incidents. On some occasions they save lives, on others they go badly wrong and cause Incidents.

4.3.2 Conditions that Promote Unsafe Acts

Error-producing conditions are ranked in the order of their known effects as shown below. The numbers in parentheses indicate the risk factor: -

a. Unfamiliarity with the task (x17)
b. Time shortage (x11)
c. Poor signal: noise ratio (x10)
d. Poor human-system interface (x8)
e. Designer-user mismatch (x8)
f. Irreversibility of errors (x8)
g. Information overloads (x6)
h. Negative transfer between tasks (x5)
i. Misperception of risk (x4)

j. Poor feedback from system (x4)
k. Inexperience (not lack of training) (x3)
l. Poor instructions or procedures (x3)
m. Inadequate checking (x3)
n. Educational mismatch of person with task (x2)
o. Disturbed sleep patterns (x1.6)
p. Hostile environment (x 1.2)
q. Monotony and boredom (x 1.1)

The error-producing factors at the top of the list are those that lie squarely within the organizational sphere of influence.

4.3.3 Conditions that produce Violation

Violation producing conditions include:

1. Manifest lack of organizational safety culture
2. Conflict between management and staff
3. Poor morale
4. Poor supervision and checking
5. Group norms condoning violations
6. Misperception of hazards
7. Perceived lack of management care and concern
8. Little élan or pride in work
9. A macho culture that encourages risk-taking
10. Beliefs that bad outcomes won't happen
11. Low self-esteem
12. Learned helplessness ('Who gives a damn anyway' attitude)
13. Perceived Licence to bend rules
14. Ambiguous or apparently meaningless rules
15. Age and sex

4.3.4 General Failure Types (GFT)

There are 12 General Failure Types that are likely to apply to any aviation system. These are:

1. Inadequate regulation/procedure
2. Incompatible goals
3. Organizational deficiencies
4. Inadequate communications
5. Poor Planning
6. Inadequate control and monitoring
7. Design failures
8. Inadequate defenses
9. Unsuitable materials
10. Poor procedures (both operations and maintenance)

11. Poor Training
12. Inadequate maintenance

Together, these GFTs constitute the ‘vital signs’ of an organization, providing an indication of its current ‘safety health’.

4.3.5 Post Incident Application

The principles of Incident causation form the basis of a powerful Incident investigation tool that allows the underlying latent failures to be identified in a step by-step fashion. In particular, it permits the basic facts of an Incident to be assembled into a coherent and remedially useful analysis. This would begin with the failed defenses and end with the fallible top-level decisions that set the Incident sequence in motion.

Defenses - What aspect(s) of the aircraft’s defensive system was absent, Failed or circumvented (that is, detection, recovery, containment, protection or escape)?
Unsafe Acts - What types of actions were involved in breaching or bypassing the defenses (that is, slips, lapses, rules-based mistakes, and knowledge based mistakes, routine violations, optimizing violations or Exceptional violations)? Were these individual or group failures?

Preconditions - What was the task, situational or environmental factors that promoted the occurrence of these unsafe acts (that is, error-producing conditions and violation-producing conditions)?

General Failure Types - Which of the 12 GFTs were implicated in creating these preconditions? Were there any other failure types involved?

Fallible decisions: Which departments were primarily responsible for these Incident-implicated GFTs? What were the factors that shaped their underlying decisions? What shortcomings, if any, does this Incident reveal in the organization’s safety culture (that is, top-level commitment to safety goals, competence to achieve these goals and cognizance of the variety of hazards threatening the system)?

The steps listed above merely indicate the main stages of Incident analysis. At each level, it is possible to make detailed connections between the identified ‘facts’ and their likely precursors at the preceding level, though this process becomes more problematic at the higher levels of the organization where there is likely to be a ‘many-to-many’ mapping between top-level decisions and GFTs.

See Appendix 3 Organizational factors analysis tools.

Chapter - 5

Operation-Investigation

5.1 General

This relates to the history of the flight and to the activity of the flight crew before and during the occurrence. The major areas involved in the operations investigation are;

a. Crew histories
b. Flight Planning
c. Weight and Balance
d. Weather
e. Air Traffic Services
f. Communications
g. Navigations
h. Aerodrome facilities
i. Aircraft Performance
j. Compliance with relevant instructions
k. Examining witness statements
l. Determination of final flight path
m. Sequence of flight

There is close link between the work in the Operations Investigation and that in other investigation areas, such as the flight path of the aircraft can be constructed from ATC data and witnesses and also from FDR data. These must be compared and crosschecked to properly execute the investigation.

The area specialist shall be included to investigate the respective aspects of an occurrence. This person is responsible for establishing, recording, and verifying the accuracy of all information relevant the area in connection with the safety of flight operation.

5. 2 Crew Histories

A study of all the facts pertaining to the crew forms an important part of both the Operations and Human Factors investigations. A high degree of coordination in the collection and evaluation of the relevant facts is required to achieve the best possible use of the information collected. The crew histories should cover their overall experience, their activities, especially during the 72 hours prior to the occurrence, and behavior during the events leading up to the occurrence.

5.3 Flight Planning

A flight plan may have been prepared and filed with air traffic services. This will provide the Investigator with data such as the route, cruising altitudes and timings. It may also provide fuel load and fuel consumption etc. that may need to be examined in detail and correlated to the actual flight path. In the case of occurrences involving navigation factors or fuel consumption problems, it may be necessary to check flight plans and navigation logs to ensure that the data from which the flight plans were derived relevant to the particular circumstances of the intended flight, such as weather, aircraft type and model, cruising altitude etc. In the case of light aircraft operated on private and training flights, it will be useful to ascertain the crew's intentions regarding the flight and any maneuvers planned

5.4 Weight & Balance

A Weight & Balance sheet based on the planned flight may have been prepared. Commercial flights generally use a standard form for these calculations. In the case of light aircraft, a weight and balance sheet is rarely prepared. Since weight, balance and load are critical factors that affect aircraft stability and control, considerable effort should be made to deduce the most probable weight of the aircraft at the time of occurrence, having regard to the flight time since take-off. Elevator trim settings may give a clue to the center of gravity at the time of occurrence.

5.5 Weather

Weather conditions at the time of occurrence may be obtained from actual observations or by a post-flight analysis requested from the Department of Meteorology.

5.6 Air Traffic Services

Operations or Air Traffic specialist must be included to investigate these aspects of an occurrence. This person is responsible for establishing, recording, and verifying the accuracy of all information relevant to Air Traffic Services in connection with the flight. These include the following:

a. Relevant AIPs
b. NOTAM
c. Aeronautical Information Circulars
d. Flight plan
e. R/T transcripts
f. Radar plots
g. ATS procedures
h. ATS software

The various functions exercised by Air Traffic Services such as ground movement control, area control, approach control and aerodrome control may enable an Investigator to trace the progress of the flight from the planning stage up to the occurrence.

Communications between aircraft and ATS are normally recorded in the ATS tape. Since the tapes are recycled, an immediate request must be made to ATS, if access to them is required.

5.7 Navigation

The navigation equipment carried in the aircraft should be checked against the aircraft records and the remains of the navigational equipment recovered from the wreckage. The serviceability and performance of navigation aids, which may have been in use, should be checked. The adequacy of current maps and the currency of the charts used in the aircraft should be checked.

5.8 Aerodrome Facilities

The status of aerodrome facilities used by the aircraft may have to be examined and verified.

5.9 Compliance with Instructions

A necessary part of the operational investigation is to establish whether particular directives were complied with. The directives should also be examined to distinguish what material has mandatory effect and what is advisory. The directives may have many different forms including the following:

i. Flight Manual
ii. Operations Manual
iii. NOTAM
iv. Aeronautical Information Publications
v. Aeronautical Information Circulars
vi. Aircraft Manufacture's Notices
vii. Airworthiness Directives
viii. Maintenance Control Manuals
ix. Aviation Safety Notices
x. Maintenance systems

5.10 Final Flight Path

The reconstruction of the Incident path necessitates close cooperation between the various groups or individuals involved in the investigation. If a separate team has been set up for Operation Investigation, this becomes its primary concern. The intention should be to build up a complete picture of the final events as they occurred, in proper sequence, and to evaluate their interrelationships. The period of time to be covered will depend on the circumstances. Generally, the period should commence when the flight departs from safe (normal) operation and should terminate when the inevitability of the Incident is indisputably apparent. This may or may not always be the point of impact - for example, in the case of an in-flight break-up.

Chapter-6

Flight Recorder/ATS Recording

6.1 General

The term 'Flight Recorders' encompasses three separate and distinct types of airborne recorders:

1) The Flight Data Recorder (FDR),

2) The Cockpit Voice Recorder (CVR)

3) The Quick Access Recorder (QAR).

Because of the sophisticated and expensive replay equipment required for analyzing recorded information, the Authority will seek assistance of the services of Manufacturer or Manufacturer's recommended facility if this information is necessary for an investigation.

As Nepal does not have adequate facilities to read out the flight data recorders, the Authority as the State conducting the investigation, will use the facilities made available to it by other States, giving consideration to the following:

a) the capabilities of the read-out facility;

b) the timeliness of the read-out; and

c) the location of the read-out facility.

The Authority will also arrange timely read-out of the flight recorders and the analysis of the data contained therein and recovery and handling of recorders, including damaged recorders and recorders recovered from water. For an expeditious recovery and handling of recorders including damaged recorders and recorders recovered from water by seeking assistance as applicable through the services of Police and other defense services such as Army and police. To this effect the Authority will issue necessary correspondence to these State agencies for expeditious recovery of the recorders for the purpose of investigation.

Procedures for handling of recorders have laid down in paragraph 8.4 below.

6.2 Recorder Types

6.2.1 Flight Data Recorder

The FDR, often referred to as the 'flight recorder', or Digital Flight Data Recorder (DFDR), is a system for recording the values of defined basic flight parameters in relation to a time base. The number of parameters recorded varies from aircraft type to aircraft type. The parameters recorded for a particular aircraft can be obtained from the operator. The digital recorders in use in the majority of aircraft have a limited recording cycle of 25 (operating) hours. If they are required for investigation, prompt action is required to ensure their removal from the aircraft.

Although FDRs are built to withstand rough handling, keep them away from any radiation (radar source) or strong magnetic fields.

6.2.2 Cockpit Voice Recorder (CVR)

The CVR is a system for recording crew conversations and ambient noises in the cockpit, via a multidirectional microphone, the cockpit intercommunications system, the Public Address system, and radio (R/T) communications.

6.2.3 Quick Access Recorder (QAR)

The QAR, or Flight Data Acquisition Unit, is a recorder installed in some aircraft, which uses the same information sources as the impact-protected DFDR (required by legislation). The difference, however, is that the operator is able to program this recorder to obtain higher resolution information for their own monitoring purposes. All CVRs shall retain the information recorded at least the last 2 hours of their operations.

6.3 ATS Recordings

The Authority shall ensure that in the event of an incident, serious incident or accident, all air traffic services communication and radar data recordings and documents associated with the flight are secured and placed in safe keeping. Since as a part of International requirements to the implementation of the SARPs, all State Organization are required to ensure security and safe keeping of the ATS communication and radar data recordings. The Authority will ensure its access for the purpose of investigation, by providing necessary instructions to continue the security and safe keeping of the data.

Communications with Air Traffic Services are normally recorded and may be made available provided the tapes are requested before they are recycled through the system. If an opportunity to listen to a communications tape is made available, the Investigator should not only listen to any spoken words but also listen to background noises.

Other sources of communications evidence should not be overlooked although some may not be recorded. Other aircraft on the frequency and ground stations monitoring it may be useful. Continuous recordings are made of communications on ATS frequencies as well as radar data. These tapes are re-used after a period.

6.4 Procedures for handling Recorders

The FDR and the CVR must be handled in accordance with the following instructions.

CAUTION: UNDER NO CONDITIONS SHOULD ANY ATTEMPT BE MADE TO REMOVE OR TO PLAY A TAPE FROM AN FDR OR CVR IN THE FIELD. THE TAPE COULD BE ERASED OR DAMAGED.

Protect the recorder from strong magnetic fields. It is important to remember that an X- ray transmitter at an airport security station may damage the data. If a recorder, tape or solid state memory unit is mailed, please mark the package “SENSITIVE FLIGHT RECORDING WITH CRITICAL DATA. DO NOT EXPOSE TO X-RAY RADIATION OR MAGNETIC FIELDS”.

Do not open the recorder and do not allow anyone to remove the tapes or solid state memory unit under any circumstances.

If the recorder is dry and undamaged, use a shipping container obtained from the operator involved in the accident or incident, if possible. Otherwise package it carefully for shipment, unless it is to be hand-carried; it is not necessary to package an undamaged recorded for hand-carriage.

If the case is broken, do not remove the tape or solid state memory unit from the device. Wrap the entire recorder and its contents in polyethylene or similar material or heavy paper before packaging for shipment.

If the tape reels or solid state memory boards are separated from the unit, wrap them in polyethylene or paper before applying sealing tape. Never apply sealing tape directly to the recording medium. Do not remove the recording medium from the reels or enclosure.

If the recording is a tape and it is found separated from the recorded, try not to wrinkle or cease it. Carefully wrap it on a spool or cardboard tube or something similar. Wrap this in polyethylene or paper and pack it carefully. Enclose all fragments of tape, no matter how small. Never stuff the tape randomly into a box or container. Data are easily degraded; creases and wrinkles can cause electronic noise and permanent data loss.

If the recorder is found in water, do not attempt to dry it. Observe the following instructions; Rinse it in fresh water, preferably distilled, then arrange to ship the recorder immersed in water to the lab in a watertight container. Make sure the recorder stays immersed in water until it arrives at the laboratory. Pack it very securely. If the recording medium is tape, it must not be allowed to dry out under any circumstances.

6.5 Underwater recovery techniques

Flight data recorders and cockpit voice recorders must have an approved device to assist in locating them under water (underwater locator beacon or ULB's). These devices are ultrasonic beacons that operate at 37.5 khz. They are cylindrical in shape and are usually mounted on the face of recorder. ULB receiver kits are available from the manufacturer. The ULB is supposed to operate for 30 days. However, searchers should be keenly aware that operation for a full 30 days is not assured. There are several circumstances that may adversely affect operating life. Because locator beacon battery operating time is limited and because flight recorders containing vital Incident data deteriorate in a water environment, they should be given a very high priority in the recovery operation.

6.6 Obtaining Readouts for FDR's and CVR's

It is very important to secure these recorders as soon as possible after an accident or incident and deliver them intact to laboratory. So that the laboratory may obtain the best possible recovery of the relevant data in a controlled atmosphere using an experienced staff.

The following information will be needed when requesting FDR and CVR readouts.

a) type and condition of recorders
b) Circumstances of the accident or incident
c) Arrangements for method of shipping

For flight data recorders, the following information is required to facilitate the data readout;

a) Local altimeter setting at time of occurrence

b) Elevation at accident/incident site
c) Incident runway, if applicable d) location of previous takeoff, runway used and field elevation
d) location of previous takeoff, runway used and field elevation
e) Local altimeter setting at time of takeoff
f) flight number
g) Coordinated Universal Time of departure
h) Coordinated Universal Time of Incident and accident.
i) A flight itinerary, if the recorder is not pulled immediately after the event

Chapter- 7

Specialized Examinations and Testing

7.1 General

The Committee will take measures for examination and testing of aircraft parts or components in a thorough manner. The Committee will also ensure that in conduct examinations or tests will have adequate supervision.

Specialized examinations may include component testing, examination using scanning electron microscope, chemical analysis, systems testing, flight testing (with an actual aircraft or in a simulator), complete or partial reconstruction of the aircraft or specific systems.

Laboratory examination and testing generally entails the use of specialized equipment not available in the fields and often beyond the capability of an aircraft maintenance facility. Consideration should be given to using the component manufacturer’s facilities where specialized equipment and trained personnel are readily available.

For flight testing in a simulator, the aircraft manufacturer’s facilities may have to be considered. Laboratory testing should not be limited to standards tests. In addition to testing for compliance with appropriate specifications, it is sometimes necessary to determine the actual properties of the specimen (such as metal, material, fuel and oil).

The Chief Investigator should assign an investigator to supervise the specialized examination and testing, or delegate the supervision to a suitable person (e.g. an accredited representative or one of his advisors, or an official of a foreign Incident investigation authority).

Where necessary, non-disclosure agreement with the examination or testing service providers should be worked out.

7.2 Documentation

A test plan should be formulated for the test to be conducted. As far as possible, the test plan should identify the following:

1. Item/system to be tested
2. Objective of the test
3. Test venues
4. Test methods
5. Test equipment
6. Test conditions
7. Test procedures
8. Test schedule
9. Responsibilities of the various parties
10. Data to be collected from the test

Adequate records should be kept and reports compiled for the examination or testing. Photographs should be taken. Videotaping of the examination process should also be considered.

7.3 Practical Arrangement

7.3.1 General

When choosing a system and components for specialized examination and testing, it is desirable to include as many components of the system as practicable, e.g. wiring harnesses, relays, control valves and regulators. Tests conducted on a single component will reveal information about the operation of that particular unit only, whereas the problem may actually have been in one of the related components. The most valid test results will be obtained by using as many of the original system component as possible.

7**.3.2 Information pertinent to failed parts or components to be examined**

Each component should be tagged with its name, part number, serial number and the Incident identifier. The investigators should maintain a listing, descriptive notes and photographs of all components which are to be tested. The components themselves should be kept in protective storage until ready for shipping.

When investigators forward failed parts or components for laboratory testing, they should provide as much information as possible relative to the circumstances contributing to the failure of such parts or components, including a detailed history of the parts or components and their own suspicions, if any. The information in respect of a part or component may include the following:

a. The date it was installed on the aircraft.

b. The total number of service hours.

c. The total number of hours since last overhaul or inspection.

d. Previous difficulties reported.

e. Any other pertinent data that might shed light on how and why the part or component failed.

f. Relevant manuals

The information provided by the investigator is intended only as a guideline to the specialist carrying out the examinations who should, nevertheless, explore all relevant aspects.

7.3.3 Transporting of parts or components

Components should be packed to minimize damage during transport. Particular care should be taken to ensure that fracture surfaces are protected by appropriate packing material so that they are not damaged by mating surfaces coming into contact with each other or with other parts.

Whenever possible, power plants should be shipped in their special stands and containers. Other heavy components, such as flight control power units, stabilizer screw jack assemblies and actuators, should be packed in protective wrapping and placed in separate wooden containers. Blocks or bracing should be installed inside the containers to prevent any movement of the component during transport.

Smaller and lighter components may be shipped in the same manner with more than one to a box but in a manner which will prevent them from coming into contact with one another.

Very light units may be packaged in heavy corrugated pasteboard cartons with sufficient packing material to prevent damage from mishandling during transport.

The investigators should label all boxes and cartons appropriately and should make an inventory list for each container.

7.4 Notes and test results

Notes concerning the specialized examinations should be kept by the facility personnel, and the results should be recorded on the standard forms used by the facility for such work. The investigator supervising the work should also take notes.

Prior to conducting the examinations, the supervising investigator should brief the investigators and the facility personnel involved on the type and extent of the examinations and tests to be carried out and review with them the test procedures to ensure their adequacy.

Any discrepancies found during testing should be photographed and documented with an explanation as to their bearing on the operation of the system or component. It should be kept in mind that the tolerances called for in the test procedures may only apply to new or overhauled components and that components which have been in service for some time may have acceptable limits outside these tolerances. If the nature of the discrepancy warrants, a component should be disassembled following completion of the tests to ascertain the cause of failure. Photographs should be taken of the parts prior to and during disassembly, and the findings should be documented.

Following completion of the examinations, the supervising investigator should review and discuss the results with the investigators and the facility personnel. When there is agreement that the data gathered present a true and factual picture of the component’s condition and capabilities, the notes and test results should be reproduced to serve as a record of the examination and testing of the system or component

Chpater-8
Aircraft Structure Investigation

8.1 General
The aircraft structure investigation concentrates on the airframe, including primary and secondary structure, lift and control surfaces.
When investigating an Incident caused by structural failure of the airframe or system, study the wreckage and evaluate separated components and fractured surfaces. Failure of the airframe structure, fittings, attachments, and other components are sometimes obscured by the ensuing Incident. However, these may have been the primary cause of in-flight disintegration or ground impact in an out-of-control situation.
Knowledge of the history of the flight, prevailing weather conditions, aircraft behavior, and the probable type of air loads sustained during flight maneuvers will assist in determining failure areas.

8.2 Reconstruction of Wreckage

Reconstruction is employed for specific components such as a wing panel, tail surface or control system, although in some instances it has been necessary to reconstruct almost all major components.

First phase of the reconstruction process is to identify the various pieces and arrange them in their relative positions. Second phase is to examine in detail the damage to each piece, and establish the relationship of this damage to the damage on adjacent or associated pieces.

8.2.1 Preliminaries

Before commencing reconstruction work, complete the procedures as follows: Photograph the entire site and wreckage Complete the wreckage distribution chart Inspect and make notes on the manner in which the various pieces were first found, by walking around the site.

8.2.2 Identification of Pieces
The difficulty in reconstructing a component, such as a wing, lies in identifying the various pieces of wreckage. If, on the other hand, the wing has broken up into a few large pieces, the task is relatively simple. If, on the other hand, the wing has broken into a number of small pieces as a result of high impact speed, reconstruction can be extremely difficult. The most positive means of identification are:
1. Part numbers, which are stamped on most aircraft parts, which can be checked against the aircraft parts catalogue
2. Coloring (either paint or primer)
3. Type of material and construction
4. External markings
5. Rivet or screw size and spacing.

8.2.3 Reconstruction on Site

Collect parts from the suspected area, identify them and then arrange them on the ground in their relative positions.

Lay out major components such as the wing, tail and fuselage in planform for ease of later examination.

Note: however, that if the suspected area is at the junction of the major components, these areas are sometimes reconstructed separately. For ease of examination, lay out individual cable runs with their associated bell cranks, idlers and quadrants separately.

If significant markings are found on any of these latter items, corresponding markings must be sought out in the relative positions in the wing, fuselage etc.

8.2.4 Reconstruction off Site

In cases where, due to prevailing conditions, reconstruction is not feasible at the Incident site, it may be decided to transport wreckage to another location. This decision is based on:

1. The type of Incident

2. The facts developed up to that time

3. The importance and validity of the type of information that could be developed by reconstruction under more favorable conditions.

Since additional damage may be caused to wreckage during transportation, ensure that a complete set of notes on all significant smears, scores, tears etc is made prior to moving wreckage.

Prior to transportation, tag, identify and key all major pieces to the wreckage distribution chart. Keep disassembly to the absolute minimum.

If bolted assemblies must be disconnected, make a record of the sequence of the various parts. In cases where control cables have to be cut, take care to identify and tag all cuts.

If these precautions are not followed, valuable information may be lost.

8.3 Examination of the Aircraft Structure

8.3.1 Airframe

The first priority during the preliminary examination at the Incident site is to determine if a structural failure occurred before impact. To do this, the first step is to separate impact damage from in-flight structural failure damage.

Valuable information can be gathered from a study of the various smears and scores found on different parts of the wreckage. Where possible, study these before the wreckage is disturbed, since movement of the wreckage may destroy clues or create misleading ones.

8.3.2 Main planes, Fuselage and Empennage

One of the primary aims when examining the structure is to determine whether there is evidence that any part of the structure was not in its correct relative position at the time of impact.

Components such as cables, pulleys, hinges and tab mechanisms must be examined to determine whether the failure of any of these items was caused by wear, inadequate maintenance or impact.

8.3.3 Undercarriage

Examine the selector, link mechanism, up and down locks and position of the operating jacks or actuating cylinders to ascertain whether the undercarriage was up or down. If the gear had failed or separated, note the direction of the force that caused the failure or separation.

8.3.4 Flight Controls

Trace and carefully inspect all controls, both manually operated and power operated, to confirm that all component parts are accounted for. Note tail plane incidence, tab and flap settings, and compare these with their respective setting indicators in the cockpit.

Check all operating levers and the attachment of control rods or cables to these levers to determine whether they were properly assembled, adequately lubricated and had not jammed.

Examine spoilers, where installed, to determine whether they were extended at the time of impact and whether any failure occurred in their mountings.

Chapter-9

Power Plant Investigation

9.1 General

The failure or malfunction of one or more power plants is often the cause of an occurrence. For this reason it is essential that a careful examination of the power plants and their associated components be made to determine whether they are involved as a causal or predominant factor in the particular occurrence under investigation. The purpose of power plant investigation and analysis is to determine:

a) The condition of the engine at the time of impact

b) The engine power or thrust at the time of impact or failure

c) The sequence of failure and cause of any engine malfunction or failure.

The power plant investigation should include a carefully detailed documentation of all evidence, to include:

a) A comprehensive survey of the impact site and extent of wreckage distribution giving references to the information recorded during the initial site inspection. Any additional details that the power plant investigation turns up should be added as overlays to the original site plan and wreckage-distribution chart, and later copied to the original.
b) An inventory of the engine(s) to ensure that all engine parts, components, and accessories are accounted for and aligned with each respective engine.

9.2 Guidelines to examine various engine components and systems

Check the original Site Plan and Wreckage Distribution Chart for the geographical location and scatter pattern of all engine, parts and accessories, and correct where necessary.

Note the identity and location of any part that may be moved (or removed from the crash site for any reason), altered, or affected by rescue, salvage, or weather conditions. Few examples are:

a. Evidence of case penetration
b. Bum-through damage
c. Ruptured fuel or oil lines
d. Loose fittings
e. Any items that are suspected to be of foreign origin.

Collect any fuel, oil, and hydraulic fluid samples to minimize post-impact contamination or loss of the limited quantities that may remain.

Note: An immediate investigation should be made of the fuel servicing and storage facilities at the last refueling point

Examine the fuel system, including:

a) All filters, screens and pumps
b) Check tanks and cells
c) Fuel lines and valves.

Examine propeller(s) for:

a) Impact damage and overall condition
b) Evaluate broken blades to determine the reason for failure - that is, impact, over speed, malfunction, or fatigue breakage.

Blade angle is a function of power being delivered by the engine. Therefore, blade angle may be one method that can be used to establish engine power or thrust. As a rule, propellers under high power at impact can be expected to bend or curl forward at the tips, while under low power, the blades should curl rearward at the tips. Wind milling or stationary blades should be bent rearward.

Record the condition in which the engine or component was found. Original condition should be indexed, marking the position of any control, valve, actuator, lever etc Photographs of the original setting or position should be taken.

Where possible take statements from witnesses, noting any reference to engine sounds and aircraft performance.

Chapter- 10

Aircraft Systems Investigation

10.1 General

Systems Investigation covers investigating and reporting on the following areas.

i. Hydraulics
ii. Electrics and electro-pneumatics
iii. Vacuum
iv. Pressurization and air conditioning
v. Ice and rain protection
vi. Instruments
vii. Air data computer
viii. Flight director
ix. Stall warning
x. Radio and navigation systems
xi. Autopilot
xii. Fire detection system
xiii. Oxygen system

There is inevitably a degree of overlap with systems covered under chapters relating to structures and power plants. The technical information necessary to enable a detailed analysis of individual aircraft systems/components should be obtained from AMM or CMM published by the manufacturer Each aircraft system must be accorded the same degree of importance regardless of the circumstances of the occurrence.

There is no way to determine adequately the relationship of any system to the general area without a thorough examination. The examination of the system will generally involve more than examination of components in-situ. It can involve the functional testing, under laboratory conditions, of an individual component, or of the complete system using off-the-shelf duplicates of the component or system. Computer software fitted in some modem aircraft may be recovered and operated in a simulator to determine its role in the occurrence.

10.2 Guidelines to examine Aircraft Systems

Following guidelines may be followed investigating aircraft systems.

a) Obtain from the aircraft manufacturer or from the operator, appropriate detailed schematic diagrams or working drawings to determine what components are included in each system.
b) The diagrams will also be helpful in analyzing the effect of a malfunctioning component on the rest of the system.
c) Make every effort to account for all the components

d) Each system can be broken down into different areas as shown below to ease the work need to perform.

I. Supply
II. Pressure
III. Control
IV. Protection
V. Distribution
VI. Application Documentation of components should include:
   a) Nomenclature
   b) Component manufacturer's name;
   c) Part number;
   d) Serial number;
   e) Specification number (where provided).

Some components having the same part number may be used in various parts of the same system especially in the hydraulic and pneumatic systems. It may be necessary to obtain listings showing actual location of these components in the system by serial number.

The positions of switches and controls in the cockpit, together with the found position of any moving parts will have been photographed during the initial stages of the investigation. Obtain copies of these photographs and crosscheck the readings on all available instruments. If the original photographs are not ready, take an additional set of photographs to supplement your documentation.

Chpater-11

Fracture Investigation

11.1 General

Listed below are ten general areas of inquiry in any fracture investigation. Although these areas could be interrelated, the sequence in which these areas are considered is not important.

11.2 Surface of fracture

a. What is the fracture mode? For example, shear cleavage, intergranular, fatigue.
b. Are the origins of the fracture visible? Are they located at the surface or below the surface?
c. How many fracture origins are there? The answer concerns the relative magnitude of the actual stress to the actual strength of the part at the location of failure.
d. Is there evidence of corrosion, paint or some other foreign material on the fracture surface? Possibility of a pre-existing crack prior to the fracture?
e. What is the relation of the fracture direction to the direction of the stress that caused the fracture and to the normal or expected fracture direction?
f. Was the stress unidirectional or was it reversed in direction? Is the assumption regarding the operation of the mechanism correct?

11.3 Surface of part

a. What is the contact pattern on the surface of the part and on the surface of the mating parts?
b. Has the surface of the part been deformed by loading during service or by damage after fracture?
c. Is there any evidence of damage on the surface of the part from manufacture, assembly, repair or service? For example, tool marks, grinding damage, poor welding or plating, arc strikes, corrosion, wear, pitting fatigue, fretting.

11.4 Geometry and design

a. Are there any stress concentration related to the fracture?
b. Is the part intended to be relatively rigid, or is it intended to be flexible? - Does the part have a basically sound design?
c. How does the part and its assembly work? - Is the part dimensionally correct?

11.5 Manufacturing and processing

a. Are there internal discontinuities or stress concentrations that could cause a problem?
b. Wrought metal - Does it contain serious seams, inclusions, or forging problems such as end grain, laps or other discontinuities that could have an effect on performance?
c. Casting - Does it contain shrinkage cavities, cold shuts, gas porosity, or other discontinuities, particularly near the surface of the part?
d. Weld - Was the fracture through the weld itself or through the heat-affected zone in the parent metal adjacent to the weld? If through the weld, was gas porosity, undercutting, under-bead cracking, lack of penetration, or other problems a factor? If through the heat-affected zone

adjacent to the weld, how were the properties of the parent metal affected by the heat of the welding?

e. Heat treatment - Was the treatment properly performed? Evidence of inadequate heat treatment like too shallow or too deep a case depth, excessive decarburization, very coarse grain size, over tempering, under tempering, and improper microstructure?

13.6 Properties of the material

a. Are the mechanical properties of the metal within specified range? - Are the specifications proper for the application?
b. Are the physical properties of the metal proper for the application? For example, coefficient of thermal expansion (for close-fitting parts), density, melting point, thermal and electrical conductivity.

11.7 Adjacent parts

a. What was the influence of adjacent parts on the failed part? Possibility that the fractured part may not be the primary or original failure?
b. Were fasteners tight?

11.8 Assembly

a. Is there evidence of misalignment of the assembly?
b. Is there evidence of inaccurate machining, forming, or accumulation of tolerances?
c. Did the assembly deflect excessively under stress?

11.9 Service conditions

a. Were there any unusual occurrences such as strange noises, smells, fumes, or other happenings that could help explain the problem?
b. Is there evidence that the mechanism was over speeded or overloaded?
c. Is there evidence that the mechanism was abused during service or used under conditions for which it was not intended?
d. Did the mechanism or structure receive normal maintenance with the recommended materials (e.g. lubricants)?
e. What is the general condition of the mechanism?

11.10 Environmental reactions

a. What chemical reactions could have taken place with the part during its history (manufacturing, shipping, storage, assembly, maintenance and service)? For example, exposure to hydrogen (during acid pickling, electroplating, etc.), exposure to corrosive environment.
b. To what thermal conditions has the part been subjected during its existence? For example, abnormally high temperature localized electrical arcing, grinding damage, adhesive wear, frictional heat.

Chapter-12

Maintenance Investigation

12.1 General

The purpose of the maintenance investigation is to review the maintenance history of the aircraft in order to determine: Information that could have some bearing on the occurrence, or which could point to a particular area of significance for regulatory investigation and action Whether the aircraft has been maintained in accordance with the specified standards whether, having regard to information gained during the investigation, the specified standards are satisfactory.

12.2 Securing Aircraft and Maintenance Documentation

Following notification of the commencement of a regulatory investigation of an aircraft incident or occurrence, secure the related documents by applying to the operator to hand over the following:

a. Aircraft log books
b. A copy of the current, and if possible, expired Maintenance Releases
c. Maintenance work-packages and any other appropriate certification documentation
d. Approved Maintenance System, or the applicable accepted maintenance schedule for the aircraft.
e. FDR raw data
f. CVR recordings in CD
g. Current copy of aircraft certificate of release in services.
h. Maintenance work package of last major check done on the aircraft
i. Normal/emergency checklist
j. Quick reference handbook (QRH)
k. Aircraft flight manual
l. Engine logbook
m. Aircraft technical logbook
n. Airframe logbook
o. Propeller logbook
p. Load and trim sheet
q. Passenger and cargo manifest
r. Competency card of crew members
s. Flight and duty time limitation records of the crew members
t. Records of major maintenance work carried out in last 6 months before the incident date
u. Refresher/continuation training records of certifying staff.

12.2.1 Aircraft Log Books and Maintenance Release

Inspect the aircraft log books and both current and expired maintenance releases to ascertain the following information:

a. The operating history of the airframe, engines, and associated components; the hours flown, cycles, landings, and, where appropriate, the status of any life-limited components

b. The history of accidents, incidents, defects and irregular or abnormal operations which have been reported or which become known during the investigation and any subsequent rectification or other action taken
c. Whether all required maintenance, including applicable Airworthiness Directives, have been carried out
d. That all modifications incorporated have been accomplished in accordance with approved data
e. Whether the aircraft history has been entered in the log books in accordance with the applicable logbook instructions.

12.2.2 Maintenance Documentation

In addition to an inspection of the aircraft documentation, an examination of the maintenance organization’s work packages and any other certification documentation relating to maintenance should be undertaken to determine:

a. That all maintenance and modifications have been carried out on the aircraft by authorized or approved persons
b. That all the maintenance carried out was certified-for in accordance with applicable legislation by authorized or approved persons
c. If the maintenance system has been followed correctly d. Note down recordable discrepancies or omissions.

Chapter 13

Cabin Safety Investigation

13.1 General

To assist investigators in investigating cabin safety related Incidents, the following guidelines could be used.

a. Checklist for documenting cabin condition
b. Checklist for information to be gathered from cabin crew
c. Checklist for information to be gathered from passengers

The information gathered may be used in conjunction with the information gathered by other investigation groups (medical, human factors and operations) to determine the cause of the injuries and the survival aspects of the accidents and incidents, as well as to develop related recommendations.

13.2 Checklist for documenting Cabin Condition

13.2.1 General information

a. Weather conditions
b. Engineering drawing of interior that depicts seat layout, seat pitch galleys, lavatories and emergency exit(s)

13.2.2 Damage to cabin interior

a. Document overall condition of cabin (e.g. intact, broken apart, fire damaged).
b. Location of debris such as galley equipment, seats, luggage and areas with indication of fire or smoke damage.
c. Use photographs to supplement written report

13.2.3 Cabin crew and passenger seats

a. Manufacturer, model number, serial number, date of manufacture and rated loads.
b. Evidence of impact.
c. Description of the integrity of tie-downs and rails.
d. Measurement and description of the deformation/separation of seats and tie-downs.
e. Location of child restraint system (CRS), seat-loaded cargo, stretchers and bassinets.

13.2.4 Seat belts and shoulder harnesses

a. Seat belt manufacturer, model number, serial number, date of manufacture and rated loads.
b. Condition of seat belts and seat belt extensions (e.g. damaged, detached, intact and cut).

16.2.5 Stowage compartments

a. Describe damage to storage areas, such as overhead bins, closets and compartments.
b. Condition of latching mechanisms for storage areas.

13.2.6 Carry-on luggage

- Location of carry-on luggage found in cabin (e.g. overhead bins, under seat storage, closets and piled near exits)

13.2.7 Communication

a. Conduct functional check of the PA system.
b. Conduct functional check of the interphone system.
c. Describe the positions of switches for emergency evacuation alarm systems (cockpit and cabin). - Describe the positions of switches for the emergency lighting systems (cockpit and cabin).
d. Describe the content of the pre-departure safety briefing and how the information is conveyed to passengers (PA system, recording, or video demonstration).
e. In what language(s) was the briefing conducted? - Describe the airline's procedures for exit row briefing.

13.2.8 Exits

a. Describe the location of all exits (cockpit and cabin). Were they open or closed?
b. Describe the location of emergency exit hatches.
c. Describe the deployment of ropes, tapes or inertia reels.
d. Describe the damage to exit and surrounding fuselage.
e. Describe the position of arm/disarm lever or girt bar.
f. Describe the position of exit opening handle.
g. Describe the condition of power-assist device (record pressure, if appropriate).
h. Describe the assist space available at exit.
i. Measure the height of the exit sills above the terrain if the aircraft has an unusual attitude.

13.2.9 Evacuation slides and/or slide/rafts

a. Position of the device (deployed, stowed, inflated, deflated, removed from aircraft).
b. Name of manufacturer, date of manufacture, model number, serial number, Technical Standard Order (TSO) number, and date of last overhaul.
c. Describe any damage to the slide.

13.2.10 Emergency equipment

Using a cabin crew manual as a guide, document the location and condition of emergency equipment in the cabin:

a. Flashlights
b. Megaphones
c. Fire extinguishers
d. Protective breathing equipment (PBE)
e. Crash axe/pry bar
f. Portable oxygen bottles
g. First aid kits
h. Medical kits
i. Defibrillator
j. Emergency location transmitters (ELT)

k. Protective gloves
l. Smoke barriers
m. Smoke detectors
n. Lavatory waste bin automatic extinguishers
o. Emergency lights
p. Floor proximity lighting system

13.2.11 Incidents involving water contact

- Document the condition and location of:

a. Life rafts or slide/rafts
b. Life vests
c. ELT
d. Water conditions at time of Incident (wave height, swell height and temperature)
e. Survival kits

13.3 Checklist of information to be gathered from cabin crew

13.3.1 General information

a. Weather conditions
b. List of cabin crew members
c. Passenger manifest with names and seat assignments of occupants (including lap-held infants)
d. Cabin crew member manual (used to determine emergency procedures, cabin layout and emergency equipment location)
e. Cabin crew member training records (initial, transition and recurrent)
f. Safety briefing card
g. Engineering drawing of interior that depicts seat layout, seat pitch galleys, lavatories and emergency exit(s)

13.3.2 Cabin crew member

a. Name, business address and phone number
b. Gender, age, height and weight
c. Operational experience on the Incident aircraft type in hours or years
d. Work category-cabin crew member, purser, lead crew member, etc.
e. Number of different aircraft types/models that the cabin crew member is qualified on
f. Medical history and medication taken at the time of the event
g. Current medical condition and medication taken at time of the interview
h. Experience as a cabin crew member (in years) with current carrier/previous carrier
i. Flight and duty schedule 72 hours prior to the event
j. Food and beverage consumed during the 24 hours period before the occurrence
k. Sleep/wake cycle for the 7 day period before the occurrence
l. Travelling time to airport
m. Were you injured? Describe your injuries. When and how were you injured?

13.3.3 Pre-flight/in-flight activities

a. Describe the pre-flight crew briefing. What was covered? Who are present? Who conducted the briefing?
b. Describe any cabin system(s) that was unserviceable at the beginning of, or during the flight?
c. Describe observations of, or interaction with, maintenance, ground service personnel and flight crew that may be pertinent to the investigation.
d. Describe the location of passengers with special needs/children travelling alone.
e. Describe the location of infant/child restraint system(s).
f. Describe the location of passengers with disabilities.
g. Describe the passenger safety briefing. Were passengers attentive to the briefing?
h. Describe the amount and stowage of carry-on baggage.
i. Describe your pre-departure cabin activities.
j. Was alcohol served before/during the flight? If yes, approximately how many drinks did you serve?
k. When did you prepare your emergency exit(s) for departure?
l. Where were you seated for take-off and landing?
m. Describe the type of seat restraint system used at your jump-seat.

13.3.4 Occurrence information

a. Describe if and how you were informed of a problem. If briefed by the Captain, what information were you given? If briefed by another crew member, what information were you given?
b. Describe your location during occurrence.
c. Describe if and how the passengers were informed of a problem? What was their reaction?
d. Describe the pre-occurrence preparations (i.e. type of warning, cabin preparation).
e. Describe the occurrence.
f. Describe your view of the cabin. If your view was obstructed, please explain.
g. Describe the impact.
h. Describe the emergency commands you used, if any.
i. Describe the passenger reaction to your commands.
j. Describe the passenger's brace positions.
k. Describe your brace position.
l. Describe the security of cabin furnishings in your area.
m. Describe any difficulties you may have had with your seat/seatbelt/shoulder harness.
n. Describe any safety or emergency equipment you used. Why and how did you use it? Was it effective?

13.3.5 Evacuation

a. How did you decide to evacuate?
b. Captain's order?
c. Personal judgment?
d. Evacuation alarm?
e. PA announcement?
f. Firefighter's order?
g. Describe the evacuation.

i. Which exit(s) did you open?
j. What was your assigned exit(s)?
k. If you did not open an exit, explain why.
l. Did you have a direct view of your primary/secondary exits from your jump-seat?
m. Did you assess the conditions? How?
n. Were there any difficulties assessing outside conditions? Opening the exit?
o. Deploying or inflating the evacuation slide? If yes, please describe
p. Did the emergency lights operate? Which emergency lights did you observe?
q. Describe the illumination inside/outside the aircraft.
r. Describe passenger reactions during the evacuation (calm, panic, etc.).
s. Did the passengers attempt to take carry-on baggage during the evacuation?
t. Did you have passengers' assistance at your exit? How did the passengers assist?
u. Describe any problems with the passengers during the evacuation.
v. Describe any difficulties with passengers with special needs or children travelling alone.
w. Approximately how long did the evacuation take? What is the estimate based on? (Note: Time estimates may be unreliable)
x. Did you see other cabin crew members evacuate the aircraft? Which exits did they use?
y. Did you take emergency equipment with you? Which equipment? How was it used?
z. Describe the flight deck crew activities outside the aircraft.
aa. Describe the rescue/fire fighting activities.
ab. Were you injured? Describe your injuries and how they were sustained.
ac. Were you transported to a hospital or medical facility?
ad. Approximately how long did the rescue efforts take?
ae. Describe your clothing and its suitability for the evacuation.

13.3.6 Training

a. Describe your initial and annual emergency/safety training.
b. Did your training include basic instructions in aerodynamics and aircraft performance?
c. When was your last evacuation drill? Describe the drill. How often is the drill conducted?
d. When was your last door drill? Describe the drill. How often is the drill conducted?
e. Describe your fire fighting training.
f. Describe your initial and annual ditching training.
g. Do you participate in a wet ditching drill? Describe the drill.
h. Describe your practical training with respect to the use of emergency/safety equipment.
i. Did you participate in crew resource management training with pilots or other members of your company? Explain.
j. Did your training prepare you for what happened?

13.3.7 Turbulence

a. Describe your company's crew communication procedures for turbulence.
b. Describe the crew communication procedure used in this event.
c. Were you warned before you experienced the turbulence? How? Was the seatbelt sign on? If yes, for how long? - Were passengers seated when the seat belt sign was on?

d. Were you seated at your cabin crew member assigned seat? If you were not seated, why not?
e. Where were you when the turbulence occurred?
f. What announcement was made regarding the turbulence? Were passengers instructed to remain seated? When were the announcements made?
g. Were there problems with stowing equipment before or after the turbulence event?
h. Were you injured? Describe your injuries. Were you able to assist others following the turbulence? - Describe injuries that you observed in other crew members or passengers.

13.3.8 Smoke/Fire/Fumes

a. When did you become aware of smoke fire, or fumes?
b. Where did you first observe smoke or fire?
c. Describe what you saw and/or smelled (color, density and odor)
d. Where were you when you first became aware of fumes?
e. Did the conditions increase, decrease or change during the occurrence?
f. Did you have difficulty breathing? Did you use PBE or other protection?
g. Did you have problems communicating with other crew members or passengers? If yes, describe the problems
h. Did you use fire-fighting equipment?

13.3.9 Ditching/Inadvertent water landing

a. Was there any problem deploying, inflating or boarding the slide/rafts or life rafts?
b. Did you move a slide/raft or life raft from one location to another? Describe any difficulties
c. What type of personal flotation device did you use? From where did you obtain it?
d. Did you have any problems obtaining it or using it? - What personal flotation devices did passengers use?
e. Did passengers have any problems obtaining or donning their life preservers? (adults/infants/children)
f. Who commanded the lift raft or slide/raft that you boarded? Were there other crew members in that raft? - Describe the rescue operation.
g. Did you retrieve an ELT? If yes, from where? Was the ELT used?
h. Describe sea survival procedures that were used.

13.3.10 Additional comments

a. Based on your experience, can you suggest any improvements to procedures or equipment?
b. Do you have any further information that you think you may assist in the investigation of this occurrence?
c. Do you know of any passengers who would like to or could provide information?

13.4 Checklist of information to be gathered from passengers

13.4.1 Personal data

a. Name, gender, age, height and weight
b. Address
c. Phone number

d. Occupation
e. Seat number and location
f. Aviation experience
g. Any disability that could impair egress from the aircraft
h. Languages spoken
i. Were you injured? Describe your injuries. When and how were you injured?

13.4.2 Pre-flight preparations

a. Describe the weight, size and stowage of your carry-on baggage.
b. Describe the clothing and footwear that you were wearing when the Incident occurred.
c. Was there a pre-departure safety briefing? How was it provided (i.e. pilot, cabin crew member, video or other means)? Did you understand the safety briefing?
d. Did you read the safety card? - Did you understand the information on the safety card?
e. Did you note the locations of more than one exit near your seat?
f. Were you seated adjacent to an emergency exit?
g. Were you briefed prior to departure on the operation of the exit? If yes, by whom?
h. Describe the observations of maintenance, ground service personnel (de-icing) or flight crew that might be pertinent to the investigation.

13.4.3 Occurrence information

a. How and when did you first become aware of a problem? Where were you when you first became aware of a problem?
b. How did the crew prepare you for the emergency? Were you given instructions over the PA system? By an individual crew member? Shouted instructions?
c. Did you hear any shouted commands? If yes, what did you hear? Did the information help you?
d. Did you brace for impact? Describe your brace position.
e. Were you travelling with infants/children? How were they restrained? Were there any problems?
f. How tightly was your seat belt fastened? Did you have any problems releasing your seat belt? If yes, describe them - Did you remove your shoes? Why? If you did not remove them, did they stay on during the impact and evacuation?
g. Describe the impact sequence. What happened to you during the impact sequence?
h. Did anything happen to your seat during impact?
i. Did you remain seated until the aircraft stopped?

13.4.4 Evacuation

a. Which exit did you use? Why?
b. Did you encounter problems reaching your exit? If yes, describe.
c. Did you attempt to take anything with you when you left the aircraft? If yes, what did you take?
d. Did you assist anyone during the evacuation?
e. Did anyone assist you?
f. Did you open an exit? If so, which one? Did you experience difficulty operating or using the exit?
g. Did you notice any lights on in the cabin? Where?

h. Approximately how long did it take you to evacuate the aircraft? What is your estimate based on?
i. What did you see when you got out of the aircraft?
j. Did help arrive quickly? Describe the rescue efforts.
k. Did a rescuer assist you? How?
l. Did you sustain any injury? If yes, please describe your injury and, if known, its causes.

13.4.5 Turbulence

a. Where were you when the turbulence occurred?
b. Was your seat belt fastened? If not, whey not?
c. Was the seat belt sign on?
d. Did you hear any announcement regarding seat belts? If yes, describe what you heard.
e. Who do you think made the announcement(s)? Flight deck crew and/or cabin crew members(s)?
f. Were you injured? Describe your injuries.Were you given first aid by a cabin crew member or passenger?
g. If you were travelling with an infant/child, what happened to the infant/child? How were they restrained?

13.4.6 Smoke/Fire/Fumes

a. When did you become aware of smoke, fire, or fumes?
b. Where did you first observe smoke or fire? Describe what you saw and smelled (colour, density, odor)
c. Where were you when you first became aware of fumes?
d. Did the conditions increase, decrease or change during the occurrence?
e. Did you have difficulty breathing? If yes, what action did you take to protect yourself?
f. Did you observe fire-fighting procedures? Describe.

13.4.7 Ditching/Inadvertent water contact

a. What types of flotation devices were available?
b. Did you obtain a life preserver?
c. Where was it stored?
d. Did you have a problem retrieving it?
e. Did you put it on?
f. When did you inflate it?
g. Did it work properly?
h. If you were travelling with an infant or child, was a life preserve provided for the child?
i. Did you use the seat bottom cushion as a flotation device? Describe how the cushion was used and its effectiveness.
j. Did you board a life raft or slide/raft
k. Were there any difficulties?
l. Describe the type of raft you boarded.
m. What equipment in the life raft (slide/raft) was used?
n. How many people were in the life raft?

o. Describe the water conditions.
p. Describe any sea survival procedures that were used.
q. Describe the weather conditions.
r. Describe the rescue effort.

13.4.8 Additional comments

a. Based on your experience, can you suggest any improvements to procedures or equipment?
b. Do you have any further information that you think may assist in the investigation of this occurrence?

13.4.9 Others

a. Reports of follow-up component tests
b. Photographs
c. Written statements
d. Interviewing techniques for investigator has been given in Appendix 6 to this Manual

Chapter-14

Air Navigation Services (ANS) Investigation

The failure or malfunction of one or more ANS facilities or non - compliance with procedures (requirements) may often be the cause of an occurrence. For this reason, it is essential that a careful examination of the ANS facilities and requirements be made to determine whether they are involved as a causal or predominant factor in the particular occurrence under investigation. The purpose of study of such facilities and compliance with requirements is to collect the Information that could have some bearing on the occurrence, or which could point to a particular area of significance for regulatory investigation and action.

While investigating the following items related to ANS are checked and verified:

1. General

a. siting of and visibility from the control tower;
b. adequacy of accommodation of associated ATS centres and units;
c. ATS personnel, including appropriate number, qualifications (licenses) and supervision of personnel;
d. work and rest schedules of ATS personnel ;
e. adequacy of specified procedures and practices including the provision of separation minima depending on the approval status of the aircraft in RVSM airspace;
f. adequacy of equipment including ATS surveillance systems, signal lights, binoculars and anti-glare devices.

2. Personal Record The following personal information should be obtained in respect of each Air Traffic Service officer involved in the occurrence:

a) full name;
b) contact address and telephone number/s;
c) date of birth;
d) type of air traffic services license/certificate;
e) total length of service;
f) length of continuous service at relevant location;
g) ratings held and date/s obtained;
h) operating position occupied at the time of the occurrence ;
i) proficiency check records;
j) medical history (recent illness, last medical examination, investigation of fatigue factor including an assessment of duty time and rest time within the 28 days preceding the occurrence and particularly within the last week and last 72 hours);
k) initial and continuation training (including assessments);
l) use of corrective and anti-glare lenses.

3. Activity before, during, and after the occurrence

Before the occurrence.

The Air Traffic Services investigation should examine specifically:

i) activities within the 72 hours prior to the occurrence with particular reference to psychological factors that might have a bearing on the performance of the relevant Air Traffic Services personnel, their physical condition in relation to the work/rest cycle and meal irregularity and an assessment of their sleep patterns

ii) circumstances such as distance travelled in the journey to the location of the Air Traffic Services centres and units including preparation activity prior to commencing duty.

iii) the activities and workload since commencing duty at the workstation. This information can usually he obtained and substantiated from statement and/or hard copy and/or electronic data recordings.

During the occurrence.
In the light of the information obtained above, the investigation should endeavour to reconstruct the role, workload and behaviour of each of the relevant Air Traffic Services personnel during the sequential phases of the occurrence itself. It may also be relevant to examine, in conjunction with the Human Factors Group, the contribution made by such factors as the workstation layout, the operating environment, flight progress display, facilities presentation and controls, etc.

After the occurrence.
The role of the Air Traffic Service investigation and the information useful for the conduct of the investigation may not be limited to establishing the history of the flight and of the occurrence. The activities of the Air Traffic Services personnel immediately following the occurrence such as the organization of search and rescue where relevant, relief from operational duty etc. should be evaluated.

4. Flight Planning

Where it is necessary to investigate the efficiency and effectiveness of the flight planning processes, the following aspects should be considered:

a. flight planning requirements
b. flight plan submission, type and content
c. operation planned
d. operational information obtained/provided

5. Airways Facilities

Some or all of the following items may be relevant depending upon the relevant airways facilities and technology status:

a) aeronautical information processing
b) meteorological information displays
c) surveillance data processing
d) flight data processing
e) local and wide area data processing
f) aeronautical fixed telecommunications network
g) aeronautical telecommunications network
h) aeromobile? ground/air/ground voice communication and data links
i) inter and intra-unit voice communication and data links
j) local and remote facility monitoring and status register
k) dynamic air route planning and processing
l) satellite navigation and communications
m) conflict/collision probe and avoidance
n) facility diagrams, drawings and operator notes

6. Communications Facilities, Procedures and Phraseology

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to communications aspects:

a) air-ground-air in use (VHF, UHF, HF, data link etc)
b) air-ground-air outlet sites, elevations, networks, configuration aid coverage diagrams
c) terrestrial and satellite-controlled intercommunications
d) calibration of ATS equipment
e) frequencies and propagation characteristics
f) telephony and microphone techniques
g) calling, replying and acknowledgment standard operating procedures
h) unit/service identification
i) clear, unambiguous standard operating procedural words, phrases and language used in communications
j) readback/hearback errors or omissions

7. Navigation

a) location (geographic co-ordinates)
b) identification signal
c) power output and supply
d) emergency equipment - warning system(s) recording of malfunction
e) equipment calibration and radiation pattern
f) operating and maintenance schedules, and their notification (AIP, NOTAMs)
g) normal level of performance
h) interference(s)
i) past complaints, interruptions and failures (crew, operation, etc.)
j) statements from relevant personnel including other aircrew who used these aids

For GNSS core constellations, a recording of the following monitored items should be available for all satellites in view:

a) observed satellite carrier-to-noise density (C/N0);
b) observed satellite raw pseudo-range code and carrier phase measurements;
c) broadcast satellite navigation messages, for all satellites in view; and
d) relevant recording receiver status information.

For SBAS, the following monitored items should be recorded for all geostationary satellites in view in addition to the GNSS core system monitored items listed above:

a) observed geostationary satellite carrier-to-noise density (C/N0);
b) observed geostationary satellite raw pseudo-range code and carrier phase measurements;
c) broadcast SBAS data messages; and
d) relevant receiver status information.

For GBAS, the following monitored items should be recorded in addition to the GNSS core system and SBAS monitored items listed above (where appropriate):

a) VDB power level;
b) VDB status information; and
c) broadcast GBAS data message.

When there is any reason to suspect that a navigation aid may be involved as a causal factor, the Air Traffic Services investigation should request, without delay, special ground and flight checks. Standardized checks should be prescribed by States and performed on navigational aids if they were being used, or if there is any possibility that they were being used, by an aircraft involved in an air safety occurrence. In addition to reviewing the result of special ground and in-flight checks, the investigation should study the records of former routine checks (site evaluation, commissioning and recent periodic checks). Attention should be drawn to the value of the checks in regard to possible differences between the state of the equipment used at the time of the occurrence and the state of the equipment at the time of ground or in-flight check.

7. Aerodrome Facilities

Amongst the items that may need to be checked and verified are the following:

a) characteristics of the runway(s) in use
b) characteristics of the movement areas
c) surrounding terrain, obstructions and meteorology characteristics
d) aerodrome diagrams
e) lighting and guidance signage
f) electronic surface movement detection systems
g) standard, contingency and emergency operating procedures
h) visual and electronic navigation aids
i) communications networks

j) environmental conditions
k) facility status register

8. Aircraft Performance

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) knowledge of aircraft performance and limitations
b) reconstruction of relevant flight profiles
c) flight plan validity and conformance
d) horizontal and vertical navigation
e) aircraft physical operating environment emergency operations

9. Standard Operating Procedures and Practices

a) National legislation
b) ICAO Annexes
c) ICAO Procedures for Air Navigation Services
d) air traffic services manuals and instruction circulars
e) workstation/sector handbooks and/or instructions
f) copies of any pertinent letters of agreement
g) map/chart of area of responsibility
h) co-ordination requirements with other units
i) aeronautical information publications
j) applicable aircraft proximity standard/s
k) NOTAMs
l) flight progress preparation, processing and displays
m) level change and non-standard flight levels procedures
n) communications, navigation and surveillance procedures

10. Flight Reconstruction

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) separation standard
b) relative tracks
c) horizontal and vertical proximity
d) surveillance service/s available/provided
e) evasive actions
f) flight conditions
g) collision avoidance systems available
h) aircraft proximity assessment

11. Sequence of Flight

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) displays facilities

b) symbols
c) data blocks, leader lines and orientation
d) control settings
e) display operator notes
f) aircraft identification procedures
g) sensor/s inputs
h) display mapping
i) coverage diagrams
j) terrain clearance charts
k) SSR code
l) system display track number
m) system alerts and alarms
n) point of closest approach

11. Flight Profile Reconstruction

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to the reconstruction of the flight profiles and variations between actual and planned flight profiles:

a) horizontal trajectory and deviations
b) vertical trajectory, deviations and altitude busts
c) rate of climb/descent
d) ground speed(s)
e) estimated/actual time intervals
f) waypoints and geographic graticule

13. ATS Duties and Functions

a) duties and functions
b) area of responsibility

14. Work Practices and Staffing

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) prescribed work practices
b) actual and required staffing requirements
c) licensing and staffing qualifications/requirements
d) recency and ratings qualifications/requirements
e) initial and continuation training

16. Work Stations

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) display maps and charts
b) air situation and flight progress display
c) operational information display
d) workstation ergonomics
e) workstation modifications, certification and serviceability active systems configuration and operational status
f) communications systems configuration and operational status
g) headset and microphone facilities

17. Traffic Processing Sequence — Tactical and Strategic

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to determining tactical (short term/ immediate) and strategic (long term/later) processing effects and outcomes:

a) terminal airspace approach and departures
b) enroute airspace
c) holding and diversions
d) traffic flow, speed control and level assignment/s
e) on and off- airway flight paths
f) air traffic information management
g) air traffic sequencing and priorities

18. Traffic Disposition

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to reconstructing the traffic disposition and possible variations of actual and planned flight paths for each active aircraft:

a) airspace jurisdiction
b) ATS routes and waypoints
c) range
d) azimuth
e) level
f) track
g) holding pattern
h) meteorological effects
i) vertical and horizontal separation minima

19. Information Flow Coordination

Dependent upon the nature of the occurrence, some or all of the following items may be relevant in ascertaining information flow, coordination and distribution of aircraft movement messages to, from, or between, co-located/remote Air Traffic Service personnel and units:

a) unit responsibilities

b) inter-unit communications
c) intra-unit communications
d) distribution of aircraft movement and control messages
e) frequency change management
f) phraseology
g) readback/hear back errors and omissions
h) flight progress display data and notations

20. Situational Awareness

Dependent upon the nature of the occurrence, some or all of the following items may be relevant for determination of workload:

a) active and pending traffic disposition

b) flight progress display
c) communications
d) facility control and presentation settings
e) aircraft performance
f) actual and expected meteorological situation
g) airspace operational configuration, instructions and limitations h) terrain and other obstructions

1.Separation Assurance Techniques

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to determining continuous effective planning and implementation of separation assurance techniques:

a) selected procedure for vertical and horizontal separation
b) tactical and strategic traffic processing including procedures for accommodation of non approved aircraft into RVSM airspace
c) airways and available communications facilities
d) conflict warning systems
e) timely execution
f) monitoring and surveillance of traffic
g) re-evaluation of outcomes

21 Workload and Distractions

Dependent upon the nature of the occurrence, some or all of the following items may he relevant to determination of workload:

a. uninterrupted communications
b. timely co-ordination
c. airspace dimensions and configuration
d. mix of aircraft types

e. aircraft performance
f. operational and non-operational activity in the workstation vicinity
g. task complexity
h. fatigue
i. facilities status
j. information queuing and processing time
k. recognition of task saturation
l. task reduction techniques
m. system alarms and message queue processing

22. Conflict Detection and Safety Net

Dependent upon the nature of the occurrence, some or all of the following items may be relevant:

a) situational awareness

b) tactical and strategic plan
c) flight progress display
d) communications
e) information flow
h) conflict alert and avoidance systems.

23. Investigation of Airspace Management Practices

Dependent upon the nature of the occurrence, some or all of the following items may be relevant to airspace management issues:

a. establishment of airspace and legal status
b. administrating and controlling authority
c. controlled and non controlled airspace limits
d. provision of air traffic services
e. special use, prohibited, restricted airspace and danger areas
f. co-ordination requirements
g. airways clearances, block clearances and airspace reservations
h. traffic priorities
i. military activities
j. national contingency plans
k. limits of RVSM airspace and transition areas

24. Enroute

During cruise, the aircraft is usually at an assigned altitude, either given by ATS, or determined by adherence to specific rules. Aircraft operating under visual flight rules, for example are to cruise at specific altitude (odd or even thousand plus 500 ft if flying below FL290) depending on course. Under instrument flight rules, ATS assigns a specific altitude which conforms to State established clearance from obstacles and other aircraft. Transitioning from one State or FIR or portion of airspace to another may result in a change in enroute airspace design changes and these should be evaluated and compared to crew actions.

25. Terminal Procedures:

Terminal procedures are based on two factors: performance capability of the aircraft and equipment, both on the ground and in the aircraft. When an aircrew is assigned a procedure, the controller assumes the aircraft has both the ability to fly the procedure and the proper equipment for the procedure assigned. This is often communicated in the flight plan, but it remains the aircrew responsibility to accept the procedure cognizant of these factors. For example, it may be physically possible for a crew to fly a non-directional beacon (NDB) approach requiring two Automatic Direction Finder (ADF) receivers with only one receiver installed. Without the designated equipment, however, the ability of the crew to ensure terrain clearance may be circumvented. This may be especially true as Global positioning Satellite (GPS) systems become more common. It is relatively simple for a pilot using GPS to fly a ground-track depicted on an approach for which he does not have the proper equipment, but terrain clearance and proximity to other traffic cannot be depicted. GPS approaches have to be certified by the State, like any other procedure.

26. Climb

During climb to altitude, specific obstacle clearance and gradient of climb may be required. The availability of published data concerning the procedures is essential for crew understanding of the restrictions that may reduce these clearances. Design requirements should be evaluated based on the routing, standard departure or vectors provided by controllers.

27. Approach and Landing

Like climb, arrival procedures have specific design criteria. A designated runway may have several approaches available. An arrival procedure designed to establish a flow of traffic may be assigned to ensure terrain clearance and traffic separation. Deviation in routing, airspeed, or altitude may subject an aircraft to hazards not depicted in the published procedure. If an aircraft was attempting a published approach when the accident occurred, investigators should attempt to examine the actual approach plate diagram being used by the crew, as there are several sources of published approaches available. Published approaches are usually designed first by the State agency responsible for this action. Commercially available approach diagrams utilize these as models but no further flight testing is normally accomplished. The commercial vendor may add data to the approach plate, or change how it is depicted.

28. Non-standard Procedures

a) Noise Abatement. Many airports have been encroached upon by the population to the extent that airport management has been forced to require out-of-the-ordinary procedures in order to climb-out or arrive with the minimum of noise to the population below. This procedure normally calls for the crew, once safely airborne, to abruptly climb in order to be above a pre-established altitude when departing the airport boundaries. Similarly, a steeper than normal approach may be called for. Still others require a turn, even at low altitude, to fly over less noise-sensitive areas. While these procedures make sense in the normal operations world, an aircraft with an emergency may be placed dangerously close to its safety margins. When the procedure becomes “standard” to a crew operating from the locale repeatedly, the crew may continue to fly the procedure while dealing with a problem without considering the effect of the emergency on the procedure. This is a function of awareness and attention which is discussed under Human Factors

in Chapter 16. For example, the crew of an aircraft sustaining an engine failure after takeoff may deal with the engine failure while still pulling the aircraft nose-up to follow a normal noise abatement takeoff procedure.
In the course of flying either a published approach or departure, it is not uncommon for an ATS controller to assign an aircraft a vector off the normal routing. Communications should be evaluated if the accident occurred during this period. Accidents have been documented in which the aircraft collided with terrain or obstacles due to the pilot relying on the ATS controller to maintain both terrain, obstacle and traffic separation.

Chapter-15
Aerodrome Investigation

The failure or malfunction of one or more aerodrome facilities may often be the cause of an occurrence. For this reason, it is essential that a careful examination of the aerodrome facilities and their associated components be made to determine whether they are involved as a causal or predominant factor in the particular occurrence under investigation. The purpose of study of aerodrome facilities and associated components and their detailed analysis is to review the facilities and components' history and current status in order to collect the Information that could have some bearing on the occurrence, or which could point to a particular area of significance for regulatory investigation and action.

While investigating the aerodrome facilities and associated components following items are checked and verified:

Aerodrome Investigation

When an accident involves departure from, arrival at or when it occurs within the confines of an aerodrome, the investigator needs to have the facilities evaluated for contribution to the accident sequence. Criteria established by ICAO Annex 14 and State legislation are intended to make these facilities as safe as possible for operations of aircraft. Deviations from established standards need to be evaluated in light of the accident. However, investigators should also continue to evaluate the standards themselves in case they present some unacceptable risk to the aircraft or occupants. Due to the continuing evolution of aerodrome standards, it is not always feasible for all airports to meet all criteria. In some cases, deviations from standards are necessary for continued operation. Investigators should make themselves aware of any deviations from standards, and the status of the airport in light of current standards. When permanent hazards have not been corrected, or when decisions have been made to not comply with a specific standard, the investigator must evaluate these conditions for adequacy. As circumstances dictate, the investigator may have to examine and verify the condition and status of many aerodrome facilities used by or available to the aircraft involved in the accident (see CAR 14).

1. **Runways**

Runway in use:

When the takeoff or landing is directly involved in the accident sequence, the investigator should evaluate the following and their potential contribution to the accident sequence:

a) dimensions (length and width) of runways, stopways, clearways, runway strips, runway end safety areas (RESA), deceleration areas and shoulders
b) location of threshold at the time of the accident i) this should address the intentional use of less than full runway available ii) is the position visible from the tower (blindspots)?
c) runway markings including centre line, side stripe, and touchdown zone markings. Also examine runway designation, threshold, fixed distance, and taxi-holding position markings. Notice should also be taken of special markings such as land-hold short markings, acute angle taxiway lead in lines,

runway displacement and/or relocation markings and any specialized markings for use during lowvisibility operations. e.g., Surface Movement Guidance and Control System (SMGCS).

d) runway signs including hold-position signs, ILS critical area signs, distance remaining signs and destination signs as appropriate.

e) Lighting
   i. approach (type, dimensions, color, intensity)
   i. VASIs, PAPIs and PLASI (check alignment)
   ii. runway edge, threshold, and end (color, intensity) and number and locations of inoperative fixtures. iv) runway centre line and acute-angle taxi centre line (color, intensity and number and locations of inoperative fixtures.)
   iii. runway touchdown zone, distance remaining marker illumination and locations, land-hold short lighting
   iv. Runway environment and background lighting contrast including lighting distractions such as laser lights or special events

f. runway and/or runway end elevation(s) slopes, and gradients)

g. type(s) and descriptions of surface(s), concrete, asphalt, porous friction course, gravel, etc. Also describe measurements, depths, and conditions of texture treatments for diminishing the effects of hydroplaning, such as runway grooves and any friction treatments

h. runway surface condition–describe levels, textures and dimensions of contaminants
   i. Surface type
   ii. current condition (dry, wet, ice, snow, slush, etc)
   iii. excessive rubber buildup iv) presence of debris (potential for foreign object damage (FOD))
   iv. evaluate the frequency and adequacy of runway sweeping schedules

i. texture and coefficient of friction measurement, conduct pavement texture measurements and coefficient of friction evaluations in accordance with ICAO Airport Services Manual, Part 2, as appropriate, utilizing approved continuous friction measuring equipment (CFME).

j. runway bearing strength

k. aircraft arresting system. (presence of military equipment on civil aerodromes and the effect of contact with it.)

l. obstructions, construction hazards and frangibility. Describe protruding objects and/or ruts, ditches, holes or depressions within or near safety areas and ascertain the degree of frangibility of nearrunway equipment or markings. Careful examination of frangible object support bases for erosion which may render the base more of a hazard than the equipment mounted upon it.

   a. work in progress (NOTAM or ATIS applicable)
   b. wildlife hazards – history and description of aerodrome program(s) for reducing incursions with aircraft by wildlife and relevant NOTAMs or ATIS, if any.

2. Alternative Runways

Investigators should evaluate all runways available in light of the aircraft condition and emergency, if present. The assignment of the runway by a controller or the selection of a runway by the crew is sometimes dictated by need, in which case it may be appropriate. In other cases, the assignment or selection was made for convenience rather than with consideration of the actual requirements. Where pertinent, the factors listed above should be used to evaluate alternative runways.

3. Taxiways

The route of taxi to/from an active runway should be evaluated. Similar to runways, the assignment or selection of the route of taxi should be compatible with the aircraft and the circumstances.

Depending upon the nature of the occurrence, some or all of the following items may be relative:

a. bearing strength
b. dimensional adequacy, shoulders
c. markings
d. lighting
    i. taxiway (centre line, edge, surface movement guidance and control and aerodrome sign illumination, etc.)
    ii. aerodrome lighting vaults and control tower lighting panels as appropriate
    iii. aerodrome beacon
    iv. obstruction

e. obstructions

f. current condition

i. dry, wet, ice, snow, slush, , etc

ii. presence of debris (potential for foreign object damage (FOD))

iii. evaluate the frequency and adequacy of runway sweeping schedules.

g. layout

i) logical sequencing

ii) ground radar

iii) blind spots

h. type of surface and surface qualities

i. work-in-progress (NOTAM or ATIS applicable)

4. Apron or Ramp

The condition of the aircraft parking area with regard for the requirements of the aircraft involved should be evaluated. The following items may be relevant:

a. bearing strength
b. condition
c. markings i) signage ii) “red” zones iii) FOD areas iv) paintovers v) nosewheel stop markings
d. lighting (edge, floodlights, etc) e) obstacles f) Jetways g) proximity to active runways h) vehicle operations i) high power areas j) blind spots

5. Other Aerodrome Issues

5.1 Navigational Aids (NAVAIDS)

The presence and location of navigational aids is frequently a factor in the successful (or unsuccessful) departure or approach and landing. The compatibility of aircraft equipment with the NAVAIDS available sometimes determines the selection of available runway or approach.

5.2 Air Traffic Control

While paragraph 5.2 above deals specifically with the investigation of Air Traffic Services, investigators should also investigate the practices and procedures for ground movement. In some cases where air traffic services are limited or non-existent, ground movement is not monitored by a controlling agency. In this case, pilots are responsible for movement and clearance to and from active runways and for their own takeoff/landing clearance.

5.3 Communications

Communications between aircraft or between aircraft and air traffic services usually necessitates radio transmissions. Several factors involving communications have been linked to accident factors and, therefore, should be considered by investigators.

5.3.1 Common Frequency Complex operations sometimes involve communications between multiple controllers or agencies. Use of multiple frequencies for different parts of the aerodrome as well as for different controllers complicates communications. In some cases, air traffic communicated with a single controller on two separate frequency bands (VHF and UHF, for example). This is sometimes the case with the presence of military traffic on civil aerodromes. In this case, each aircraft overheard only one-half of the communications between an air traffic controller and another aircraft. This may lead to confusion.

5.3.2 Single Frequency Approach

When handling an emergency aircraft, it has become increasingly useful to assign a single frequency for the aircraft. Air traffic controllers utilize this emergency frequency as control of the aircraft is passed from one controller to another. This has demonstrated a simplification of procedure from the crew perspective. They are handling an emergency condition and are less capable of making multiple frequency changes than the respective controllers enroute to landing.

5.3.3 Language

ICAO standards require pilots and air traffic controllers to have a specified proficiency in English. However, it is very common for communications in non-English speaking States to be in the native language. This has been found to be a contributing factor in several aircraft accidents in which communications were not understood by the various airline pilots and controllers involved.

6 Emergency and Rescue Services

Civil Aerodrome Requirements Annex 14, Chapter 9 identifies the basic requirements for Crash, Fire and Rescue (CFR) at Civil Aerodrome. . Some of these standards include:

6.1

a) Fire-fighting service
   i. equipment
   ii. ii) personnel
   iii. iii) training

b) Rescue service i) equipment ii) personnel iii) training

c) Water rescue capability, if appropriate to the aerodrome location.

Some of the recommended practices that are key to aircraft accident mitigation include:

a) category for CFR based on largest aircraft
b) CFR response within two minutes of alarm to end of farthest runway
c) emergency access roads maintained
d) discrete CFR communication system. This system should involve all responding agencies including the air traffic control tower. However, it has been demonstrated that the ability of the CFR responders to directly communicate with the aircraft is valuable and should be considered if survival is a factor in the investigation.

7 Mutual Aid Resources Aerodrome

CFR resources have been expanded by the inclusion of municipal and regional fire fighting and rescue services. When these services are required by the nature of the accident and available, it has been demonstrated that post-accident response is improved. The following conditions should be investigated to ensure mutual-aid CFR contributed to the overall effort: a) Agency alert and notification b) Assembly points and routing c) Compatibility of equipment with aircraft accident conditions i) Fire Fighting ii) Communications d) Training of mutual-aid CFR personnel e) Inclusion of mutual-aid in command and control assignments.

8. **Documentation**

Investigators should retrieve and examine the aerodrome documentation with regard to the above. Included in this documentation should be:

a. AIP
b. NOTAMs and current ATIS
c. Aerodrome Obstruction Chart (ICAO Type A)
d. adequacy of dissemination of pertinent information
e. aerodrome operator records, (operations logs, NOTAMs, aerodrome inspection records, planning documents and minutes, etc.)

Chapter-16

Incident Prevention Measures

The objective of the following specifications is to promote Incident prevention by analysis of Incident and incident data and by a prompt exchange of information.

16.1 Incident reporting systems

CAAN has established a mandatory incident reporting system to facilitate collection of information on actual or potential safety deficiencies and a voluntary incident reporting system to facilitate the collection of information that may not be captured by a mandatory incident reporting system. A voluntary incident reporting system is non-punitive and afford protection to the sources of the information. To this effect the CAAN has published 'Safety Occurrence Procedure, 2016' for all mandatory occurrence reporting and voluntary occurrence reporting.

16.2 Database systems

CAAN shall establish an accident and incident database in Safety Management Division to facilitate the effective analysis of information obtained, including that from its incident reporting systems. The CAAN shall use standardized formats to facilitate data exchange in its database systems.

16.3 Analysis of data — Preventive actions

CAAN having established an accident and incident database and an incident reporting system will analyze the information contained in its accident/incident reports and the database to determine any preventive actions required. Additional information on which to base preventive actions may be contained in the Final Reports on investigated accidents and incidents. If the analysis of the information contained in the database, identifies safety matters considered to be of interest to other States, the Authority will forward such safety information to them as soon as possible. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies. If safety recommendations are addressed to an organization in another State, the Authority will transmit such recommendations to that State's investigation authority.

16.4 Exchange of safety information

CAAN shall promote the establishment of safety information sharing networks among all users of the aviation system and will facilitate the free exchange of information on actual and potential safety deficiencies.

Chapter-17
Other Investigations

17.1 Special Investigations

a. Contraventions by Military Aircraft

The Nepalese Civil Aviation Regulations do not apply to:

(1) Nepalese Military aircraft operating under the authority of the Minister of Defense; and

(2) foreign military aircraft.

The CAAN shall forward any incident involving Nepalese military aircraft or for any incident involving foreign military aircraft issues operating in Kathmandu FIR to Nepal Army Headquarters for further actions.

b. Contraventions of Foreign Aeronautics Legislation by Nepalese Aviation Document Holders

These procedures apply whenever a Nepalese document holder is alleged to have violated foreign Aviation legislation.

If the allegations concern a regulation having a direct Nepalese equivalent, the investigation should proceed normally.

In cases where allegations relate to a regulation without Nepalese equivalent and where the contravention is confirmed, the Director, Flight Safety Standard Department (FSSD) may proceed administratively or judicially under Civil Aviation Regulations, 2002.

c. Special Cases Involving Nepalese Registered Aircraft

Where Nepalese operators are involved in contraventions which may have certification implications, the Director, Flight Safety Standards Department (FSSD) shall advise the operational authority for that operator.

Chapter-18

Developing conclusions and Recommendations

18.1 Conclusion

Once all of the information is collected and analysed using one of the pre-established analysis techniques, the team of investigators shall work to draw conclusions. While drawing conclusion of the occurrence, appropriate findings, contributing factors, casual factors and recommendations are defined. Identifying appropriate findings and recommendations is the key focus of any investigation, and it is vital to remain focused on organisational learning, rather than pinpointing individual failings. When drawing conclusions, it is important to answer "why" the accident occurred. It is also important to support and document the root causes with evidence and reasoning.

Drawing conclusions based on the gathered information may lead to gaps in the original analysis. If gaps are discovered, the existing information shall be re-examined. Sometimes, additional information may need to be gathered to bridge these gaps.

No findings, contributing factors and (or) casual factors shall be defined which are not supported by the analysis of facts and figures related to the particular occurrence.

18.2 Recommendations

The final step is to develop recommendations for corrective actions to prevent future reoccurrences improving safety. Recommendations shall be derived from conclusions of the investigation. This step is extremely important to reduce and prevent accidents of a similar nature from occurring in the future. The written recommendations should be as specific as possible and address all root causes and contributing factors. When making recommendations consider phraseology that emphasizes the safety-related improvements attainable by implementation. Management should address all recommendations from accident and incident reports by updating safety policy and procedures if necessary.

If the directed organizations have already implemented the safety actions included in the list of recommendation, then the organizations are not required to implement them again. The organizations should notify the fact to the issuing authority.

If the directed organizations are not able to implement the recommended safety actions due to various reasons, the organizations should furnish the clarification to the issuing authority describing the reasons in- details of not being able to implement the recommended actions.

Chapter-19
Report Writing

At the conclusion of an investigation, the investigation report shall be prepared detailing the relevant factual information; analysis of the information collected; conclusions and significant factors which flow directly from the analysis; and recommendations, if appropriate, which derive from the conclusions.

Specifically, final reports will be modeled on the following format as appropriate:

I. Title
II. Synopsis
III. Body
IV. Appendixes

I. Title - The Final Report begins with a title comprising, name of the organization; manufacturer, model, nationality and registration marks of the aircraft, if applicable; place and date of the occurrence.

II. Synopsis - Following the title is a synopsis describing briefly all relevant information concluding with a brief résumé of the circumstances leading to the occurrence.

III. Body – The body of the Final Report comprises the following main headings;

a. Factual Information

b. Analysis

c. Conclusion

d. Safety Recommendations

Each heading consisting of a number of sub-headings as outlined in the following.

a. **Factual Information** –

(the number of subtitles may vary according to the type of investigation).

A typical aircraft accident or incident shall include the following subtitles:

1. History of the flight, if relevant.

2. Injuries to persons.

3. Damage to aircraft or equipment.

4. Other damage.

5. Personnel information.
6. Aircraft information.
7. Meteorological information.
8. Aids to navigation.
9. Communications.
10. Aerodrome information.
11. Flight recorders.
12. Wreckage and impact information.
13. Medical and pathological information
14. Fire
15. Survival aspects.
16. Tests and research.
17. Organizational and Management information
18. Additional information.
19. Useful or effective investigation techniques.

b. Analysis –

Once the evidence is gathered, all the facts/information shall be analysed to identify 'what' happened and, more importantly, 'why' it happened (root cause). While performing the root cause analysis, investigators shall conduct human factor analysis, organizational factor analysis and other type of analysis if required. There are various analytical tools, investigators can use any one or combination of them in the investigation process for the purpose of facts and/or information analysis.

c. Conclusions –

Statement of conclusions drawn from the analysis, and the various causal factors identified from the circumstances surrounding the occurrence. It should be ensured that the conclusions flow out of finding and the findings flow out of analysis of the facts. The conclusions should not include any factors or lapses/procedures of personnel observed during investigation which do not have direct bearing on the occurrence. Such lapses/practices can be separately intimated to the concerned divisions of CAA for taking appropriate action.

d. Safety recommendations –

Recommendations made for the purpose of future accident and Incident prevention, and providing corrective action.

IV. Appendices-

Any other pertinent information considered necessary for the understanding of the report.

Chapter-20

Distributing and presenting the safety investigation report

The final report shall be presented to all personnel and organisations involved, particularly those who have findings / recommendations assigned to them. It is important to remember that distributing a report with commercially sensitive information may not always be possible. Therefore, summaries of reports may be a more appropriate means of communicating outcomes.

Chapter-21

Monitoring safety investigation Outcomes

Once the report has been presented and communicated to all the concerned personnel and organizations, the actions resulting from the findings and recommendations shall be monitored and recorded as a function of 'closing the loop'. In the subsequent routine and ad-hoc surveillance activities those findings and recommendations' implementation shall be verified to ensure the continuous implementation of those actions.

Chapter-22

Enforcement Actions

To ensure the just culture policy in the CAAN, individual or organization's gross negligence, wilful violations and misconducts are not tolerated. These type of culpabilities are determined on the basis of basic principles of natural justice and impartiality. During the investigation process, to decide whether any enforcement action is required, human performance culpability evaluation tools (ie, decision tree) shall be applied. The Human Performance Culpability Evaluation tool has been included in Appendix 1.

If Culpability Evaluation results to the requirement of enforcements actions, then the actions shall be taken according to the Aviation Enforcement Policy Procedure Manual.

Appendix - 1

Human Performance Culpability Evaluation

Decision – Tree

A tool to be applied for the purpose of deriving to a decision regarding culpability of individuals in an organization.

(This tool is basically based on the idea of culpability decision tree given by Dr. James Reason in his book "Managing the Risks of Organizational Accidents" published in 1997.)

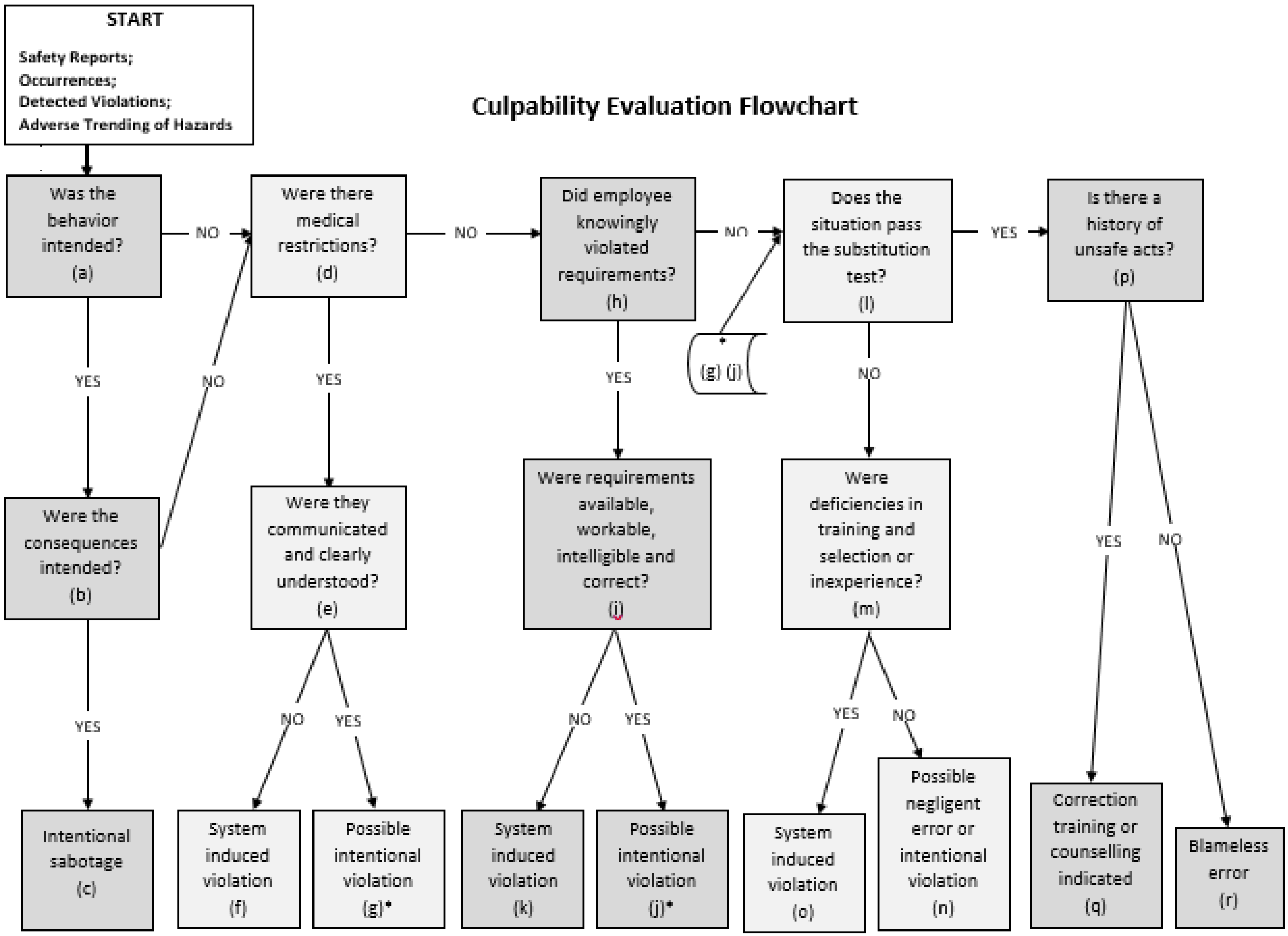
Using Procedure:

- Every test should start from **START** box and flow down (↓) or side (→) as indicated by arrow and as led by the decision (YES or NO).
- Boxes are only identified by either the question or outcome that they contain;
- Regarding the arrangement of the tree, it is normally considered that the severity of outcome of culpability diminishes from left of right. As is evident, the degree to which the individual is culpable for the actions being scrutinized diminishes as one progresses further and further through the tree with each question that leads to another question, rather than to an outcome or conclusion;
- This diagram sketches out the basic essentials of a decision tree for discriminating the culpability of an unsafe act (behavior) of an individual. The main assumptions of use of this tool are:
    1. the actions under scrutiny have contributed either to an accident, a serious incident or equivalent degree of impact of safety consequences.
    2. in an organizational accident, there are likely to be a number of different unsafe acts, and the decision tree is intended to be applied separately to each of them;
- Conclusions like system induced violation and error are more organization related and should be dealt with accordingly.

Definition:

1. Culpability – the amount of blameworthiness that an individual's behavior merits based on the nature of the deviation from expected behavior, the outcomes of the deviation, and the responsibility and authority of that individual, in the context of the situation in which the behavior occurred
2. Behavior – a human act or sequence of human actions. Behavior consists of a plan or intention (a goal plus the means to achieve it), a sequence of actions initiated by the plan, and the extent of success in achieving the goal as each action is performed.
3. Consequence – the final, overall effect(s) or outcome(s) of an individual's behavior with respect to the situation or environment in which the behavior occurred.
4. Sabotage – behavior in which both the act and the damaging outcome were intentional.
5. Violation – the intentional deviation from expected behavior as specified in operational procedures, rules, or standards, but in which the consequences were not intended.
6. Substitutional Test - This test will momentarily take the specific individual out of the picture and replace him/her with another person, in order to give us further insight into the influence of the organization on the behavior of an individual in the situation being evaluated.
7. Error – an unintentional deviation from expected behavior.
    a. Skill-based Error – an error associated with highly-practiced actions in a familiar situation usually executed from memory without significant conscious thought or with little attention. In terms of failing to achieve the intended goal, the plan was adequate, but the action(s) failed to go as planned
    b. Rule-based Error – an error associated with behavior based on selection of stored rules derived from one's recognition of the situation;
    c. Knowledge-based Error – an error associated with behavior in response to a totally unfamiliar situation (no skill, rule or pattern recognizable to the individual). Usually arises as a problem-solving situation that relies on personal understanding and knowledge of the system, the system's present state, and the scientific principles and fundamental theory related to the system. In terms of failing to achieve the intended goal, actions conformed to the plan, but the plan was inadequate to achieve its intended outcome due to an inaccurate mental picture.

Culpability Evaluation Flowchart



Appendix - 2

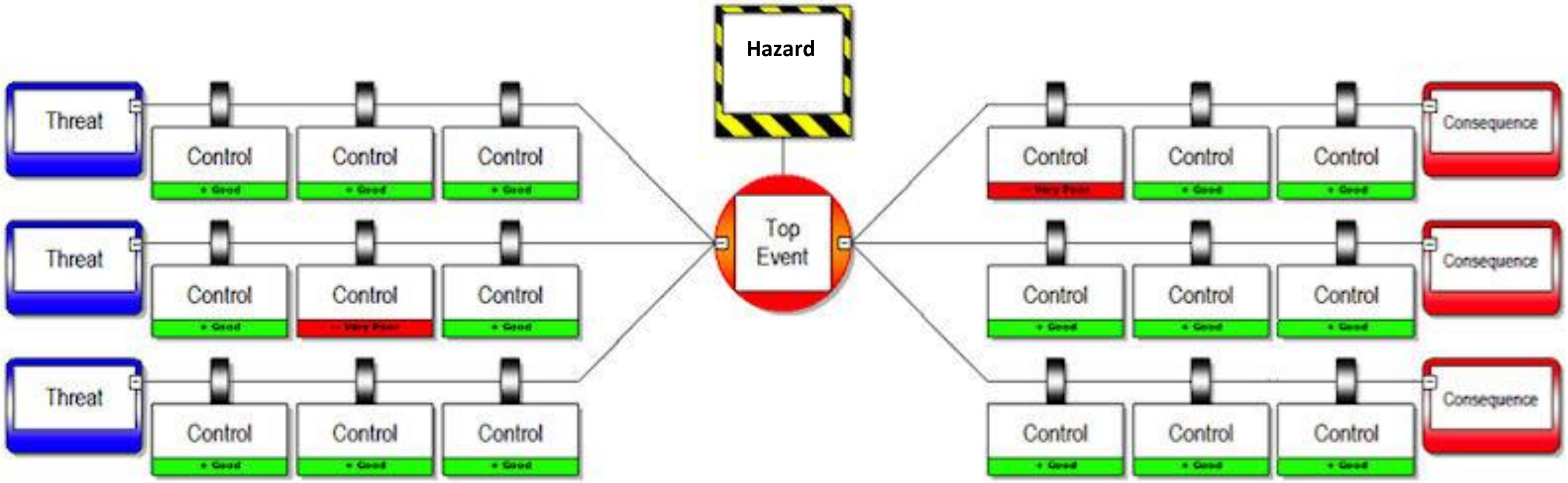
Root Cause Analysis Tools

A. Root Cause Analysis Tools

1. Bow-Tie Analysis

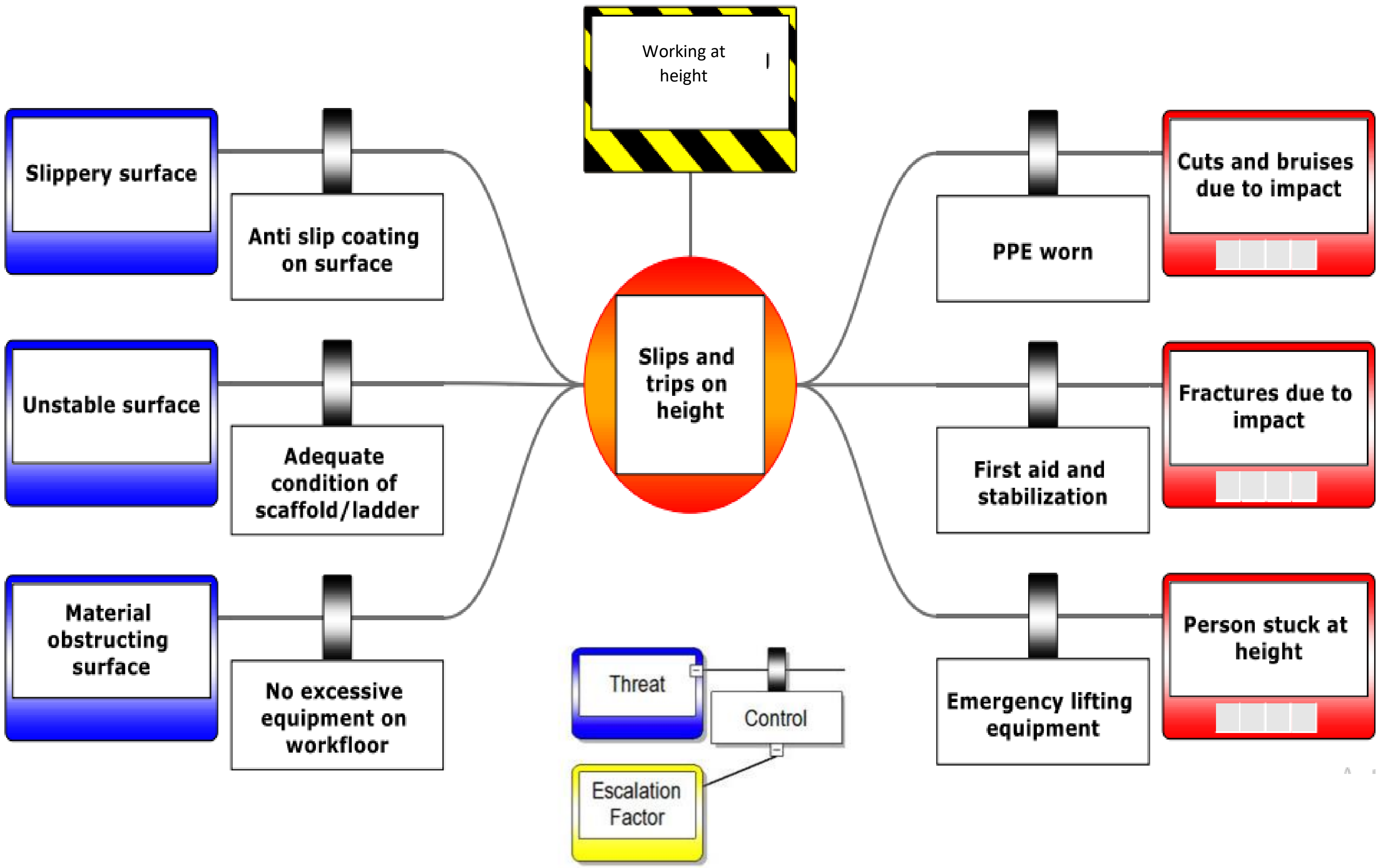
A Bow Tie is a diagram illustrating proactive and reactive risk management at any working environment. Bowtie method is an effective visualization tool that can be used to analyze the hazard, top event, threats, consequences, barriers (controls) and escalation factors of an accident or incident; and therefore gives an overview of everything not wanted around a certain hazard. Bow Tie method can also be used to identify the contributing and causal factors for an accident or incident. Normally, all the threats identified are contributing factors and the top event is the casual factor.

The Bow Tie diagram shall be shown as below:



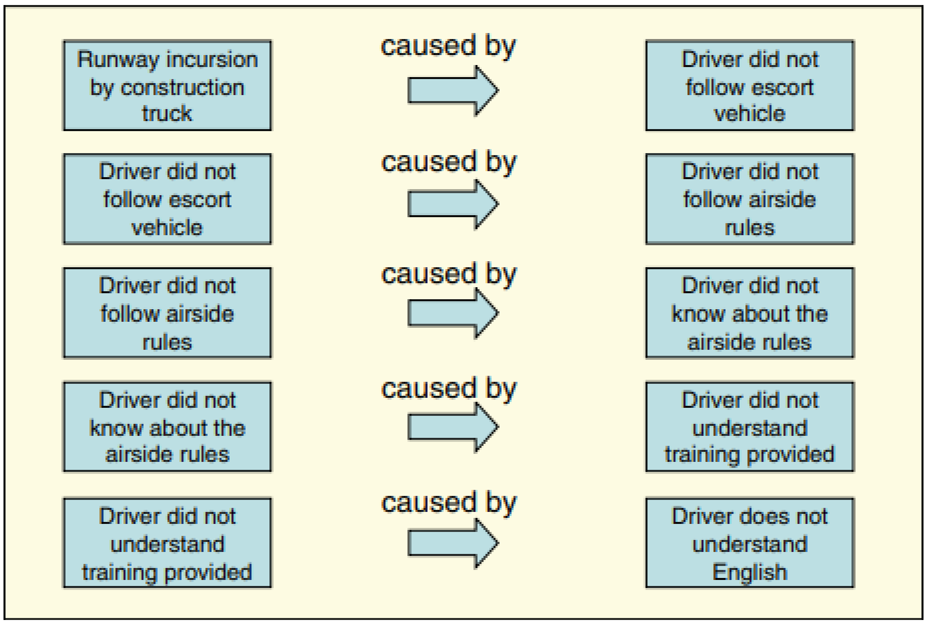
An example of application of Bow Tie Analysis

(This example is about an occurrence in a workplace.)



2. 5 – Whys

The following is a simple example of the questioning technique used in the "5 Whys." In this example, depicted in Figure below, a driver that was hired by a contractor to conduct a construction job on the airside failed to follow the directions from the escort vehicle. The incident resulted in a runway incursion because the driver was not able to speak or understand English; therefore, the training provided was ineffective. The escort person was not aware of that. The important point is that the investigation discusses issues that would preclude repetition of the problem.

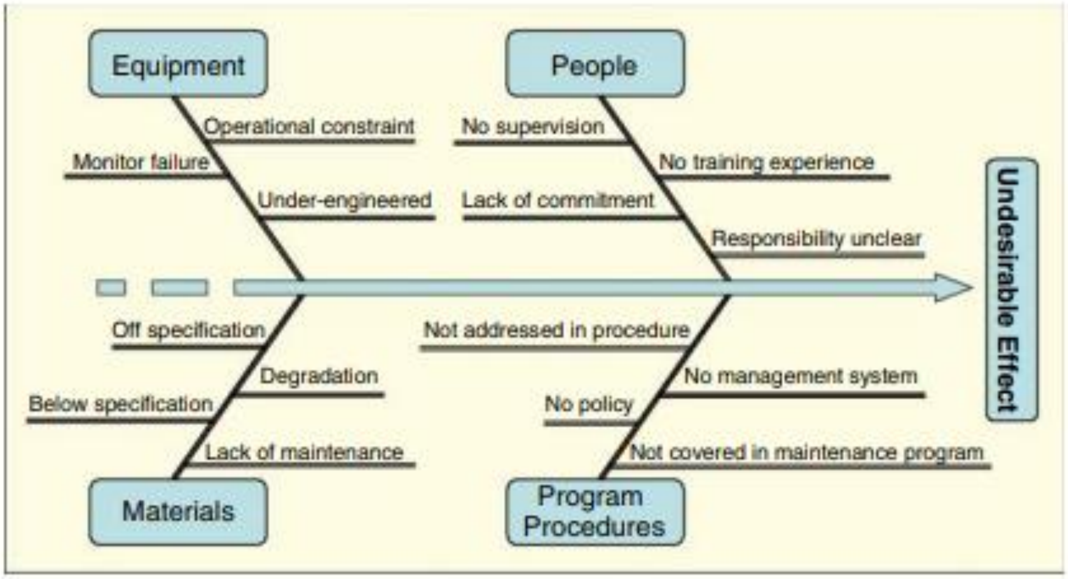


3. Fish Bone Analysis

This analysis is used to establish the cause and effect in investigations and is particularly useful when many experts are gathered. Typically, each will have his or her own particular expertise and concerns, and the fishbone analysis focuses all participants in the investigation to defined aspects of the operation. An example outline of the technique is shown in Figure below. The group will include the elements determined from the brainstorm session.

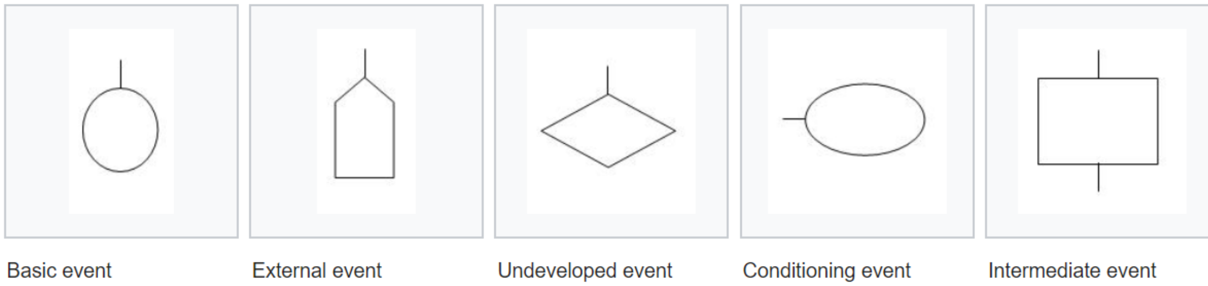
In this example, all participants are asked to focus on issues related to defined topics—equipment, people, materials, and programs/procedures. Each is discussed in turn, and concerns for each are written on the diagram. Other defined topics may be added at the discretion of the investigating team. At the end of the analysis, the resultant fishbone will look somewhat like the example shown.

The concerns identified are then investigated in detail to get to the root causes of the issue. It can be seen clearly that this technique will allow for multiple root causes, ranging from mechanical to human and organizational factors.



4. Fault Tree Analysis

- Any sufficiently complex system is subject to failure as a result of one or more subsystems failing.
- Fault tree analysis maps the relationship between faults, subsystems, and redundant safety design elements by creating a logic diagram of the overall system.
- The undesired outcome is taken as the root ('top event') (Casual factor) of a tree of logic.
- Fault tree analysis is also used to establish the casual and contributing factors for the occurrence.
- Generally, the immediate action before the occurrence is known as causal factor and the branches descended downward are known as contributing factors.
- The basic symbols used in FTA are grouped as events, gates, and transfer symbols. Minor variations may be used.

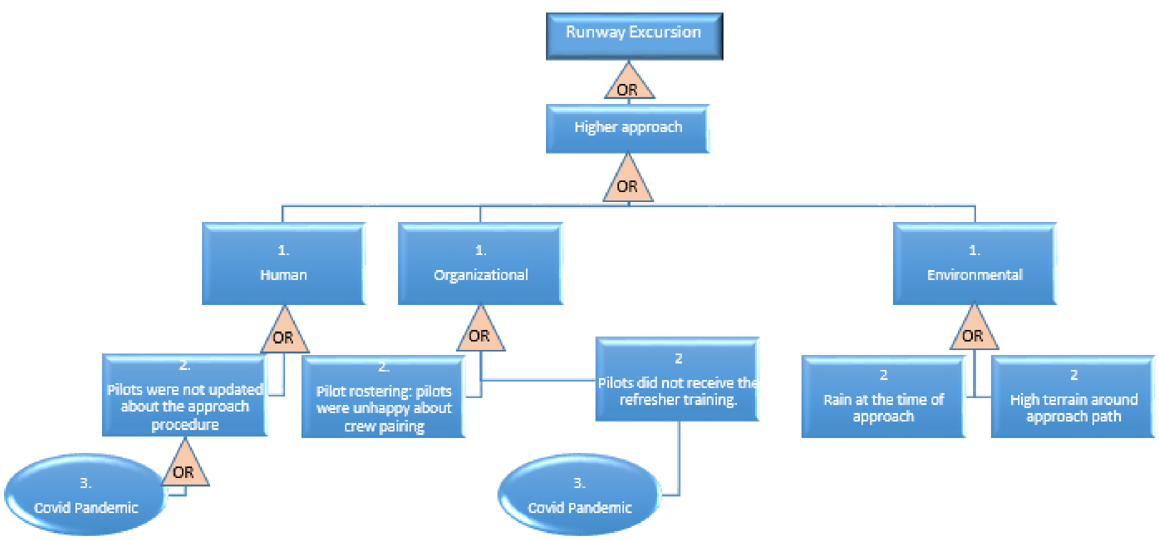


The primary event symbols are typically used as follows:

- **Basic event** - failure or error in a system component or element (example: switch stuck in open position)
- **External event** - normally expected to occur (not of itself a fault)
- **Undeveloped event** - an event about which insufficient information is available, or which is of no consequence
- **Conditioning event** - conditions that restrict or affect logic gates (example: mode of operation in effect)

An intermediate event gate can be used immediately above a primary event to provide more room to type the event description.

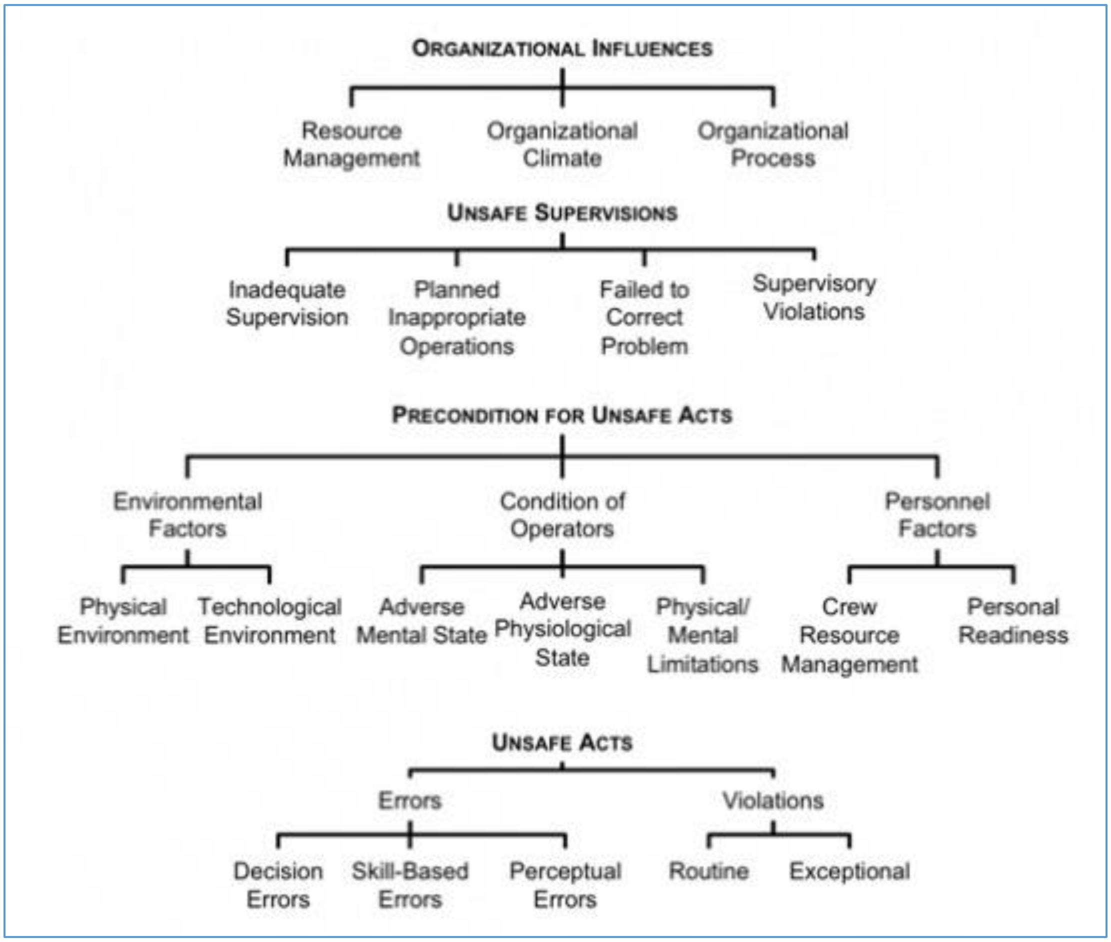
Below FTA diagram is about an occurrence of Runway Excursion. The immediate action before the occurrence (ie, The Higher approach) could be taken as the casual factor and the subsequent steps (ie, 1, 2, 3 …) could be taken as contributing factors for the occurrence.



Appendix - 3

Human and organizational Factor Analysis Tools

1. Human Factor Analysis and Classification System (HFACS)



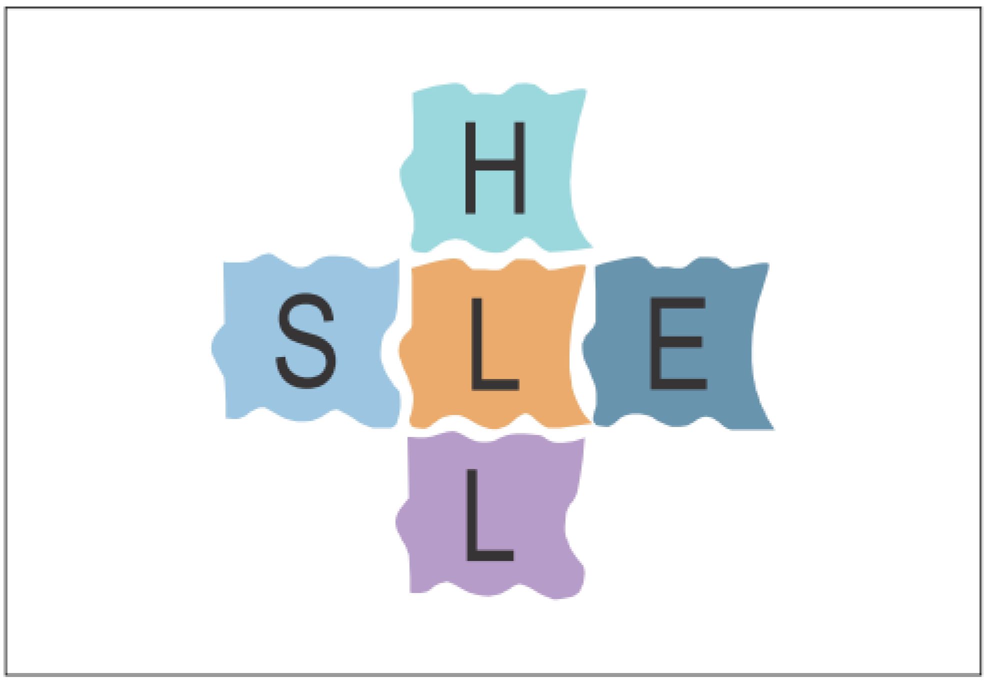
2. SHELL Model

This model illustrates the relationship between the human (at the centre of the model) and workplace components. The SHELL Model contains four satellite components:

a. Software (S): procedures, training, support, etc.;
b. Hardware (H): machines and equipment;
c. Environment (E): the working environment in which the rest of the L-H-S system must function; and
d. Liveware (L): other humans in the workplace

In this analysis model, the interaction of Liveware with other components are analysed. The analytical method shall be as:

4.4 Interaction of Liveware with Software;
4.5 Interaction of Liveware with Hardware;
4.6 Interaction of Liveware with Environment;
4.7 Interaction of Liveware with Liveware.



Appendix - 4
Report Writing Format

Report format

Clear reporting of the investigation will enable effective and consistent communication of the results. Report structure shall be as follows:

A. Synopsis –
(administration details and a brief description of the circumstances)

B. Factual information –
(established as such, not opinion or conjecture, documents the event timeline)

C. Analysis –
(provides a logical framework that ties the facts together and identifies any missing information. All type of analyses including Root Cause Analysis (RCA) and Human Factor Analysis (HFA) are conducted to supports the conclusions and recommendations.)

D. Conclusions –
(list findings (chronological sequence of events), identifies causes (contributing factors and casual factor).

E. Recommendations
(lists corrective actions for future improvement**,** actions should be as specific as possible and address all root causes and contributing factors).

Appendices-

Any other pertinent information considered necessary for the understanding of the report.

Appendix- 5

Examples of high and poor quality investigation practices

High quality accident and incident investigation

- A common and effective methodology for the investigation.
- An underlying 'Just Culture approach to investigation.
- Trained, competent investigators, with resources to identify trends and be proactive.
- An understanding of the human factors that contribute to such events, using a formal human factors approach.
- A process for reliably identifying systemic causes of occurrences, resulting in recommendations focusing on aspects additional to training, e.g. interface design, airspace design etc.
- A common "language" for communicating lessons learned from occurrences to all relevant parties.
- Investigator-led briefings to stakeholders to discuss de-identified incidents and share lessons learned.

Poor quality accident and incident investigation

- Reporting forms and requirements are not clear.
- No standard investigation methodology used.
- Tendency to focus on individual error- "did not follow the procedure….".
- 'Blame' approach rather than a Just Culture philosophy.
- Little emphasis on understanding human factors.
- Systemic causes not properly investigated or identified- all recommendations concern 're-training' of personnel involved.
- Recommendations are not followed-up of analysis.
- Lessons learned from occurrences not shared or communicated.
- Investigators not trained in formal investigation methodology or principles.
- Insufficient resources to look for trends in incident patterns.

Appendix - 6

Interviewing Techniques

Purpose of interviews

Information collected from interviews is used to confirm, clarify, or supplement information learnt from other sources. In the absence of other data, interviews can become the singular source of information. The role of an investigator, as an interviewer, is to obtain from witnesses evidence that is accurate, complete and as detailed as possible. To accomplish this, the investigator must:

- Be prepared –

Have a clear objective

- Have a good knowledge of the occurrence and related background information

- Be able to adapt to the witness' style

- Be willing to go beyond the actual facts

Witnesses for an occurrence investigation can include surviving flight crew and cabin crew, passengers, next-of-kin, eyewitnesses, air traffic controllers, maintenance personnel, training personnel, rescue and firefighting personnel, and management.

Interviews should be conducted as soon as practicable to avoid:

- Loss of perishable information from fading memory

- Interpretation and rationalization of events

- Contamination caused by exchange of information (e.g. news media, other witnesses).

If it is not practicable to immediately interview individuals whose information is perishable, the investigators should request that they prepare a written statement. The investigators shall bear in mind that an interview is not an interrogation.

Preparing for the interview

The investigators should take time to thoroughly prepare for the interview and consider doing the following:

- Follow appropriate company or agency protocol when arranging for the interview
- Assess the audience and dress accordingly
- Prepare a brief on the status of the investigation
- Study the background information (e.g. relevant manuals, regulations)

- Prepare for technical descriptions and explanations
- Review the following:
    - the facts relating to the crash sequence
    - The ATC or CVR/FDR tapes, if applicable
    - Technical information (e.g. aircraft systems, ATC system etc.)
    - Any operational peculiarities in procedures
    - The crew's personal records
    - Human performance references to identify relevant questions
    - ATS or airport references, if relevant
    - Any legal aspects
- Ensure all relevant documents and equipment (e.g. models, maps, pictures, diagrams of aircraft seat rows/exits/lavatories/galleys) are available
- Define the general objectives of the interview
- Prepare a set of appropriate questions to address all areas of concern during the interview
- Request the assistance of experts for interviews of a highly technical nature

The interview process

An interview is normally structured in three parts:

1. an opening
2. a main body and
3. a closing

An interview session should not last for more than two hours. The number of people attending the interview should be as few as possible, e.g. two interviewers and the interviewee (plus may be an expert). The interviewee may be allowed to be accompanied by a third person during the interview, provided that this person is not his superior. This person is not allowed to answer questions or to suggest answers to questions. Permission for his presence may be withdrawn if he is not cooperative. If possible, the investigators should conduct interviews in a neutral location and select a location that is quiet and comfortable, free from interruptions and familiar to the interviewee (if appropriate).

The investigators should determine the language of choice of the interviewee. If the language is not one spoken by the interviewing investigators, arrangement should be made for another qualified investigator suitably fluent in that language to conduct the interview. If such an investigator is not available or if the interviewee cannot communicate effectively in a language spoken by the investigator, arrangement will have to be made for an interpreter.

The interview process

Opening

When opening an interview, the investigators should reassure the interviewee about:

1. The purpose of the investigation
2. Their roles as investigators in the Incident
3. The goals of the interview
4. The importance of the information the interviewee may provide
5. The interviewee's rights
6. Protection of the statement made by the interviewee
7. Use of tape recorder, if the interviewee has no objection
8. The interview procedure to be followed

The investigators should establish a rapport with the interviewee at the outset by:

1. Being polite
2. Introducing themselves
3. Having mobile phones turned off before the interview
4. Behaving in a natural manner and not making the interview seem artificial
5. Keeping interruptions to a minimum
6. Striving for an atmosphere of friendly conversation
7. Intervening only enough to steer the conversation in the desired direction
8. Displaying a sincere interest

Main body

The investigators should begin the main body of the interview with a "free recall" question to let the interviewee talk about what he knows of the occurrence or subject matter. Such a free recall question allows the interviewee:

1. To ease into the interview in a more relaxed manner.
2. To feel that what he has to say is significant.
3. To provide information which is uncontaminated by the investigators.

As the interview progresses, the investigators may use a mixture of other types of questions:

1. Open-ended questions would evoke rapid and accurate descriptions of the events and lead to more participation from the interviewee.
2. Specific questions are necessary to obtain detailed information and may also prompt the interviewee to recollect further details.
3. Closed questions produce "yes" or "no" answers.
4. Indirect questions might be useful in delicate situations.

Investigators should avoid questions with the definite article unless the object in question has already been mentioned by the interviewee. For example, they should ask "Did you see a broken strut?" rather than "Did you see the broken strut?" They should also use neutral sentences without adjectives or figurative verbs and avoid leading questions. For example, they should ask "Which way was the aircraft travelling?" rather than "was the aircraft travelling west?'

Appendix -7

Guidelines for Flight Recorder Read-out and Analysis

Initial response

The Authority has identified that it's demanding time is the aftermath of a major Incident. One of the immediate decisions has to be taken by the Authority after the serious incident as to where to find the flight recorder and subsequently read out and analyse. It is essential that the flight recorders be read out as early as possible after an Incident. In this effect the Authority has understood that the early identification of problem areas can affect the investigation at the Incident site where evidence is sometimes transient. Early identification of problem areas may also result in urgent safety recommendations which may be necessary to prevent a similar occurrence.

In case of an ongoing parallel investigation in accordance to Annex 13, cooperation must be ensured between the investigation Commission and the committee formed by CAAN, especially for recorder readout facility.

Cooperation may be achieved by legislation, protocols, agreements or other arrangements, and may cover the following subjects: access to the site of the accident; preservation of and access to evidence; initial and ongoing debriefings of the status of each process; exchange of information; appropriate use of safety information; and resolution of conflicts.

Since Nepal does not have its own facilities for the playback and analysis of flight recorder information (both voice and data) and the Authority will request assistance from other States or entity having the facility.

Choice of facility

The Authority will request assistance from any State or entity that, in its opinion, the said States or entity can best serve the investigation. The Authority feels that manufacturer's standard replay equipment and playback software, which is typically used by airlines and maintenance facilities, is not considered adequate for investigation purposes. Special recovery and analysis techniques are usually required if the recorders have been damaged. According to the requirement of the Authority, facilities for the read-out of flight recorders should have the following capabilities:

a) the ability to disassemble and read out recorders that have sustained substantial damage;
b) the ability to play back the original recording/memory module without the need for the use of a manufacturer's copy device or the recorder housing that was involved in the Incident or incident;
c) the ability to manually analyse the raw binary waveform from digital tape flight data recorders;
d) the ability to enhance and filter voice recordings digitally by means of suitable software; and
e) the capability to graphically analyse data, to derive additional parameters not explicitly recorded, to validate the data by cross-checking and other analytical methods to determine data accuracy and limitations.

Recommended procedures

The flight data recorder and the cockpit voice recorder should be read out by the same facility, because they contain complementary data which can help validate each recording and aid in determining timing and synchronization.

Flight recorders should not be opened or powered up and original recordings should not be copied (particularly not by high-speed copy devices) prior to the read-out because of the risk of damage to the recordings.

The facility at which the flight recorders are read out may require the expertise of the aircraft manufacturer and the operator in order to verify the calibration data and validate the recorded information.

The investigation team shall ensure to leave the original recordings, or a copy of them, with the read-out facility until the investigation is completed, in order to facilitate the timely resolution of additional requests or clarifications, providing that the facility has adequate security procedures to safeguard the recordings.