AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course

Handout Nº 1 – The Anytown City Airport accident

International Civil Aviation Organization

Page left blank intentionally

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

Exercise Nº 02/01 – The Anytown City Airport accident

Scenario

The following fictitious scenario, based on real-life events, fully illustrates all of the safety system components. In the late hours of a summer Friday evening, while landing on a runway heavily contaminated with water, a twin-engine jet transport aircraft with four crew members and 65 passengers on board overran the westerly end of the runway at Anytown City airport. The aircraft came to rest in the mud a short distance beyond the end of the runway. There were no injuries to crew or passengers, and there was no apparent damage to the aircraft as a consequence of the overrun. However, a fire started and subsequently destroyed the aircraft.

Anytown City is a popular summer resort. The predominant weather for a typical summer day is low stratus and fog in the early morning, which gradually develops into convective cloud as the air warms. Severe thunderstorms are common in the early afternoon and persist until the late evening hours. The whole region where Anytown City is situated is *"thunderstorm country"* during summer.

The runway at Anytown is 4 520 feet long. It is a relatively wide runway with a steep downward slope to the west. It is served by a low-power, short-range, non-directional beacon (NDB), unreliable in convective weather. Runway lighting is low-intensity, and there are no approach lights or visual approach aids. It is a classic *"black-hole"* approach during night landings.

The flight had originated at the airline's main base, 400 km away. This was the second-to-last flight for the flight crew that day. They had reported for duty at 11:30 hours and were due to be relieved at 22:00 hours. The crew had been flying a different schedule for the last three weeks. This was the beginning of a new four-day schedule on another route. It had been a typical summer afternoon, with thunderstorms throughout the entire region. Anytown City had been affected by thunderstorms during the early afternoon. No forecast was available, and the pilot-in-command (PIC) had elected to delay the departure.

The flight schedule was very tight, and the PIC's decision to delay created a number of additional delays for subsequent flights. The dispatcher working the flight did not bring to the flight crew's attention the need to consider a contaminated runway operation at Anytown, and did not review the landing performance limitations with them. After a long delay, the PIC decided to add contingency fuel and depart.

Visual conditions were present at Anytown, although there were thunderstorms in the vicinity of the airport, as well as a persistent drizzle. With no other reported traffic, they were cleared for a night visual approach. After touchdown, the aircraft hydroplaned and overran the end of the runway slightly above taxiing speed.

The PIC was a very experienced pilot. He had been with the airline for many years, accumulating several thousand hours of flying time as a second-in-command (SIC) in two other types of large jet aircraft. However, he had limited experience with the aircraft type he was flying the night of the accident. He had not had the occasion to fly into Anytown before because the larger aircraft types he had been flying previously did not operate into Anytown. This was his first month as a PIC. He was a well-balanced individual, with no personal or professional behavioural extremes.

At the time of the accident the SIC was very inexperienced. He had recently been hired by the airline and had only been flying the line for about a month. He had flown into Anytown on two other occasions with another PIC, but only during the day. His training records indicated standard performance during induction into the airline's operations.

Investigation

Initially, the investigation would focus on determining what actually happened at Anytown. It was learned that it had rained heavily at the airport and that there was standing water on the runway. Readout of the flight recorders disclosed that the PIC flew the approach with excess airspeed which resulted in the airplane touching down smoothly, but well beyond the touchdown zone, and then hydroplaning off the end. It was also determined that the PIC neglected to consult the performance charts in the aircraft flight manual for the correct landing distance on a wet runway. Also, the SIC did not make the required callouts during the approach.

These unsafe flight crew actions could in and of themselves explain the overrun and focus the investigation on a conclusion of *"crew error"* as a cause for the accident. However, if one were to investigate further into the company's operational procedures and practices and look upstream for other factors influencing the crew's performance, one could identify additional active and latent failures which were present during the flight. So the investigation should not stop at the point where the crew made errors.

If the investigation were to determine whether any other unsafe acts occurred in the operation, it would discover that not only did the dispatcher fail to brief the PIC on potential problems at the airport (as required by company procedure), but that the company's agent at Anytown had not reported to the dispatcher at headquarters that heavy rain had fallen. Inspection of the runway revealed poor construction, paving and lack of adequate drainage. It was also discovered that maintenance and inspection of the NDB was not in accordance with prescribed procedures. Over the past month, other flight crews had reported on several occasions that the ground aid had given erratic indications during instrument approaches; no attempt had been made to rectify the problem.

With these facts in mind and by referring to the Reason model, it can be seen that the actions of other front-line operators were also unsafe and had an influence upon the performance of the flight crew and the outcome of the flight. These activities can be classified as active failures and are also linked to line-management and decision-makers' performance.

Next, the investigation should determine if there were any adverse pre-conditions under which the flight crew had to operate. These can be listed as follows:

1) a night non-precision instrument approach to an unfamiliar airport;
2) a poorly lit, short, wide and steeply sloping runway;
3) poor runway pavement and drainage;
4) a lack of reliable information on the performance of the NDB;
5) a lack of reliable information about the wind conditions;
6) a flight schedule which allowed only a 15-minute turnaround at Anytown;
7) an arrival delayed by two hours, compromising crew duty-time requirements;
8) an aircraft not equipped with thrust reversers;
9) an inadequately trained flight crew, inexperienced in the type of aircraft and at the airport; and
10) inadequate crash, fire, and rescue services.

The Reason model classifies these pre-conditions as latent conditions, many of which lay dormant for some time before the accident and which were the consequences of line management and decision-maker actions or inactions. For example, pairing two pilots who were inexperienced in the type of aircraft and allowing the PIC to operate into an unfamiliar airport with a non-precision approach procedure was the result of decisions made by line management. Also, the failure to follow up on reported discrepancies with the NDB and the failure to conduct adequate inspections of the airport indicate either a lack of awareness of the safety implications or a tolerance of hazards by the line management and the regulatory authority. The investigation found that pilots were not briefed on the use of performance charts for contaminated runways, nor did they practice hydroplaning avoidance techniques. These discrepancies can be attributed to both line and upper management's failure to provide adequate training.

At the roots of this occurrence were other decisions made by both upper management levels within the company and in the regulatory authorities that had a downside. Management had decided to operate a scheduled service at an airport with known deficiencies in facilities (poor lighting and approach aids, inadequate weather services). More importantly, they chose to operate without the required level of crash, fire and rescue services available at the airport. In addition, management selected this type of airplane for this route out of marketing and cost considerations, despite its unsuitability for all-weather operations at Anytown. Compounding the problem was the decision by the regulatory authority to certify the airport for scheduled air transport operations in spite of its significant safety deficiencies.

The organizational perspective portrays the interactive nature of the conditions and failures and how they can combine to defeat the defences that one might expect to find within an organizational and operational environment. It also depicts the critical importance of identifying latent failures as they relate to the prevention of accidents.

In summary, the approach to the organizational accident encourages the investigator to go beyond the unsafe actions of front line operators to look for hazards that were already present in the system and which could contribute to future occurrences. This approach has direct implications for the prevention activities of operators and regulators, who must identify and eliminate or control latent conditions.

EXERCISE 02/01

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 Anytown City 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);

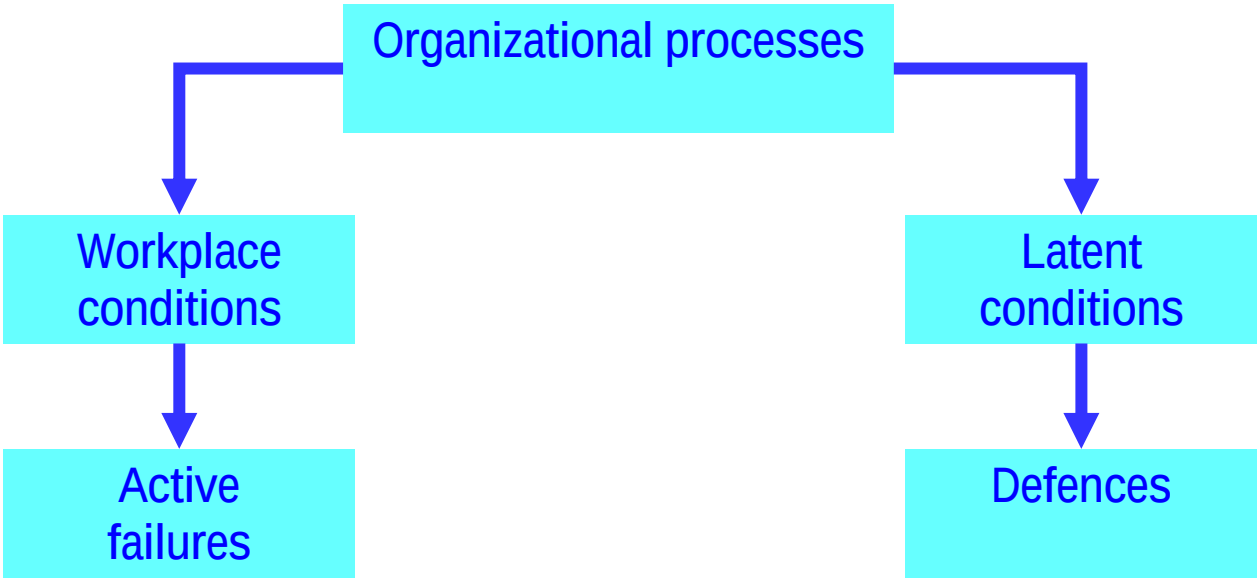
b) **Latent conditions** in the system safety which became precursors of active failures;

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 02/01 – *Analysis* classifying your findings according to the Reason Model.



Reason Model

Table 02/01 – *Analysis*

Organizational processes *Activities over which any organization has a reasonable degree of direct control*	
Certification: decision by the regulatory authority to certify the airport for scheduled air transport operations	a flight schedule which allowed only a 15-minute turnaround at Anytown;
Oversight	
1. decision to operate a scheduled service at an airport with known deficiencies	
2. Operator's decision to operate without the required level of crash, fire and rescue services	
3.Management choice on type of aircraft to Anytown	
4.Management choice on experience of crew to operate	
Failure by management to act on flight crew reports	

Workplace conditions *Factors that directly influence the efficiency of people in aviation workplaces*
Standing water
Thunderstorm activity
lack of reliable information on the performance of the NDB, and wind conditions

Latent conditions *Conditions present in the system before the accident, made evident by triggering factors*
Runway conditions (Pavement/drainage)
a night non-precision instrument approach (black hole effect)
a poorly lit, short, wide and steeply sloping runway;
Inexperienced PIC and Low experience SIC

Active failures *Actions or inactions by people (pilots, controllers, maintenance engineers, aerodrome staff, etc.) that have an immediate adverse effect*
Did not consult charts
Pilot flew at excess speeds on landing

Defences *Resources to protect against the risks that organizations involved in production activities must confront*
Contaminated runway operation charts
Aircraft of inadequate technology utilised(reversers, ILS, etc)

	Inadequate Route Qualification
PIC neglected to consult the performance charts on a wet runway	Inadequate training (hydroplaning,)
Dispatch failure to brief crew on airport problems information	Inadequate crash, fire, and rescue services.
Company agent failure to report weather condition at Anytown	Procedures (briefing)
Failure to follow up on reported discrepancies on Unreliable NDB	Precision Approach Nav Aid
Failure to take action on poor construction of runway	

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

Page left blank intentionally

AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course

Handout N° 3 – International airport construction work

International Civil Aviation Organization

Page left blank intentionally

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

Exercise 04/01 --------INTERNATIONAL AIRPORT CONSTRUCTION WORK----------   ***---------GROUP----03-----WORKSHOPE----***

PHASE (I)

	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
1	**1-Air Traffic Services** *2-Aerodrome/ operator* 3-Air line operator *4-Construction company*	*(Aerodrome construction).*	*(operation)* - *Single runway operation* - *Airspace Congestion* ---------- - *Runway congestion* ---------- *(technical)* - *Rising sand and dust* - *FODs* - *Delays (Economy).* ---------- *FODs (technical).*	- A/c colliding with Construction equipment - RWY incursion ---------- - A/c taxing in closed taxiway - Air proxies- - Midair collision. ---------- - Engine ingestion - A/C damage - More fuel consumption - ---------- - *Damage to construction* *Equipment* and personne

	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
	PHASE (II) **Air Traffic Services** *Aerodrome/ operator* Air line operator *Construction company*	*(Aerodrome construction)*	- *Single runway operation* - *Congested air space.* - *Closed taxi way* - *Runway congestion* - *Congested parking area* --- - *Rising sand and dust.* - *FODS* - *A/C back track (Rwy 10) (economy)* - *FODs* - *the construction equipment*	- A/c colliding with Construction equipment - Air proxies A/C using the wrong taxiway - A/c taxing in closed taxiway- - RWY incursion - A/C Colliding --- - Engine ingestion - A/C damage - Delays - Tyre wear --- Serious Injuries to construction personnel.

	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
3	***PHASE (III)*** **Air Traffic Services** *Aerodrome/ operator* Air line operator *Construction company*	*(Aerodrome construction)*	- *Single runway operation* - *Runway congestion* - *Congested air space.* *Reduced number of taxi ways* *Reduction of ability.* --- - *Rising sand and dust* - *FODS* - *A/C back track* - *Short RWY operation* - *Displaced threshold* *construction equipment& personnel*	- A/c colliding with Construction equipment - RWY incursion - A/c taxing in closed taxiway - Air proxies- - Midair collision. - Engine ingestion - Engine failure - A/C damage - Delays - Over run the Rwy. - Undershoot. - Cancellation of operation by some operator. - Tire burst or break failure - unstabilized approach. - Limited A/C Type. Damage & serious injures and death

	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
4				
5				

	Type of operation or activity	Generic hazard (hazard statement)	Specific components of the hazard	Hazard-related consequences
6				
7				
8				
9				
10				

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

AFI Comprehensive Implementation Programme (ACIP)

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

International Civil Aviation Organization

Page left blank intentionally

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.

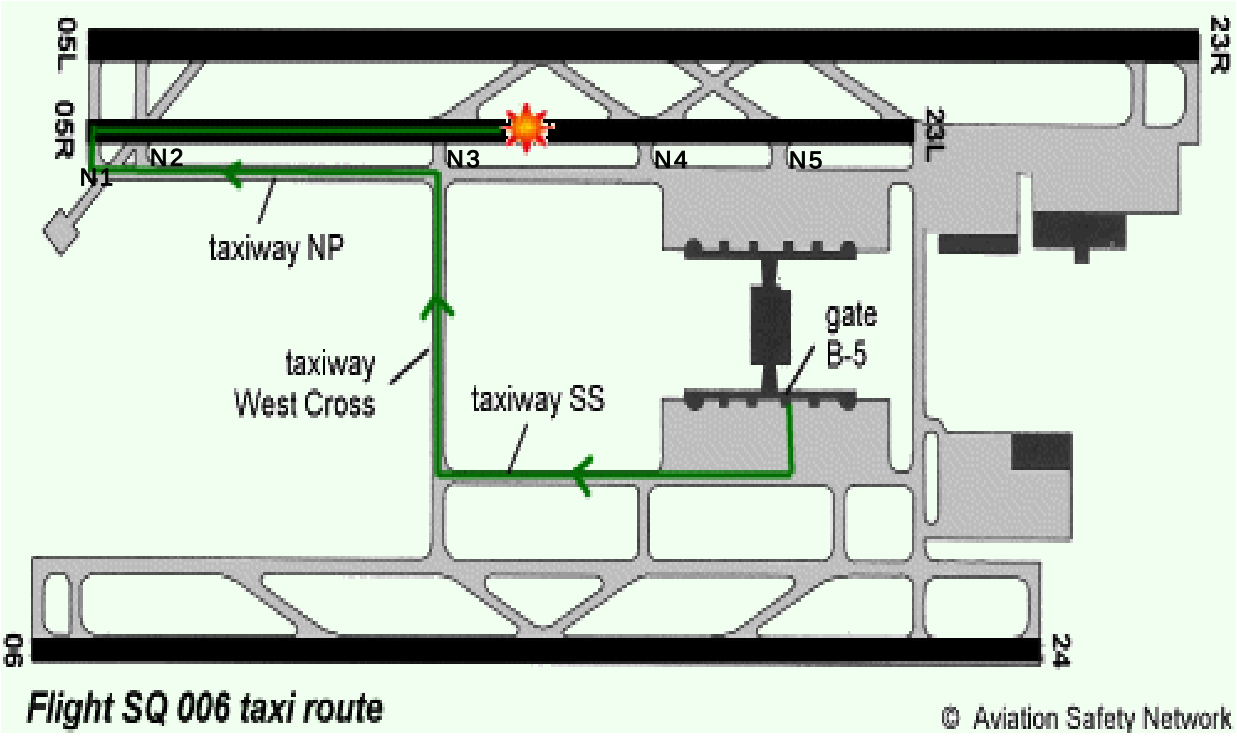
As SQ006's PIC taxied down **N1** and approached **05R**, he was *"focused on the image of the runway to his right, and he did not notice any further green lights ahead and along the extension of N1,"* he told investigators.

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.

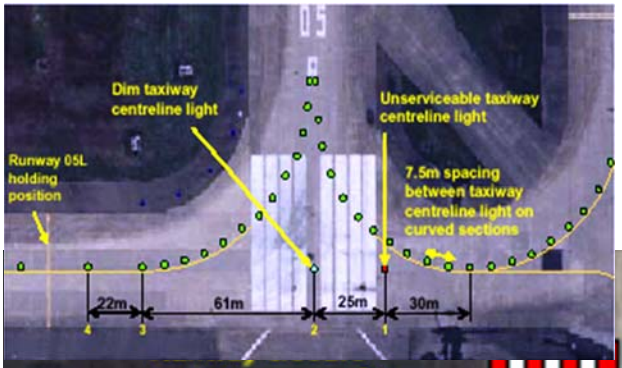
The SQ006 PIC told investigators he was aware of **05R's** status. He had used the runway in the past; his last departure on it was *"two or three years"* ago, report said. The PIC's last flight to CKS Airport before October 31 was sometime in early to mid-September, the report said.

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."*

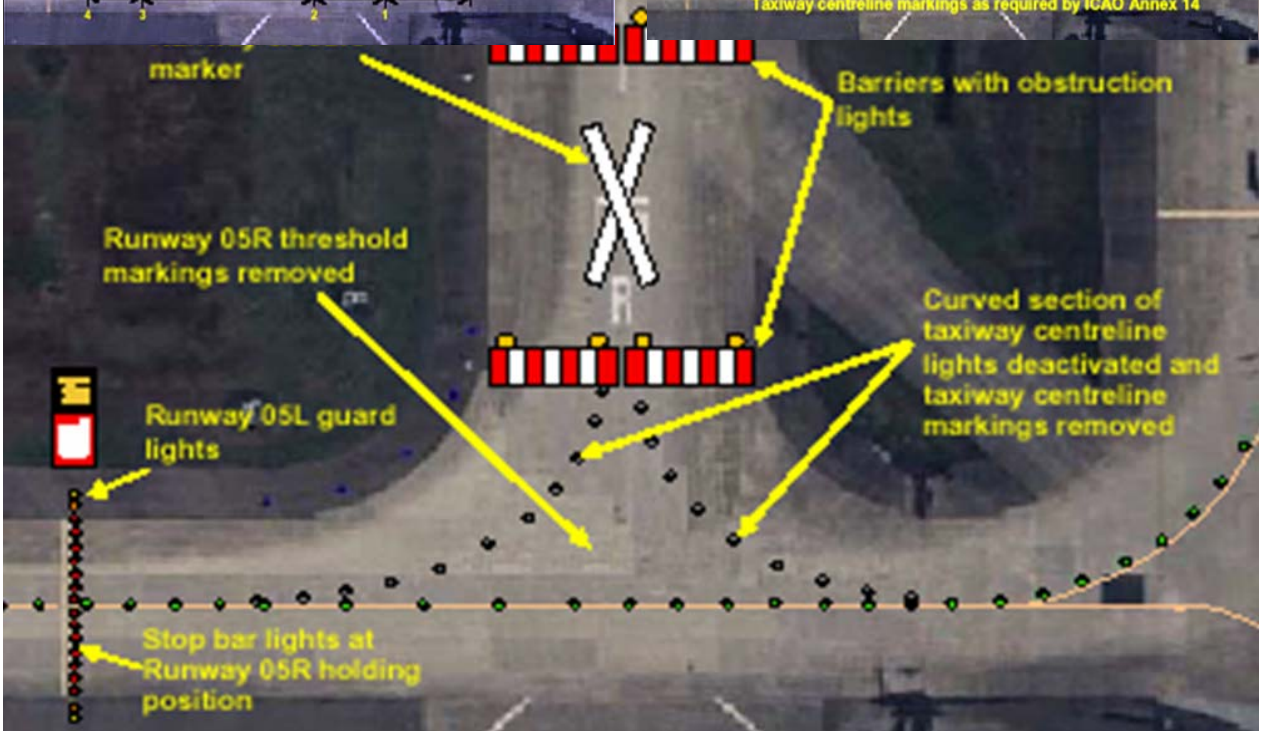


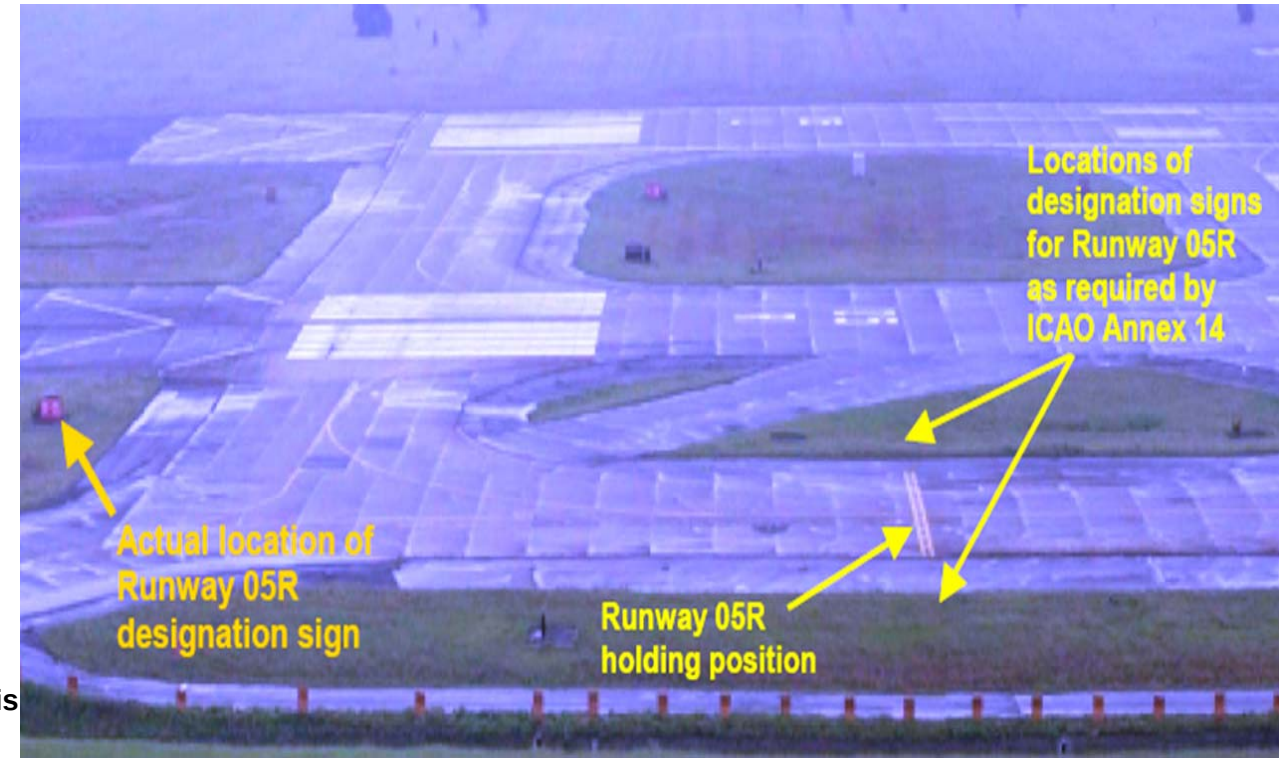

Stop Bar lights (Inset) as required by ICAO Annex 14
Flashing Guard Lights on both sides of the holding line of Runway 05L as required by ICAO Annex 14


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


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

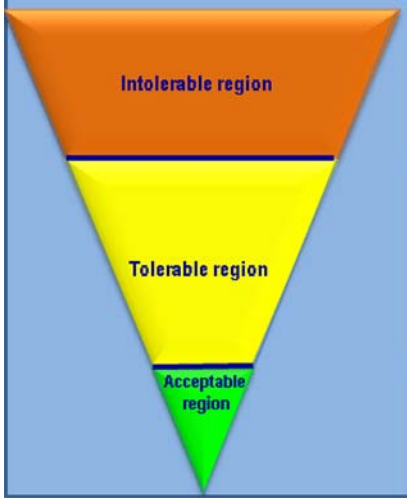


4. Ris

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	*Air operator*	*Aerodrome construction*	*Construction equipment obstructing the closed runway*	1. *Injury/ fatalities (pax and workers)* 2. *Damage to aircraft* 3. *Damage to construction equipment* 4. *Damage to runway*	1. *NOTAM* 2. *Airport Navigation Chart* 3. *Runway & taxiway signage and markings* 4. *Colour of the centeline lights (Green) on 05R* 5. *Automatic Terminal Information System (ATIS)* 6. *Aircraft heading references* 7. *Colour of runway centre lights (green and not white)* 8. *PVD indication (Para-visual display)* 9. *PFD information (Primary flight display)*	1. *Request use of runway 06* 2. *Extra pilot briefing during dispatch* 3. *Delay flight in the event of deteriorating weather* 4. *Question PF decision during operations (call outs & SOPA)*
			Improper markings and signage	*Taxing into the closed runway*		
			Weather – poor visibility due to typhoon **(heavy rain and gusting winds)*	*Taxing into the closed runway* *Poor communication (CRM)* *Loss of situational awareness*		
			Time pressure (Closing in of weather)	*Loss of situational awareness* *Taxing into the closed runway*		
			Failure to review of aerodrome layout (Charts) • *runway familiarity 06*	*Loss of situational awareness*		

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
			Lighting system *1. Inadequate taxi and runway light system* *2. Stop bar lights were in the wrong position*	*Taxing into the closed runway* *Loss of situational awareness* *Taxing into the closed runway*	*Risk index: 3A* *Risk tolerability:* *Unacceptable under the existing circumstances*	*Risk index: 2A* *Risk tolerability: Acceptable based on risk mitigation. It might require management decision*
2	*Aerodrome operator*	*Aerodrome construction*	*Lighting system* *1. Inadequate taxi and runway light system* *Stop bar lights were in the wrong position*	*Damage to equipment and runway* *1. Loss of life* *2. Damage to aerodrome/ construction equipment/ Aircraft*	*1. Runway & taxiway signage and markings* *2. Colour of runway centre lights (green and not white) on 05R* *Risk index: 3A* *Risk tolerability:* *Unacceptable under the existing circumstances*	*1. Replace the missing lights* *2. More frequent inspection* *3. Ensure the aerodrome lighting and signage meets ICAO annex 14 requirements* *4. Runway closed marker missing* X (05R) *5. Use of follow me car during low visibility operations* *Risk index: 1A* *Risk tolerability:* *Acceptable*
			2. Weather (Typhoon)	*1. Loss of situational awareness* *2. Taxing into the closed runway*		

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	*Air traffic controller*	*Aerodrome construction*	*Aerodrome procedures coupled by Weather (Typhoon)* *Aerodrome (poor) visibility and deteriorating conditions*	• *Take-off on the closed runway* • *Time pressure to ATC due to possible aerodrome closure*	*ATIS* *Risk index: 3B* *Risk tolerability:* *Acceptable based on risk mitigation. It might require management decision*	1. *Requirement by ATC for confirmation by crew before clearance for take-off* 2. *Use of surface movement radar* 3. *Use of Low visibility procedures* *Risk index: 1B* *Risk tolerability:* *Acceptable*

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

Table 03/01 – *Analysis*

Organizational processes *Activities over which any organization has a reasonable degree of direct control*	
- **Planning**	
- **Scheduling**	
- Failure to install Surface Movement Radar (SMR), and special taxiway-lighting facilities for use under low visibility-conditions,	
- Air Traffic Control at Anyfield is slightly understaffed,	
- consecutive nightshifts,	
- Time pressure to the pilot to have the aircraft back asap	

Workplace conditions *Factors that directly influence the efficiency of people in aviation workplaces*	**Latent conditions** *Conditions present in the system before the accident, made evident by triggering factors*
- **OJT**	- **ATC understaffing**
- Obstructed by the newly constructed extension to the terminal building at Anyfield Airport.	- They were both completing their third consecutive nightshift
- The pilot of the twin-engined piston-driven aircraft was unfamiliar with Anyfield Airport,	- Absence of the signage to various TWY intersection
- Inexperienced ATC in operating in this specified Wax conditions	- Unproper scheduling of atc
- TWR is not equipped with Frequency coupling	

Active failures *Actions or inactions by people (pilots, controllers, maintenance engineers, aerodrome staff, etc.) that have an immediate adverse effect*	**Defences** *Resources to protect against the risks that organizations involved in production activities must confront*

- **ATCO did not challenge ambiguous position report by twin-engine pilot**	- **Progressive taxi instructions**
- intruded the departure-runway	- (Technology) Surface Movement Radar (SMR), special taxiway-lighting facilities for use under low visibility-conditions.
- ATC failure to locate the actual position of the pilot	- proper scheduling of atc
	- Signage in grass
	- Proper taxi-instructions could have been given to the *"lost"* aircraft

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

AFI Comprehensive Implementation Programme (ACIP)

ICAO Safety Management Systems (SMS) Course
Handout N° 5 – Cuzco
International Airport operation

International Civil Aviation Organization

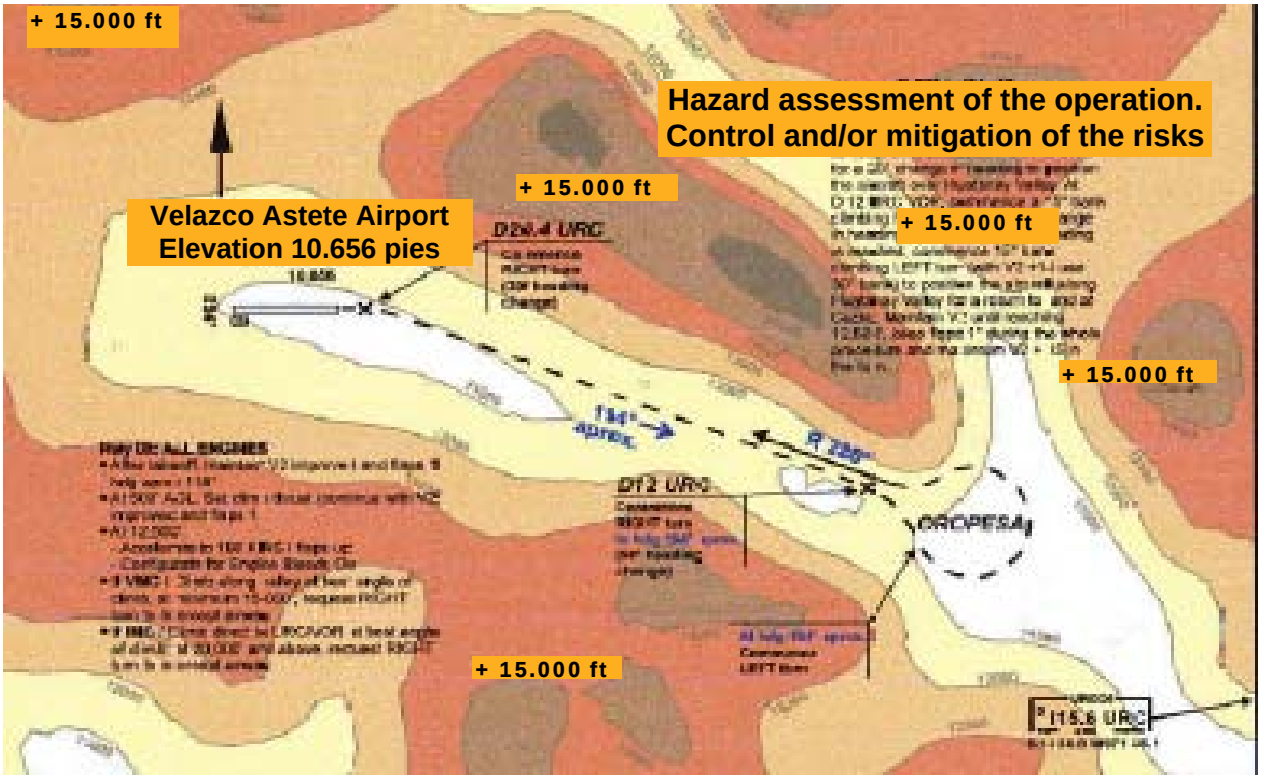
Page left blank intentionally

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

Exercise 08/01 – Cuzco International Airport operation

Scenario

This is a proposed airline operation with a commercial twin-engine jet aircraft (e.g. B-737, MD-80, A-320, etc.) at Cuzco International Airport.

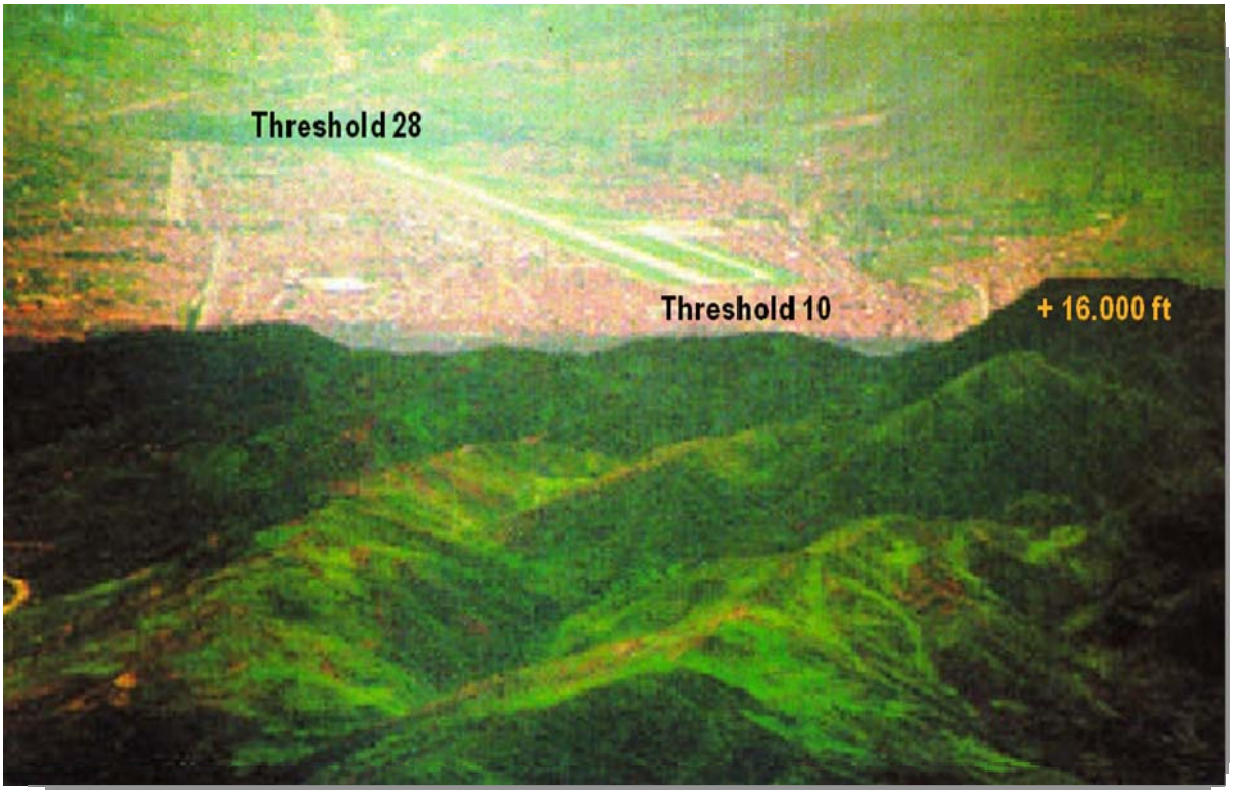


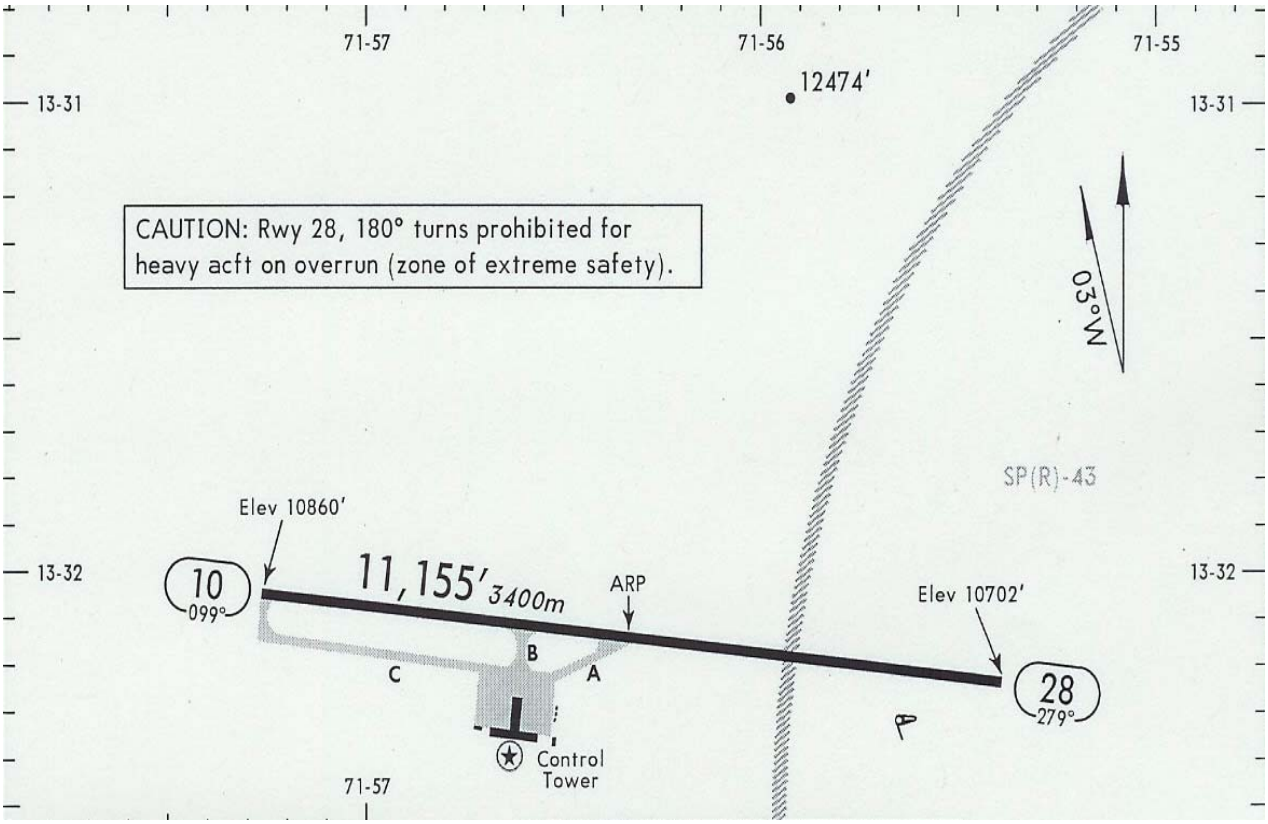
1. Cuzco Airport characteristics and operation

- VMC and day-light aircraft operation
- Landing on runway 28 only.
- Take-off on runway 10 only.
- In case of engine fire, engine-out or emergency condition return to airport is mandatory, except if the aircraft's weight and performance allow the aircraft to comply with obstacle clearance net trajectory.
- Katabatic wind forces tailwind take offs from approximately 16:00 hours daily.
- No ILS approach is available.
- VOR used for instrument letdown (URCOS) not located at the aerodrome.


Velazco Astete Airport
Elevation 10.656 ft
Threshold 28


+ 16.000
Threshold 10
Velazco Astete
City of Cuzco
Threshold 28


Threshold 28
Threshold 10
+ 16.000 ft


71-57
71-56
71-55
13-31
12474'
13-31
CAUTION: Rwy 28, 180° turns prohibited for heavy acft on overrun (zone of extreme safety).
030°M
SP(R)-43
Elev 10860'
13-32
10
099°
11,155'3400m
ARP
Elev 10702'
13-32
C
B
A
28
279°
Control Tower
71-57

2. What is the safety concern?

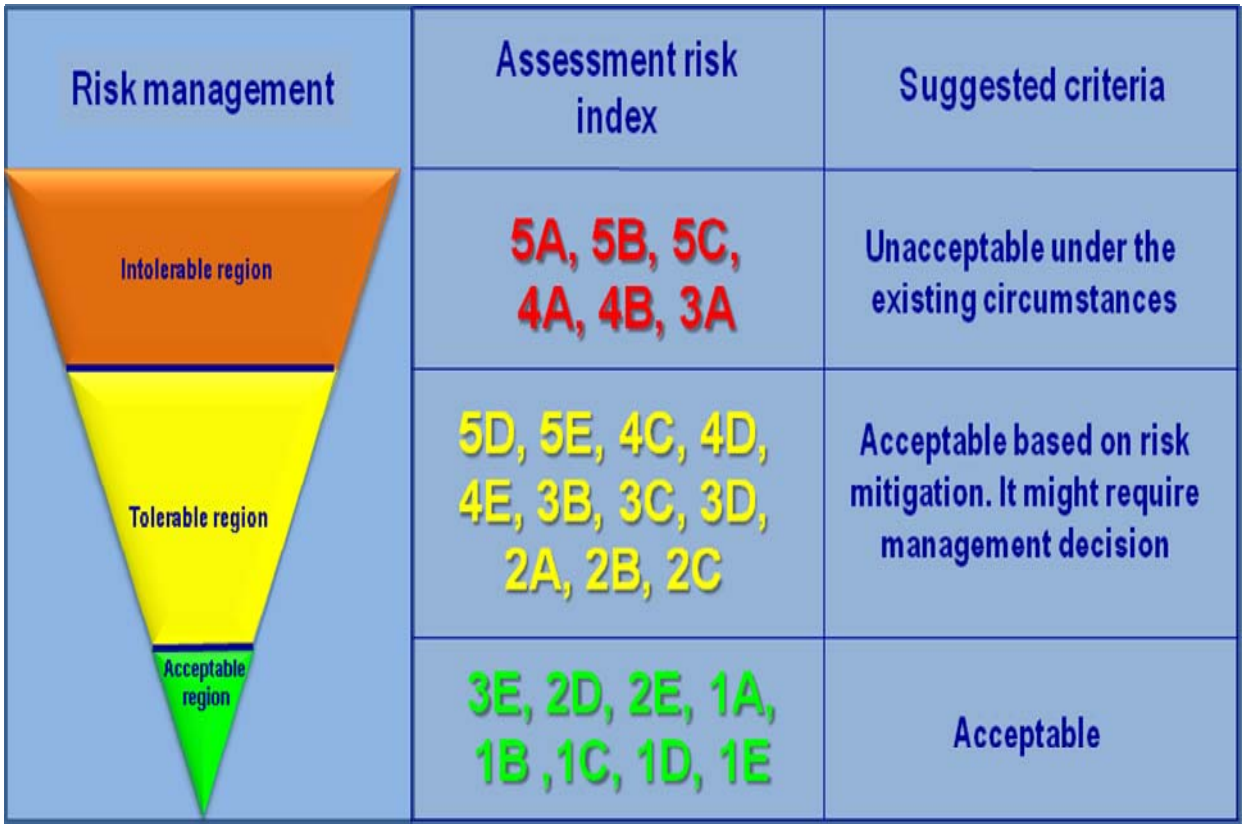
- Issues to be considered:
  - Aerodrome infrastructure
  - Navigational radio aids
  - Weather conditions
  - Aircraft performance
  - Take-off obstacle clearance net path
  - En-route obstacle clearance net path (trajectory)
  - In-flight procedures
  - Documentation
  - Training
    - Pilots and cabin crew
    - Flight dispatchers
    - Safety ground crew

3. 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



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. 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 08/01).*

6. Utilization of the hazard identification and risk management log

- From Table 08/01 – *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.

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

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
Flight operations	All weather operations at an aerodrome where one of the two parallel runways is closed due to a construction work. *(Example only, not related to the present case study)*	Aircraft taking off or landing on a closed runway. *(Example only, not related to the present case study)*	Aircraft colliding foreign object. *(Example only, not related to the present case study)*	1. NOTAM issued by the aerodrome manager to notified users on the construction work on the closed runway. 2. ATIS 3. Aerodrome layout available in the national AIP 4. New signage and lighting 5. Company operations manual 6. Dispatch performance manual 7. Aircraft operating manual 8. Flight crew competency requirements in AWOP. 9. Recurrent training 10. CRM training *(Example only, not related to the present case study)* *Risk index: 3A* *Risk tolerability: Unacceptable under the existing circumstances*	1. Ensure that flight dispatchers and operations officers inform flight crew on the risk of taking mistakenly the closed runway. 2. Ensure that flight crew is aware of the current layout of the aerodrome. 3. Issuance of company NOTAM concerning the closed runway and new routing on the movement area. 4. Review of the Low Visibility Operations (LVO) during training sessions. 5. Review procedures in the Company Operations Manual and Route Manual. *(Example only, not related to the present case study* *Risk index: 1A* *Risk tolerability: Acceptable after review of the operation*	1. Director of the operations control centre (OCC) 2. Chief pilot 3. Head of Flight operations engineering 4. Flight training manager 5. Head of Documentation Department *(Example only, not related to the present case study)*

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 OPS	ADVERSE TERRAIN	*- High Airfield Elevation*	*- Reduced A/C performance*	*- Type of A/C (A320)* *- strict control of takeoff/landing weight* *Risk index: 3A* *Risk unacceptable:*	*- Training on high elevation ops to pilots & dispatchers* *Risk index: 2A* *Risk tolerability:*	- Airline training manager
		- High mountains around the airport	*- Controlled flight into terrain.* *- Unstable approach.*	*- landing on RWY 28 & takeoff on RWY 10 only.* *- VMC & day-light A/C Operations.* *- A/D charts* *- Procedure for engine failure/ emergency.* *Risk index: 3A* *Risk unacceptable:*	*- EGPWS* *- Equip A/C with GPS* *- GNSS approach procedure.* *- Training pilot & ATC on new procedures* *Risk index: 2A* *Risk tolerability:*	Director of OPS Head ATS Training Mgrs
		Dep/Arr Procedures	*- Congested air traffic.* *- Air proxies*	*- VMC & day-light A/C Operations.* - Equip A/C with TCAS. *Risk index: 3B* *Risk acceptable:*	- Height separation SIDS & STARS. *Risk index: 2B* *Risk tolerability*	Head of ATS

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
	Adverse Weather	*- Katabatic Wind forces.*	*-Tailwind takeoff* *- RWY overrun*	*- Information available* *- Performance chart* *Risk index:2B* *Risk tolerability:*	*- Reschedule departure time.* *- Provide curate Wx before departure* *Risk index:1B* *Risk tolerability:*	- Chief Pilot & Ops Mgr - ATS Mgr
		- Flight Delays	*- Increased ops cost*	*Information available* *Risk index:3C* *Risk tolerability:*	*- Reschedule departure time* *Risk index:2C* *Risk tolerability:*	- Chief Pilot & Ops Mgr

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
				Risk index: *Risk tolerability:*	*Risk index:* *Risk tolerability:*	