

# Protection from Ionizing Radiation

*This paper supersedes 14POS12 Radiation Protection of Flight Crews.*

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

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

## **NOTE**

While this Position Paper is specific to ionizing radiation, exposure to non-ionizing radiation such as UV-A rays as well as high-energy visible light are increasingly suspected to have adverse health effects on skin and eyes.

## **INTRODUCTION**

Despite the international recognition that cosmic radiation poses a workplace health risk to airline pilots, there is an immediate requirement for comprehensive research into all forms of radiation exposures of airline pilots. Keeping in mind the complexity of exposures in the cockpit environment, this Position Paper endeavors to provide for the protection of flight crews with respect to the potential health risks of ionizing radiation exposure.

The International Commission on Radiological Protection (ICRP) is the recognized international body that develops the principles, philosophies, and policies for radiological protection. The guidance for a generic system of radiological protection was published in [ICRP Publication 103](#) in 2007 and specifically for aviation in [ICRP Publication 132](#) in 2016.

These internationally recognized documents are the cornerstone of this IFALPA position.

ICRP Publication 132 recommends that the exposure of aircraft crew should be treated as occupational exposure in an existing exposure situation. In terms of managing that exposure, ICRP Publication 103 states that the principles of protection for planned exposure situations also apply to planned work in existing exposure situations. The European Commission encourages its member states to categorize aircrew work as a planned exposure situation, leading to a full adoption of aircrew as planned exposure e.g. in Germany.

IFALPA, noting differing national legal systems, supports [EU Council Directive 2013/59/EURATOM of 05 Dec 13](#) (the “2013 EURATOM BSS”) as an exemplary legal framework for MAs to recommend as a model for national legislation for basic safety standards for radiation protection. Where differences exist, IFALPA recommends the 2013 EURATOM BSS over ICRP Publication 132.

While not all States have the capacity to adopt the complete radiation protection protocols recommended by the ICRP, many capable States have chosen to leave radiation protection for flight crews in the hands of operators. IFALPA believes this outcome risks placing commercial interests ahead of flight crew safety which could result in a public and occupational health failure.

## **IFALPA POSITION**

### **1. Flight crew radiation protection should be managed as if it is a planned exposure situation**

Although ionizing radiation exposure of flight crew is categorized by the ICRP as an existing exposure situation, the occupational exposure of flight crew shares many characteristics with what the ICRP attributes to planned exposure situations, namely “where radiological protection can be planned in advance, before exposures occur, and where the magnitude and extent of the exposures can be reasonably predicted,” (ICRP Publication 103). IFALPA believes that all facets of radiation protection of flight crew should be managed in accordance with the more stringent ICRP recommendations for planned exposure situations. Furthermore, IFALPA encourages the ICRP to reconsider if there are better criteria than solely the source of radiation to base their system of exposure categories upon - and eventually categorize air crew exposure as a planned exposure situation in future recommendations.

### **2. Flight personnel should be recognized as Category A occupationally exposed workers**

Flight personnel with an effective dose of more than 1 mSv per year should be recognized 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.

### **3. Optimization and dose minimization**

Initial dose reference levels for all flight crew in each fleet should be set at 6 mSv per year. Flight crew radiation exposure doses should be individually monitored and optimized to As Low As Reasonably Achievable (ALARA), even if the reference level is not exceeded.

Reference levels should only be increased:

- where an appropriate statistical analysis demonstrates a sound application of optimization principles and minimization techniques to reduce both the average annual effective dose and the variation in annual effective doses
- as increments of 1 mSv.

### **4. Cumulative radiation dose assessment and recording for flight crew members**

Operators should produce individual annual dose records to which flight crew members should have regular access on a permanent basis, unless competent analysis shows that no flight crew member will be exposed to inflight radiation of 1 or more mSv per year.

Exposures caused by energetic particle events (e.g. solar particle events) must be taken into account in dose assessments.

To allow a better comparison with cancer statistics and facilitate epidemiological studies in the future, dose and medical records - obtained through applicable regulation (and thus containing de-identified data only) - 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.

## **5. 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 programs:

- that high altitude flying exposes them to significantly higher ionizing radiation levels and associated health implications,
- of the effects of flying above optimum altitude, and
- of exposure optimization options through avoidance of short time step climbs or lateral rerouting.

Crew members should receive education on applying ALARA principles to minimize their radiation exposure where they can influence their flight duty assignments.

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. Similarly, flight crew members may influence their lifelong radiation exposures by making use of their options regarding selection of aircraft type(s) flown, the types of operation (short haul/ long haul), and their retirement age.

Crew members should also receive education on avoiding lightning strikes for economical and flight safety reasons as well as additional ionizing radiation doses.

## **6. Dose minimization through flight plan optimization**

Operational flight plans should also be optimized for radiation protection, thus contributing to dose minimization.

Flight crews should be provided with regular information of actual and forecasted solar activity on the Operational Flight Plan (OFP) and via SIGMET-type information.

## **7. 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.) in polar/subpolar regions.

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

During flight, the cockpit crew should have the display of the dose rate and accumulated flight exposure plainly visible.

Collected data should be used to validate, confirm and update mathematical radiation exposure models for individual routes.

IFALPA encourages operators to monitor gamma doses received during lightning strikes.

## **8. Dose rate warning devices onboard aircraft**

All aeroplanes intended to be operated above 8,000 m (approx. 26,000 ft.) 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 a warning function of the device plainly visible to allow timely response to sudden increases in the dose rates.

## **9. Measures against sudden increases in dose rates**

IFALPA recommends that ICAO sponsors or takes part in current multi-party task force efforts (e.g. LWS SAFESKY, EURADOS) to address all issues associated with an ionizing radiation event, including the possible subsequent descent of a large number of aircraft.

## **10. Pregnant flight crew**

Flight crew members should be adequately informed that radiation exposure to the fetus should not generally exceed the general population limit of 1.0 mSv, since occupationally exposed limits are not appropriate to the fetus. Noting that a flight crew member may have exceeded that limit before confirmation of pregnancy, operators should have provisions in place to ensure that the flight crew member does not exceed a dose of 1 mSv after declaration of pregnancy.

## **11. 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, however IFALPA recommends that efforts be made to clarify the validity of this factor.

## **12. Reduction of exposure to other ionizing radiation**

Aviation security lawmakers should be encouraged to legislate for alternative security arrangements so that flight crews should not be exposed to any kind of ionizing radiation emitted by security scanning devices (e.g. x-ray backscatter).

Crew members should avoid radiological examinations that are not strictly essential. These should not form part of a routine medical check.

## **References**

International Commission on Radiological Protection (ICRP) 2007, Publication 103, [\*Recommendations of the International Commission on Radiological Protection.\*](#)

International Commission on Radiological Protection (ICRP) 2016, Publication 132, [\*Radiological Protection from Cosmic Radiation in Aviation.\*](#)

European Union 2013, [\*Council Directive 2013/59/EURATOM \[Basic Safety Standards\].\*](#)