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Our Ref: O50-0019

Dear Dr Charalambous,

AusALPA COMMENTS ON THE DRAFT GUIDE FOR RADIATION PROTECTION IN EXISTING EXPOSURE SITUATIONS (RPS G-2)

INTRODUCTION

The Australian Airline Pilots' Association (AusALPA) represents more than 5,000 professional pilots within Australia on safety and technical matters. We are the Member Association for Australia and a key member of the International Federation of Airline Pilot Associations (IFALPA) which represents over 100,000 pilots in 100 countries. Our membership places a very strong expectation of rational, risk and evidence-based safety behaviour on our government agencies and processes and we regard our participation in the work of the Australia's safety-related agencies as essential to ensuring that our policy makers get the best of independent safety and technical advice.

AusALPA is particularly disappointed that ARPANSA chose not to engage with any pilot representative bodies in developing the Draft Guide for Radiation Protection in Existing Exposure Situations (RPS G-2), especially given that many people within ARPANSA from the CEO down are quite familiar with the long term contributions of Dr Ian Getley and IFALPA in the field of managing cosmic radiation exposure of pilots. Balanced policy development cannot come from agencies being seen to respond only to airline management and their commercial interests while ignoring the concerns of the actual workforce being irradiated.

While we will deal later with specific editorial issues, AusALPA notes that both the draft Guide and its recently published companion Code *Radiation Protection in Planned Exposure Situations* (RPS C-1) reflect ARPANSA's higher level policy choices, parts of which both AusALPA and IFALPA consider to be incorrect or unwise.

As much as we respect the research and policy recommendations of the International Commission on Radiological Protection (ICRP), we also recognise that attempting to separate and exclusively characterise exposures between "planned" and "existing" events cannot satisfy all situations and, therefore, careful consideration by ARPANSA must replace rote acceptance of ICRP recommendations. More broadly, AusALPA is concerned that ARPANSA may be surrendering its leadership role in radiation protection of air crew by recommending increased exposure monitoring levels to the point where exposure becomes trivialised.

IFALPA has provided a separate analysis of the ARPANSA proposal for RPS G-2, which we have attached. While some overlap in our comments is inevitable, we will attempt to complement the IFALPA paper with additional Australian context. We have also attached a communication from Dr Ian Getley that further supports our views on this proposal.

Radiological Protection from Cosmic Radiation in Aviation: ICRP Publication 132

The ICRP published ICRP Publication 132 (ICRP 132) in June 2016. Consistent with their recommended taxonomy in ICRP Publication 103 *The 2007 Recommendations of the International Commission on Radiological Protection* published in March 2007, ICRP 132 categorises aircrew as occupationally exposed workers, categorises cosmic radiation as an existing exposure situation and makes, *inter alia*, the following main point:

> The Commission recommends that exposure be maintained as low as reasonably achievable with a dose reference level selected to take into account the level of exposure of the most exposed individuals who warrant specific attention in the particular circumstance, typically in the 5–10 mSv year^{-1} range.

AusALPA is advised that the ICRP offered no scientific basis for the broadening of the previous reference level of 6 mSv year^{-1} to the range of 5–10 mSv year^{-1} and no justification whatsoever for recommending that the choice of reference level should be left to “operating management”, despite the clear risk that commercial considerations may be elevated well above those of safe work conditions for radiation exposed workers.

Importantly however, in discussion either missed or ignored by ARPANSA, the ICRP also clearly stated that:

> The specific level selected should take into account the prevailing circumstances, so that the value can contribute meaningfully to the optimisation process.

Critically, ICRP 132 did **not** reverse the situation described in Table 4 of ICRP 103, which clearly **precludes** the setting of reference limits for occupationally exposed workers in existing exposure situations! Note (c) provides”

> Exposures resulting from long-term remediation operations or from protracted employment in affected areas should be treated as part of planned occupational exposure, even though the source of radiation is ‘existing’.

AusALPA maintains that, in opting for the highest reference level of 10 mSv year^{-1} suggested by ICRP for the mixed public and occupational exposure group comprising all persons on board aircraft in flight to be applied to aircrew despite Table 4 of ICRP 103, ARPANSA has comprehensively failed to take account of the complete advice of the ICRP, the prevailing circumstances in Australia and two of the three principles of radiation protection, namely justification and optimisation.

ARPANSA clearly has not considered the consequences of effectively approving a reference level so much greater than existing exposures that it will almost completely negate any interest in, let alone monitoring and optimisation of, air crew exposure to cosmic radiation.

Are we compelled to adopt ICRP 132?

Both AusALPA and IFALPA recognise that the ICRP must strive to make suggestions and recommendations palatable to a very wide cross-section of State jurisdictions with variable regulatory capacities. We also recognise that each State must assess those suggestions and recommendations against the background of their legal and cultural frameworks with a view to achieving the objectives of optimising protection from harmful radiation. Australia has an obligation to comply with our international treaties and agreements, but only to the extent that such compliance is in the national interest.

Importantly, in this case we are free to adopt a more stringent approach without compromising our international obligations, just as we are free to apply regulatory caution in workplace safety in preference to slavishly "cutting red tape" regardless of the potential human costs.

ARPANSA should heed its own statement in the preface to RPS G-2 that states:

> To the extent possible and **relevant for Australian circumstances**, the RPS publications give effect in Australia to international standards and guidance.

What is an appropriate reference level for Australian aircrew?

AusALPA is advised that, of the limited aircrew population monitored in Australia, we have cohorts of pilots with exposures around 5.5-5.7 mSv year^{-1} and cabin crew with exposures around 6.0-6.5 mSv year^{-1}. Importantly, more recent changes in aircraft types and routes have seen an increase in exposures from around an average of 3.5 mSv year^{-1} for Qantas pilots in the early 2000s to much higher levels today.

The available data indicate that average exposure levels and the range of exposure levels are generally increasing, most likely in ways and rates not historically contemplated, as a result of the operational capabilities of newer aircraft types and route planning options that previously were not possible. It is therefore important that the reference level be sensibly close to the highest current exposures in order to make the monitoring relevant in both capturing and managing the changes. In the absence of contrary scientific advice, AusALPA believes that 6 mSv year^{-1} retains both national and international relevance and satisfies the ICRP principle "that the value can contribute meaningfully to the optimisation process".

The ARPANSA imprimatur for a reference level of 10 mSv year^{-1}, combined with the suggestion at subsection 3.3.8 in the draft that assessments and the related records need only to be made "where the doses of aircrew are likely to exceed the reference level", sends two unacceptable messages: first, that there are no health risks attendant upon current exposure levels; and second, that optimisation to ALARA is largely irrelevant because current exposure levels are now so relatively low compared to that reference level.

In our view it is bad enough to shift the reference level to around 160% of the higher current levels, but it is much worse (500%) when considering that ARPANSA's own documents refer to exposure levels of domestic airline pilots of only 2 mSv year^{-1}. That chosen combination will undo everything we have done up until now to monitor and understand this internationally recognised workplace hazard and will be entirely contrary to ARPANSA's public health objectives.

Alternative radiation protection models

AusALPA is drawn, as is IFALPA, to the approach taken by the European Union in Council Directive 2013/59/EURATOM, the EURATOM Basic Safety Standards. That Directive was made into law noting the recommendations of ICRP 103 among other considerations and adopted 6 mSv $year^{-1}$ as a widely used reference level. It also created in Article 35(2) a transitional arrangement not contemplated by ICRP 103:

> 2. …where the exposure of workers is liable to exceed an effective dose of 6 mSv per year …, these shall be managed as a planned exposure situation and the Member States shall determine which requirements set out in this Chapter are appropriate...

As noted in the IFALPA paper, paragraph 26 of the preamble to the EURATOM Basic Safety Standards makes it clear that the exposure of air crew to cosmic radiation should be managed as a planned exposure situation, contrary to the approach taken by the ICRP.

AusALPA asserts that Australia is not compelled to adopt ICRP 132 (or ICRP 103) verbatim and strongly recommends that, to the extent permitted by the Constitution, ARPANSA should adopt the extant aircrew protection provisions of the EURATOM Basic Safety Standards.

Who should determine the appropriate reference level?

ICRP 132 places the responsibility on "operating management":

> For aircraft crew…, appropriate management of protection is required, based on regular monitoring of all individual doses and modification of the flight roster for those individuals with doses approaching the reference level adopted by the operating management.

Clearly, the ICRP has some aspirational beliefs about how airline managers view their workplace safety and general HR obligations to their staff, confirmed by the conclusions:

> (83) For the protection of aircraft crew, the Commission maintains its previous recommendations, and introduces the use of a reference level to be selected by operating managements. Values in the 5–10 mSv $year^{-1}$ range are generally appropriate. The specific level selected should take into account the prevailing circumstances, so that the value can contribute meaningfully to the optimisation process. The available options to reduce exposures from cosmic radiation are very limited. The most effective option is the adjustment of flight rosters when doses are approaching the selected reference level.
>
> (84) With the above recommendations, the Commission expects to keep doses of the most exposed individuals – aircraft crew and some frequent flyers – as low as reasonably achievable below the selected reference levels. The Commission also anticipates that by raising general awareness about exposure to cosmic radiation in aviation, a more informed dialogue among stakeholders can take place. All involved stakeholders – occasional flyers, frequent flyers, and aircraft crew – are encouraged to make informed decisions with regard to the exposures associated with flying, and also to consider all the benefits they receive from air travel.

Both AusALPA and IFALPA consider this approach to be unlikely, but more probably incapable, of success. The most obvious conflict arises as a consequence of management's commercial and promotional interests – they have little or nothing to gain from actively managing their workforce's radiation exposure to the detriment of the roster and there is little incentive for them to select a reference level that might cause that outcome.

The best illustration of why a reference limit needs to be imposed is simply the current state of radiation exposure monitoring by Australian airlines. Undoubtedly, one of the drivers behind the ICRP's belief in management protecting their workforce is the relatively broad application of strong workplace safety regulations among the various countries adopting ICRP advice. Unfortunately, interstate and international aviation operations in Australia reveal the holes in the constitutionally constrained workplace safety framework that varies between States. There is no doubt that radiation exposure is a workplace hazard for aircrew, yet seemingly not one of the Australian airlines feels legally compelled to monitor exposures or to mitigate that hazard, despite apparently strong workplace safety legislation in each State

Qantas has voluntarily run radiation monitoring processes for some time. However, AusALPA is advised that Virgin, Jetstar and Tiger have refused direct attempts to get them to conduct these internationally accepted practices, despite the fact that the ICRP has never wavered from the need to monitor and keep records of crew exposure as well as to ensure that management have appropriate intervention strategies in place. While it only makes sense to us that they are refusing to do so on the basis of legal advice that there is no compulsion, it inarguably illustrates the fallacy of relying on airline management to provide the required workplace safety outcomes.

We have attached a copy of an article titled *Cosmic radiation, aircrew and WHS obligation* by David Chitty which offers another view of airline obligations.

AusALPA strongly believes that a uniform regulatory imposition is required in order to achieve a single consistent cosmic radiation protection scheme for Australian aircrew wherever they happen to be flying.

We realise that ARPANSA is not empowered to impose those requirements on airlines and in any event is constitutionally constrained from accepting such a role. However, ARPANSA as the accepted lead agency must use its influence with the State radiation protection bodies to close whatever legislative loopholes may exist that allows airline operators to abrogate their responsibilities to provide safe working environments to the greatest practicable extent.

Detailed Comments

We have separately attached specific comments on the proposed document.

Yours sincerely,

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Attachments:

1. IFALPA comments on proposed RPS G-2

2. Dr Ian Getley comments on proposed RPS G-2

3. David Chitty, *Cosmic radiation, aircrew and WHS obligation,* (2015) 6 WR 11, Thomson Reuters

4. Editorial comments on proposed RPS G-2

February 21st, 2017

IFALPA Comments on the Public Consultant Draft, *Guide for Radiation Protection in Existing Exposure Situations from the Australian Radiation and Nuclear Safety Agency* (herein denoted ARPANSA Guide)

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I. General comments of the ARPANSA Guide:

The ARPANSA Public Consultation Draft (as of December 15th 2016) represents a guide to manage the risks from ionizing radiation based on fundamental principles of radiation protection, safety and security. The guide applies to existing exposure situations of occupational exposure that include the exposure of aircrew and space crew due to cosmic radiation (clauses 3.3.6, 3.3.7, 3.3.8 and 4.3).

Classifying aircrew in existing exposure (though in agreement with ICRP 132[3]) is in contradiction with state-of-the-art jurisdiction (title, clause 4.3), e.g. EURATOM Basic Safety Standards[1]. In Europe, aircrew exposure is considered a planned exposure since there are various possibilities of dose reduction, e.g. through rostering and route planning (see e.g. in the USA, Delta Airlines action plan for active space weather [2]).
Aircrew is exposed by flying into an environment of (enhanced) radiation levels. Exposure can be anticipated (e.g. through space weather forecasts or on-board measurements), reduced[2] and is therefore in many ways comparable to uranium mine workers.

The most critical point of the document itself is the establishment of a contradictory criterion, which states that the employers have no obligation to assess and keep records of doses and make records available to aircrew if they are below a given **reference level** (for the accumulated annual dose of ionizing radiation).

Furthermore, radiation protection levels should be set by the respective authority and with utmost concern to protecting the exposed individuals. ICRP 132 [3] recommends operating managers monitor and communicate doses, and strive to reduce the doses their employees receive, but an operating manager is by no means an adequate person to select reference values since his/her primary interest is in economic aspects.

According with the ICRP 132 [3], the **reference level** is defined as: *In emergency and existing exposure situations, this dose criterion represents the level of dose or risk above which it is judged to be inappropriate to plan to allow exposures to occur, and below which optimisation* *of protection should be implemented. The chosen value for a reference level will depend upon the prevailing circumstances of the exposures under consideration.*

According with IAEA GSR Part 3 [4], the **reference level** is defined as: *1.24. Reference levels are used for optimization of protection and safety in emergency exposure situations and in existing exposure situations. They are established or approved by the government, the regulatory body or another relevant authority. For occupational exposure and public exposure in emergency exposure situations and in existing exposure situations, a reference level serves as a boundary condition in identifying the range of options for the purposes of optimization in implementing protective actions. The reference level represents the level of dose or the level of risk above which it is judged to be inappropriate to plan to allow exposures to occur, and below which the optimization of protection and safety is implemented. The value chosen for the reference level will depend on the prevailing circumstances for the exposures under consideration. The optimized protection strategies are intended to keep doses below the reference level. When an emergency exposure situation has arisen or an existing exposure situation has been identified, actual exposures could be above or below the reference level. The reference level would be used as a benchmark for judging whether further protective actions are necessary and, if so, in prioritizing their application. Optimization of protection and safety is to be applied in emergency exposure situations and in existing exposure situations, even if the doses initially received are below the reference level.*

According with ICRP 103 (2007) [5], the recommended **reference level** for existing exposure radiation should be in the range from 1 to 20 mSv/y. For cosmic radiation protection in aircrew the recommended values are within 5 to 10 mSv/y. In this regard, the reference level of 10 mSv/y adopted by ARPANSA Guide is in agreement with ICRP standards. Those who are liable to receive an effective dose greater than 6 mSv per year should be classified as Category A workers [1].

The effective doses absorbed by the crew members are estimated to be in the range of 1.2 to 7.0 mSv/y [6]. Consequently, the reference level of 10 mSv/y is not consistent with the prevailing circumstances and unlikely to be exceeded by the Australians, which means that preventive actions related with radiation protection will not be taken at all (clause 3.3.8).

Also, considering the definition from IAEA GSR Part 3 [4]: "*Optimization of protection and safety is to be applied in emergency exposure situations and in existing exposure situations, <u>even if the doses initially received are below the reference level</u>.*" Furthermore, both IAEA GSR Part 3 [4] and ICRP 132 [3] clearly state that optimisation should be implemented below the **reference level**.

In this regard, one should be very careful with the wording of clauses 3.3.7 and 3.3.8 from ARPANSA Guide:

"*3.3.7 Where such assessment is deemed to be warranted, there should be an established framework which should include a reference level of dose and a methodology for the assessment and recording of doses received by aircrew from occupational exposure to cosmic radiation (see Annex A).*

3.3.8 In accordance with clause 3.3.7:

(a) where the doses of aircrew are likely to exceed the reference level, employers of aircrew should:

(i) assess and keep records of doses

(ii) make records of doses available to aircrew

(b) employers should:

(i) inform female aircrew of the risk to the embryo or foetus due to exposure to cosmic radiation and of the need for early notification of pregnancy

(ii) apply the requirements of clause 3.2.14 in the Planned Exposure Code, ARPANSA C-1 in respect of notification of pregnancy."

In other words, the ARPANSA Guide does not introduce any obligations for the employers, such as assessing and keeping the records of doses, if the accumulated annual dose of ionizing radiation is kept below 10 mSv/y, which is very likely to occur most of the times even in polar or sub-polar latitudes and long range flights.

According with Council Directive 2013.59/EURATOM (article 35) [1]: "… *3. For an undertaking operating aircraft where the effective dose to the crew from cosmic radiation is liable to exceed* ***6 mSv*** *per year, the relevant requirements set out in this Chapter shall apply, allowing for the specific features of this exposure situation. Member States shall ensure that where the effective dose to the crew is liable to be* ***above 1 mSv*** *per year, the competent authority requires the undertaking to take appropriate measures, in particular:*

1. *(a) to assess the exposure of the crew concerned;*
2. *(b) to take into account the assessed exposure when organizing working schedules with a view to reducing the doses of highly exposed crew;*
3. *(c) to inform the workers concerned of the health risks their work involves and their individual dose.*

Consequently, any exposure above 1 mSv/y should be assessed and recorded by the employers as a protective measure against ionizing radiation.

The ICRP 132 'right to know' principle [3], states that *people have the right to be informed about the potential risks that they may be exposed to in their daily life, and the underlying ethical values of autonomy, justice, and prudence, the Commission encourages national authorities, airline companies, consumer unions, and travel agencies to disseminate general information about cosmic radiation associated with aviation. This information must be easily accessible and should present the origins of cosmic radiation; the influence of altitude, latitude, and solar cycle; and indicate typical doses associated with a set of traditional flight routes and the potential of receiving unexpected exposure in the case of a rare but intense GLE*.

Ensuring that the dose to a foetus remains below 1mSv/y requires special attention since that dose can easily be accumulated within a few long-haul flights and especially during enhanced space weather activity.

II. Typo comments/questions:

II.1 Front Page:
DECMEMBER --> DECEMBER
II.2 p. 4, line 111:
The caption of figure 2.1 is written twice
II.3 p.11, line 283:
(e) …and should submit… --> … and submit…
II.4 p.14, line 390:
We did not find Section 2.2.3 in the document (?)

III. Conclusions

Considering clauses 3.3.7 and 3.3.8 from the ARPANSA Guide, the employers will have no obligation to assess and keep the records of doses if they do not exceed 10 mSv/y. This means that in practical life, the issue of ionizing radiation in aircrew in Australia will not be a concern among the operators and regulators.

Following the concept of optimization (ARPANSA Guide, page 31, line 832): *"Optimisation*

For existing exposure situations, optimisation of protection and safety is the process of determining what level of protection and safety would result in the magnitude of individual doses, the number of individuals (workers and members of the public) subject to exposure and the likelihood of exposure being as low as reasonably achievable, economic and social factors being taken into account' (ALARA)"

The key factors informing the selection of the reference level are shown in page 18. As one can easily verify, there are two factors tending to decrease the reference level: (i) detriment to health caused by radiation and (ii) difficulty of implementing self-help measures.

Consequently, it is reasonable to admit that a considerably lower reference level could be adopted by Australia taking into account the ALARA concept, and the factors (i) and (ii) shown above.

Any value between 1 and 20 mSv/y would be in line with international standards and given the global average between 1.2 and 7.0 mSv/y [6] one could argue to choose a more realistic reference value rather than 10 mSv/y. In fact, as mentioned in Ref. [7]:*"each state in Europe may have, and quite few have, more strict national legislation concerning radiation. Usually, this national legislation restricts the annual radiation dose from occupational exposure of cosmic radiation to 6 mSv."*

As presented in Figure 1, the average annual doses in few European States (light grey) never exceed 3 mSv/y, whereas the maximum annual doses (dark grey) never exceed 7 mSv/y. Nine between ten States have a maximum annual dose below 6 mSv/y.

ICRP Publication 132

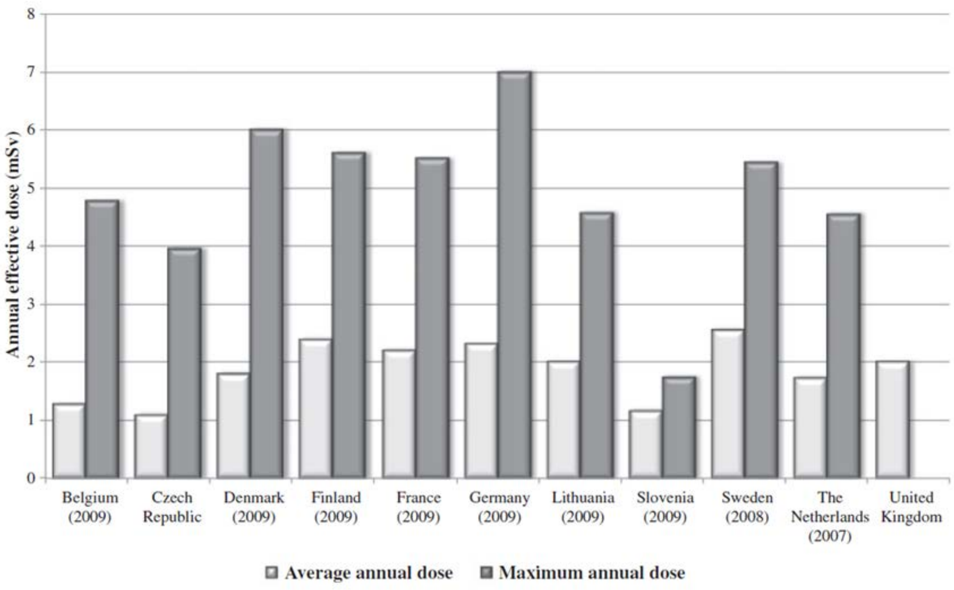

Fig. 2.6. Average and maximum annual effective dose for aircraft crew in European countries (Andresz and Croüail, 2015).

Figure 1: Annual effective doses (mSv) for aircraft crew in European countries, extracted from ICRP 132.

The question that rises is: what if Australia sets the reference level at 6 mSv/y? What's is the fraction of crewmembers above this limit every year in Australia?

As described by IFALPA Medical Briefing Leaflet [7]: *"…it is certainly worth noting that whilst the annual exposure of other radiation workers (e.g. nuclear workers, medical and industrial radiographers, etc.) is decreasing following the introduction of the principle to reduce doses 'as low as reasonably achievable', radiation doses of airline flight crew do continue to increase, as advances in aerospace technology permit longer duration, higher* *altitude, and higher latitude flights. Many of the epidemiological studies are ongoing and further information can be expected."* It is clear the importance of claiming a more realistic reference level in line with the prevailing circumstances otherwise the annual effective doses will tend to increase progressively.

IV. Recommendations/ concerns

1. Air crew exposure should be classified as a planned exposure, not as an existing exposure. IFALPA understands the importance that ICRP 132 and EURATOM BSS converge in the classification of the aircrew as planned exposure situations. **Considering that this Public consultation Draft applies to existing exposure situations and given the fact that the document assumes the ICRP 132 definition that classifies the aircrew as existing exposure situations, we reinforce the recommendations presented below regardless of the ICRP 132 and EURATOM BSS divergence in the matter.**

2. IFALPA recognizes 20 mSv/y as the average annual dose limit of ionizing radiation for pilots, so in this regard the reference level of 10 mSv/y is in line with IFALPA position [8], however we recommend to adopt a limit value of 6mSv/y [1]. Those who are liable to receive an effective dose greater than 6 mSv per year should be classified as Category A workers [8]. The ICRP recommends that exposure be maintained as low as reasonably achievable with a dose reference level selected to take into account the level of exposure of the most exposed individuals who warrant specific attention in the particular circumstance, typically in the 5–10 mSv/year range [3].

3. According with Council Directive 2013.59/EURATOM (article 35) [1], the employers should assess and record the absorbed dose of ionizing radiation of aircrew if they are above 1 mSv/y. In this regard, clause 3.3.8 of ARPANSA Guide introduces a serious concern and contradicts this protective policy against ionizing radiation. The absorbed doses in aircrew can be measured using calibrated devices or estimated with reasonable accuracy using the available codes [9]. IFALPA recommends that aircraft with a maximum operational altitude of more than 8,000m (approx. 26,000ft) operating in polar/sub-polar 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 [8].

4. Reference levels shall be selected by authorities, not by operating managers (clause 4.3).

5. Despite to the fact that the reference level adopted in ARPANSA Guide (10 mSv/y) is in line with ICRP 2007 [5] one can also invoke the ALARA principle and claim a lower value (6 mSv/y), which is also adopted by some EU countries [1,7]. This value is consistent with the global estimate (1.2 to 7.0 mSv/y) [6] and in line with the upper limits found in many European countries (Figure 1) It is important that protective measures tend to decrease or at least to keep at the same level the exposure of aircrew to ionizing radiation as time evolves. These protective measures could be related with flight schedule policies (balancing more polar and sub-polar flights among the crew members) and also constraints in the total flight hours per year. These strategies will be very correlated with the choice of the reference level for the annual dose.

6. Monitoring space weather, especially for companies that operate in polar routes is strongly recommended due to the possibility of a suddenly increase of the dose rate during a solar storm. Delta Airlines procedures [2] may be a reference for this matter. The FAA/NOAA Solar Radiation Alert System can be very useful for this purpose [10].

References

[1] EURATOM BSS paragraph 26 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:013:0001:0073:EN:PDF

[2] Delta Hazard Avoidance Procedures & Use of Space Weather Information http://www.swpc.noaa.gov/sites/default/files/images/u33/SpaceWx_20minFINAL_ver3.pdf

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[4] International Atomic Energy Agency (IAEA) 2014. *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*. General Safety Requirements Part 3, Number GSR Part 3. [www-pub.iaea.org/MTCD/publications/PDF/Pub1578_web-57265295.pdf]

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[6] United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2008. *Sources and Effects of Ionizing Radiation*. Report to the General Assembly with Scientific Annexes. [http://www.unscear.org/docs/reports/2008/11-80076_Report_2008_Annex_D.pdf]

[7] Cosmic Radiation - IFALPA - 13MEDBL01 – Medical Briefing Leaflet (2012) http://www.ifalpa.org/downloads/Level1/Briefing%20Leaflets/Medical/13MEDBL01%20-%20Cosmic%20radiation.pdf

[8] Radiation protection of flight crews - IFALPA - 14POS12 – Position (2013) http://www.ifalpa.org/downloads/Level1/IFALPA%20Statements/Human%20Performance/14POS12%20-%20Radiation%20protection%20of%20flight%20crews.pdf

[9] J. F. Bottollier-Depois, P. Beck, M. Latocha, V. Mares, D. Matthia, W. Ruhm and F. Wissmann (2012). Comparison of Codes Assessing Radiation Exposure of Aircraft Crew due to Galactic Cosmic Radiation. EURADOS Report 2012-03.

[10] Solar Radiation Alert System - DOT/FAA/AM-09/6 - (2009) http://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/2000s/media/200906.pdf

Report on ARPANSA Radiation Guidelines

(specifically Aircrew Radiation Doses)

(4th February 2017)

Background

The radiation monitoring of aircrew internationally, is not demanded by regulatory authorities in many countries. In Europe, legislation since the mid 1990's required all European Union member states to set up and monitor aircrew radiation doses. Since then Canada, Japan and several middle eastern countries have similarly set up and require monitoring, the middle east, generally because they originally commenced operation under the auspices of the British CAA operators certificate.

The International Federation of Airline Pilots (IFALPA), has followed the general principal of ALARA, as low as reasonably achievable and because of European legislation, has generally been happy with the administration of monitoring of flying radiation, through computer predictive software.

Since initial inception of the EU regulations the ICRP, International Commission of Radiation Protection has on several occasions updated its position on required monitoring and threshold levels of guidance for aircrew doses. Originally the ICRP's required medical monitoring of flying rosters if an individual's doses exceeded 6 mSv (milliSieverts) in a rolling 12 month period. During the 1990's and early 2000's annual crew doses rarely exceeded this level averaging in Europe 3.5 – 5.0 mSv's. Since that time aircraft material and design have produced aircraft that fly at higher altitudes and over ever increasing flight hours (ultra long-haul operations).

Aircrew radiation is dependent on these very two factors, ie at altitudes above 26,000 ft, the dose levels increase by approximately 40% for every 4,000ft and the flight times for long-haul operations have increased from approximately 12 hours a sector to now up-wards of 17 hours, as currently on Melbourne-Dallas and longer flights proposed for B787 operations Perth- London and in the future announced Sydney – New York, greater than 18 hours. So in the future aircrew assigned to such aircraft can expect much higher doses than the current B744 operations of 14 hour flight to South Africa or South America that average between 130 – 150 µSv (micro Sieverts). My expectation would be such proposed flights would increase, round trip, sector doses to between 150 – 190 µSv, whilst this only appears at most a 30% dose increase, because these aircraft will be route specific, the aircrew will repeat these flights regularly and more often because of reduced time away.

Since the introduction of the A330 services to and from Perth on regular daily services, we have found that no longer are the long-haul Africa and South America flights, at higher latitudes which also increase radiation dose levels, the issue for exposure, but that the domestic pilots on the A330 usually have the higher dose levels, usually between 4.0 – 5.0 mSv/yr and more than ten pilots have levels approaching 6 mSv (ie 5.2 – 5.7 mSv). This usually occurs because these aircraft fly straight to a higher altitude, between 37,000 – 41,000 ft and stay there for 4 -5 hrs. So we already see these crew, who are utilised up to five times per fortnight, now approaching the current guidance level of 6 mSv's. Imagine the effect of flying 3x Sydney- New York flights, or 3 x Perth- London's return per fortnight. The maths would indicated minimum exposures of 5.2 mSv's per year, getting close to our current guidance level of 6 mSv's.

So we have already observed increased doses of all Qantas pilots from an average of 3.5 mSv/yr up until early 2000's, to now, in a number of cases 5-6 mSv/yr. That's a significant increase in dose exposure, approximately 48% in the current highest cases of exposure and not consistent with ALARA.

Proposed ARPANSA Guidelines on Aircrew Exposure

ARPANSA have produced a revised "Guidelines to Radiation Protection in Existing Exposure", a guide by definition, provides a recommendation and guidance on how to comply with the codes or apply the principals of those fundamentals. They are written in an explanatory and non-regulatory style and indicate the measures recommended to provide good practice. These are generally expressed as "should statements".

In this draft guide, page 5 states: "the guide is not intended to apply to planned exposure situations, and emergency situations (flying rosters are planned up to two months in advance). Such exposure situations are expected to be covered by other publications in RPS and other supporting guides. Presently there is no State or Federal regulations covering a requirement for Aircrew radiation monitoring. Federally, NPRM 119, (specifically 119.345) has been delayed for five years to date and at State Health level, no such consideration has been given to aircrew radiation issues and certainly not to a requirement for airline management to implement and monitor the exposure levels of their employee aircrew. Qantas Airways, has, under my guidance, voluntarily monitored its aircrew for over five years, at very minimal cost, (11,000 aircrew at less than $30,000/yr), but after many years of attempting to get Virgin Australia, Jetstar and Tiger Airways to similarly take responsibility and create a voluntary program, they refuse.

ARPANSA Guidelines (Specifics to Aircrew)

2. Identification of existing exposure

2.2 Refers to existing exposure situations that need to be measured in order to characterise the exposure situation and are generally characterised by a wide distribution of individual doses.

"In many cases, the exposure can be at least partially controlled by exposed individuals themselves (self-help protection)". Currently, the only Australian aircrew that can achieve this are at Qantas Airways, who are monitored by computer software codes from their flight data profiles and rosters.

3. General Guidance – Regulatory Compliance to Existing Exposures

3.1.2 Requirement for legal and regulatory framework for protection and safety, to include provision to manage existing exposure situations?? This, as stated, has not been implemented at either Federal or State levels??

3.1.3 Establishment of a protection strategy for an existing exposure situation?? This has not been achieved by any State Health Ministry via their State Radiation Health Committees, which in light of the attached legal opinion from aviation accredited barrister at law, potentially leaves States, involved with airline dealings, at risk under provisions in their Acts.

3.3.6 , 3.3.7 and 3.3.8 Exposure of Aircrew and Space crew due to Cosmic Radiation. "Where assessment is deemed to be warranted, there should be an established framework which should include a reference level of dose (6mSv not 10mSv for Australian Aircrew due to nature of their flying) and a methodology for the assessment and recording of doses received by aircrew for occupational exposure to cosmic radiation"

Qantas complies with this provision on a voluntary basis only, the other carriers do not and will not unless regulations require them to do so. This is from my personally approaches since 2010.)

4. Aircrew Exposure to Cosmic Rays

4.3 Lines 500 and 501 provide statements setting a reference level at 10 mSv in Annex A and under note 4, "to be administered by airline managers and states that it considers this appropriate"! By whom, a pilot body (IFALPA), best medical evidence from epidemiology studies of aircrew cancers over past 20 years? This is at least a very arbitrary figure set by scientists not working in the field of aviation. Not support by

IFALPA, or my own personal research into health of aircrew studies over many years and appears to be supporting airline managers. The airline managers would consider commercial imperatives ahead of personal aircrew health considerations, particularly without regulatory compliance to administer a suitable radiation monitoring and recording system. (Fox in control of the "chicken coupe")

5. Conclusion

Again advises a guidance level of 5-10 mSv's and talks of optimisation processes and considers the small margins to effectively reduce radiation exposure, but then states the only way to reduce radiation exposure is to reduce flight times. This at a time when world flying is headed to longer flight times and hence exposures, why are we suggesting higher review levels other than to plaicate some airline managers and a few aircrew individuals, who put their pecuniary interest ahead of potential future health risks!

Appendix 2 – 10 Principals of radiation risk management

Leadership

1. Clear division of responsibilities, both organisations and individuals. Currently again, only Qantas complies with any form of radiation monitoring guidelines and to allow its management team to administer upper guidance levels would certainly blur their objectivity, as operational managers would be under pressure to find/provide aircrew regardless of doses levels noted. This has been noted over past 5 years where Qantas medical have had to intervene because of "world's best practice" in this regard, was not being adhered to by several cabin crew and failure to act by their management. Has this proposed increase been to appease management at the expense of the aircrew members??

2. Legislative and Regulatory Framework. Currently does not exist for aircrew in Australia! (CASA's NPRM 119.345 stalled since 2012).

3. Leadership and Management of Safety. Again only Qantas complies on a self / voluntary basis of monitoring aircrew and from Qantas medical perspective adheres to a reference level of 6 mSv's as per European practice. In fact this proposed increase puts added pressure on the medical department, as operational managers will place pressure, needlessly, on senior medical officers to allow aircrew increased exposure, when their own knowledge of international best practice, within the industry, dictates otherwise.

Conclusion

As a leading aviation radiation expert recognised by my scientific peers internationally and having represented the international pilot body (IFALPA) as regional vice president in Asia/Pacific and been in charge of their radiation committee from 2005- 2010, I can see no benefit to the aircrew body in Australia by an increase of these guidance levels.

In fact, conversely, I consider it a reduction in potential health benefits to the pilot and cabin crew group, especially in light of the fact of no regulatory compliance regulations and the increased flying in future years for Australian aircrew as outline in my introduction.

Ian Getley

Captain(Ret) Ian Getley J.P.

PhD, MSc, BSc (phys)

Cosmic radiation, aircrew and WHS obligation

David Chitty

Solar radiation exposure is an inflight hazard, which whilst rare in normal latitudes exposure, can be significantly increased in the polar-regions. The legislative requirement for an employer to monitor the health of employees, where identified hazards exist, is beyond doubt and includes those which occur inflight.

BACKGROUND

Cosmic radiation exposure is not a "new" workplace hazard. Increasingly, here in Australia, people are reminded of the dangers of solar radiation each and every day, for example the "slip, slop, slap" campaigns and the associated high-levels of reported melanoma and various skin cancers. However, one associated area that probably escapes the attention of the travelling public at large, and possibly domestic authorities, is the risk and hazard of excessive exposure to cosmic radiation caused by space-weather events, particularly during "solar highs",[1] such as the extreme event that occurred in 2012 and is only now (as of 25 July 2014) being reported in the public domain.[2]

Regulators, including aviation authorities and nuclear energy agencies, in many jurisdictions (except current Australian aviation legislation) have express requirements for airlines to *monitor* the radiation dosage their employees, specifically flight crew (frequent flyers may also be exposed in limited extreme cases), are exposed to during a defined reporting period, whether monthly, quarterly or annually, with maximum recommended exposure limitations outlined, especially for pregnant flight crew.[3]

These limits for individuals are recommended by the Australian Radiation Health Committee under the *Australian Radiation Protection and Nuclear Safety Agency Act 1998* (Cth), and are produced in Table 1 below:

Occupational exposure	Members of public exposure	Pregnant crew exposure
Maximum of 20mSv/yr (average max 5 years)	Maximum of 1mSv/yr	Maximum of 2mSv/yr (1mSv/yr occupational)

mSv/yr = milliSievert per year.

Examples of typical route exposure[4] are well documented and it is noteworthy how the southern latitudes (those flights where the most efficient routes take the aircraft into the south polar-regions) have the highest recorded dosage, as outlined in Table 2:

[1] The sun goes through cycles of high and low activity that repeat approximately every 11 years. Solar minimum refers to the several Earth years when the number of sunspots is lowest; solar maximum occurs in the years when sunspots are most numerous.

[2] Hannam P, "'Pushed Back to the Stone Age': Massive Solar Storm Missed Earth by Just One Week", *The Sydney Morning Herald* (25 July 2014), http://www.smh.com.au/environment/pushed-back-to-the-stone-age-massive-solar-storm-missed-earth-by-just-one-week-20140725-zwo0c.html.

[3] While Australian flight crews fall well below international limits for radiation dosage, greater caution must be exercised by pregnant crewmembers. A 1990 study by the International Commission on Radiological Protection (ICRP) recommends a limit for unborn children of 1mSv from the declaration of the pregnancy to full term: Civil Aviation Safety Authority, "In-Flight Radiation", *Flight Safety Australia* (1999).

[4] Australian Radiation Protection and Nuclear Safety Agency, *Cosmic Radiation Exposure When Flying*, Fact Sheet 27 (2011), http://www.arpansa.gov.au/RadiationProtection/Factsheets/is_cosmic.cfm.

Route estimates	Dose/Flight (μSv)	Flights for 1 mSv
Darwin-Perth	16	62
Perth-Broome-Darwin	8	131
Darwin-Singapore	9	107
Frankfurt-Singapore	39	25
Melbourne-Johannesburg	71	14
Melbourne-Singapore-London	65	15
London-Singapore-Melbourne	42	23
Sydney-Buenos Aires	68	15
Buenos Aires-Sydney	80	13
1 mSv = 1000 μSv		

Some comparative examples of international regulation include:

1. The Council of the European Union adopted Council Directive 96/29 Euratom (the Directive) on 13 May 1996. Article 42 of the Directive imposes requirements relating to the assessment and limitation of air-crew members exposure to cosmic radiation and the provision of information on the effect of cosmic radiation. Member States were required to implement the Directive by 13 May 2000.
2. Operators of public transport aircraft registered in Hong Kong shall, in respect of any flight by that aircraft during which it may fly at an altitude in excess of 26,000 feet, keep a record of the total dose of cosmic radiation to which the crew are exposed together with the names of that crew. The crew has the meaning assigned to it by Art 98(4) of the *Air Navigation (Hong Kong) Order 1995* (Hong Kong).

Note that the Federal Aviation Administration in the United States does not include specific requirements for cosmic radiation monitoring.

Australian environment

The current aviation legislative framework within Australia is a patchwork of antiquated Regulations and Orders dove-tailed with contemporary regulatory reform initiatives, known as the Civil Aviation Safety Regulations (CASRs),[5] which are subsequently supported by various complimentary documents, such as the Manual of Standards for various operational Parts, which are quasi-legislative in nature and provide detail and guidance on how operators and authorised persons satisfy the various CASR requirements.

To ensure compliance, an aircraft operator and/or individual (for example, the pilot-in-command) must interpret and navigate through legislation that is: struggling to keep up with technological advancements; being amended in a piece-meal manner; and new legislation that is struggling to transition from industry consultation stage to assent and implementation. The opportunities for statutory interpretation errors are not insignificant.

A detailed description and commentary on how aviation legislation is structured within Australia was provided by Stone and Moore JJ in *Heli-Aust Pty Ltd v Cahill*, where their Honours stated that:

> The [*Civil Aviation Act 1988* (Cth)] and Regulations together create a regulatory framework to ensure the safety of civil aviation. The Act "binds the Crown in right of the Commonwealth, of each of the

[5] See *Civil Aviation Regulations 1988* (Cth); *Civil Aviation Safety Regulations 1998* (Cth).

States, of the Australian Capital Territory, of the Northern Territory and of Norfolk Island" (s 5) and extends to foreign aircraft flying in Australian territory (s 7). It establishes the Civil Aviation Safety Authority (CASA). The role of CASA in maintaining air safety is addressed in detail in ss 9, 9A and 11.[6]

Under s 9(2) of the *Civil Aviation Act 1988* CASA also has the following *safety related* functions:

(a) encouraging a greater acceptance by the aviation industry of its obligation to maintain high standards of aviation safety, through:

(i) comprehensive safety education and training programs; and

(ii) accurate and timely aviation safety advice; and

(iii) fostering an awareness in industry management, and within the community generally, of the importance of aviation safety and compliance with relevant legislation;

(b) promoting full and effective consultation and communication with all interested parties on aviation safety issues.

The substantive question(s) that arose in *Heli-Aust* included: at what point does the Commonwealth legislation cease to "cover the field" (that is, regulating the safety of civil aviation) and the *Occupational Health and Safety Act 2000* (NSW) impose obligations for the control of a safe workplace?

The history of Commonwealth regulation of civil aviation and its connection with associated international obligations, the main object of the *Civil Aviation Act* with its emphasis on safety and on preventing air accidents, and the detailed provisions in the *Civil Aviation Act 1988* and CASRs concerning the regulation of air safety all suggest that the Act and CASRs are intended to regulate the safety of civil aviation in Australia comprehensively, and are not intended to operate in conjunction with State legislative schemes directed to the same end.

However, there are a number of additional obligations which may arise when transporting passengers in a civil aviation context; an aircraft is a place of work for many people, for example on an Airbus A380 there may (depending upon the operator) be in excess of 20 crew on board. Obligations relating to the monitoring of crew-health, discrimination and workplace bullying may also arise, which by their nature, sit outside of the Commonwealth aviation safety regulatory framework. Therefore, State legislation can extend its reach into the flight deck and cabin of aircraft in flight. This is where an operator or employers current obligations to monitor cosmic radiation dosage, an identified hazard in the workplace arises.

Civil Aviation Safety Regulations

The current aviation legislation framework does not expressly require aircraft operators to monitor radiation exposure of crew or passengers. However, cosmic radiation, as a hazard, is considered in an *operational* environment. For example, *Civil Aviation Order 82.0* (Cth), r 3BD.2 (CAO) which refers to Polar Operations[7] only with approval of CASA in accordance with Appendix 6. It is of interest to note that this Appendix includes the following requirement:

(d) a plan for mitigating flight crew and passenger exposure to radiation during solar flare activity.

Consequently, CASA has identified a potential hazardous exposure[8] that requires the aircraft operators to include mitigation plans for the periods of solar flare activity. The plans for this mitigation may include limiting the flight altitude to below 28,000 feet during periods of identified solar activity. For flights in the southern latitudes (for example, Australia to South Africa or South America) however, this altitude limitation imposes significant costs in additional fuel burn. Other options could include the installation of measuring equipment on the flight deck.

[6] *Heli-Aust Pty Ltd v Cahill* (2011) 194 FCR 502; [2011] FCAFC 62 at [8].

[7] Defined to be above 78°N or below 60°S (degrees latitude).

[8] Space Weather Prediction Centre – NOAA Space Weather Scale for Solar Radiation Storms – classifies events between 1 (minor) though to 5 (extreme), see http://www.swpc.noaa.gov/noaa-scales-explanation.

Civil Aviation Safety Regulations Part 119

The draft, *Civil Aviation Safety Regulation* (Cth), Pt 119 (Air Transport Operators – Certification and Management), which is currently waiting Notice of Final Rule Making, includes at Table 119.360, Item 20 (Retention Periods – Personnel Records) a requirement for operators to maintain radiation exposure records of flight crew:

> A record about cosmic radiation dosage for a flight crewmember or a cabin crew member required by regulation [121.685 – Note: Draft yet to receive industry comment]
>
> The period ending on the earlier of:
> (a) the end of 3 years after the record was created; or
> (b) 12 months after the day on which the cabin crew member ceases to be employed by the operator.

The specific aviation legislative requirement for the monitoring of flight crew exposure to radiation will eventually be found within *Civil Aviation Safety Regulation* (Cth), Pt 121 (High Capacity Air Transport Operations), however, the regulatory reform program is far behind schedule and a Parliamentary Review into Safety Regulation in Australia has published its Report containing 37 recommendations.[9] Industry is currently waiting for a government response.

Model WHS legislation

The *Work Health and Safety Act 2011* (NSW) (WHS Act) which came into force in NSW on 1 January 2012 requires a person conducting a business or undertaking to ensure, so far as reasonably practicable, the health and safety of workers and or other persons who may be put at risk by the business or undertaking. Section 19(1) provides that:

> (1) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the health and safety of:
> (a) workers engaged, or caused to be engaged by the person, and
> (b) workers whose activities in carrying out work are influenced or directed by the person,
>
> while the workers are at work in the business or undertaking.

The WHS Act then specifically requires at s 19(3):

> (3) … a person conducting a business or undertaking must ensure, as far as reasonably practicable:
> ...
> (f) the provision of any *information* … that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business and undertaking, and
> (g) that the health of workers and the conditions are *monitored* for the purposes of preventing illness or injury of workers arising from the conduct of the business or undertaking.[10]

Reasonably practicable test

Whilst the "new" WHS Act is in its infancy and an absence of authority exists in dealing specifically with s 19(1), a number of cases do exist which have considered similar provisions. This includes *Edwards v National Coal Board*, where Lord Asquith said:

> Reasonably practicable is a narrower term than "physically possible" and it seems to me to imply that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrificed involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and that if it be shown that there is a gross disproportion behaviour then – the risk being insignificant in relation to the sacrifice – the defendant's discharge the onus on them.[11]

[9] See Commonwealth, *Aviation Safety Regulation Review* (May 2014), http://www.infrastructure.gov.au/aviation/asrr/files/ASRR_Report_May_2014.pdf.

[10] Emphasis added.

[11] *Edwards v National Coal Board* [1949] KB 704 at 712.

Then in *Slivak v Lurgi (Aust) Pty Ltd*[12] Gaudron J set out three general propositions on the meaning of "reasonably practicable":

- The phrase "reasonably practicable" means something narrower then "physically possible" or "feasible";
- What is "reasonably practicable" is to be judged on the basis of what was known at the relevant time; and
- To determine what is "reasonably practicable" it is necessary to balance the likelihood of the risk occurring against the cost, time and trouble necessary to avert that risk.

The High Court stated in *Kirk v Work Cover Authority NSW* that:

> The measures which must be taken are those which are reasonably practicable. The term is not defined in the [*Occupational Health and Safety Act 1983* (NSW)], but it may often involve a common sense assessment.[13]

Applying these authoritative judicial tests to the obligations imposed by s 19 of the WHS Act where the provision of information and monitoring the health from adverse affects of exposure of employees to a recognised hazard (especially for pregnant flight crew), namely cosmic radiation exposure, it is reasonably practicable, weighing the *risk versus "money, time or trouble"* for an employer to implement a programme of radiation monitoring for its employees and procedures to follow should a crew member approach or reach the recommended maximum dosage.

Once the new *Civil Aviation Safety Regulation* (Cth), Pts 119 and Pt 121 become effective (however, who knows when!) the monitoring requirements (under aviation legislation) will be mandatory, but in the interim, State WHS legislation obligations *require* an operator/employer to ensure adequate monitoring and the provision of information to workers of this *inflight* workplace hazard.

David Chitty is barrister at Denman Chambers and has previously held a senior executive position at Qantas Airways Ltd as Head of Compliance and Industry Relations (Operations). David has also held industry positions on regulatory reform committees within the Civil Aviation Safety Authority.

[12] *Slivak v Lurgi (Aust) Pty Ltd* (2001) 205 CLR 304; [2001] HCA 6.

[13] *Kirk v Work Cover Authority NSW* (2010) 239 CLR 531; [2010] HCA 1 at [18].

Attachment 4 to
AusALPA Letter to ARPANSA
dated 02 March 2017

AUSALPA EDITORIAL COMMENTS ON PROPOSED GUIDE RADIATION PROTECTION IN EXISTING EXPOSURE SITUATIONS

AusALPA provides these comments as an interested party rather than an affected party, since ICRP 103 makes it clear that workers occupationally exposed to existing situations are to be managed under the constraints of **planned** exposure. ICRP 132 does not set aside that principle, rather it merely confirms the two necessary conditions: first, cosmic radiation is an existing exposure; and second, aircrew are occupationally exposed. All references to aircrew in this Guide are therefore inappropriate and based we believe to be a misreading of ICRP 132.

Title Page

"CONSULTATION DRAFT – DEC**ME**BER 2016"?

Foreword

Last paragraph, second sentence:

> "These exposure situations are ~~expected to be~~ dealt with by other publications in the RPS and supporting Guides."

1.2 Background

Line 7

The ICRP or Commission in this context is a singular collective noun – the first word should be "takes".

1.5 Interpretation

We find the sentence structure and its outcome to be awkward. While the Foreword in part explains that the Guide is the agreed Commonwealth/State advice, it does expand on the legal structure. Adding:

> "...however, it is not required to be complied with per se."

to line 46 unnecessarily begs the question "why not?". Our understanding is that each jurisdiction, whether Commonwealth State or Territory, regulates separately for radiation protection and that the Guide can only be a companion document to the legislation in each jurisdiction. We suggest that this section be briefly expanded along lines similar to the following examples, noting the relative simplicity of the relevant legislation:

> Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.
>
> Advisory Circulars should always be read in conjunction with the relevant regulations.

> Civil Aviation Advisory Publications (CAAP) provide guidance, interpretation and explanation on complying with the Civil Aviation Regulations 1988 (CAR 1988) or a Civil Aviation Order (CAO).

This CAAP provides advisory information to the aviation industry in support of a particular CAR 1988 or CAO. Ordinarily, the CAAP will provide additional 'how to' information not found in the source CAR 1988, or elsewhere.

Civil Aviation Advisory Publications should always be read in conjunction with the relevant regulations.

2.1 Principles for Protection

The use of bold font is not explained and appears to be inconsistent. For example, line 75 refers to three situations, two of which are subsequently bolded but the third is not. Similarly, line 82 refers to three principles, the first and third of which are subsequently bolded but the second is not. It is difficult to ascertain whether there is an intended pattern of emphasis or just a failure of proof reading. In any event, the outcome is confusing and therefore unacceptable.

Lines 102-105

Given that both the explanations of reference levels and dose limits refer to the applicable exposure situation, consistency demands that it should be clear that dose constraints apply in planned exposures (such as for aircrew occupationally exposed to cosmic radiation as per Table 4 of ICRP 103).

2.2 Identification of Existing Exposure Situations

Line 137

The example given of uranium workers creates an interesting comparison with aircrew. Data from *ANRDR in Review*. 2016 Edition, shows an occupational exposure generally less than aircrew that, without explanation, invokes a planned protection regime.

Figure 2.2

The inclusion of aircrew as a dot point is incorrect and demonstrates the "confirmation bias" that pervades the document – aircrew are not a radiation source. Cosmic radiation is the appropriate source.

3.2 Guidance for Public Exposure

Line 207

Who decides what is feasible and is it challengeable?

Line 213

Where is Section 1.4(a)?

Subsection 3.2.7

Why is there a cross-reference to a responsibility in the RPS C-1? If it is a responsibility deemed to be applicable in existing situations, why not set it out in its own right in this document without needing to procure the Code to check why three paragraphs give rise to one with 5 dot points?

3.3 Requirements for Occupational Exposure

Section 3.1 *General Guidance* sets out responsibilities specific to existing exposure situations but there is no mention of any specific "requirements in respect of occupational exposure in existing exposure situations". We are unsure of the intention behind lines 361-363.

In any event, it appears that ARPANSA rejects the ICRP recommendation set out in Table 4 of ICRP 103 and the associated discussion regarding the treatment of protracted occupational exposure in existing exposure situations as planned exposures.

Subsection 3.3.6

The sentence is grammatically incomplete and there is no "section" 2.2.3 in this document.

Subsection 3.3.8

AusALPA considers this paragraph represents a major policy failure by ARPANSA. The ICRP protection concept cannot work in the absence of exposure assessments and dose records. ARPANSA should be well aware that aircrew show few signs of uniformity of exposure and it is well established that we have cohorts of aircrew being exposed at around 6-6.5 mSv year^{-1} despite the propensity to cite average exposures without any mention of the relevant descriptive statistics. To suggest therefore that assessments only be conducted "where the doses of aircrew are likely to exceed the reference level" is not only illogical but also an abrogation of ARPANSA's own public health charter.

Optimisation is an individual control process – how is an operator expected to decide when a crewmember is likely to exceed the reference level/dose constraint if there is not a monitoring process already in place? How does an operator detect and manage the outliers if ARPANSA recommends a reference level/dose constraint that is significantly higher than their current exposure levels? Moreover, who audits the operator to ensure that their "likely to exceed" decision is sound and reasonable?

One of the significant reasons that so many of the world's aircrew support EURATOM's mandatory monitoring at 6 mSv year^{-1} is that it completely avoids this unedifying *laissez-faire* policy trap that ARPANSA has created in this subsection.

Figure 4.1

AusALPA reminds ARPANSA that the occasionally overbalancing emphasis on "the greater good" in the hands of "operating managers" is essentially a free ride for the managers in that the dollar costs borne by the operator are quite insignificant to the personal cost that may be faced by an effected worker. For most occupationally exposed workers, the concept of self-help is illusory – exercising exposure choices as an individual because your employer will not is largely incompatible with continued employment.

4.3 Aircrew Exposure to Cosmic Rays

At line 500, ARPANSA asserts:

> For Australia, a reference level of 10 mSv y-1 (see Annex A), is considered appropriate.

Given that ICRP offered a range from 5-10 mSv year^{-1} (which provided ample scope to retain the existing guidance of 6 mSv year^{-1}), on what basis did ARPANSA opt for the maximum? Was it the same science that sees uranium workers managed under a very tight regime despite an apparently lower annual dose or was it commercial pressure from the airlines to justify their lack of commitment to a safe workplace?

4.5 Transition from an Emergency Exposure Situation to an Existing 532 Exposure Situation

Termination of an Emergency

Most people would interpret the choice in this section to select a value “from the lower part of the reference band of 1-20 mSv y^{-1} as a long-term objective for existing exposure situations” as meaning to select a value something less than the midpoint of 10 mSv y^{-1}. This would hardly be logical in comparison with how ARPANSA views aircrew exposure levels.

Annex A

Annex A merely repeats an ARPANSA choice to recommend the maximum rather than a value more practically closer to actual exposure dose levels. On what scientific basis did ARPANSA determine that 10 mSv y^{-1} was an appropriate level, knowing full well that commercial pressures would prevent managers from selecting anything lower?

AusALPA notes the clear anomaly between the treatment of “legacy and post-accident sites” and of occupationally exposed aircrew: in the former, “a generic intermediate reference level of 10 mSv y^{-1} applies and revision of the intermediate reference level to improve the situation progressively is required”; whereas for the latter ARPANSA has increased the reference level by 160% with no requirement for any, let alone progressive, reduction.

-- END --