



**GUIDANCE**

**FOR**

**TURBULENCE MANAGEMENT**

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## 0.0 Abbreviations and Glossary of Terms

|      |   |
|------|---|
| ATC  | Air Traffic Control                       |
| FSB  | Fasten Seat Belt                          |
| ICAO | International Civil Aviation Organization |
| IFE  | In Flight Entertainment                   |
| MW   | Mountain Wave                             |
| PA   | Passenger Address                         |
| PIC  | Pilot in Command                          |
| SCC  | Senior Cabin Crew                         |
| SMS  | Safety Management System                  |
| SOP  | Standard Operating Procedures             |
| TEM  | Threat and Error Management               |
| TS   | Thunderstorm                              |
| WS   | Windshear                                 |

## 1.0 Cabin Safety

IATA plays a key role in raising awareness of important cabin safety issues. Cabin safety is a component of an airline safety management program that includes proactive data collection and the ensuing prevention activities related to cabin design and operation, equipment, procedures, crew training, human performance, and passenger management. Cabin safety also comprises of all activities that cabin crew must accomplish in order to contribute to the safe and efficient operation of the aircraft during normal, abnormal and emergency situations.

These guidelines are the product of work carried out by the IATA Cabin Safety Task Force (CSTF) which is comprised of safety experts from IATA member airlines. The CSTF is established to develop, promote and improve standards, procedures and best practices to ensure safety and security in all aspects of cabin operations. The representatives are experts in the domain of: Cabin Safety, Cabin Crew Training, Accident Investigation, Human Factors and Quality Assurance. IATA wishes to thank the IATA Cabin Safety Task Force for their dedication and hard work.

For further information regarding these guidelines contact: [cabin\\_safety@iata.org](mailto:cabin_safety@iata.org) To order the Turbulence Management toolkit or for information on IATA Cabin Safety initiatives visit [www.iata.org/cabin-safety](http://www.iata.org/cabin-safety)

## 2.0 Turbulence Management

The Turbulence Management guidelines provide in depth analysis including a compilation of significant risk factors and recommendations. These guidelines are to help safety officers, training instructors and airline managers to evaluate safety risks, develop turbulence management

procedures, re-evaluate and amend current operators SOPs and develop strategies to prevent turbulence injuries.

Turbulence is leading cause of injury in non-fatal accidents. Over 25% of serious injuries result in diversions. Unrestraint equipment can damage cabin interior and may seriously injure passengers and crew. Turbulence events attract media attention and may result in negative impact on public view of the airlines safety record.

Cabin crewmembers are injured due to turbulence at a disproportionate rate compared to passengers. Cabin crew injuries occur at a higher rate as their duties require them to be standing and moving about in the passenger cabin and/or galleys, unseated and therefore not always secure with their seatbelt during flight. Cruise is the predominant phase associated with turbulence-related injuries. However, cabin crewmembers also sustain physical harm during climb, descent and approach.

Investing in turbulence management strategies can result in less incidents or accidents which in turn could also result in significant savings for airlines.

### 3.0 Safety Risk Management

When formulating SOPs hazards and consequences must be considered.

**HAZARD:** Hazard is a condition, object or activity with the potential of causing injuries to personnel, damage to equipment/structures or loss of material.

**CONSEQUENCE:** Consequences are the potential outcome(s) of the hazard.

The table below is a non-exhaustive list of hazards and consequences which should be considered:

| Hazards                                     | Consequences                                   |
|---|--|
| ↗ Unexpected moderate or severe turbulence  | ↗ Burn and scalds to passengers and cabin crew |
| ↗ Continuation of services                  | ↗ Injuries to passengers and cabin crew        |
| ↗ Inadequate SOPs                           | ↗ Structural damage from unsecured objects     |
| ↗ Not complying with SOPs                   | ↗ Diversions and delays                        |
| ↗ Customer service culture                  | ↗ Image/Media interest                         |
| ↗ Cabin design                              | ↗ Negative publicity                           |
| ↗ Catering services equipment               | ↗ Legal proceedings                            |
| ↗ Service delivery process                  |  |
| ↗ Non-compliance with fasten seat belt sign |  |

**SAFETY RISK:** The assessment, expressed in terms of predicted in terms of probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation.

RISK MANAGEMENT: The identification, analysis and elimination (and/or mitigation to an acceptable or tolerable level) of those hazards.

Risks can be managed to a level *as low as reasonably practicable* (ALARP).

## 4.0 Establishment of Standard Operating Procedures (SOPs)

To effectively manage turbulence, SOPs should include the following:

- ↗ Definition of turbulence intensity and types
- ↗ Cabin Crew duties
- ↗ Procedures for turbulence management
- ↗ Communication and coordination
- ↗ Human factors and prevention strategies

## 5.0 Definition of Turbulence Intensity and Types

### 5.1 Turbulence intensity

Three levels of turbulence can be encountered:

- ↗ Light
- ↗ Moderate
- ↗ Severe

| Intensity | Aircraft Reaction   |
|-----------|---|
| Light     | <b>Light Turbulence:</b> Slight, erratic changes in altitude and/or attitude (pitch, roll, yaw)   |
| Moderate  | <b>Moderate Turbulence:</b> Changes in altitude and/or attitude occur but with more intensity than light turbulence. Aircraft remains in control at all times |
| Severe    | <b>Severe Turbulence:</b> Large, abrupt changes in altitude and/or attitude. Usually causes large variations in airspeed.                                     |

Flight crew and cabin crew must use this terminology to describe the level of turbulence experienced in the cabin. Standard terminology ensures that flight crew and cabin crew share a common understanding of the level of turbulence and the inherent dangers that accompany it.

The use of an immediate aural (public address announcement) and visual (fasten seat belt sign on) as a communication method at all three levels of turbulence is critical. Do not rely on the seatbelt sign alone!

## ***5.2 Turbulence types***

Turbulence or rough air can be subdivided into visible and invisible causes. Clouds, especially thunderstorms, create turbulence of varying severity. Thunder clouds, or cumulonimbus clouds are filled with parcels of air moving up and down at great speeds and often contain ice crystals as well as rain drops. These particles can be seen by the aircraft's radar enabling the flight crews to avoid the storms and hence the turbulence. Other causes include thermals, as heat from the sun makes warm air masses rise and cold ones sink.

### **Thunderstorm Turbulence**

Turbulence associated within and in the vicinity of thunderstorms or cumulonimbus clouds. A cumulonimbus cloud with hanging protuberances is usually indicative of severe turbulence.

### **Clear Air Turbulence**

By definition invisible; High level turbulence (above 15,000) often associated with fast moving bands of air or "Jet Streams" which occur as part of the global weather environment and with the "Fronts" you see on television weather programs. These fast, high altitude air currents shift disturbing the air nearby. Clear Air Turbulence can be forecasted but rarely detected before an aircraft encounters it. It is therefore vital to prepare the cabin and secure the passengers and Cabin Crew in order to minimize the effects of turbulence inside the passenger cabin.

### **Mountain Wave Turbulence**

Turbulence as a result of air being blown over a mountain range or a sharp bluff causing a series of updrafts and downdrafts.

### **Wake Turbulence**

Wake turbulence is experienced when an aircraft passes through the jet stream of an aircraft flying in front. ATC will regulate the separation distances between aircraft, but on rare occasions wake turbulence may occur and will result in the aircraft rolling quickly.

## ***5.3 Turbulence Duration***

**Occasional:** Less than 1/3 of the time

**Intermittent:** 1/3 to 2/3 of the time

**Continuous:** More than 2/3 of the time

**NOTE:** Duration may be based on time between two locations or over a single location.

## 5.4 Conditions inside the aircraft

| CONDITIONS INSIDE THE AIRCRAFT  |   |   |
|---|---|---|
| LIGHT   | MODERATE  | SEVERE  |
| <ul style="list-style-type: none"> <li>↗ Liquids are shaking but not splashing out of cups</li> <li>↗ Carts can be maneuvered with little difficulty</li> <li>↗ Passengers may feel a light strain against seatbelts</li> </ul> | <ul style="list-style-type: none"> <li>↗ Liquids are splashing out of cups</li> <li>↗ Difficulties to walk or stand without balancing or holding on to something. Carts are difficult to maneuver</li> <li>↗ Passengers feel definite strain against seat belt</li> </ul> | <ul style="list-style-type: none"> <li>↗ Items are falling over unsecured objects are tossed about.</li> <li>↗ Walking is impossible</li> <li>↗ Passengers are forced violently against seat belts</li> </ul> |

## 6.0 Cabin Crew Duties

Based on the level of turbulence described, the crew should be aware of the appropriate actions to be taken with regard to service duties and passenger management. Service may continue during light turbulence; *however the service of all hot beverages should stop*. Cabin crew should complete a seat belt compliance check to ensure passengers are fastened and the cabin is secure. During a turbulence encounter above light, it is important to secure the cabin and galley when conditions permit.

However, the most appropriate first response by cabin crew might be self-preservation. Cabin crew can increase risk and compromise their personal safety by attempting to adhere to routine procedures normally performed on all flights such as the seat belt compliance checks, rather than responding in accordance with the level and intensity of turbulence.

Another example that poses risk is on a short flight cabin crew often feel the pressure to complete a service and therefore are less cautious with their own personal safety than on a longer flight with no time constraints. Cabin crew should always secure themselves, sit down and fasten their seat belt immediately *when turbulence levels are a risk to personal safety*.

## 6.1 Action required for carts and galleys

| CARTS AND GALLEYS  |  |   |
|--|--|---|
| LIGHT  | MODERATE   | SEVERE  |
| <ul style="list-style-type: none"> <li>➤ Ensure carts and galley equipment not in use is properly secured.</li> <li>➤ <b>Note:</b> Airline should decide whether their SOPs would allow cabin crew to continue with any service</li> </ul> | <ul style="list-style-type: none"> <li>➤ Ensure carts and galley equipment is properly secured.</li> <li>➤ <b>For short duration:</b> set brakes on carts and secure items from top of carts.</li> <li>➤ <b>For extended duration:</b> carts must be stowed in galley. If not possible to maneuver back to the galley, set the brakes on all carts at present location. Wedge between seats.</li> <li>➤ Place hot liquids, water jugs/pots in the carts. If not possible place them on the floor</li> <li>➤ Take the nearest available seat, fit full harness or fasten seat belt (if passenger seat)</li> </ul> | <ul style="list-style-type: none"> <li>➤ Set the brakes on all carts at present location. Wedge between seats.</li> <li>➤ Place hot liquids, water jugs/pots in the carts. If not possible place them on the floor</li> <li>➤ Take the nearest available seat, fit full harness or fasten seat belt (if passenger seat)</li> </ul> <p><b>Note:</b> Hold on to cart if possible, ask adjacent passenger to assist in holding cart down</p> |

## 6.2 Action required for seat belt compliance

| SEATBELT COMPLIANCE  |   |  |
|--|---|--|
| LIGHT  | MODERATE  | SEVERE   |
| <ul style="list-style-type: none"> <li>➤ Cabin crew visually checks that passengers are seated with seatbelt fastened and cabin baggage stowed.</li> <li>➤ Infants must be removed from bassinets and secured and restraint on guardian's lap or in a car type child seat. (as per the airline's applicable CAA regulations)</li> <li>➤ Cabin crew confirm "cabin secured" to SCC/ Purser</li> <li>➤ SCC / Purser reports to flight deck</li> <li>➤ Recheck for longer period of turbulence</li> </ul> | <ul style="list-style-type: none"> <li>➤ If possible, maneuver carts back to galley, at the same time check that passengers are seated with seatbelt fasten and hand baggage stowed or placed under the seat.</li> <li>➤ Infants must be removed from bassinets and secured and restraint on guardian's lap or in a car type child seat.</li> <li>➤ Cabin crew confirm "cabin secured" to SCC / Purser</li> <li>➤ Cabin crew takes their seats and fit full harness.</li> <li>➤ SCC / Purser reports to flight deck.</li> </ul> | <ul style="list-style-type: none"> <li>➤ Cabin Crew will not attempt to ensure passenger compliance. It is imperative that cabin crew sit down immediately.</li> <li>➤ Cabin Crew take the nearest available seat, fit full harness or fasten seat belt (if passenger seat)</li> </ul> |

## 7.0 Procedure for Turbulence Management

### 7.1 Pre-flight Briefings

It is important to always include any weather information of concern in the pre-flight briefing. Every pre-flight briefing should include possible turbulence encounters on each sector of the flight. The flight crew should brief the cabin crew on expected intensity/level of turbulence, the methodology for communicating to the cabin crew the onset or worsening of turbulence (via cabin interphone or PA), phraseology as per company SOPs for the cabin crew to communicate the severity of turbulence, the estimated time until reaching the zone of turbulence and the duration. Lastly and equally important, how the "all clear" will be communicated to advise the cabin crew of when they may commence/resume their duties. The Senior Cabin Crew (SCC) / Purser should inform all cabin crew members of any turbulence information received from the flight crew. In case of anticipated turbulence, cabin crew should adapt the service accordingly. Depending on the level and the expected time of turbulence the cabin crew may conduct the service earlier or later than planned.

### 7.1.1 Two-way communication

Communication and coordination among crewmembers is critical. Communication between cabin and flight crew should not be limited to pre-flight briefings. The flight crew should promptly and clearly communicate turbulence advisories to the cabin crew and passengers. The flight crew should inform the SCC / Purser of upcoming expected turbulence (light, moderate, severe). The SCC / Purser should inform the flight crew of the duties the cabin crew are performing and any activities taking place in the cabin and as required mitigation measures and/or service level adjustments due to turbulence. The level of turbulence expected may be more intense especially in the aft section of the aircraft. When turbulence is encountered, cabin crew must communicate conditions in the cabin to the flight crew and to all other cabin crew. If required the cabin crew should request that the seat belt sign be turned on.

### 7.1.2 Read back instructions

When the flight crew communicates a message, the cabin crew must read-back the instructions to prevent an error that could compromise safety. This method is a means of double checking information, ensuring it is accurately understood and avoids miscommunication and confusion. For example: if the PIC warns the crew that turbulence will be encountered in 15 minutes, the cabin crew may understand 50 minutes, leaving them less time than they think to secure the cabin. When the cabin crew read-back, the instructions and state *50 minutes* the pilot in command will hear the error and reconfirm: *No, 15 minutes, 1-5.*

## 7.2 SOPs for take-off

To prevent injuries as a result of turbulence during climb, prior to take-off the cabin crew must:

- Visually check that passengers are seated with seatbelts fastened
- Infants restraint on guardian's lap or in a car type child seat
- All cabin baggage stowed in overhead lockers or under the seat
- Overhead lockers closed securely
- Visually check that galley equipment and latches are secured
- Return to their assigned stations and ensure that seatbelt and harness are properly fastened.

## 7.3 SOPs for Cruise

Service carts should never be left unattended. All service equipment must be re-stowed in its correct stowage when it is not in use.

### 7.3.1 Seatbelt sign

At all times during turbulence and especially during moderate levels and above, the most appropriate response for cabin crew is self-preservation. The cabin crew should be informed of routine turbulence and if the cabin crew experience uncomfortable turbulence without notification from the flight crew, they should secure themselves in their seats and inform the flight crew. Cabin crew should feel free to request that the fasten seatbelt sign be switched on whenever they judge it necessary. Often what the cabin crew experience at the rear of the aircraft can be very different from what the crew is experiencing at the front of the aircraft. Passengers should be informed of routine turbulence via the PA. Again, do not rely on the seatbelt sign alone!

The seatbelt sign should not be left on during the entire flight if the air is smooth. This diminishes its effectiveness as a warning function. Passengers also tend to respond more to seatbelt compliance announcements made by the flight crew.

### 7.3.2 SOPs for anticipated turbulence

When advanced notice enables the PIC to brief the cabin crew during the flight, the flight crew will advise the cabin crew of the time available to secure the cabin and the level and duration of turbulence anticipated. The flight crew should clearly state the expectations of the cabin crew as per SOPs and request confirmation of completion by the SCC / Purser. There are times when little warning exists. Cabin crew should stow all service items, conduct compliance checks and secure themselves in their seats. When the conditions improve the PIC should use the cabin interphone or PA to advise the cabin crew that they may resume their duties and if passengers may move about in the cabin.

### 7.3.3 SOPs for unanticipated turbulence

If there is sudden moderate to severe, unanticipated or imminent turbulence requiring immediate action, the flight crew will switch on the fasten seatbelt sign. The flight crew will make a standard PA (as per their SOPs) such as: "All passengers and crew please fasten your seatbelts immediately." *Immediately* is the key word that communicates the urgency of the situation to the cabin crew. The cabin crew must cease all duties, secure themselves in the first available seat and remain seated until advised by the flight crew or until the fasten seatbelt sign is switched off. Compliance checks should only be performed and items secured if this presents no delay in securing themselves in a seat. When the conditions improve the PIC should use the cabin interphone or PA to advise the cabin crew that they may resume their duties and if passengers may move about in the cabin. Cabin crew may then leave their seats, check conditions of the cabin, passengers and crew members and inform the flight crew if injuries or damages have occurred.

With advanced notice, and if the turbulence is moderate and of extended duration, the flight deck will make the following PA: "Ladies and gentlemen please fasten your seat belt, cabin crew stow all applicable service items". The cabin crew will then proceed according to the action defined in cabin crew duties.

### 7.3.4 Post Turbulence Management

The following are recommended post turbulence duties:

- ✈ Flight crew will advise cabin crew when it is safe to resume duties.
- ✈ Cabin crew check for passenger and crew injuries and administer first aid if necessary.
- ✈ Report to SCC / Purser any passenger injuries and/or cabin damage.
- ✈ Calm and reassure passengers.
- ✈ Check cabin for any damage.
- ✈ The SCC / Purser will report any passenger injuries and/or cabin damage to the flight crew.

Warning: Cabin crew should not risk personal injury by continuing service during turbulent conditions. The personal safety of the cabin crew is the priority.

## 7.4 SOPs for descent and final approach

At 20,000 feet a PA should be made by the flight crew, such as: "Cabin crew prepare cabin for arrival" or the flight crew may advise the SCC / Purser via the interphone. The cabin crew will cease all cabin service activities and secure cabin and galley for landing. In addition, some

operators make a PA to passengers advising them to use the lavatories and stow their cabin baggage and/or personal items at this time. This permits passenger to stow items to the overhead lockers so that they are not standing or moving around the cabin once the seatbelt sign is turned on.

In case of anticipated turbulence on descent, the flight crew must be aware that the securing the cabin may take 10-15 minutes and therefore should inform the cabin crew in a timely manner. When the fasten seatbelt sign is switched on, the SCC / Purser will make a PA instructing passengers that the PIC has informed them that they might experience some turbulence on descent and the importance of fastening their seatbelts in preparation for landing. Cabin crew must:

- ↗ Visually check that passengers are seated with seatbelts fastened
- ↗ Infants are restraint on guardian's lap or in a car type child seat
- ↗ All carry-on baggage stowed in overhead lockers or under the seat
- ↗ Overhead lockers closed securely
- ↗ Visually check that galley equipment and latches are secured
- ↗ Return to their assigned stations and ensure that seatbelt and harness are properly fastened.

Note: If cabin is not secured, SCC / Purser must contact the flight deck immediately. Be aware that sterile flight deck SOPs will come into effect as of flight level 10,000 feet and that cabin crew should *only contact the flight crew for safety or security critical information.*

## 8.0 Communication and Coordination

Good communication applies to every phase of the flight including pre-flight briefing. The use of standard terminology allows a shared understanding of the effects of turbulence and the crews to make well-informed, effective decisions. Communication in addition to its most widely perceived function of transferring information enhances situational awareness, enabling individual crew members to contribute appropriately and effectively to manage turbulence and prevent injuries.

### 8.1 Communication and coordination for anticipated turbulence

If flight into forecast turbulence is unavoidable, timely notification to the cabin crew is crucial.

| Event               | Flight Deck  | SCC / Purser   | Cabin Crew   |
|---------------------|--|--|--|
| Expected turbulence | <p>Inform SCC / Purser on the expected turbulence level and its duration. Clearly articulate expectations from cabin crew (as defined in cabin crew duties) and confirmation of completed actions. Switch on FSB sign.</p> <p>Make a PA to passengers: We are entering an area of turbulence please fasten your seat belt.</p> <p>If above light: "cabin crew stow all applicable service items and take your seats"</p> <p><b>Note:</b> PA may be delegated to cabin SCC / Purser</p> | <p>Read-back information and inform cabin crew according to flight deck brief.</p> <p>If PA is delegated: Make a PA: "We are entering an area of turbulence, please be seated with seatbelt fastened"</p> <p>On receiving cabin secured by cabin crew, report back to flight deck: "cabin secured"</p> | <p>Receive information from SCC / Purser. Perform visual check as defined in seat belt compliance and confirm to SCC / Purser "cabin secured".</p> <p>On hearing the PA, cabin crew will perform cabin, galley and seatbelt compliance checks as defined in cabin crew duties.</p> |

### ***8.2 Communication and coordination for unanticipated moderate turbulence***

| <b>Event</b>                            | <b>Flight Deck</b>   | <b>SCC / Purser</b>  | <b>Cabin Crew</b>                    |
|---|--|--|--------------------------------------|
| Unexpected light to moderate turbulence | <p>Switch on FSB sign. Make a PA: "please be seated with seatbelt fastened" please fasten your seat belt"</p> <p>If turbulence above light:</p> <p>"Cabin crew please take your seats"</p> | Receive "cabin secure" from cabin crew and report back to flight deck: "cabin secured" | Confirm SCC / Purser "cabin secured" |

### ***8.3 Communication and coordination for unanticipated severe turbulence***

| <b>Event</b>                 | <b>Flight Deck</b>   | <b>SCC / Purser</b>  | <b>Cabin Crew</b>  |
|------------------------------|--|--|--|
| Unexpected severe turbulence | <p>Switch on FSB sign. Make a PA: "All passengers and crew fasten seatbelts immediately"</p> | On hearing the PA, cease all duties, sit down immediately fasten seatbelt and fit full harness. Remain seated until advised by the flight crew or the fasten seatbelt sign is switched off | On hearing the PA, cease all duties; set brakes on all carts and wedge between seats. Place hot liquids, water jugs/pots on the floor Take the nearest available seat, fit full harness or fasten seat belt. Sit down immediately Remain seated until advised by the flight crew or the fasten seatbelt sign is switched off |

### ***8.4 Communication and coordination for unanticipated severe post turbulence***

| <b>Event</b>                         | <b>Flight Deck</b>   | <b>SCC / Purser</b>   | <b>Cabin Crew</b>  |
|--------------------------------------|--|---|--|
| Fasten seatbelt sign is switched off | Advice cabin crew that it is safe to get up and reassume duties. | Receive the status of the cabin if injuries or damage have occurred and inform the flight deck. | Receive information that it is safe to get up. Verify that passengers are not hurt and check if any damage has occurred. Inform the SCC / Purser of the status of the cabin. |

## ***8.5 Turbulence reporting***

It is recommended that all incidents of *moderate and severe* turbulence be reported by the cabin crew. This would permit for post-incident investigations which are important to continuous safety improvements. Each internal investigation that the airline may conduct could lead to new knowledge which may contribute to new turbulence management mitigation measures. A regular review of SOPs should be conducted to ensure that they remain applicable and effective.

In incidents where injuries occur, reports usually are required to be submitted by the operator to the competent authority. Check with your local CAA to see if this is applicable.

Reports of *light* turbulence can also prove useful in assessing routes which are more likely to encounter turbulence, (see Section 10.1 for an example) the data obtained from these reports may act as aids for cabin crew, including but not limited to, additional information during the pre-flight briefing.

By setting up a system to report all levels of turbulence, an operator can provide reactive, proactive and predictive information and/or advice to cabin crew, service designers and passengers. It is worth noting that as some degree of turbulence is anticipated on most flights, therefore reports could be plentiful and the operator would likely require a system in place to solicit and manage them.

## **9.0 Human Factors in turbulence management**

Human factors involve the gathering of information about human abilities and limitations, and applying it to produce safe and effective human use. That understanding should be translated into training, policies, or procedures to help humans perform better. Understanding human performance can help the industry to reduce the risks associated with turbulence.

### ***9.1 Threat and Error Management***

Threat and Error Management is an overarching safety concept regarding aviation operations and human performance. The TEM framework is a conceptual model that assists in understanding the inter-relationship between safety and human performance in dynamic operational contexts. It helps operators to capture data from everyday flights and as well as from incidents and accidents. With this data, operators can develop information that assists in understanding strengths and weaknesses, clarify human performance needs thus contributing to improve the effectiveness of its training interventions, and consequently to an efficient safety management of cabin operations.

The basic components of the TEM framework are:

- **Threats** – generally defined as events or errors that occur beyond the influence of cabin crew, increase operational complexity, and which must be managed to maintain the margins of safety.
- **Errors** – generally defined as actions or inactions by cabin crew that lead to deviations from organizational or cabin crew intentions or expectations. Unmanaged and/or miss-managed errors frequently lead to undesired states. Errors in the operational context thus tend to reduce the margins of safety and increase the probability of an undesirable event.
- **Undesired states** – generally defined as operational conditions where an unintended situation results in a reduction in margins of safety. Undesired states that result from

ineffective threat and/or error management may lead to compromised situations and reduce margins of safety aviation operations.

- ✘ **End state** – final event that completes the incident/accident sequence. An end state can be responded to, but margins of safety are **not** recoverable. There is no going back.

Originally developed for flight deck operations, the TEM framework can nonetheless be used at different levels and sectors within the aviation industry. The TEM model can be used as an analytical tool to determine potential threats, errors and undesired states that can lead to incidents. TEM findings can be used to develop prevention strategies that are particular to your current safety issues.

## ***9.2 Threats and Errors Management related to Turbulence***

A threat analysis was conducted based on the turbulence injuries statistics to determine the contributing factors. The objective of the analysis is to produce effective management strategies and tools to prevent turbulence injuries. The following threats and errors were identified:

### **Threats:**

- ✘ Inadequate seat belt policy
- ✘ Inadequate SOPs
- ✘ Anticipated and unanticipated turbulence
- ✘ Service-related duties
- ✘ Operational pressure
- ✘ Service equipment and equipment restraining device
- ✘ Galley-specific threats such as carts, bins, countertops, protruding latches and hot liquids
- ✘ Cabin-specific threats such as overhead bins, partitions and armrests

### **Errors:**

- ✘ Cabin crew do not secure themselves in turbulence
- ✘ Cabin crew standing during critical phase of flight
- ✘ Handling errors such as leaving service equipment unrestrained and handling hot liquids during turbulence

### **Undesired States:**

- ✘ Cabin crew unsecured in turbulence
- ✘ Equipment unrestrained cabin or galley
- ✘ Hot liquids in cabin or galley during turbulence

## 10.0 Prevention strategies

The following prevention strategies should be combined and considered to maintain safety margins and to manage turbulence encounters effectively.

- Establishment of policies and procedures
- Communication, pre-flight briefings, route charts
- Managing complacency
- Cabin Crew training

### 10.1 Establishment of Route Charts

Airlines can raise awareness of turbulence encounters on particular routes in their network. Depending on the area and the season, aircraft may be more likely to encounter turbulence because of factors such as the Jet Stream. Airlines can hand out such information to crews and discuss it during pre-flight briefings. Making cabin crew alert to the probability that turbulence could be encountered will help them be more safety-minded during their duties throughout the flight and could help them manage cabin activities in a more efficient manner.

#### Example of Route Charts

| AREA         | SEASON           | SECTOR            | CAUSES          |
|--------------|------------------|-------------------|-----------------|
| Andes        | All season       | Chile / Peru      | Leeward Wind/MW |
| Australia    | Summer (Winter)  | SYD / BNE         | Jet Stream      |
| Caribbean    | Hurricane Season |                   | Wind            |
| Costa Rica   | All season       | San Jose          | Thunderstorm    |
| Ecuador      | All season       | Quito             | Thunderstorm    |
| Europe       | Winter           | AMS / FRA         | Jet Stream / TS |
| Europe       | Summer/Autumn    | Mediterranean See | Thunderstorm/WS |
| Europe       | All season       | Pyrenees / Alps   | Windshear       |
| Indian Ocean | Winter           | AMS / ROM         | Jet Stream      |
| Japan        | Winter           | U.S. – JPN        | Jet Stream/MW   |
| Japan        | All season       | PEK – JAP         | Jet Stream/MW   |

### Example of Route Charts Continued

|                 |                            |                                     |               |
|-----------------|----------------------------|-------------------------------------|---------------|
| Lhasa           | All season                 | CTU - LXA                           | Altiplano     |
| Pacific         | All season                 | PEK – LOS<br>PEK – SAN              | Jet Stream    |
| Russia          | All season                 | TPE – FRA                           | Mountain Wave |
| South China Sea | All season                 | PEK – MNL<br>PEK – SIN<br>PEK – KUL | Typhoon       |
| South-East Asia | Summer                     | South-East Asia                     | Thunderstorm  |
| United States   | All season                 | SEA – IAH                           | Mountain Wave |
| United States   | Hurricane Season<br>Spring | JFK – SJU                           | Wind          |

### Sample of SOPs Adapted as Per Particular Route

One IATA Member airline identified a particular route to be historically problematic and adapted their cabin crew procedures as a result. Initially this procedure was applied only in specific seasons, but given the complicated intersection of the Chilean Coastal Range and the resulting clear air turbulence it was very difficult to detect or predict when this procedure should be activated. For this reason the airline implemented this as a standard operating procedure for all flights inbound/outbound of Santiago de Chile (SCL):

#### ***CROSSING MOUNTAIN - FLIGHTS LEAVING AND COMING TO SCL***

*Cabin Crew must give a notice to passengers, stating that during the crossing of mountain fasten seat belts signal will remain on. While seat belt sign stays on during the crossing of the mountain of range, passengers must remain in their seat with their seatbelts fastened and Cabin Crew must be secured in their jump seats with full harness. If passengers do not comply with the advisory to remain seated, the Cabin crew should reaffirm the PA announcement. When the seat belt sign is turned off, the SCC / Purser coordinates with the Pilot in Command regarding an adjustment or suspension of service on board according to flight time remaining.*

## **10.2 Turbulence Management Task Force**

Some operators have a turbulence management task force in order to review incidents, injuries, training and SOPs and to recommend appropriate actions. Airlines who have an SMS system in place may consider the use of the safety action group to address turbulence injury management.

## 11.0 Proactive Seat Belt Policy

With injuries on going, IATA continues to address the causes and contributing factors and specifically what can be done to mitigate them. The most effective mitigation measure to a turbulence injury is to: fasten your seatbelt at all times while seated. With the commitment to reducing incidents and accidents the aviation industry continues to assess all areas. Turbulence injuries to both passengers and crew continue to be a very real safety concern with some resulting in serious injuries thus being classified as “accidents” under the ICAO definition of accident. In addition, negative media attention due to turbulence injuries and/or from resulting diversions could ensue and an increase in operational costs could also result.

The following illustrates the problem:

- ↗ Turbulence is the leading cause of injury in non-fatal “accidents”
- ↗ In 2011, the IATA-ICAO accident list contained 19 turbulence injury related accidents out of a total 123 accidents meeting the definition
- ↗ Result: turbulence accidents accounted for 15% of the total accidents reported in 2011
- ↗ 25% of “serious injuries” result in diversions

Prevention is key. Injuries are far less likely to occur to passengers who are secured with their seatbelt fastened than to those who are not. The best defense to turbulence related injuries is to ensure persons on board are buckled-up.

The promotion of seatbelt use at all times *while seated* is an effective safety initiative to mitigate turbulence incidents or accidents and resulting injuries. The benefits include but are not limited to:

- ↗ Promotes increased safety
- ↗ 0\$ to implement
- ↗ Will contribute to the reduction of injuries
- ↗ Will contribute to cost savings for airlines through the reduction of injuries
- ↗ Will mitigate negative media attention due to incidents/accidents

At the present time some airlines have a proactive policy on the use of seatbelts. Some have included this policy in their Terms & Conditions via their company websites and/or under the Conduct on Board information. Other means to communicate the proactive use of seat belt at all times while seated policy can be via the IFE, the in-flight magazine, the safety announcements or during the safety video presentation.

Cabin crew should lead by example and fasten their restraint devices at all times when not performing safety or service related duties. This includes while seated at their assigned crew seat, or while seated or sleeping in the crew rest area or bunks, even if the seat belt sign is not illuminated.

NOTE: Airlines should not adopt the procedure of illuminating the seat belt sign at all times during flight. Doing so will diminish the warning function of the seatbelt sign. The seat belt sign should only be illuminated when required including during taxi, take-off, landing, turbulence, when the pilot-in-command considers it necessary to do so for safety/security reasons, and at the request of the cabin crew.

For comments or for further information please contact [cabin\\_safety@iata.org](mailto:cabin_safety@iata.org)