ICAO

Presentation Title:

Chemical Emergency Preparedness in Aviation

Nairobi, Kenya

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Outline

- Regulatory Framework (Key References)
- Why Focus on Chemical Emergencies in Aviation
- Harmful chemicals and their health risks
- Common Chemical Hazards in Aviation
- Preparedness – The “Four Pillars”
- Prevention – Key Controls
- Preparedness – Planning Elements
- Response – Immediate Actions (First 10 minutes)
- Decontamination & Medical Care- Personnel decontamination
- Recovery – Post-Incident Steps
- Training & Competency
- Case study
- Key Take-aways

Why Aviation is vulnerable?

Airports are among the most complex civilian facilities, and that complexity makes them potentially vulnerable to chemical incidents. The degree of vulnerability depends on several inter-related factors:

- Types and quantities of chemicals on-site- Aviation fuels (Jet A-1, gasoline, diesel) are stored in large tanks and moved through pipelines, hoses and tanker trucks. A breach can release hundreds or thousands of liters of flammable liquid.
- Maintenance chemicals – solvents, degreasers, paints, adhesives, and acids used in aircraft servicing. Many are volatile, corrosive or toxic in relatively small amounts.
- Industrial gases – oxygen, nitrogen, argon, and specialty gases for welding or leak-testing.
- Hazardous cargo – some airlines carry quantities of dangerous goods (e.g., lithium batteries, chemicals for laboratories).

- The goal is to verify that the spill or exposure is safely contained, that personnel are protected, and that regulatory requirements are met

Regulatory Framework (Key References)

- ICAO Annex 6 – Operations of Aircraft (chemical carriage requirements).
- ICAO Annex 14
- Aerodromes (hazardous material handling).
- IATA Dangerous Goods Regulations (DGR).
- National civil-aviation authority rules (e.g., CAAZ Safety Orders).
- International Health Regulations (IHR) - coordination with public-health authorities.
- Compliance is mandatory, not optional

Why Focus on Chemical Emergencies in Aviation

- Chemical incidents are low-frequency but high-impact events.
- Aviation transports a wide range of hazardous materials (fuel, cleaning agents, pesticides, industrial chemicals).
- A spill, leak, or fire can affect passengers, crew, ground staff, and the surrounding community.
- Rapid response limits health impacts, protects the aircraft, and reduces downtime.

Harmful chemicals and their health risks

- **Lead:** Found in old paints and plumbing, exposure can lead to neurological damage.
- **Mercury:** Used in thermometers and lighting, it can adversely affect the central nervous system and kidneys.
- **Arsenic:** Found in pesticides and some industrial processes, it can be highly toxic.
- **Benzene:** A component of gasoline and found in some industrial settings, it is linked to cancer.
- **Formaldehyde:** A common preservative and disinfectant, it can irritate the respiratory tract and eyes.
- **Pesticides:** Can include various chemicals like organophosphates that are toxic if not handled properly.
- **Chlorine:** Found in some cleaning products, this volatile gas can severely damage lungs.
- **Asphalt fumes:** Generated during roadwork, asphalt can be hazardous to respiratory health.

Common Chemical Hazards in Aviation

The presentation will reference the IATA DGR for classification and packaging.

- Fuel (Jet A-1, Avgas) – fire, explosion, environmental contamination.
- Cleaning & de-icing fluids – corrosive, toxic if ingested/inhaled.
- Pesticides for disinsection – aerosolised chemicals, health risks.
- Industrial gases (oxygen, nitrogen, CO_2) – asphyxiation or fire hazards.
- Cargo-related chemicals – acids, bases, solvents, radioactive materials.
- Each hazard requires a specific response strategy (e.g., containment vs. neutralization).
- The most frequent incidents involve fuel and cleaning fluids.

Preparedness – The “Four Pillars”

- Prevention- robust handling procedures, proper labeling, regular inspections.
- Preparedness - written emergency plans, trained personnel, equipment ready.
- Response - Immediate activation of the chemical response team, safety-zone establishment, decontamination.
- Recovery - Clean-up, waste disposal, incident reporting, lessons-learned review.

Prevention – Key Controls

- Risk assessment for each chemical class used on-site.
- Standard Operating Procedures (SOPs) for loading/unloading, storage, and spill containment.
- Regular training (e.g., HAZMAT awareness for ground crew).
- Engineering controls – spill-containment trays, secondary bunding, ventilation.

Chemical emergency plan must be integrated with the airport's emergency plan.

Prevention also includes security measures to deter sabotage

Preparedness – Planning Elements

- Chemical Emergency Response Plan (CERP) – site-specific, approved by the airport authority.
- Command structure – Incident Commander, Chemical Safety Officer, Liaison Officer (public health).
- Communication – predefined radio codes, phone lists, public-address scripts.
- Equipment cache – absorbent pads, neutralizing agents, personal protective equipment (PPE), portable detection meters.
- Drills & exercises – tabletop and live-scenario drills at least annually.

Note:

- The CERP should be reviewed after any change in operations (new cargo routes, new chemicals).
- It is important to have a single, unified command to avoid confusion

Response – Immediate Actions (First 10 minutes)

- Alert – Activate the chemical alarm and notify the incident commander.
- Secure the area – Establish a 30-metre safety zone; deny entry.
- Identify the chemical – Use detection equipment or consult the Safety Data Sheet (SDS).
- Protect personnel – Don appropriate PPE; ensure respiratory protection if needed.
- Contain the spill – Use absorbent barriers, booms, or dikes as appropriate.
- Notify authorities – Fire brigade, civil-aviation authority, and, if required, the national health agency.

Short scenario (e.g., a leaking drum of de-icing fluid on the ramp) - demonstrate the steps.

Note: The first responder's safety is paramount; never attempt clean-up without proper protection.

Decontamination & Medical Care- Personnel decontamination

- Remove contaminated clothing, wash skin with water and mild soap, eye-wash stations.
- Passenger care – Isolate affected individuals, provide oxygen if inhalation risk, transport to medical facility if symptoms appear.- Documentation
- Record exposure details for follow-up and workers' compensation.

Note:

Decontamination facilities should be located near high-risk areas (fuel farms, cargo handling zones).

There is need for a medical liaison to coordinate with hospitals.

Recovery – Post-Incident Steps

- Site clearance– Verify that residual chemical levels are below safety thresholds (use air-monitoring equipment).
- Waste disposal – Follow hazardous-waste regulations; use licensed contractors.
- Incident reporting – Submit a detailed report to the civil-aviation authority and, if applicable, to ICAO via the Aviation Safety Reporting System (ASRS).- After-action review – Conduct a debrief with all stakeholders, update the CERP, and adjust training.

Notes:

The “lesson-learned” phase is where long-term safety improvements are made.

Encourage a no-blame culture to ensure honest feedback.

Training & Competency

- Initial HAZMAT awareness for all ground-handling staff (online module + practical).
- Specialist training for chemical response team (e.g., NFPA 472-compliant).
- Refresher drills – quarterly tabletop, annual live-scenario. Competency assessment – written test and observed

Notes:

Training records must be kept for at least 3 years as per most regulatory schemes.

Use realistic simulants (e.g., water-based “spill” kits) to reduce chemical waste during drills.

Key Take-aways

- Chemical emergencies are inevitable; preparation saves lives and aircraft.
- A robust CERP, clear command chain, and well-maintained equipment are non-negotiable.
- Ongoing training, drills, and a culture of reporting drive continuous improvement.

Notes:

Reinforce the “four-pillar” model and the need for everyone to know their role.

Case study- Sulfuric acid spill

Sulfuric-acid spill at Los Angeles International Airport (LAX), 2015

Date and location- June 30 2015, Terminal 5 of LAX, a cargo-handling area.

What happened

A tanker truck delivering concentrated sulfuric acid to an aircraft-maintenance facility was being off-loaded when a valve failed.
About 1 cubic metre (≈ 1 000 L) of the strong acid spilled onto the tarmac and began to react with the concrete, releasing a dense white cloud of sulfur-dioxide-laden vapor.

Immediate impact

The acid burned the concrete and damaged a section of the runway surface.

Approximately 150 workers and passengers were evacuated from the terminal; a few people reported eye irritation and shortness of breath.- Fire-fighters and hazardous-materials (HAZMAT) teams were called to contain the spill, neutralize the acid with soda-ash, and ventilate the area.

Response actions

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Case study cont…

- **Site isolation** - Police and airport security cordoned off a 200-metre radius.
- **Personal protection** - HAZMAT crews wore full-encapsulating suits and supplied-air respirators
- **Containment** - Portable berms and absorbent booms were placed to prevent the acid from reaching the storm-drain system.
- **Neutralization** - Soda-ash (sodium carbonate) was spread over the spill; the reaction produced carbon-dioxide gas and a harmless salt solution that was later pumped into a hazardous-waste tanker.
- **Decontamination** - Personnel showered and changed before leaving the hot zone
- **Medical evaluation** - Affected workers were assessed at the on-site clinic; none required hospitalization.
- **Runway inspection** - Engineers inspected the damaged runway section before it was reopened

Case study cont…

Lessons learned

- Valve-failure prevention - The incident prompted LAX to require double-valve isolation and regular non-destructive testing on all chemical-transfer equipment.- Improved signage and barriers
- Clear “Hazardous Material” markings and permanent spill-containment berms are now installed at all cargo-handling bays.
- Enhanced training
- Airport HAZMAT teams now conduct quarterly tabletop exercises that include scenarios of strong-acid releases.
- Communication - A dedicated chemical-incident hot-line was set up to ensure rapid notification of airport authorities, local emergency services, and the airline’s safety office.

This case illustrates how a relatively small equipment failure can quickly escalate into a chemical-spill emergency at a busy airport, and why preparedness through robust equipment standards, trained responders, and clear communication is essential

Table top/drill exercise

Scenario Overview

At 08:30 hrs a Boeing 737-800 is being refueled on the north-west apron of Terminal 1. While the fuel-truck is transferring Jet A-1, a faulty coupling on the truck's hose fails, releasing approximately 1 500 L of fuel onto the concrete. The spill spreads rapidly toward the drainage trench that leads to the airport's storm-water lagoon and, ultimately, the nearby Mukuvisi River.

Purpose

Test the coordination, speed and effectiveness of the airport's response to a large-volume Jet A-1 fuel spill on the apron, with particular focus on containment, protection of water sources, communication and recovery of operations.

Key Objectives

- Verify that the spill detection alarm and automatic shut-off work responded as designed.
- Confirm that the on-site HAZMAT team can isolate and contain the spill within the 15-minute "golden window".
- Evaluate the interaction between airport emergency services, the Civil Aviation Authority (CAA), the Environmental Management Agency (EMA) and the local fire brigade.
- Assess the clarity and timeliness of public information messages to passengers and staff.
- Identify gaps in equipment, procedures or training that need correction before a real event.

Timelines

One Hour

Table top/drill exercise cont…

Participants

- Incident Commander (IC)
- Airport Operations Manager
- Safety Officer
- Airport Safety Department
- HAZMAT Team – 5 members (lead, 2 spill-control technicians, 2 PPE specialists)
- Fire & Rescue – 2 fire-engines, 1 rescue vehicle, 1 command vehicle-
- Ground-Handling Crew – 3 aircraft servicing technicians
- 1 fuel-truck driver
- Airport Police - 2 officers for traffic control
- Civil Aviation Authority Liaison
- 1 officer- Environmental Agency Representative
- 1 officer- Medical Team
- 1 nurse, 1 ambulance driver-
- Communications Officer – for internal alerts and media release
- Observers – 2 external auditors (e.g., from the Ministry of Transport)Scenario Overview

Timelines and key actions

- 1. 08:30 – Discovery fuel-truck driver sees a sudden loss of pressure and a dark sheen on the apron. He activates the truck's emergency shut-off and presses the "fuel-spill" button on the apron alarm panel.
- 2. 08:31 – Alarm & Notification - The alarm sounds in the Control Centre; the system automatically sends an SMS alert to the IC, Safety Officer, HAZMAT lead and the fire-rescue station. The Control Centre logs the event and notifies the CAA and EMA via the national incident-reporting portal.
- 3. 08:32 – Initial Response - HAZMAT team dons Level B PPE, positions portable spill-berms 5 m from the spill edge, and deploys absorbent booms along the drainage trench. - Fire-rescue sets up a water-spray curtain to suppress vapor and protect nearby aircraft.
- 4. 08:35 – Containment - The HAZMAT lead directs the placement of a vacuum-recovery unit; within 10 minutes roughly 800 L of free-flowing fuel is sucked into a sealed tanker. - Additional absorbent pads are spread to capture the remaining sheen.

Timelines and key actions cont..

- 5. 08:45 – Environmental Protection - The EMA representative authorizes the use of a biodegradable dispersant in the trench; the fire-crew applies it while the vacuum unit continues recovery.
- 6. 08:55 – Personnel De-contamination - All HAZMAT and fire-crew members pass through a portable de-contamination shower before exiting the hot zone.
- 7. 09:00 – Medical Check - The medical team evaluates the fuel-truck driver and two ground-crew who had brief skin contact; all are cleared after a brief rinse.
- 8. 09:10 – Communication - The Communications Officer releases a brief statement to passengers: “A fuel spill has occurred on the north-west apron. All flights are being delayed by 30 minutes while crews secure the area. No injuries reported. Further updates will follow.” - The IC briefs the airport staff via the public-address system and updates the CAA through the incident-reporting system.
- 9. 09:30 – Operational Restart after the apron is inspected, the spill area is marked, and the drainage trench is verified clean, the IC authorizes resumption of ground operations.
- 10. 10:00 – Debrief - All participants gather for a hot-wash. Observers note the time each milestone was met, any equipment failures, and communication gaps.

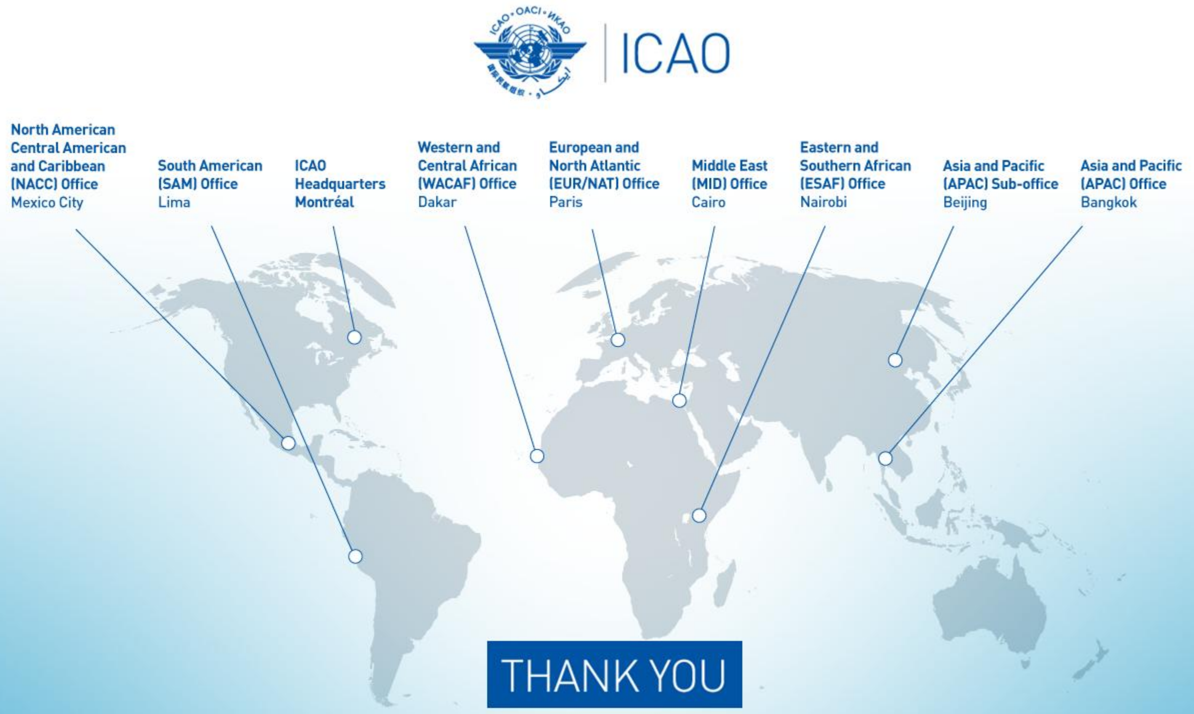
Drill evaluation criteria

Time to shut-off ≤ 1 minute from detection.
Time to contain the spill ≤ 15 minutes (no fuel entering the storm-water system).-
Quantity recovered ≥ 80 % of spilled fuel.-
PPE compliance 100 % of responders in appropriate gear.-
Communication clarity – All internal alerts sent within 2 minutes; passenger notice issued within 5 minutes of the incident.

After-Action Report
The Safety Officer prepares a report within 48 hours, documenting the timeline, equipment used, any deficiencies observed, and recommended corrective actions (e.g., replace the faulty coupling, increase the number of portable vacuum units, conduct a refresher training on spill-berm deployment).

The report is circulated to the IC, CAA, EMA and the airport's senior management for sign-off.

Adaptations
Use locally sourced absorbent material (e.g., sand or sawdust) as a backup if commercial booms are unavailable.
Coordinate with the National Water Authority for rapid water-quality testing of the Mukuvisi River after the drill.
Include a liaison with the Security Forces' Chemical Response Unit, which can provide additional containment resources if needed.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