United Arab Emirates

الهيئـــة الـعـامـــة للطيـــران الـمـدنـــي
GENERAL CIVIL AVIATION AUTHORITY

SMS IN ANNEX 13 INVESTIGATIONS

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رؤيـتـنـا: منظومة طيران مدني آمنة ورائدة ومستدامة
OUR VISION: A LEADING, SAFE, SECURE AND SUSTAINABLE CIVIL AVIATION SYSTEM

Objectives

At the end of this presentation, the audience will be able to:

- Identify the SMS involvement in accidents and incidents.
- The link between proper risk assessment and safe operations.

Safety Culture is not New

- Aviation is an environment in which significant amounts of knowledge, skill and effort are already spent to assure safety.
- There is already a strong safety culture and an excellent safety record.
- This resulted in a belief that the existing way of doing things was just fine.
- In some respects, this was correct. There were already a number of SMS elements in place, but these tended to focus on service delivery.
- Missing was a systematic, comprehensive and explicit system.

NAV Canada "Pre-Flight", March, 2013

Safety

Safety is the state in which the possibility of harm to persons or property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.

ICAO Doc 9859

Safety management system is a systematic approach to managing safety, including the necessary organizational structure, accountabilities, policies, and procedures.

Annex 19

SMS vs SSP

SSP components and elements

1. **State safety policy and objectives**
   - 1.1 State safety legislative framework
   - 1.2 Safety responsibilities and accountabilities
   - 1.3 Accident and incident investigation
   - 1.4 Enforcement policy
2. **State's safety risk management**
   - 2.1 Safety requirements for service providers' SMSs
   - 2.2 Agreement on service providers' safety performance
3. **State safety assurance**
   - 3.1 Safety oversight
   - 3.2 Safety data collection, analysis, and exchange
   - 3.3 safety data driven targeting of oversight on areas of greater concern or need
4. **State safety promotion**
   - 4.1 Internal training, communication and dissemination of safety information
   - 4.2 External training, communication and dissemination of safety information

SMS components and elements

1. **Safety policy and objectives**
   - 1.1 Management commitment and responsibility
   - 1.2 Safety accountabilities
   - 1.3 Appointment of key safety personnel
   - 1.4 Coordination of emergency response planning
   - 1.5 SMS documentation
2. **Safety risk management**
   - 2.1 Hazard identification
   - 2.2 safety risk assessment and mitigation
3. **Safety assurance**
   - 3.1 Safety performance monitoring and measurement
   - 3.2 The management of change
   - 3.3 Continuous improvement of the SMS
4. **Safety promotion**
   - 4.1 Training and education
   - 4.2 Safety communication

Key Changes Arising from 1992 AIG Meeting

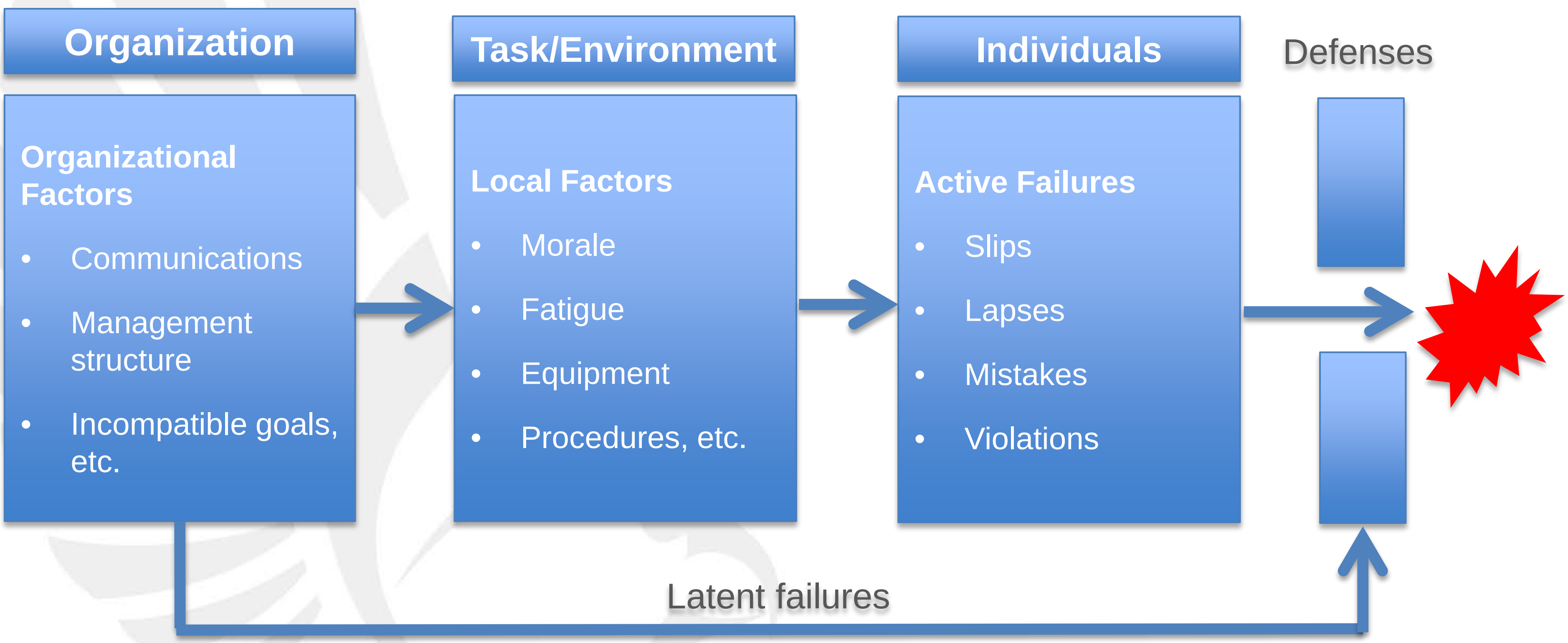
- New or revised definition of causes, investigation, serious incident…
- Increased emphasis on systems safety.
- Annex 13 was extended to cover the investigation of serious incidents as well as accidents.
- Requirements to include analysis of organizational and management information in the Final Report.
- The Reason Model was endorsed by the AIG meeting as a guide to the investigation of organizational and management factors.
- New and strengthened specifications concerning accident prevention measures.

Key Changes Arising from 1992 AIG Meeting

1.17 Organizational and management information:

- Pertinent information on any organization and its management whose activities may have directly or indirectly influenced the operation of the aircraft.
- Information could include: safety culture; resources and financial viability; management policies and practices; internal and external communications; and certification, safety oversight and regulatory framework.
- When relevant, provide pertinent information concerning the operator, including deficiencies found in the operator's company OM and other documentation, when the deficiencies had a bearing on the accident.

Basic Reason Model



Risk Management and Investigation

- The reactive investigation process and the proactive risk management process consider exactly the same components of Reason Model.
- Risk management **before** the occurrence, and investigation **after** the occurrence.
- Risk management and safety investigation are two sides of the same coin.
- Therefore, they require an integrated approach in managing the safety of operations.

➢ The traditional approach to safety management ultimately does not enhance safety because it concentrates on the surface deficiencies such as maintenance or pilot errors.

➢ If the underlying factors are not rectified, other occurrences will occur by the same contributing factors.

Risk

Consequence				Increasing Probability				
				A	B	C	D	E
Rating	People	Assets	Environment	Never heard in Industry	Incident heard in Industry	Incident heard in company	Incident happens several times per year in company	Incident happens several times per year in a location
0	No injury	No damage	No effects	Low risk	Low risk	Low risk	Low risk	Low risk
1	Slight injury	Slight damage	Slight effect	Low risk	Low risk	Low risk	Med./low risk	Med./low risk
2	Minor injury	Minor damage	Minor effect	Med./low risk	Med./low risk	Med./low risk	Med./low risk	Med./low risk
3	Major injury	Local damage	Localized effect	Med./low risk	Med./low risk	Med. risk	Med. risk	High risk
4	Single fatality	Major damage	Major effect	Med. risk	Med. risk	Med. risk	High risk	High risk
5	Multiple fatality	Extensive damage	Massive effect	Med. risk	High risk	High risk	High risk	High risk

New thinking of safety management

- Change the primary focus from the events to:
    - the **preventive** controls that failed
    - the **recovery** controls that worked
- The same sets of preventive and recovery controls are common to many generic categories of adverse operational events.

Why the SMS has become ICAO Standards?

The subsequent systemic investigations of accidents and incidents showed that:

- The primary contributing systemic factors were all present before the accident/incident.
- In many cases they were common knowledge, and had often been formally documented.
- In all cases, they could, and should, have been identified before the accident.

The SMS shall be Integrated (ISMS) in that:

- The components are integrated with each other.
- Integrated into the management processes: Operational, financial, and human resource management.

Where does the SMS fit?

Organizational Factors

- Equipment
- Training
- Communication
- Incompatible Goals
- Procedures
- Maintenance Management
- Design
- Finance
- Culture

SMS Elements

1. **Safety policy and objectives**
   - 1.1 Management commitment and responsibility
   - 1.2 Safety accountabilities
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Organizational Factors

4. Identifying absent or Absent Failed Barriers

- A critical step in safety occurrence analysis.
- Typically, we have multiple barriers or defenses to protect us against hazards and undesired events.
- A safety occurrence indicates inadequate barriers.
- Important to identify barriers that:
  - failed to prevent the occurrence or minimize harm
  - could have prevented the occurrence had they been in place
- Then recommend action to strengthen these

Organizational Factors

TR	Training
WM	Workforce Management
AC	Accountability
CO	Communication
OC	Organizational Culture
CG	Competing Goals
PP	Policies and Procedures
MM	Maintenance Management
EI	Equipment and Infrastructure
RM	Risk Management
CM	Change Management
EE	External Environment

CM- Factors associated with the planning, testing, implementation and review of significant modifications to the organizational structure, or major transition from one business process to another.

Example Cases

Case 1 **Engine Hot Gas Leak**

- On 9 September 2012, a Bombardier DHC-8-315Q departed at 0245UTC, on a scheduled 35-minute passenger flight, with 49 persons onboard.
- After several minutes inflight, and before reaching 5,000 feet, a passenger informed the cabin crewmember about signs of paint blisters on the RH engine inboard panel, as seen through the cabin window.
- The passenger's observation was confirmed by the co-pilot who informed the Commander of a possible engine fire.
- A PAN was declared.
- Cockpit indications were normal but the crew decided to return to the airport due to the possibility of an engine fire.
- Unknown to the crew and passengers that the same condition also existed on the LH engine.
- The Aircraft landed uneventfully and the ARFF confirmed that there was no sign of fire.
- No injury was reported among the passengers or crewmembers.

Example cases

Case 1

Causes

The omission to reinstall the left engine igniters on both of the aircraft's engines following maintenance work.

Contributing Factors

- Unrecorded maintenance work performed on the Aircraft by the Operator's maintenance personnel.
- Introduction of an engine wash without a maintenance task card.
- Engineer signed off work on the Aircraft without verifying that the work had been performed.
- Mechanics performed unsupervised work.
- Mechanics performed engine motoring without the Operator's approval.
- Work was performed on the Aircraft without maintenance task card.

Example cases

Case 1 **Contributing Factors**

- Engine washes were not considered a critical task by the Operator.
- Performing similar tasks on both engines during the same maintenance visit.
- Not carrying out an engine run after the engine washes were performed.
- Not performing a system check of the engine ignition system after engine wash normalization.
- Not attaching a telltale streamer to indicate that parts have been removed and are in a concealed area.
- Operator's quality oversight, as unrecorded work was being performed regularly prior to the Incident.
- Mechanics not signing for work performed, following engine washes.
- The removal, in 2009, of the engine wash card which was requiring a signature by the mechanic, before the engineer signoff.

Example cases

Case 1

Contributing Factors

- The effect of fatigue on the decision making process of the Engineer due to his shift pattern of working an average of 8.5 hours a day for 32 days with 2 staggered days off.
- The Engineer, in addition to supervising the shift work, was required to enter data into the Operator's electronic system.
- Application of the Operator's human factors training, as unrecorded work was a practice associated with engine washes.
- The Operator's SMS implementation, since there were GCAA audit findings between 2009 and 2012.
- Lack of guidance provided by the GCAA, and the Operator, of the effect of shift duty times, and management of the risk associated with fatigue.

Example cases

Case 1 Analysis

- In May 2011, the GCAA raised an audit non-conformance that required Safety to be independent from Quality.
- In August 2011, in response to this non-conformance, the Operator appointed a new SMS postholder who was subsequently accepted by the GCAA in September 2011.
- The GCAA accepted that the SMS Manual be submitted before end December 2012. The GCAA also accepted that the Operator would have a phased approach of SMS implementation over 2 years, late 2012 to 2014.
- Internal audit in May 2012, revealed nonconformities related to SMS implementation, staffing issues within the safety department, risk assessment not defined, safety hazard identification, safety audits and flight data monitoring.
- All the internal audit findings were closed by the Operator three months before the occurrence (June 2012).

Example cases

Case 1 **Analysis**

Fatigue Risk Management System (FRMS)

Feeling committed to return the aircraft to service on time, maintenance personnel tend to take control of their own working time. Thus, there will always be engineers willing to work excessive hours.

ICAO *Human Factors Manual for Maintenance* states that maintenance personnel are subjected to physical and mental fatigue mainly due to excessive hours of work, poor planning, insufficient staffing, poor shift scheduling, and a working environment with no proper control of temperature, humidity or noise.

Fatigued maintenance personnel means a higher likelihood of maintenance errors occurring, resulting in potentially harmful occurrences and a decrease in production efficiency, undermining the workforce, aircraft and workplace safety.

FRMS for aircraft maintenance personnel has already been mandated into the civil regulations of some National Aviation Authorities, but for the UAE GCAA, this has yet to be regulated.

Example cases

Case 1 **Analysis**

Fatigue Risk Management System (FRMS)

Similar to *CAR-OPS* regarding flight crew, the implementation of FRMS for sensitive work will bring benefits for safety.

CAAP 22, Appendix B- List of Examples of Reportable Incidents, addressed fatigue for flight crew as a reportable incident. There is no requirement for maintenance.

The GCAA audit findings on the Operator highlighted SMS deficiencies including inadequate staffing, and that the Operator's Quality had not audited any aspect of the SMS as per *CAR Part X*

Example cases

Case 1 **Safety Recommendations**

The Operator:

- Review the process of identifying aircraft maintenance critical tasks.
- Review the practical implementation of aircraft maintenance human factors training and SMS awareness training.
- Review and implement procedures for risk mitigation for activities affecting aircraft maintenance.

Example cases

Case 1 **Safety Recommendations**

The GCAA:

- Issue duty time and FRMS guidance to Industry for workers involved in safety-sensitive jobs.
- Gather maintenance errors and hazard identification information and should:
  - Disseminate this information to all UAE operators and certificate holders so that they are aware of the areas of concern that have been identified.
  - That this information to be inserted within the certificate holders training.
  - Access of this information should be available on the GCAA website for the benefit of the aviation Industry.
- Amend CAAP22 to include that aircraft maintenance personnel should report fatigue in a similar manner as aircrew report fatigue.

Example cases

Case 2 **Runway Confusion**

- On 29 June 2014, on the approach of Ilyushin IL-76TD to Sharjah, a 'go-around' was flown as the Aircraft had been aligned to carry out an approach to a runway which was still under construction instead of to the active runway 30.
- The Aircraft continued the final approach until shortly before the beginning of the inactive new runway.
- When the Aircraft was at a late point in the approach, the captain realized, by observing the cross marks painted on the runway, that the runway was not in operation.
- The construction workers rapidly vacated the area when they observed the Aircraft at approximately 50ft, and at a distance of approximately 0.3 miles from the threshold.

Example cases

Case 2 **Analysis**

Aeronautical Information

- Drawing the attention of the crew to the fact that two runways would appear in-sight during the approach, was not sufficiently emphasized during the dispatch brief.
- The Operator's had no SMS to manage the changed situation at Sharjah.
- Confusion was caused when Jeppesen entered the AIC information into the new Jeppesen runway information page.
- The AIC contained a written caution that formed the main source for Jeppesen page, the AIC caution statement was vulnerable to misunderstanding and could, in itself, contribute to runway confusion.

SMS in Ar

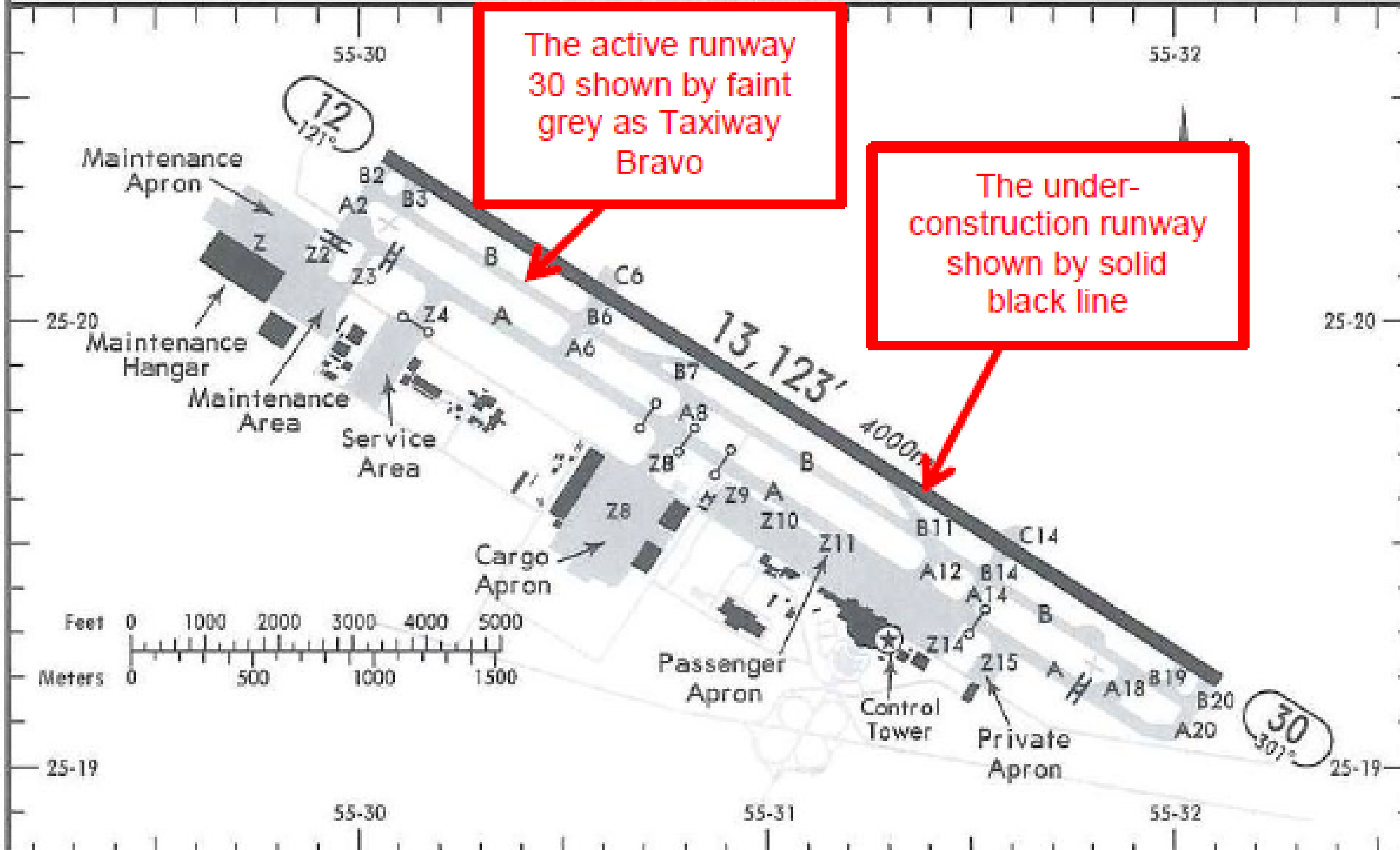
OMSJ/SHJ
Apt Elev 116′
N25 19.8 E055 31.0

JEPPESEN
30 MAY 14 (10-8)

SHARJAH, UAE
SHARJAH INTL

TEMPORARY CONSTRUCTION WORKS

REFER ALSO TO LATEST NOTAMS



ADDITIONAL RUNWAY INFORMATION

RWY		LANDING BEYOND (USABLE LENGTHS) Threshold	Glide Slope	TAKE-OFF	WIDTH
12	HST - B11				197′ 60m
30	HST - B7				

CAUTION: During the construction period and prior to opening Pilots are cautioned to correctly identify the RWY in use. This is particularly important at later stages of construction when full markings may be available in readiness for completion and/or the lightning system may be under test. Until opening the new RWY is marked with

Example cases

Case 2 **Analysis**

ANSP SMS:

- Previous incidents were not properly investigated by the ANSP to the root causes, because of:
  - Lack of specific ANSP SMS.
  - Appropriate training in investigation.
- The Airport 's GCAA-accepted SMS was fragmented between the Airport Authority and the ANSP causing vague assignment of responsibilities.
- The number of go-arounds was a KPI mentioned in the SLA between the Airport Authority and the ANSP.
- Aviation accident historical literature contains fatal accidents caused by crews continuing unsafe approaches because of the concern of the pilots that they would be blamed for a 'go-around'.

Example cases

Case 2 **Findings**

Findings relevant to the air traffic services and airport facilities:

- There was no proof that proper testing/training had been provided to the Tower Controller as was required by the risk assessment plan issued by the Airport Authority for the runway construction project.

Findings relevant to the Operator:

- The Operator did not have in place an SMS accepted by the Operator's authority.

Example cases

Case 2 **Safety Recommendations**

- The Operator to enhance operational safety by assessing the safety impact of operational changes.
- The ANSP to enhance the training of the air traffic controllers, especially in dealing with:
  - Visual approach flights,
  - Visual ground movement control
  - The appropriate division of scanning and attention to the visual control of departure, ground manoeuvring, and arrival of flights.
- The ANSP to review the current SMS to be totally separate from the Aerodrome SMS. Part of its function may be delegated to the ATS Provider with proper integration and oversight.

Example cases

Case 3 **PBE Fire**

- On 4 October 2014, an Airbus A330 was in departure preparation for a flight of 82 POB.
- The flight crew sensed an odor accompanied by a yellow hydraulic system low pressure indication on the ECAM.
- The odor was due to hydraulic fluid mist coming from a fractured hose that provides hydraulic pressure to the rudder yellow system actuator that entered the cabin and cockpit through the airconditioning system.
- The leaking hydraulic fluid entered the auxiliary power unit (APU) from where it entered the airconditioning system.
- The mist filled the cockpit and cabin and caused difficulty in breathing, throat discomfort, and eye irritation for some occupants.
- In an attempt to determine the source of the mist, one of the cabin attendants donned the PBE and pulled the lanyard to activate the PBE oxygen generator.

Example cases

Case 3 — **PBE Fire**

- The PBE caught fire. The crewmember removed the PBE immediately and threw it on the floor next to the L3 door. This caused a localized fire that was suppressed by other crewmembers.
- After sometime, and on receiving information form the cabin crew, the Commander decided to order an evacuation while the Aircraft was at its final pushback position.
- The evacuation of the Aircraft was well-managed with only minor injuries to some of the passengers.
- Following the evacuation, the passengers were not given directions as to what to do or where to go.

Example cases

Case 3

Analysis and Findings

- Some of the female cabin crewmembers were not comfortable wearing skirts while using the slides.
- There was no associated safety risk study carried out for changing the uniform of the female cabin crew form trousers to skirts. The Operator's safety unit was not consulted on the change.
- There was no specific requirement that the trainee crew use a packed PBE unit in the simulator class or wear clothing similar to that used in operation, which deprived the Operator from identifying hazards arising from testing the preset emergency procedure.

Example cases

Case 3 **Safety Recommendations**

The Operator:

- Conduct a safety risk analysis of cabin crewmembers' uniforms for appropriateness in dealing with onboard emergency situations.
- Consider a policy of initiating comprehensive safety risk assessments in cases of any addition to, or change of, existing processes or equipment that may have a significant effect on air safety.
- Address cabin crew simulator training to ensure that it accurately reflects actual operational conditions in terms of clothing worn and PBE use.

Airbus:

- Assess the risk of amending the *existing SMOKE/FUMES/AVNCS SMOKE* and *SMOKE/FUMES REMOVAL* checklists to distinguish between inflight and on-ground smoke scenarios, and insert text in the checklists to differentiate between the aircraft be on the ground or inflight.

Example cases

Case 4 **Transportation of O_2 Generators Onboard Commercial Aircraft**

- A Boeing B737-800 passenger aircraft returned as a ferry flight to its base following a maintenance visit to a foreign AMO.
- Six PSUs each containing a chemical oxygen generator, were loaded into the cargo hold.

Example cases

Case 4 **Analysis**

The Operator's SMS

- The Operator operates SMS accepted by the GCAA. The SMS requires contracted engineering services to comply with it. The contractor was to be made aware of the Operator's SMS.
- The Operator's policies require due regard to the contractor's previous safety record.
- Contractors would be audited as part of the SMS audit schedule, to ensure safety standards were being maintained.
- The AMO did not have an SMS by its authority.

Example cases

Case 4

Findings

- The AMO authority requires SMS, but the authority did not ensure that the AMO had implemented this requirement.
- The GCAA did not require UAE-based operators to restrict subcontracting of aircraft maintenance activities solely to AMOs that have an accepted SMS in place.
- The GCAA did not review or risk assess aircraft maintenance contracts agreed between UAE-based Operators and AMOs prior to signature.

Example cases

Case 4 **Causes**

- The chemical oxygen generators were not labeled as dangerous goods.
- The AMO maintenance personnel did not label the oxygen generators as dangerous goods because they did not consult, and follow, the instructions contained in AMM ATA 35 - Oxygen.
- The EO prepared by the STC holder did not contain a direct reference to ATA 35 – Oxygen.
- The Operator and AMO personnel were unaware that the PSU assemblies contained dangerous material.
- The contract agreed between the Operator and the AMO contained a term related to the return of removed aircraft parts and materials to the Operator by air, which did not differentiate between normal and dangerous goods.

Example cases

Case 4 **Contributing Factors to the Incident**

- The lack of dangerous goods markings on the oxygen generator casings.
- The quality system of the AMO was unable to detect a lack of control of dangerous goods improperly kept in the stores for a lengthy period.
- The lack of an SMS did not enable the AMO to promote a safety culture.
- The noncompliance of the Operator with its Safety Manual policy that required sub-contracted AMOs to operate an SMS.
- The GCAA did not exercise sufficient oversight of the foreign contracted AMOs.

Example cases

Case 4 **Safety Recommendations**

The Operator:

- Include in contracts a requirement that the service provider operates an SMS accepted by the AMO regulatory authority.
- Make its SMS Manual accessible to all appropriate third party contractors.
- Improve the Initial Assessment and Supplier Audit checklists to include check items relevant to the Operator's SMS for maintenance contractors requirements.
- Provide initial and recurrent dangerous goods training, appropriate to the responsibilities of the position, to maintenance and stores personnel.
- Broaden the scope of the job description of the Base Maintenance Liaison Engineer to include a wider range of air safety issues.

Example cases

Case 4 **Safety Recommendations**

The AMO:

- Enhance the maintenance procedure to for a critical task requiring a dual signature.

The STC holder:

- Permanently mark each individual oxygen generator canister with the appropriate dangerous goods marking.
- Review the EO and ensure that steps that involve dangerous goods are appropriately classified and clearly identified.
- Include a caution in the EO to require a certifying engineer to verify, with his signature, that correct procedures have been adhered to.

Example cases

Case 4 **Safety Recommendations**

The GCAA:

- Consider requiring initial and recurrent dangerous goods training for:
  - certifying maintenance engineers,
  - service engineers
  - stores personnel engaged
- This requirement should be applicable to UAE Operators and AMOs, and foreign AMOs engaged in maintenance of UAE-registered aircraft.