STAR 024 V1 – November 2019	**Chemical, Biological, Radiological and Nuclear (CBRN) threats to Civil Aviation**

Background

Aviation has always been the 'crown jewel' target for an attack by individuals or organisation's with terrorist intent. Whilst aviation security endeavours to maintain a robust stance against such attacks, the nature of the threat is constantly evolving and continually trying to find a way to circumvent these preventative measures.

One such emerging threat has been from Chemical, Biological, Radiological and Nuclear (CBRN) agents. Many of these agents are invisible, odourless and difficult to detect by airport x-ray scanners, such substances could in essence easily find their way on board a commercial aircraft and used to launch an attack on the passengers, flight and cabin crew.

Flight and cabin crew therefore have specific roles to play in the event of a suspected CBRN threat to an aircraft. The purpose of this STAR is to provide guidance to operators in ensuring their crews are familiarised with information on such weaponry, the threat posed by its presence on board the aircraft and the means for responding to this in-flight emergency.

What are the CBRN Threats?

Current wisdom says that an attack using a CBRN agent has a low probability. However, should it occur the impact could potentially be enormous. A 'traditional' terrorist attack will involve some form of human interaction and physical violence from the perpetrator, whether the tool used is a knife, gun or explosive device. The CBRN threat is different in that it will be silent and go unnoticed until such a time the agent released has taken effect, which can take hours, days or even weeks.

CBRN agents can come in a number of forms, including:

- Sarin
- Ricin
- Plague
- Anthrax
- Mustard Gas

Sarin is often transported as a liquid and vaporises quickly at room temperature. If Sarin reaches a concentration of 70mg per m3, a male adult in the same room could die after only five minutes exposure. Simply speaking, you can kill a human with a tiny droplet of Sarin. Toxins such as Ricin are much more lethal, and the amount needed to be lethal is hardly visible. For Bio agents, there is no 'quantity' of an agent as such. For bacteria, it is the number of colony-forming units that are used to determine dosage. With Anthrax for example, a lethal dose is considered to be 10,000 spores. For each gram of Anthrax, a human would get 100 lethal doses (through inhalation).

It is worth noting that although it is difficult for an individual to obtain a CBRN agent. Even if they do, they will still require a dispersal device in which to deploy the agent. Finally, they will require the means of placing this device on board and aircraft, which is where the critical role of airport security comes into play.

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Airport security faces numerous challenges in ensuring its infrastructure remains protected and secure. This involves enhanced (and intelligent) surveillance systems and the use of biometric tools to protect secure areas. Improved detection equipment for passenger and baggage screening is essential in that it will provide enhanced generation solutions, for example, to detect liquids and powders in hand luggage, explosives trace detection equipment and artificial sniffers etc.

Flight Crew and Cabin Crew Responsibility

ICAO Doc 9811 'Manual on the Implementation of the Security Provisions of Annex 6' dated 2002, states that:

"Recent history has shown capability, willingness and intent exists to utilise Chemical/Biological Weapons in terrorist acidity. Clearly, it is in the interest of all to familiarise crew members with information on such weaponry, the threat posed by its presence on board the aircraft and some means for responding to this in-flight emergency".

With flight crew working and interacting with one-another as part of a team whilst performing procedural duties, this should remain sacrosanct in the event of a CBRN emergency. Whatever the level of emergency on board the aircraft, the priority of the flight crew must remain on the task of flying the aircraft. Management of the aircraft systems could also assist in slowing the spread of a Chemical/Biological threat on board by:

- Reducing the cabin temperature,
- Turning off recirculation fans and selecting maximum ventilation, and
- Keeping the cabin pressurised.
- If Available crew should use the onboard oxygen system

An additional task for the flight crew will be the requirement to coordinate with the necessary agencies on the ground and appraise them of the situation on-board. Initially this will be informing ATC by declaring an emergency followed by a rapid descent with an immediate landing being paramount. However, such information to ATC can and will determine the outcome of the flight, in whether it can proceed to its intended destination, an alternate or indeed the requirement to divert to an airfield that has the specialist logistical facilities to receive such an emergency.

For cabin crew, the task is more 'hands on' in that they will be required to deal with any suspected Chemical/Biological device in the cabin. Cabin crew should immediately don their oxygen masks, followed by the passengers. However, the latter will be breathing mixed air and thus not protected from any harmful gases/substances. Depending on the aircraft type, seating configuration and the number of passengers, may require isolating the part of the cabin where the suspected device is located. If this option is not possible, then the device should be covered and sealed. Whatever decision the cabin crew take, they should ensure that the cabin remains safe and secure, alleviate the potential for panic, execute emergency pre-landing activities and ensure the flight crew remain fully appraised on all the developments.

Crew Training

It is worth noting that aviation industry personnel are trained on explosives, whereas Chemical/Biological weapons are different. Therefore, both flight and cabin crew should be familiar with what characteristics are synonymous with such an attack. Early detection is critical to minimise the emergency.

Crew training should cover the following five basic principles:

- Knowing that there is a threat
- Ensuring both the flight and cabin crew members are prepared
- Having the necessary mitigation / reaction procedures in place
- Ensure flight and cabin crew are properly trained to deal with a CBRN emergency
- Ensure flight and cabin crew remain aware of the constantly evolving threats

Firstly, understanding that airborne transmission is a means of exposure, whether naturally of via aircraft cabin air circulation system. Such transmission passes from human-to-human via skin, eyes, lungs and nasal passages, with the rate of transmission being directly proportional to temperature. In an enclosed aircraft cabin, it is critical for the cabin crew to alleviate the transmission by the correct management of the air environment.

To aid operators, ICAO Doc 9811 provides detailed information covering the above and following scenarios:

- Training and guidelines for crew,
- Difference between explosive versus CBRN devices
- Dealing with chemical and biological weapons during flight,
- Aerosol Chemical/Biological activation,
- Scenarios covering in cabin, hold, activated and non-activated, and
- Checklists for flight deck and cabin crew.

Landing and on the Ground

Prior to landing, as with any suspected Chemical/Biological or Pandemic threat, effective communication between the aircraft and the destination airport is critical to ensure that an accurate scenario of the situation on-board is relayed to the ground authorities, enabling them to proactively set in motion the required medical response. It is though important that flight crew do not let the fear of contaminating a large populated area interfere with their decision to land at an airport. Whatever airport the aircraft lands, whether intentional or diverted, cooperation between the health authority, airport and airline is critical in order to effectively and expeditiously manage the situation.

Once landed, the aircraft should not taxi to a terminal but instead be isolated, ideally by parking at a remote stand, downwind of any populated buildings, prior to the medical authorities boarding and making an accurate assessment of the situation on-board. Once the 'all clear' order is received, the aircraft must be evacuated, preferably via the upwind aircraft exits. Once evacuated, passengers and crew should be quarantined at temporary Medical Assessment Centre (MAC), which contains facilities needed to oversee the whole exercise. This may include a decontamination station, private examination rooms, rest area, isolation transportation to/from the aircraft and a core-handling team dedicated to providing translators and processing paperwork. First response teams should trained in aviation CBRN scenarios along with the airports having the necessary procedures and equipment.

Recommendations

To minimise the effect of a CBRN threat on-board an aircraft, the following are some technical, preventative measures which operators, their flight and cabin crew should consider:

- Do not mix air from the passenger cabin with the flight deck –
    - *Any air in the cabin where the suspect device is located may already be contaminated.*

Therefore, it is important that the air supply to the flight deck is isolated in order for the flight crew to maintain safe flying of the aircraft whilst liaising with the ground authorities.

- ✈ Ensure that the airflow is maintained away from the flight deck –
  - *As with the previous point, the flight deck must remain 'sterile' and any potentially contaminated airflow should be prevented from entering the flight deck.*
- ✈ Closed oxygen system for the passengers –
  - *The primary purpose of oxygen systems is for emergency use in the event of a decompression and until descent to a safer altitude. However, there are questions on the effectiveness of donning masks during a CBRN emergency, as the supply of oxygen could be completely consumed prior to the aircraft reaching its destination.*
- ✈ Installation of detection equipment –
  - *There are numerous CBRN detection systems available globally, ranging from basic detectors to start of the art military units. For a commercial aircraft cabin, the detector will provide an audible and/or visual alarm to the cabin crew and thus afford them opportunity for early donning of protective masks before exposure to the lethal effects of a chemical agent.*
- ✈ Intelligence is key –
  - *Operators should ensure they have researched the various CBRN scenarios to ensure that they have the necessary procedures and equipment in place. Additionally, raising awareness amongst crew members, combined with effective training, will prove invaluable in the event of a CBRN emergency.*

Lastly, remember that unlikely as this method of attack is, it does represent a real threat and crews should bear such scenarios in mind when dealing with any unusual events onboard their aircraft.

References and Further Information

The EU Science Hub: This is the Science and Knowledge service provided by the European Commission, which employs scientist to carry out research in order to provide independent scientific advice and support to EU policy:
https://ec.europa.eu/jrc/en/research-topic/chemical-biological-radiological-and-nuclear-hazards

ICAO Doc 9811: The manual that covers the Implementation of the Security Provisions of Annex 6. The document is restricted from being viewed via social media platforms, but copies can be purchased via the ICAO website: https://www.icao.int/safety/airnavigation/OPS/Pages/flsmanual.aspx

ICAO Doc 8973: The ICAO Aviation Security Manual assists Member States in implementing Annex 17 to the Chicago Convention by providing guidance on how to apply its Standards and Recommended Practices (SARPs). Annex 17 and Doc 8973 are constantly being reviewed and amended in light of new threats and technological developments that have a bearing on the effectiveness of measures designed to prevent acts of unlawful interference:
https://www.icao.int/Security/SFP/Pages/SecurityManual.aspx

Study – EU Preparedness against CBRN weapons: This paper was requested by the European Parliament's Sub Committee on Security and Defence and is available to view on the European Parliaments online database 'Think tank', via the following link:
http://www.europarl.europa.eu/RegData/etudes/STUD/2019/603875/EXPO_STU(2019)603875_EN.pdf

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