AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course
Handout Nº 2 – The Anyfield Airport accident

International Civil Aviation Organization

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AFI COMPREHENSIVE IMPLEMENTATION PROGRAMME (ACIP) SAFETY MANAGEMENT SYSTEM (SMS) COURSE

Exercise Nº 03/01 – The Anyfield Airport accident

Group 3

Scenario

In the early hours of an autumn Monday-morning, a twin-engined jet transport with 5 crew-members and 63 passengers on board while in its take-off run at Anyfield Airport collided with a small twin-engined propeller-driven aircraft, with only a single crew-member that had intruded the departure-runway. Both aircraft were severely damaged as a result of the collision. The subsequent fire destroyed both aircraft and was the death-cause for most of the passengers.

Anyfield Airport is a medium-sized airport, with a single runway which can be accessed (or vacated) by a number of intersections. It is a controlled aerodrome; the control-tower is located 400 meters north of the middle of the runway. Traffic-numbers are on the rise as quite a few commuter-type airlines have started operating to and from Anyfield.

Although the airport is in a region in which several foggy days a year are common, it is not equipped with a Surface Movement Radar (SMR), nor does it have special taxiway-lighting facilities for use under low visibility-conditions.

Air Traffic Control at Anyfield is slightly understaffed, but so far it was not thought necessary to impose restrictions on operations to and from Anyfield. There is a discrete frequency (Ground Control) to handle taxiing aircraft.

At the time of the collision, the average visibility was around 700 meters with fog-banks, which is just sufficient to allow the tower-controller to see the middle part of the runway. The controllers' view at the intersection where the intruding aircraft entered the runway however was obstructed by the newly constructed extension to the terminal building at Anyfield Airport.

The Air Traffic Controller (ATCO) was a very experienced controller. He had been working in ATC for many years, at several major facilities, and had been transferred to Anyfield to act as an OJT-instructor only eight months before the date of the accident.

At the time of the collision, the **ATCO1** was alone in the control-tower, as his Assistant / Ground Controller **ATCO2** – of far less experience – had briefly left the TWR to answer a call of nature. They were both completing their third consecutive nightshift, had come on duty at 22:00 hours the previous evening and were due to be relieved within thirty minutes when the accident occurred.

The crew of the jet-aircraft was experienced operators to and from Anyfield. From their point of view, on the morning of the accident there was nothing unusual in the way their flight was handled by ATC. They taxied to the runway with the extra caution required by the fog-

conditions, and after being cleared for take-off they made certain they were lined up correctly on the runway-centerline before applying take-off power.

The pilot of the twin-engined piston-driven aircraft was unfamiliar with Anyfield Airport, having been sent there at short notice to collect an aircraft that had to divert into Anyfield two days earlier for weather-reasons.

Investigation

Although **ATCO1** was very experienced, he had only worked a limited number of solo-shifts in Anyfield TWR. Having validated his TWR-rating in early summer, he had been involved in giving on-the-job-training (OJT) instruction on most of his shifts after that. As a consequence of the staff-shortage he was required to work his share of nightshifts like all other controllers. The shift in which the accident occurred was only his second where he had worked at Anyfield TWR under foggy/low visibility conditions; the first had been the previous night, when there was hardly any traffic as it was the night from Saturday to Sunday.

A number of years ago there had been an incident at Anyfield involving runway-intrusion by a vehicle, under similar meteorological conditions as in this case. One of the recommendations at that time was the installation of a SMR, together with stop-bars at all runway-intersections. The authorities decided that in view of the limited number of days (with fog) that would warrant the use of a SMR, the benefit of having a SMR didn't match the costs of having one installed. The same applied for the installation of stop-bars, but in lieu of those, painted signs had been put in the grass next to the runway-intersections, informing those who noticed them there was a *"runway ahead".*

As the early morning-traffic began to come alive, **ATCO1** and **ATCO2** were each working an independent R/T-frequency. When **ATCO2** announced he had to visit the men's room for a second, **ATCO1** told him to go ahead, intending to work both frequencies by himself. In order to do so, **ATCO1** had to physically move between two control-positions in the TWR that are about three meters apart, for Anyfield TWR isn't equipped with a frequency-coupling installation. Transmissions on one frequency can't be heard by stations on the other frequency.

The piston-engined aircraft's pilot had arrived in Anyfield late the night before. After a short sleep he went to the airport quickly in order to waste as little time as possible, for his company wanted the aircraft back at its home base a.s.a.p. After the minimum of preparation needed, he went to his aircraft and called ATC for approval to taxi to the runway. He obtained the clearance and began taxiing, but soon found himself lost at the foggy, unfamiliar airport. The fact that there were no signs denominating the various taxiway-intersections didn't help much either.

The R/T-tapes showed that the piston-pilot then called G/C (by R/T) and asked for *"progressive taxi-instructions".* **ATCO2** replied by asking his position. The pilot said: *"I believe I'm approaching Foxtrot-intersection"*, to which **ATCO2** answered: *"At Foxtrot taxi straight ahead".* In fact the pilot had already passed Foxtrot, and should have turned onto the parallel taxiway. The instruction from **ATCO2**, though technically correct, caused the pilot to taxi onto the runway where the jet was in its take-off roll. Since the communications to both aircraft took place on different frequencies, neither pilot was aware of what was happening.

After the collision, it took **ATCO1** several minutes to realize something was wrong. Of course he hadn't observed the departing jet passing on the section of the runway that was visible to him, but he initially blamed that on the fog patches and/or being distracted by traffic on the G/C frequency.

And apart from the fog, **ATCO1** was unable to see the part of the runway where the collision had taken place because of the newly built extension of the terminal building blocking his view. So it was not until he wanted to transfer the departing jet to the next controller (Departure Control) that he became aware things weren't as they should be, when his transmissions to the jet remained unanswered.

ATCO2, who returned shortly after the accident, at the same time reported having no contact with the taxiing twin-prop. **ATCO1** then decided to alert the fire-brigade, but as he had no idea where to send them, more precious time was lost as the rescue-vehicles tried to make their way across the foggy airport. When they finally arrived at the accident-site, they found there was little they could do as the wreckage of the aircraft had almost burnt-out completely already.

Had a SMR been installed following the recommendation after the other incident, this would have provided the following lines-of-defense (in declining order):

- Proper taxi-instructions could have been given to the *"lost"* aircraft.
- The ATCOs would have observed the runway-intrusion.
- The collision-site would have been easily identified.
- Adequate instructions could have been given to the rescue-vehicles.

This goes for the stop-bars as well. Had they been installed, the twin-prop more likely than not wouldn't have entered the runway.

At the very least, special procedures for Low Visibility Operations (LVO) at Anyfield should have been developed and in force, limiting the number of movements at the field. The ATCOs should have been trained in working with these special procedures, ideally on a simulator, to help them cope with the unusual situation once it occurred.

In their talks with the airport-authorities, ATC management should have firmly opposed the plans for extension of the terminal-building. But, as a result of not having any input from the operational ATCOs (who were not available to attend the meetings due to staff-shortage), management wasn't even aware it would constitute a line-of-vision problem from the TWR.

ATCO1 shouldn't find himself in a position where he was forced to work two positions by himself. At all times ATC-positions should be sufficiently staffed to allow the traffic to be handled in a safe manner.

The installation of a frequency-coupler might have helped prevent the collision from occurring. As it is, these systems are considered *"optional"* by the aviation-authorities, so only few ATC-facilities have them.

Management should ensure that OJT-instructors are given the opportunity to stay current at the positions where they are supposed to teach, by scheduling the instructor for duties without

trainees at regular intervals. Such duties should be sufficiently challenging of nature to allow the instructor to practice his skills (in other words: shifts without traffic may look good in a roster, but are of no value for currency-maintaining purposes)

Had there been a well-devised training-curriculum that was correlated with the duty-roster, management would have recognized that **ATCO1**, although qualified, hadn't been able to acquaint himself with working at Anyfield TWR under low visibility-conditions. Ideally, they wouldn't have scheduled him for unsupervised duty when low visibility was forecast.

Dedicated LVO-training would have made **ATCO2** aware of the dangers involved, alerting him to be more positive in guiding the lost taxiing pilot. At the very least he probably wouldn't have given the pilot irrelevant information.

It is a scientific fact that when consecutive nightshifts are worked, the performance of persons engaged in cognitive tasks (such as ATC) decreases dramatically in the second and later nights, especially between 03:00 hrs and 07:00 hrs. **ATCO1** at Anyfield was on his third nightshift in a row, which could explain why he failed to recognize a potentially dangerous situation that he wouldn't have missed under other circumstances. When designing shift-rosters for ATCOs it is advisable to keep the number of consecutive nightshifts to an absolute minimum.

Based on the meteorological forecast, and taking into account the propeller-aircraft's pilot was unfamiliar with Anyfield, it may be argued that the air operator would have done better to send two pilots to collect the aircraft. Even with limited knowledge of CRM-principles, a second pilot could have prevented the other pilot from acting the way he did.

EXERCISE 03/01

Group activity

A facilitator will be appointed, who will coordinate the discussion. A summary of the discussion will be written on flip charts, and a member of the group will brief on their findings in a plenary session.

Required task

1) Read the text related to the accident of the twin-engined jet transport at Anyfield Airport.

2) From the investigation report of the above accident, you should identify:

   a) **Organizational processes** that influenced the operation and which felt under the responsibility of senior management (i.e. those accountable for the allocation of resources);

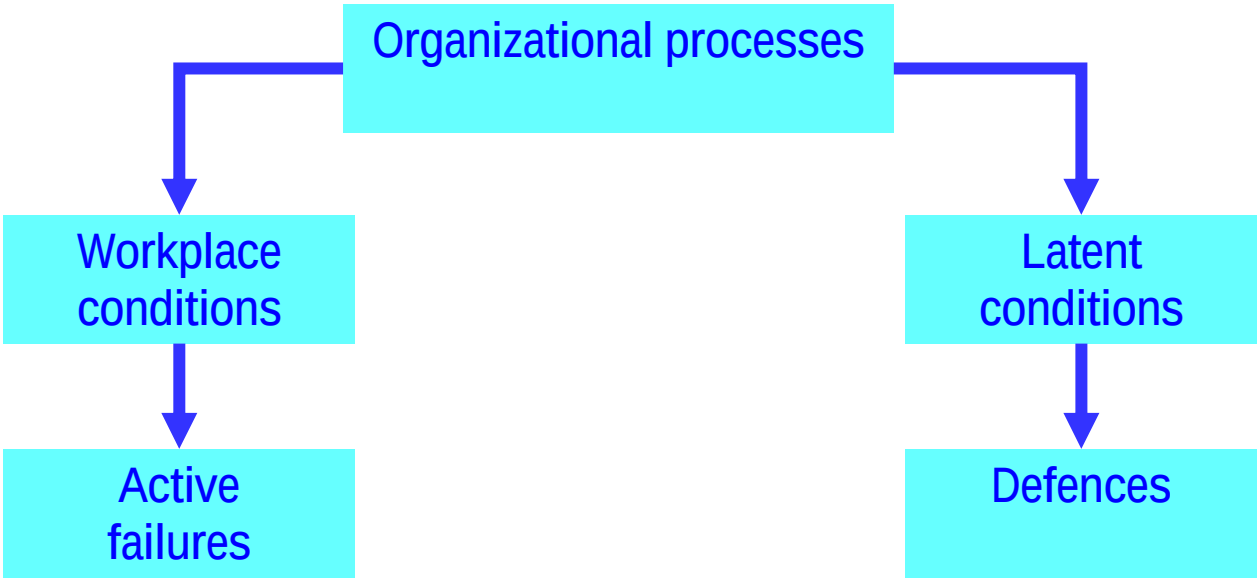
   b) **Latent conditions** in the system safety which became precursors of active failures;

c) **Defences** which fail to perform due to weaknesses, inadequacies or plain absence;

d) **Workplace conditions** which may have influenced operational personnel actions; and

e) **Active failures**, including errors and violations

3) When you have concluded the above, your task is to complete the Table 03/01 – *Analysis* classifying your findings according to the Reason Model.



Reason Model

Table 03/01 – *Analysis*

Organizational processes *Activities over which any organization has a reasonable degree of direct control*	
-Planning: extension of the terminal-building	- **ATC understaffing**
-Scheduling: 1-third consecutive nightshift	- **ATC lack of training**
2- pilot for unfamiliar airport with no assistant	-lack of procedures for Low Visibility Operations
-Ignoring safety recommendations by ATC	

Workplace conditions *Factors that directly influence the efficiency of people in aviation workplaces*
- foggy airport
- obstructed view
- third consecutive nightshift
- no signs denominating the various taxiway-intersections
- working both frequencies three meters apart

Latent conditions *Conditions present in the system before the accident, made evident by triggering factors*
-ATC understaffing
- **Scheduling:** third consecutive nightshift
- obstructed view
-

Active failures *Actions or inactions by people (pilots, controllers, maintenance engineers, aerodrome staff, etc.) that have an immediate adverse effect*
ATCO did not challenge ambiguous position report by twin-engine pilot
-short sleep of piston engine A/C pilot
- working both frequencies
-unsure position reporting by pilot

Defences *Resources to protect against the risks that organizations involved in production activities must confront*
Progressive taxi instructions
- Surface Movement Radar (SMR)
- taxiway centre line guidance-lighting
- installation of stop-bars
-training on LVO
- frequency-coupling installation
- signs denominating the various taxiway-intersections
- special procedures for Low Visibility Operations

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AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course
Handout N° 3 – International airport construction work

International Civil Aviation Organization

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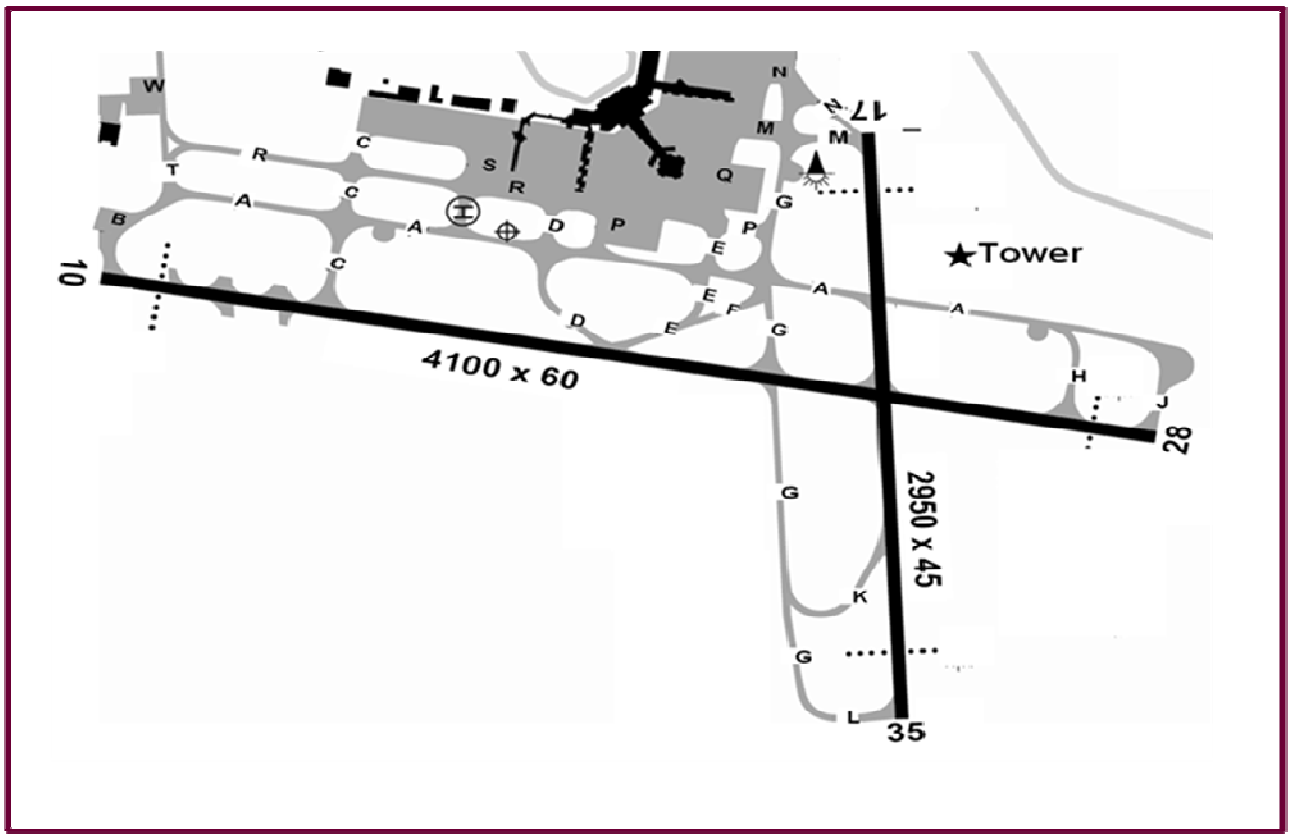
AFI COMPREHENSIVE IMPLEMENTATION PROGRAMME (ACIP) SAFETY MANAGEMENT SYSTEM (SMS) COURSE

Exercise 04/01 – International airport construction work

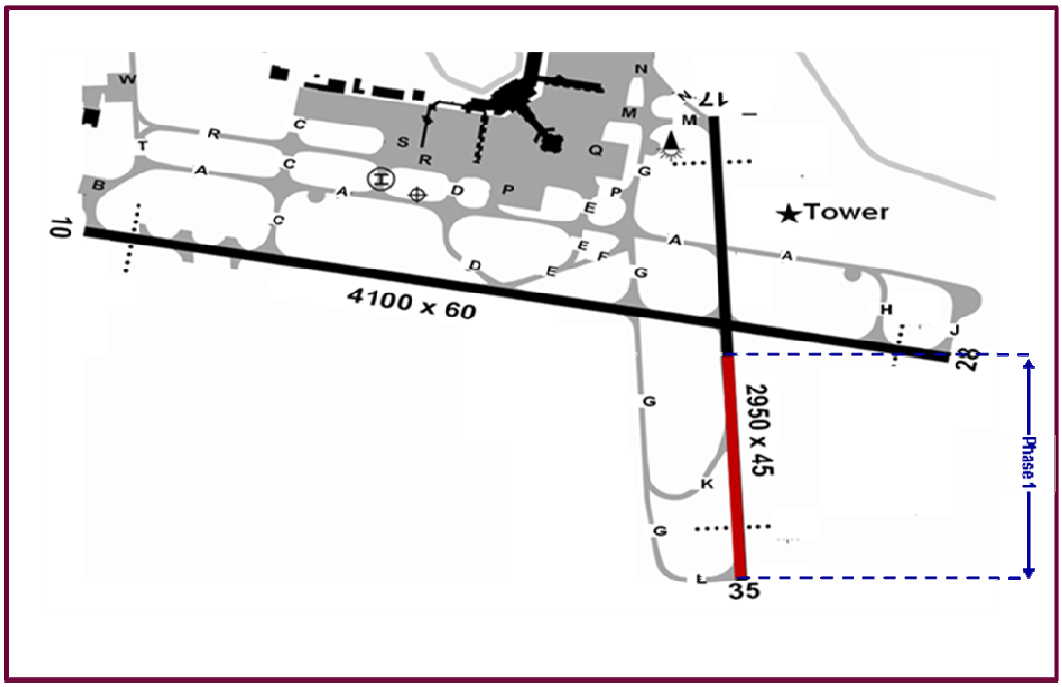
Scenario

Construction project to enlarge and repave one of the two crossing runways at an international airport (150,000 movements a year). It's a three-phase construction project.

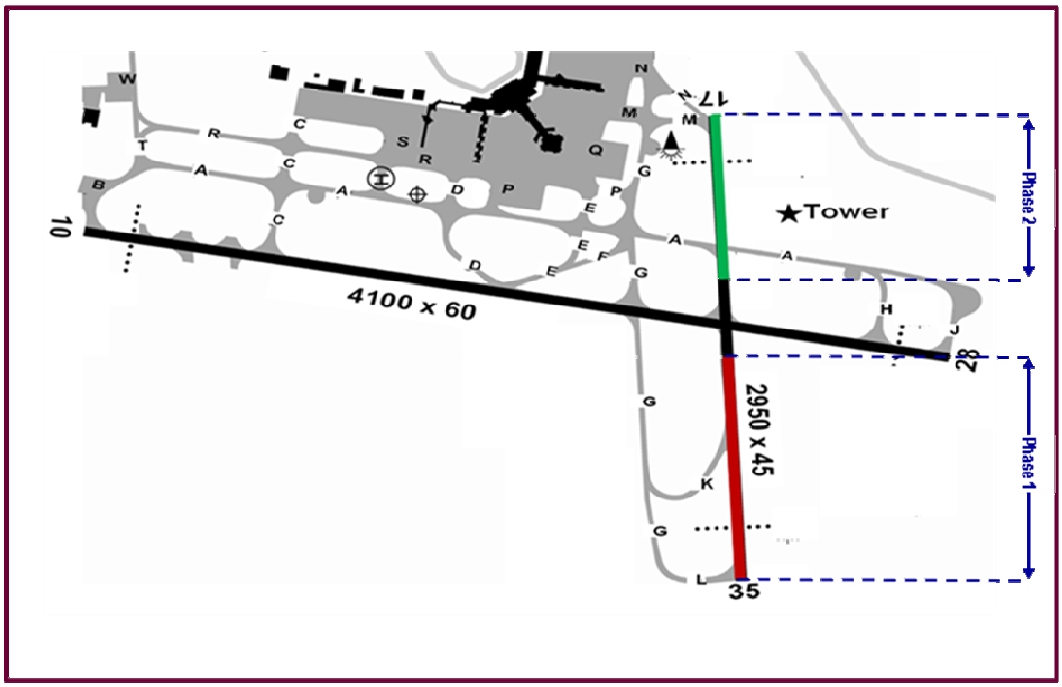


Scope of the work

- **Phase 1:**
  - Increase the width of runway 17-35 from 45 to 60 meters from a point 200 m from the intersection with runway 10-28 to the south and strengthen the runway (from asphalt to concrete) to increase its Pavement Classification Number (PCN).
  - Estimated time to complete the work:
    - Seven (7) months.



- **Phase 2:**
  - Increase the width of runway 17-35 from 45 to 60 meters from a point 200 m from the intersection with runway 10-28 to the north and strengthen the runway (from asphalt to concrete) to increase its PCN.
  - Estimated time to complete the work:
    - Seven (7) months.

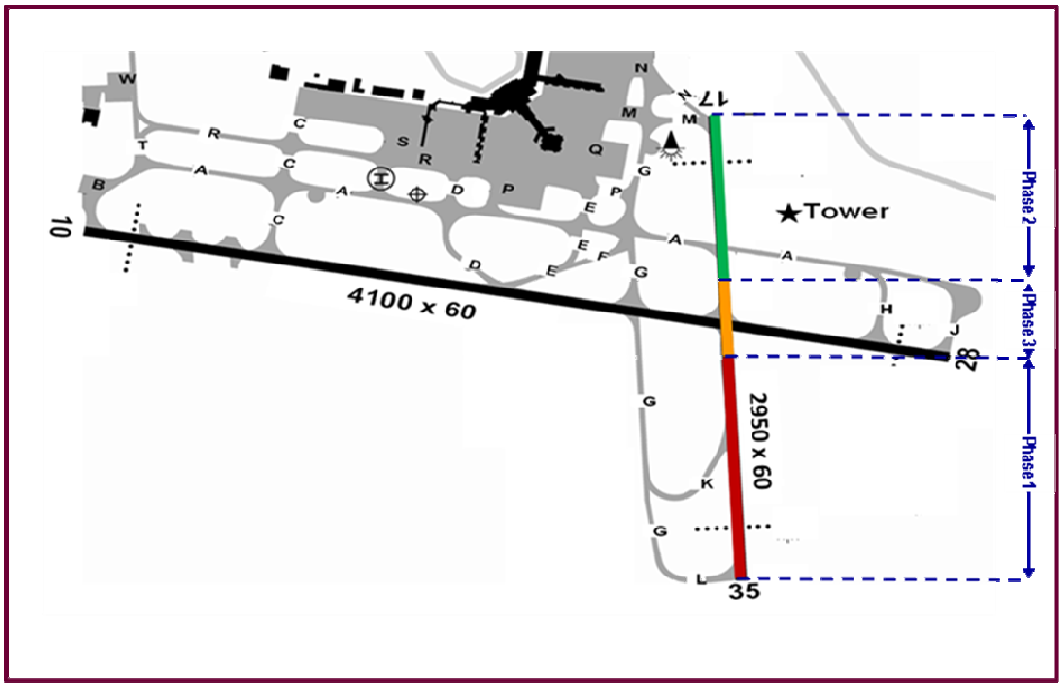


- **Phase 3:**

  - Complete the construction work of runway 17-35 for the central area of the last 400 m at the intersection of runway 17-35 and runway 10-28 (from asphalt to concrete), increasing its width from 45 to 60 meters and its PCN.

  - Estimated time to complete the work:

    - Two (4) months.



- **Runway utilization during the construction work**

  - Continuous utilization of runway 10-28 during the three-phase of runway 17-35 construction project. *[To maintain regular aerodrome operations (production) and existing margins of safety (protection) in the operations during the runway construction project].*

  - Length of runway 10-28 is currently 4.100 m and during Phase 3 its length will be reduced, leaving a distance of 2.600 m for aircraft operations measured between threshold 10 and the intersection of runway 10-28 with taxiway Golf.

Group activity

A facilitator will be appointed, who will coordinate the discussion. A summary of the discussion will be written on flip charts

A member of the group will brief on their findings in a plenary session.

Your task

1) Identify the hazards using brainstorming techniques.
    a) Brainstorm a list of possible hazards, their components and their consequences *(use a flip chart)*.
2) Complete the attached log *(Table 04/01)* as follows:
    a) List type of operation or activity
    b) State the generic hazard *(hazard statement)*
    c) Identify specific components of the hazard
    d) List hazard-related consequences
3) It is recommended to conduct the hazard identification and analysis per each construction phase of runway 17-35.

TABLE 04/01 – HAZARD IDENTIFICATION

Nº	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
1	*Air Traffic Services*	*Aerodrome construction.*	- *Single runway operation* - *Runway congestion* - *Construction equipment and untrained personnel*	- *Aircraft collision* - *Increased workload and fatigue for ATS* - *Runway incursion by construction personnel and equipment collision*
1	*Aerodrome Operations*	*Aerodrome construction*	*Equipment on airside* *FOD* *Personnel unfamiliar with airport operations* *Poor information management*	*Collision between aircraft and equipment* *Damage to aircraft, personnel and equipment..* *Runway/taxiway incursion* *Aircraft landing on wrong runways (accident), using closed taxiways (may require pushback)*

Nº	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
			Lack of surface marking and signage of closed unusable areas	*Accident / incidents caused by use of closed areas*
1	*Aircraft Operators*	*Aerodrome Construction*	*FOD*	*Aircraft damage, reduced visibility due sand*
			Crosswind	*Loss of control and damage to aircraft*
			Construction Equipment on airside	*Collision or accident risk*
			Poor information management within the airline	*Accident / incident due to lack of information (landing on wrong runway, use of wrong taxiway etc)*

Nº	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
2	*ATS*	*Aerodrome construction*	*Increased delays caused by having to back track* *Obstructed vision of departure end of R28*	*Increased stress and fatigue*
2	*Aerodrome Operator*	*Aerodrome construction*	*Same as phase one*	
2	*Aircraft Operator*	*Aerodrome construction*	*Increased delays* *Limitation in aircraft type as some may not be able to back track and turn at runway end*	*Increased cost of operations* *Economic hazard (cancellation of bookings etc)*

Nº	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
3	*ATS*	*Aerodrome Construction*		
3	*aerodrome operators*	*Aerodrome construction*	*reduction in operations*	*economic hazard*
3	*Aircraft Operators*	*Aerodrome construction*	*load limitations* *limitation on types of aircraft* *overrun* *no instrument approach on runway28 (possibility of day restricion)*	*Economic hazard* *loss of aircraft/ damage* *increased possibility of incident*

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AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course
Handout N° 4 – Accident Boeing B-747 at Taipei International Airport

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AFI COMPREHENSIVE IMPLEMENTATION PROGRAMME (ACIP) SAFETY MANAGEMENT SYSTEM (SMS) COURSE

Exercise 05/01 – Accident Boeing 747 –Taipei International Airport

1. Narrative

Singapore Airlines Flight **SQ006** with Singapore registration **9V-SPK** departed Singapore for a flight to Los Angeles (**LAX**) via Taipei (**CKS**) on October 31, 2000. Scheduled departure time at Taipei was 22:55. The flight left **Gate B-5** and taxied to taxiway **NP**, which ran parallel to runway **05L** and **05R**. The crew had been cleared for a runway **05L** departure because runway **05R** was closed due to construction work. CAA had issued a NOTAM on 31 August 2000 indicating that part of runway **05R** between taxiways **N4** and **N5** was closed for construction from 13 September to 22 November 2000. Runway **05R** was to have been converted and re-designated as taxiway **NC** effective 1 November 2000. After reaching the end of taxiway **NP**, SQ006 turned right into taxiway **N1** and immediately made a 180-degree turn to runway **05R**. After approximately six (6) second hold, **SQ006** started its takeoff roll at 23:15:45. Weather conditions were very poor because of typhoon *"Xiang Sane"* in the area. METAR at 23:20 included Wind 020 degrees at 36 knots gusting 56 knots, visibility less than 600 meters, and heavy rainfall.

On takeoff, 3.5 seconds after V1, the aircraft hit concrete barriers, excavators and other equipment on runway **05R**. The plane crashed back onto the runway, breaking up and bursting into flames while sliding down the runway and crashing into other objects related to work being done on runway **05R**. The aircraft wreckage was distributed along runway **05R** beginning at about 4,080 feet from the runway threshold. The airplane broke into two main sections at about fuselage station 1560 and came to rest about 6,480 feet from the runway threshold.

2. Findings related to probable causes

- At the time of the accident, heavy rain and strong winds from typhoon *"Xiang Sane"* prevailed. At 23:12:02 Taipei local time, the flight crewmembers of SQ006 received Runway Visual Range (RVR) 450 meters on runway **05L** from Automatic Terminal Information Service (ATIS) *"Uniform".* At 23:15:22 Taipei local time, they received wind direction 020 degrees with a magnitude of 28 knots, gusting to 50 knots, together with the takeoff clearance issued by the local controller.
- On 31 August 2000, the CAA issued a Notice to Airmen (NOTAM) A0606 indicating that a portion of the runway **05R** between taxiway **N4** and **N5** was closed due to work in progress from 13 September to November 2000. The flight crew of **SQ006** was aware of the fact that a portion of runway **05R** was closed, and that runway **05R** was only available for taxi.
- The aircraft did not completely pass the runway **05R** threshold marking area and continue to taxi towards runway **05L** for the scheduled takeoff. Instead, it entered runway **05R** and the Pilot-in-command (**PIC**) commenced the takeoff roll. The pilot second-in-command (**SIC**) and the third pilot did not question the PIC's decision to take off.
- The flight crew did not review the taxi route in a manner sufficient to ensure they all understood that the route to runway **05L** included the need for the aircraft to pass runway **05R**, before taxiing onto runway **05L**.
- The flight crew had CKS Airport charts available when taxing from the parking bay to the departure runway; however, when the aircraft was turning from taxiway **NP** to taxiway **N1**

and continued turning onto runway **05R**, none of the flight crewmembers verified the taxi route. As shown on the Jeppesen "20-9" CKS Airport chart, the taxi route to runway **05L** required that the aircraft make a 90-degree right turn from taxiway **NP** and then taxi straight ahead on taxiway **N1**, rather than making a continuous 180-degree turn onto runway **05R**. Further, none of the flight crewmembers confirmed orally which runway they had entered.

- The PIC's expectation that he was approaching the departure runway coupled with the saliency of the lights leading onto runway **05R** resulted in the PIC allocating most of his attention to these centreline lights. He followed the green taxiway centreline lights and taxied onto runway **05R**.
- The moderate time pressure to take off before the inbound typhoon closed in around CKS Airport, and the condition of taking off in a strong crosswind, low visibility, and slippery runway subtly influenced the flight crew's decision influencing the ability to maintain situational awareness.
- On the night of the accident, the information available to the flight crew regarding the orientation of the aircraft on the airport was:

  a) CKS Airport navigation chart

  b) Aircraft heading references

  c) Runway and taxiway signage and marking

  d) Taxiway **N1** centreline lights leading to runway **05L**

  e) Colour of the centreline lights (green) on runway **05R**

  f) Runway **05R** edge lights most likely not on

  g) Width difference between runway **05L** and runway **05R**

  h) Lighting configuration differences between runway **05L** and runway **05R**

  i) Para-Visual Display (**PVD**) showing aircraft not properly aligned with the runway **05L** localizer

  j) Primary Flight Display (**PFD**) information

The flight crew lost situational awareness and commenced takeoff from the wrong runway.

The Singapore Ministry of Transport (MOT) did not agree with the findings and released their own report. They conclude that the systems, procedures and facilities at the CKS Airport were seriously inadequate and that the accident could have been avoided if internationally-accepted precautionary measures had been in place at the CKS Airport.

3. Discussion

Weather at the time of the crash, which happened at 11:17 p.m. local time October 31, was rainy and windy due to a typhoon bearing down on CKS. Visibility was about 500 meters.

Facts gathered by investigators and released by CAA show that, because of the poor weather and night-time conditions, the PIC and SIC elected to switch on the PVD. The PVD, a mechanical instrument mounted on a panel in front of each pilot position that helps the pilot’s line up and stays on a given runway's centreline, works with the plane's instrumentation to monitor a runway's Instrument Landing System (ILS) signal.

The PVD resembles a barber pole sitting on its side, with black stripes on a white background. It is not mandatory equipment, and carriers that use it only require it to be activated

when visibility is much worse - 50 meters or below, in most cases - than the visibility the SQ006 crew was faced with.

When the aircraft gets in range of the ILS runway signal that the plane is tuned to, a small shutter on the PVD opens, revealing the black-and-white pattern. The stripes remain stationary so long as the plane is on the runway centreline. When it moves left or right, the stripes move in the direction of the runway centreline, helping guide the pilots back to the middle of the runway.

Both the PIC and SIC switched on their PVD at the gate, investigators found. When the aircraft taxied into position at what the crewmembers thought was the end of **05L**, all three pilots - including a relief pilot sitting in the cockpit - noticed the PVD had not activated. But since visibility was well above the level that requires PVD usage and they could all see centreline marking lights clearly, the pilots decided to proceed.

"The PVD hasn't lined up," the SIC said as the plane turned onto 05R, according to the cockpit voice recorder transcript.

"Never mind, we can see the runway," the PIC responded. *"Not so bad."*

The visual takeoff may have caused the pilots to miss two other clues on their instruments that could have indicated a problem. When a 747's ILS is tuned for a specific takeoff runway, two indicators appear on the plane's PFD. A pink diamond shows the aircraft's position relative to the runway's ILS localizer, and a green trapezoid shows the runway, which should be centred and just below the PFD's horizon when the plane is aligned properly. When the plane is not aligned with the runway centreline, both indicators are well off to the display's side.

The centreline lights could have served as another clue to the pilots. The PIC told investigators that he *"followed the curved centreline lights"* onto **05R**, report said. *"He commented that he was attracted to the bright centreline lights leading onto the runway."*

The centreline lights that run all the way down **05R** are green, designating it as a taxiway. Centreline lights on runways are white at the beginning and later change to red near the end. While a similar set of green taxiway lights leads from **N1** onto **05L**, the lights running down the middle of **05L** are white.

Both **05L** and **05R** have bi-directional runway edge lights that appear white, yellow, or red, report said. The two sets of lights are identical. The CKS ground controller working on the night of the accident told investigators that the **05L** edge lights were on, but the **05R** edge lights were not. Soon after the accident, the PIC told investigators that he was *"80% sure"* he saw edge lights along 05R, but in follow-up interviews, he was *"less sure"* report said.

While the pilots may have missed some clues regarding their wrong-runway mistake, they were almost surely hampered by airport surface marking deficiencies.

As they followed taxiway lights down **NP** and turned right onto **N1**, they did not see any centreline lights straight in front of them that would have led them to **05L**. They did, however, clearly see the curving set of taxiway centreline lights, spaced about 7.5 meters (25 feet) apart, leading to **05R** from **N1's** south end.

When investigators surveyed CKS four days after the crash, they found that the two taxiway lights designed to lead aircraft further down **N1** past the inactive **5R** to the active **5L** runway were not working perfectly. One was not illuminated at all, and the other was *"less intense than the other lights."* The lights, spaced about 25m apart, run straight down **N1's** centreline and meet up with another set of curved, green taxiway lights that connect **05R's** centreline with **N1's** north end.

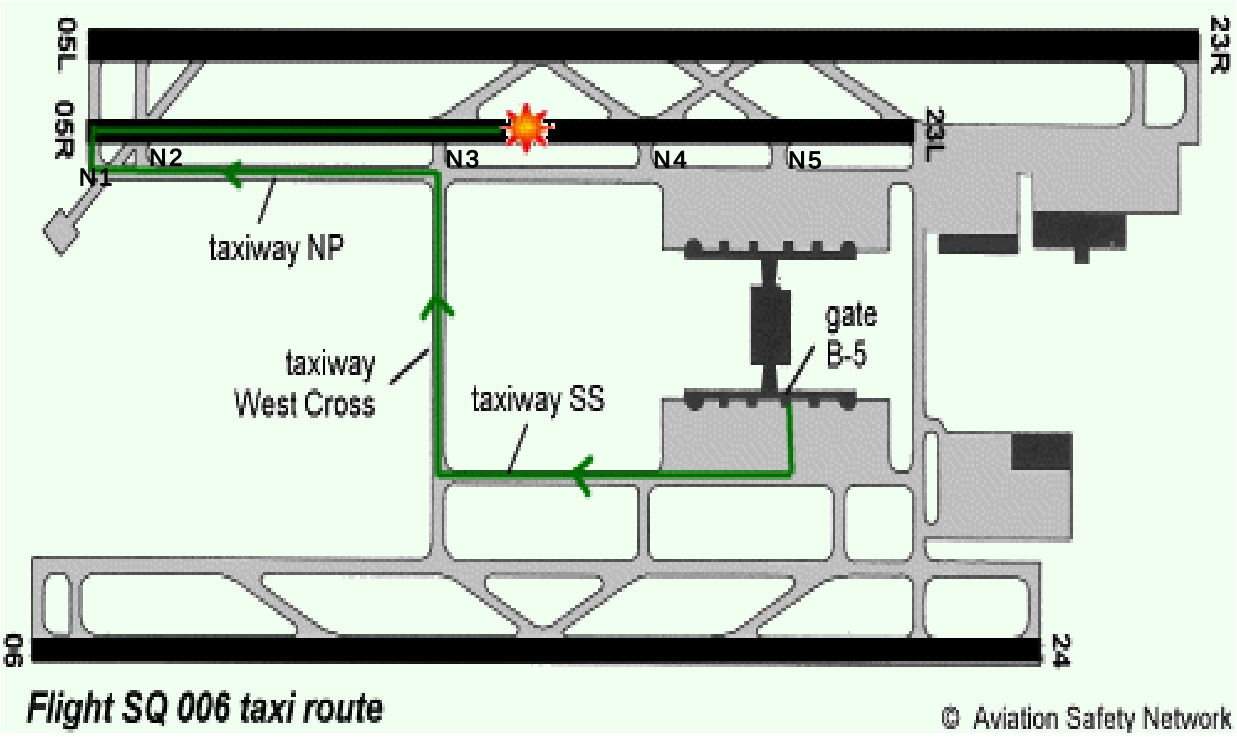
As SQ006's PIC taxied down **N1** and approached **05R**, he was *"focused on the image of the runway to his right, and he did not notice any further green lights ahead and along the extension of N1,"* he told investigators.

Investigators found several other lighting and marking problems. Some of the runway edge lights on both **05L** and **05R** were either broken or *"aligned away from the direction of the runway length,"* report said. Also, there was nothing over the **05R** threshold markings that indicated the runway was closed.

Runway **05R** had been closed since mid-September for needed pavement repairs. The plan was to convert it into a full-time taxiway on November 1, but the timeline was pushed back before the SQ006 crash. Before being closed, it was used for visual departures only.

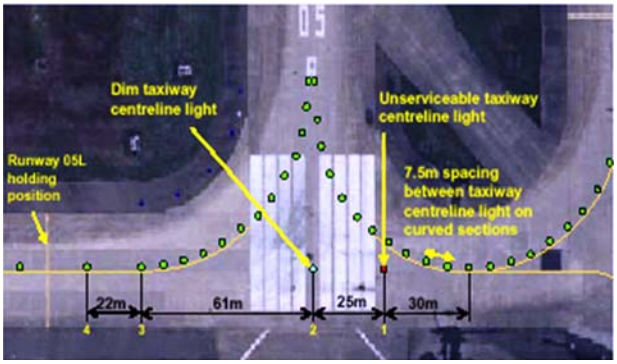
The SQ006 PIC told investigators he was aware of **05R's** status. He had used the runway in the past; his last departure on it was *"two or three years"* ago, report said. The PIC's last flight to CKS Airport before October 31 was sometime in early to mid-September, the report said.

Singapore Airlines most often used runway **06**, the parallel runway south of CKS Airport terminal, because it is *"closer to the parking bays used by the company,"* the SQ006 PIC told. But runway **06** is a Category I ILS runway, and the weather on October 31 persuaded the pilot to request runway **05L**, a Category II runway, because it is *"longer and would therefore afford better margins for the prevailing wet runway conditions."*

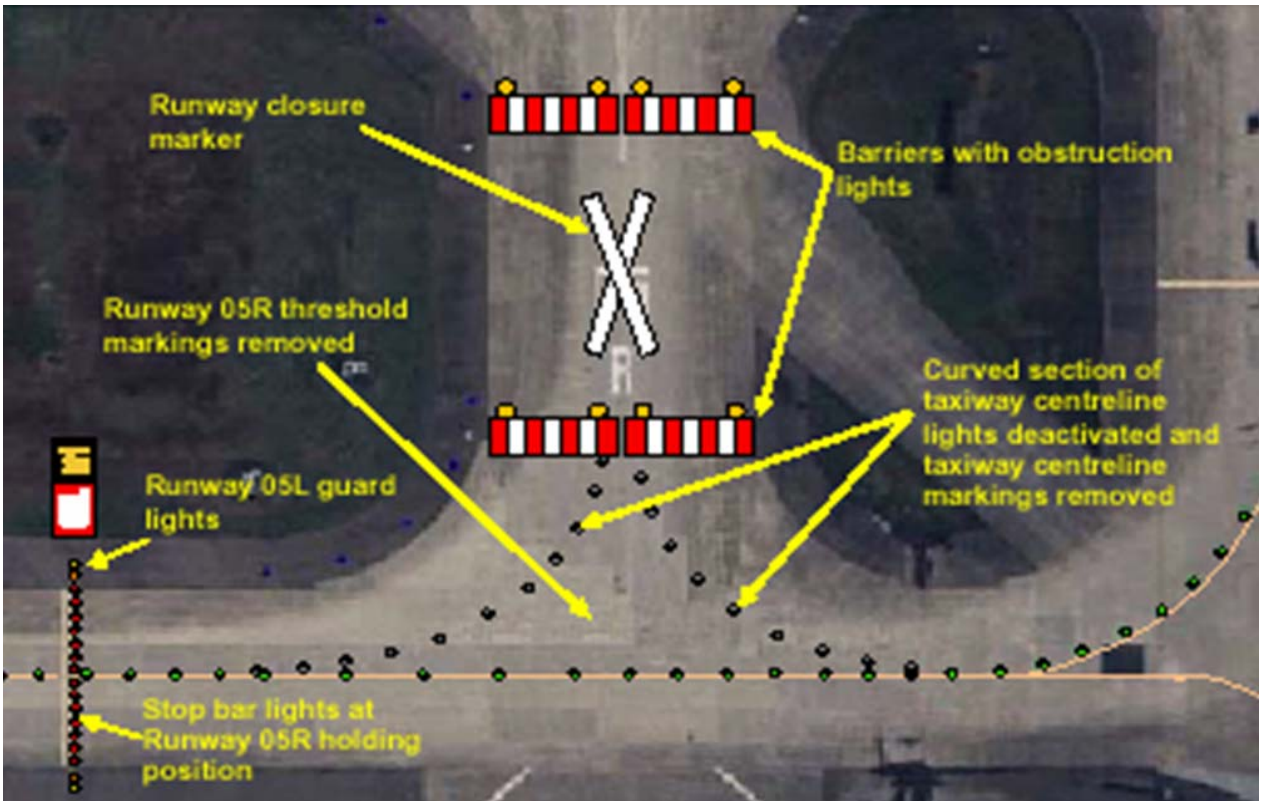


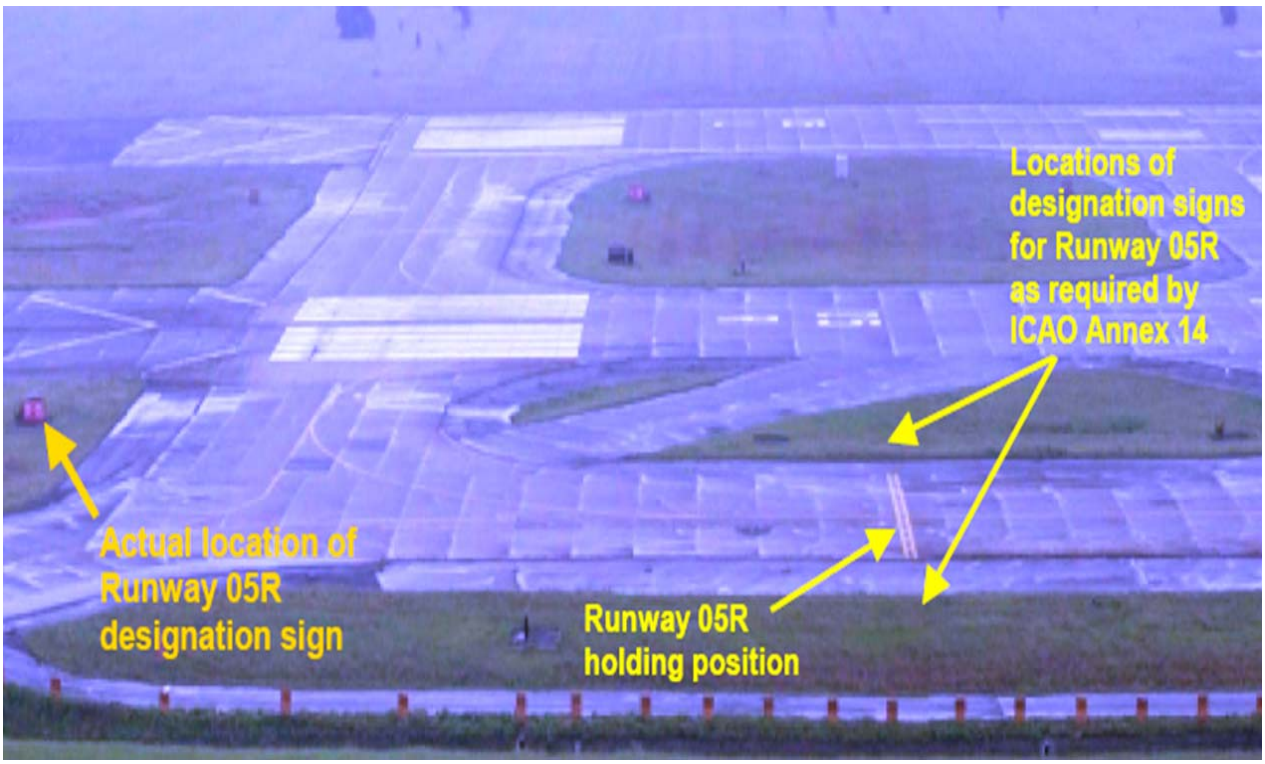

Stop Bar lights (Inset) as required by ICAO Annex 14
Flashing Guard Lights on both sides of the holding line of Runway 05L as required by ICAO Annex 14


Missing section of taxiway centreline marking


Dim taxiway centreline light
Unserviceable taxiway centreline light
Runway 05L holding position
7.5m spacing between taxiway centreline light on curved sections
22m
61m
25m
30m


Taxiway centreline markings as required by ICAO Annex 14


Runway closure marker
Barriers with obstruction lights
Runway 05R threshold markings removed
Curved section of taxiway centreline lights deactivated and taxiway centreline markings removed
Runway 05L guard lights
Stop bar lights at Runway 05R holding position

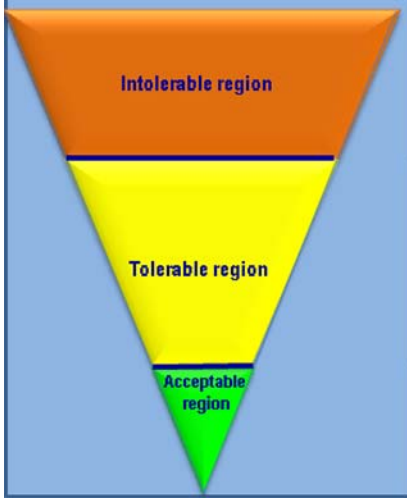


4. Risk assessment matrix

Probability of occurrence		
Qualitative definition	**Meaning**	**Value**
Frequent	Likely to occur many times *(has occurred frequently)*	**5**
Occasional	Likely to occur some times *(has occurred infrequently)*	**4**
Remote	Unlikely, but possible to occur *(has occurred rarely)*	**3**
Improbable	Very unlikely to occur *(not known to have occurred)*	**2**
Extremely improbable	Almost inconceivable that the event will occur	**1**

Severity of occurrences		
Aviation definition	**Meaning**	**Value**
Catastrophic	➢Equipment destroyed. ➢Multiple deaths.	**A**
Hazardous	➢A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. ➢Serious injury. ➢Major equipment damage.	**B**
Major	➢A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency. ➢Serious incident. ➢Injury to persons.	**C**
Minor	➢Nuisance. ➢Operating limitations. ➢Use of emergency procedures. ➢Minor incident.	**D**
Negligible	➢Little consequences	**E**

Risk probability		Risk severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

Risk management	Assessment risk index	Suggested criteria
	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. It might require management decision
	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Acceptable

EXERCISE 05/01

4. Group activity

A facilitator will be appointed, who will coordinate the discussion. A summary of the discussion will be written on flip charts, and a member of the group will brief on their findings in a plenary session.

5. Your task

1. Read the text related to the accident of the Boeing 747 at Taipei International Airport.
2. List the type of operation or activity.
3. State the generic hazard(s)
4. State the specific components of the hazard(s).
5. State the hazard-related consequences and assess the risk(s).
6. Assess existing defences to control the risk(s) and resulting risk index.
7. Propose further action to reduce the risk(s) and resulting risk index.
8. Complete the attached log *(Table 05/01).*

TABLE 05/01 – HAZARD IDENTIFICATION AND RISK MITIGATION

Nº	Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index
1	Aerodrome operations	Construction work	Equipment and barriers on airside	Collision with aircraft and equipment.	NOTAMs, Risk index 3B	Reflective material on the barriers and equipment Review the NOTAM contents Risk 1B
			Pilots unfamiliar with new airport operations	Runway and taxiway incursions	Ammended CKS airport layout charts Runway and taxiway signage and markings for 05L Risk 3C	Repaint the taxiway centreline to 05L Close runway 05R and place barriers Remove threshold marking and place runway closure sign. Daily inspection and maintenance of taxiway markings and light. Risk 2D
			Poor Signage and lights related to construction area	Improper use of closed runways and taxiways	Change runway centreline lights from usual colours to taxiway green Runway edge light OFF Risk 3D	Close runway 05R completely and do not use as taxiway.

Nº	Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index
		Bad Weather (Typhoon)	Gusty winds, heavy rain, low visibilty	Runway excursion, overrun, loss of control.	Cat II runway Risk 4B	Close the airport during the typhoon.
2	Airline Operation	Construction work	Poor information management and dissemination of safety critical info.	Use of closed runways and taxiways Collision with barriers and equipment Injuries	Airport Nav charts on board PVD/PFD equipment provided on aircraft Risk 3C	Better use of SOP's CRM training Crew scheduling recent crew Risk 1C
		Weather	Gusty winds, low visibility and heavy rain.	Runway excursion, overrun and loss of control	PVD/PFD equipped aircraft. Met report and NOTAMS provided crew training Risk 2D	Severe weather safety bulletins to crew Review takeoff and landing minimums Risk 2D

Nº	Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index
3					Risk index: Risk tolerability:	Risk index: Risk tolerability:

- - - - - - - - - - - - - - -

AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course
Handout N° 6 – Collision between two aircraft at Milano-Linate International Airport

International Civil Aviation Organization

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AFI COMPREHENSIVE IMPLEMENTATION PROGRAMME (ACIP) SAFETY MANAGEMENT SYSTEM (SMS) COURSE

Exercise 10/02 – Collision between two aircraft at Milano-Linate International Airport

1. Narrative

A brand new Cessna 525A Citation Jet 2, **D-IEVX**, arrived at Milano-Linate International Airport following a flight from Köln, Germany. The Cessna was to carry out a return flight to Paris-Le Bourget, carrying two pilots, a Cessna sales manager and a prospective customer. The plane arrived at 06:59 and was taxied to the general aviation apron, also known as **"West apron"** *(See diagram below).* It was a foggy morning at Milano-Linate International Airport and one of the passenger flights parked on the **"North apron"** was **SAS MD-87** flight **SK686,** which was being prepared for a flight to Copenhagen, scheduled to depart at 07:35. At 07:41, the pilot of the MD-87 **SK686** contacted **Linate Ground Control** for his engine start clearance, as the boarding of 104 passengers had been completed. The Ground Controller cleared the pilot to start engines and advised that the slot time for takeoff of the flight was at 08:16. Thirteen minutes later flight **SK686** was cleared to taxi to runway **36R**: *"Scandinavian 686, taxi to the holding position Cat III, QNH 1013 and please call me back entering the main taxiway."*

A few minutes later, the Cessna Citation pilot requested permission to start the engines. The Ground Controller then gave start-up clearance. The Ground Controller then requested flight **SK686** to contact the Tower Controller. From this moment on, the MD-87's crew and the Cessna's crew were tuned on two different radio frequencies. At 08:05 the pilots of the Cessna received taxi clearance: *"Delta Victor Xray, taxi north via **Romeo 5**, QNH 1013, call me back at the stop bar of the ... main runway extension."*

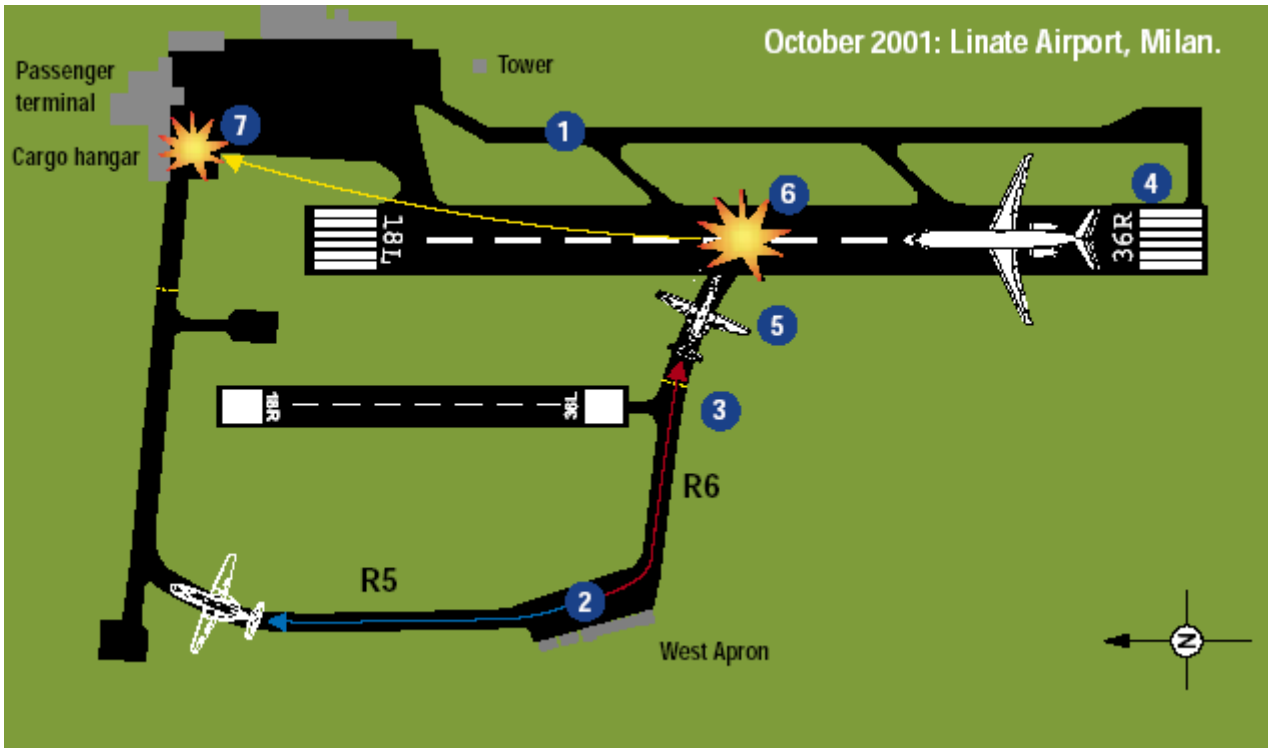
The pilot acknowledged by saying: *"Roger via **Romeo 5** and ... 1013, and call you back before reaching main runway."*

The Cessna started to taxi from the general aviation parking position, following the yellow taxi line. After reaching the position where the yellow taxi line splits into two diverging directions, the pilot erroneously took the taxi line to right and entered taxiway ***Romeo 6***. At 08:09 the Ground Controller cleared the Cessna to continue its taxi on the **North Apron**. At the same time the Tower Controller cleared the MD-87 for takeoff: *"...Scandinavian 686 Linate, clear for takeoff 36, the wind is calm report rolling, when airborne squawk ident."* The pilot advanced the throttles and acknowledged the clearance: *"Clear for takeoff 36 at when...airborne squawk ident and we are rolling, Scandinavian 686."* When the MD-87 was speeding down the runway, the Cessna crossed the runway holding sign and entered the active runway **18L/36R**.

At 08.10:21 the nose landing gear of the MD-87 had left the ground and main gears were extending the shock absorbers but the main wheels were still on the ground at airspeed of 146 knots (270, 5 km/h).

At that moment the MD-87 crew probably saw a glimpse of the Cessna through the fog and reacted with additional large nose-up elevator. At that moment the MD-87 collided with the Cessna Citation Jet. The right wing of the MD-87 sustained damage at the leading edge and the right hand main landing gear leg broke off. It damaged the right flap and struck the N° 2 engine which then separated from the pylon. The pilot of the MD-87 gradually advanced the throttles and then the aircraft was airborne for a total of 12 seconds, reaching an estimated height of about 35 feet (11 meters). The left hand engine suffered a noticeable thrust reduction as a result of debris ingestion, which became insufficient to sustain flight.

The airspeed had increased up to 166 knots (307,6 km/h), but the MD-87 descended abruptly making contact with the runway with the left hand main gear, the truncated right hand main gear leg and the tip of the right hand wing. Prior to touch down the pilot reduced engine thrust and after ground contact the engine reverse levers were activated and deployed (on the left hand engine only). Maximum available reverse thrust was selected and the brakes applied. The plane skidded past the grass overrun area, across a service road, crashing sideways into a baggage handling building, which partly collapsed. This building was located 20m/67 feet to the right of the runway, and 460m/1500 feet from the runway end.



Legend

1. Flight **SK686** taxied to the holding point for runway 36R. Heavy fog had delayed the flight by more than one hour. While the visibility was improving, RVR was still only 225 metres.
2. The Cessna Citation parked at the West Apron was cleared to taxi via taxiway **Romeo 5** and to report reaching the first holding point. The pilot read the clearance back correctly, but entered taxiway **Romeo 6**.
3. The Cessna Citation's pilot called for clearance to proceed from the **Romeo 5** holding point though it was in fact at the **Romeo 6** holding point.
4. Flight **SK686** was cleared for take-off.
5. The Cessna Citation crossed the holding point for runway **36R-18L**.
6. The two aircraft collided.
7. The stricken MD-87 skidded off the runway into a baggage hangar adjacent to the passenger terminal.


5

2. Investigation

After analysis of evidence available and information gathered, it can be assumed that the immediate cause for the accident has been the runway incursion in the active runway by the Cessna Citation. The obvious consideration is that the human factor related action of the Cessna Citation crew – during low visibility conditions – must be weighted against the scenario that allowed the course of events that led to the fatal collision; equally it can be stated that the system in place at Milano-Linate Airport was not geared to trap misunderstandings, let alone inadequate procedures, human errors and faulty airport layout.

The following list highlights immediate and systemic causes that led to the accident:

- The visibility was low, between 50 and 100 meters.
- The traffic volume was high.
- The lack of adequate visual aids.
- The Cessna Citation crew used the wrong taxiway and entered the runway without specific clearance.
- The failure to check the Cessna Citation crew qualification.
- The nature of the flight might have exerted certain pressure on the Cessna Citation crew to commence the flight despite the prevailing weather conditions.
- The Cessna Citation crew was not aided properly with correct publications (AIP Italy-Jeppesen) lights (red bar lights and taxiway lights), markings (in deformity with standard format and unpublished, S4) and signs (non-existing TWY R6) to enhance their situational awareness.
- Official documentation failed to report the presence of unpublished markings (S4, S5, etc.) that were unknown to air traffic managers, thus preventing the ATC staff from interpreting the ambiguous information from the Cessna Citation crew, a position report mentioning **S4**.
- Radio communications were not performed using standard phraseology (read back) or were not consistently adhered to (resulting in untraced misunderstandings in relevant radio communications).
- Operational procedures allowing high traffic volume (high number of ground movements) in weather conditions as were current the day of the accident (reduced visibility) and in the absence of technical aids.
- Radio communications were performed in Italian and English language.
- ATC personnel did not realize that Cessna Citation was on taxiway **Romeo 6**.
- The ground controller issued a taxi clearance toward north (main) apron although the reported position **S4** did not have any meaning to him.
- Instructions, training and the prevailing environmental situation prevented the ATC personnel from having full control over the aircraft movements on ground.
- The aerodrome standard did not comply with ICAO Annex 14; required markings lights and signs did not exist (**Romeo 6**) or were in dismal order and were hard to recognize especially under low visibility conditions (**Romeo 5** - **Romeo 6**), other markings were unknown to operators (**S4**).

- No functional Safety Management System (SMS) was in operation.
- The competence maintenance and requirements for recent experience for ATC personnel did not comply fully with ICAO Annex 1.
- The Low Visibility Operations (LVO) implementation by ENAV did not conform to the requirements provided in the corresponding and referenced ICAO Doc 9476.

The combined effect of these factors, contemporaneously present on the 8th of October 2001 at Milano-Linate Airport, have neutralized any possible error corrective action and therefore allowed the accident.

3. Epilogue

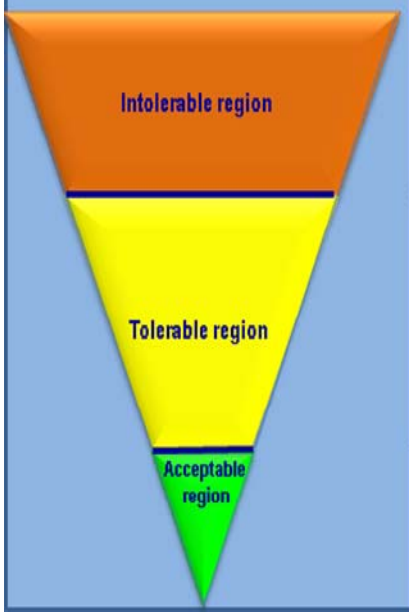
In April 2004 four officials accused of negligence and multiple manslaughter were sentenced to jail terms ranging from 6½ to 8 years. Judges gave eight-year prison sentences to the director of the Milano-Linate Airport and the air traffic controller who was on duty at the time. The former CEO of Italy's air traffic control agency ENAV and the person who oversees Milan's two airports, there were sentenced to six years and six months each.

4. Risk assessment matrix

Probability of occurrence		
Qualitative definition	**Meaning**	**Value**
Frequent	Likely to occur many times *(has occurred frequently)*	**5**
Occasional	Likely to occur some times *(has occurred infrequently)*	**4**
Remote	Unlikely, but possible to occur *(has occurred rarely)*	**3**
Improbable	Very unlikely to occur *(not known to have occurred)*	**2**
Extremely improbable	Almost inconceivable that the event will occur	**1**

Severity of occurrences		
Aviation definition	**Meaning**	**Value**
Catastrophic	➢Equipment destroyed. ➢Multiple deaths.	**A**
Hazardous	➢A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. ➢Serious injury. ➢Major equipment damage.	**B**
Major	➢A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency. ➢Serious incident. ➢Injury to persons.	**C**
Minor	➢Nuisance. ➢Operating limitations. ➢Use of emergency procedures. ➢Minor incident.	**D**
Negligible	➢Little consequences	**E**

Risk probability		Risk severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	2E

Risk management	Assessment risk index	Suggested criteria
	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. It might require management decision
	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Acceptable

EXERCISE 10/02

5. Group activity

A facilitator will be appointed, who will coordinate the discussion. A summary of the discussion will be written on flip charts, and a member of the group will brief on their findings in a plenary session.

6. Your task

Task N° 1

1. List the type of operation or activity.
2. State the generic hazard(s)
3. State the specific components of the hazard(s).
4. State the hazard-related consequences and assess the risk(s).
5. Assess existing defences to control the risk(s) and resulting risk index.
6. Propose further action to reduce the risk(s) and resulting risk index.
7. Establish individual responsibility to implement the risk mitigation
8. Complete the attached log *(Table 10/01).*

7. Utilization of the hazard identification and risk management log

- From Table 10/01 – *Hazard identification and risk management* log below is used to provide a record of identified risks and the actions taken by nominated individuals. The record should be retained permanently in order to provide evidence of safety management and to provide a reference for future risk assessments.
- Having identified and ranked the risks, any existing defences against them should be identified. These defences must then be assessed for adequacy. If these are found to be less than adequate, then additional actions will have to be prescribed. All actions must be addressed by a specified individual (usually the line manager responsible) and a target date for completion must be given. The *Hazard identification and risk management log* is not to be cleared until this action is completed.
- An example is given to facilitate the understanding in the use of the table.

8. Task Nº 2

1. The Accident Investigation Board has identified that no functional Safety Management System (SMS) was in operation at Milano-Linate International Airport. Therefore you should:

   a) Develop a SMS implementation plan for Milano-Linate International Airport.

   b) Complete the attached Gantt chart *(Table 10/02).*

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TABLE 10/01 – HAZARD IDENTIFICATION AND RISK MANAGEMENT

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
A/C OPS	1-Airport infrastructure and facilities	*1-Poor Signage, Lightings and markings*	*-RWY incursion*	*-Some signage and lighting* *Risk index: 3A* *Risk tolerability:* *INTOLARABLE*	*-RWY &TXI Way lighting* *-CURRENT DOC'S* *-Training* *Risk index:1A* *Risk tolerability:* *ACCEPTABE*	Airport manager -ops manager
			-collision	*-Some signage and lighting* *Risk index: 4B* *Risk tolerability:* *INTOLARABLE*	*-RWY &TXI Way lighting* *-CURRENT DOC'S* *-Training* *Risk index:1B* *Risk tolerability:* *ACCEPTABE*	Airport manager -ops manager
	2- WX- Fog	*Low vis.*	*-RWY incursion* *-collision*	*LVO Training* *Risk index: 4B* *Risk tolerability:* *INTOLARABLE* *LVO Training* *Risk index: 4B* *Risk tolerability:* *INTOLARABLE*	*-further training* *-Adjust minimums* *Risk index:1A* *Risk tolerability:* *ACCEPTABE* *-further training* *-Adjust minimums* *Risk index:1B* *Risk tolerability:* *ACCEPTABE*	-Crew Training Manager

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
Aerodrome	1-Airport infrastructure and facilities	*1-Poor Signage, Lightings and markings*	*-RWY incursion*	*-Some signage and lighting* *Risk index: 3A* *Risk tolerability: INTOLARABLE*	*-RWY &TXI Way lighting* *-Frequent inspection* *- Frequent maintenance* *Risk index:1A* *Risk tolerability: ACCEPTABE*	-Airport Manager -safety manager -maintenance
			-collision	*-Some signage and lighting* *Risk index: 4B* *Risk tolerability: INTOLARABLE*	*-RWY &TXI Way lighting* *-Frequent inspection* *- Frequent maintenance* *Risk index:1B* *Risk tolerability: ACCEPTABE*	-Airport Manager -safety manager -maintenance
		2-poor publication	*-RWY incursion*	*Available publications* *Risk index: 3A* *Risk tolerability: INTOLARABLE*	*-revising publications* *Risk index:1A* *Risk tolerability: ACCEPTABE*	-AIS unit manager
			-collision	*Risk index: 3A* *Risk tolerability: INTOLARABLE*	*-revising publications* *Risk index: 1A* *Risk tolerability: ACCEPTABE*	
	2- WX- Fog	*Low vis.*	*-RWY incursion*	*-Some signage and lighting* *Risk index: 3A* *Risk tolerability: INTOLARABLE*	*-RWY &TXI Way lighting* *-LVO Training* *-Follow me cars* *SMR* *Risk index:1A* *Risk tolerability: ACCEPTABE*	-Airport Manager -Apron controller
			-collision	*Some signage and lighting* *Risk index: 3B* *Risk tolerability:*		-Airport Manager -Quality manager

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
ATS	2- WX- Fog	*Low Vis.*	*-collision*	*-Some signage and lighting* *Risk index: 4B* *Risk tolerability:* *INTOLARABLE*	*-RWY &TXI Way lighting* *-LVO Training* *-Follow me cars* *SMR* *Risk index:1B* *Risk tolerability:* *ACCEPTABE*	-Airport Manager -Apron controller -ATS Manager
	Poor communications	*Misunderstanding of clearances*	*-RWY incursion*	*-Available resources* *Read back* *Risk index: 3A* *Risk tolerability:* *INTOLARABLE*	*-Training & Technology* *Risk index:1A* *Risk tolerability:* *ACCEPTABE*	-Training manager
			-collision	*-Available resources* *Read back* *Risk index: 3B* *Risk tolerability:* *INTOLARABLE*	*-Training & Technology* *Risk index:1B* *Risk tolerability:* *ACCEPTABE*	-Training manager
	2- WX- Fog	*Low vis.*	*-RWY incursion* *-collision*	*-Available resources* *-Some signage and lighting* *Risk index: 3A* *Risk tolerability:* *INTOLARABLE*	*-RWY &TXI Way lighting* *-LVO Training* *-Follow me cars* *SMR* *Risk index:1B* *Risk tolerability:* *ACCEPTABE*	-Airport Manager -Apron controller -ATS Manage

TABLE 10/02 – GANTT CHART FOR THE SMS IMPLEMENTATION PLAN

Nº	Component/element	Date: January 08				Date: February 08				Date:				Date:			

Nº	Component/element	Date: January 08				Date: February 08				Date:				Date:			

Table 02/01 – *Analysis*

Organizational processes *Activities over which any organization has a reasonable degree of direct control*	
Certification	
Oversight	
Night non- precision instrument approach	
Condensed flight schedule	
Inadequate CFS	
Training	

Workplace conditions *Factors that directly influence the efficiency of people in aviation workplaces*
Standing water
Poorly lit, short, wide and steep sloping rwy

Latent conditions *Conditions present in the system before the accident, made evident by triggering factors*
Runway conditions (Pavement/drainage)
Poorly lit, short, wide and steep sloping rwy
Condensed flight schedule

Active failures *Actions or inactions by people (pilots, controllers, maintenance engineers, aerodrome staff, etc.) that have an immediate adverse effect*
Did not consult charts
High speed approach
Consult performance chart
Deviation from SOPs
Dispatch failure to inform crew
Inspection of NDB and Erratic radiation
Night non- precision instrument approach
SW conditions

Defences *Resources to protect against the risks that organizations involved in production activities must confront*
Contaminated runway operation charts
Training
Technology

REGULATION ON SAFETY MANAGEMENT SYSTEMS (SMS)

1. Scope and applicability

1.1 Scope

1.1.1 This regulation describes the requirements for a service provider safety management system (SMS) operating in accordance with regulations of group 2.

1.1.2 Within the context of this regulation the term “service provider” shall mean any of the following aviation service providers:

a) aircraft operators,
b) maintenance organizations,
c) air traffic service providers and
d) aerodrome operators. .

1.1.3 This regulation establishes the minimum acceptable requirements; the service provider can establish more stringent requirements.

1.2 Application

1.2.1 a service provider shall have in place a safety management system (SMS) that is acceptable to group 2 , that, as a minimum:

a) identifies safety hazard;
b) ensures that remedial action necessary to maintain an acceptable level of safety is implemented;
c) provides for continuous monitoring and regular assessment of the safety level achieved; and
d) aims to make continuous improvement to the overall performance of the SMS.

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2. Definitions

- Accident
- Acceptable level of safety
- Accountable Executive
- Consequence
- Gap analysis
- Hazard
- Incident

- Mitigation
- Occurrence
- Oversight
- Predictive
- Proactive
- Probability
- Procedures
- Reactive
- Risk
- Safety
- Safety assessment
- Safety assurance
- Safety audit
- Safety manager
- Safety performance indicator
- Safety performance target
- Safety policy
- Safety survey
- Safety management system (SMS)
- Safety programme
- Severity
- System description

3. **General**

3.1 The service provider shall establish and maintain a safety management system (SMS) authorized to be conducted under its operations certificate containing the following:

a) Safety policy and objectives

I. Management commitment and responsibility

II. Safety accountabilities

III. Appointment of key safety personnel

IV. Coordination of emergency response planning

V. SMS documentation

b) Safety risk management

I. Hazard identification

II. Risk assessment and mitigation

c) Safety assurance

I. Safety performance monitoring and measurement

II. The management of change

III. Continuous improvement of the SMS

d) Safety promotion

I. Training and education

II. Safety communication

TABLE 08/01 – HAZARD IDENTIFICATION AND RISK MANAGEMENT

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
Airline operation	Operations to new airport in high terrain and elevated area	1. *Reduced aircraft performance*	1. *Overrun* 2. *CFIT*	1. *Slope* 2. *AIP* 3. *NOTAM* *Risk index:4A* *Risk tolerability:* *:intolerable*	1. *Modification of aircraft by manufacturer* 2. *Certification by CAA* 3. *Training* *Risk index:2A* *Risk tolerability:* *Acceptable based on risk mitigation*	1. Head of maintenance 2. DGCA 3. Flight Crew training manager
		2. *Non-precision approach and Offset*	1. *Workload on pilots* 2. *Unstabilized approach high possibility of Under/over shooting*	1. *VMC* 2. *Daylight ops* *Risk index:3B* *Risk tolerability:* *Tolerable with mitigation*	1. *Training* 2. *RNAV approach* *Risk index:1B* *Risk tolerability:Acceptable*	1. Flight crew training manager 2. Procedure design (PANS/OPS)

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
		3. Single runway use	1. *Airproxies* 2. *Increased workload on controllers and pilots* 3. *Revenue reduction due delays*	1. *Takeoff and landing procedure* 3. *VMC* 4. *Daylight ops* *Risk index:4C* *Risk tolerability:Tolerable with mitigation*	1. *Training TCAS* *Risk index:2C* *Risk tolerability: tolerable with mitigation*	Flight crew training manger
		5. Limited options in case of Emergency	1. *CFIT* 2. *Revenue reduction due delays*	1. *Emergency procedure* 2. *VMC* 3. *Daylight ops* 4. *DME/VOR* *Risk index:3A* *Risk tolerability: Tolerable with mitigation*	1. *Modification of aircraft engines by manufacturer* *Risk index:2A* *Risk tolerability: tolerable with mitigation*	Head of maintenance

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
		5. Katabatic wind	*1. Overrun* *2. Delays and cancellation*	*Slope* *Risk index:3C* *Risk tolerability:*	*1. Modification of aircraft by manufacturer* *2. Certification* *3. Reschedule departure before 1600* *Risk index:2C* *Risk tolerability:*	1. Head of maintenance 2. Chief operations

TABLE 10/02 – GANTT CHART FOR THE SMS IMPLEMENTATION PLAN

Nº	Component/element	Sept –Dec 09				Jan – Apr 10				May – Aug 10				Sept – Dec 10			
1	Identify the Accountable Executive and the safety accountabilities of managers																
2	Identify the person (or planning group) within the organization responsible for implementing the SMS																
3	Describe Linate Airport system																
4	Conduct a gap analysis																
5	Develop an SMS implementation plan																
6	Airport Emergency Response Plan																
7	Develop documentation																
8	Develop and establish means for safety communication																
9	Implement reactive processes																
10	Proactive VIRP																
11	Training																

Nº	Component/element	Sept –Dec 09				Jan – Apr 10				May – Aug 10				Sept – Dec 10			
12	ALoS																
13	Surveys and Audit																

Nº	Component/element	Sept –Dec 09				Jan – Apr 10				May – Aug 10				Sept – Dec 10			