

Radiation protection of flight crews

Background

The airline pilot operates within an environment with exposure to circadian dysrhythmia, chronic fatigue, reduced atmospheric pressure, mild hypoxia, low humidity, and exposure to sound, vibration, ionizing radiation and electromagnetic fields. These occupational exposures present physiological challenges to the long-term health of the airline pilot.

In particular, exposure to ionizing radiation and its carcinogenic/ mutagenic potential have received considerable attention. Whereas the annual exposures of ground based radiation workers have been successfully reduced, airline flight crew exposures remain at levels substantially above those of other radiation workers and are increasing with modern flight operations.

Therefore, there is an immediate requirement for comprehensive research into cosmic radiation exposures in airline pilots. While keeping in mind the complexity of exposures in the cockpit environment, this policy endeavours to provide for the protection of flight crews with respect to the potential health risks ionizing radiation exposure.

IFALPA recognises 20 mSv as the annual limit for occupational exposure for airline flight crews as established by the ICRP in Recommendation 103 (2007).

In order to reduce health risks to airline flight crews, operators should by law be obliged to take measures to reduce in-flight radiation exposures below those limits according to the ALARA principle (As Low As Reasonably Achievable – taking into account economical and social considerations).

Monitoring must be sufficient to allow for optimisation of in-flight radiation exposures. Exposures caused by energetic particle events (e.g. solar particle events) have to be taken into account in dose assessments.

1. Recognition of Flight Personnel as Category A occupationally exposed workers

Definition Category A : those exposed workers who are liable to receive an effective dose greater than 6 mSv per year or an equivalent dose greater than 3/10 of the dose limits for the lens of the eye, skin and extremities (NEA Paper 6920 ICRP Recommendations/ EU BSS Draft 24.02.2010).

Flight personnel with an effective dose of more than 1 mSv/y should be recognised as occupationally exposed to ionizing radiation. Those who are liable to receive an effective dose greater than 6 mSv per year should be classified as Category A workers.

2. Dose Measuring devices onboard aircraft

While present ICAO SARPs only refer to aeroplanes operated above 15,000 meters (49,000 ft), it is IFALPA policy that this paragraph should apply to all aeroplanes operated above 8,000 m (26,000 ft) operating in polar / subpolar regions.

As a general rule in radiation protection, measurements are the preferred method of assessing a dose. As long as appropriate measuring devices were not available, calculations were reasonable. In recent years however precise compact dosimeters have been developed and become affordable.

Therefore aircraft with a maximum operational altitude of more than 8,000m (approx. 26,000ft) operating in polar / subpolar regions should be equipped with active dose measuring devices. During flight, the cockpit crew should have the display of the dose rate and accumulated flight exposure plainly visible.

3. Measures against sudden increases in dose rates

IFALPA recommends that an ICAO sponsored multi-party task force be formed to address all issues associated with an ionizing radiation event including the possible subsequent descent of a large number of aircraft.

4. Dose rate warning devices onboard aircraft

All aircraft with a maximum operating altitude of more than 8,000 m (approx. 26,000 ft) operating in polar / subpolar regions, especially long-range aircraft, should be equipped with a warning device to detect sudden increases in dose rate. During flight, the

cockpit crew should have the display of the warning function plainly visible to allow timely response to suddenly increased levels of dose rates.

Flight crews should be provided with regular information of actual and forecasted solar activity.

5. Dose minimisation through flight plan optimization:

Operational flight plans should also be optimised under radiation protection aspects, and thus contribute to dose minimisation.

6. Dose and Dose-Rate Effectiveness Factor (DDREF)

Currently, there is uncertainty regarding the DDREF (Dose and Dose-Rate Effectiveness Factor) of 2, as recommended by ICRP for calculating effective dose. The value will continue to be used, but IFALPA sees the necessity to clarify the validity of this factor.

7. Education of flight crew

Air carriers should inform potential new employees about radiation exposure before recruitment.

Crew members should be made aware through extensive educational programmes that high altitude flying exposes them to significantly higher ionising radiation levels and associated health implications.

8. Cumulative radiation dosage assessment and recording for crew members involved in operations above 8,000m (26,000ft)

Operators should produce individual annual dosage records to which air crew members should have regular access on a permanent basis.

9. Pregnant flight crew

Flight crew members should be warned that radiation exposure to the foetus should not exceed the general population limit of 1.0 mSv, since occupationally exposed limits are not appropriate to the foetus. Operators should have provisions in place to ensure that this limit is not exceeded after declaration of pregnancy by the flight crew member.

10. Airport security controls using X-ray

Flight Crew Members should not be exposed to any kind of ionizing radiation emitted by security scanning devices (e.g. x-ray backscatter).

Instead, alternative measures or devices such as personal search, metal detectors should be used.

11. Recommendations

- ▶ Collected data should be used to validate, confirm and update existent mathematical radiation exposure models for individual routes.
- ▶ Work with airline management to reduce the occupational radiation exposure (e.g. scheduling crews with consideration to their cumulative radiation dose).
- ▶ Convince your authorities that flying personnel should be protected by law from excessive radiation exposure.
- ▶ In order to reduce the amount of radiation exposure, crew members should avoid radiological examinations that are not strictly essential. Such examinations should not form part of a routine medical check.
- ▶ Airline management should be reminded of their “duty of care” to their employees.
- ▶ To allow a better comparison with cancer statistics and facilitate epidemiological studies in the future, dose and medical records should be kept until the greater of:
 - ▶ the crew member reaches or would have reached the age of 75 or
 - ▶ at least 30 years after retiring from flying.

12. Guidance on steps to reduce radiation exposure and associated health implications

Owing to technical and economical restraints there are only limited means available to reduce exposure to ionizing radiation – to fly lower, to fly less, and/or to avoid high exposures of certain groups (equalise exposures). Shielding of aircraft is not feasible due to weight and extremely high radiation particle energies.

Although flying lower certainly bears an economical impact on airline operations (and is highly controversial, therefore) detailed studies may reveal useful and economically tolerable procedures some of which are named here:

- ▶ Avoid flying above optimum FL
- ▶ Avoid that last step climb
- ▶ Avoid intermediate step climbs with following descent
- ▶ Cruise at lower FL with TAS of originally planned higher FL (at least for the later part of flights)

Reducing exposure times by flying fewer hours may coincide positively with efforts to reduce yearly limits of flight hours in the interest of flight safety.

Crew members may influence their lifelong radiation exposures by making use of their options: Selection of aircraft type(s) flown, types of operation (shorthaul/longhaul), retirement age.

13. References

- ▶ ICRP 103, International Commission on Radiological Protection, Publication 103. 2007 Recommendations of the International Commission on Radiological Protection.
- ▶ European Union, Council Draft Directive 2010-02-24; Basic Safety Standards Directive
- ▶ NEA Paper 6920 ICRP Recommendations