

COSMIC RADIATION AND AIR CREW EXPOSURE

JOINT AVIATION REQUIREMENTS OPERATIONALS
JAR-OPS 1.390 **COSMIC RADIATION**

INTRODUCTION

- JAR-OPS 1.390 THE REGULATORY FRAMEWORK APPLICABLE TO CIVIL AVIATION TO MANTAIN HIGH LEVEL OF SAFETY
- TO ENSURE FAIR COMPETITION IN THE INTERNAL MARKET
- MY PURPOSE IS TO SUGGEST FEW MODIFICATIOIS OF THE DIRECTIVE/JAR-OPS THAT I FIND DEFICIENT (safety, health)
- THIRD WORKSHOP ON COSMIC RADIATION AND AIR CREW, RISKS CONCERNED, EUROPEAN LEGISLATION
- FIRST IN LUXEMBURG 1991:
 - *Air crew have to be considered as occupational workers*
 - *Dose rate measurements for inercontinental flights (D.T. Barlett)(1)*

- SECOND CONFERENCE WAS IN DUBLIN 1998:
- *To assist Airline industry and regulatory organisations to comply with the European Union's B S S Directive 96/29 Euratom,*
- *Biological risk connected, (2)*
- *The same regulation in place for ground workers.*

EUROPEAN LEGISLATION

1990 EUROPEAN COUNCIL ESTABLISH JOINT COMMISSION ON CIVIL AVIATION

- PROMOTE COOPERATION b/n EUROPEAN COMMISSION, AIRLINE INDUSTRY, AIRPORT AND EMPLOYERS' ORGANIZATIONS
- CIVIL AVIATION SAFETY FOR PROTECTION AGAINST COSMIC RADIATION particularly required for working instruction (O.M)

EU BASIC SAFETY STANDARDS ON RADIATION PROTECTION

- BSS HEALTH PROTECTION against DANGER OF IONIZING RADIATION are layd down in COUNCIL DIRECTIVE 96/29 Euratom
- TITLE VII SPECIAL PROVISIONS EXPOSURE TO NATURAL SOURCES AT WORK PLACE: art. 42 of the Directive
- *To assess the exposure of the crew concerned,*
- *To take into account the assessed exposure when organizing working schedules with a view to reducing the doses of highly exposed aircrew,*
- *To inform the workers concerned of the health risks their work involves,*
- *To apply Article 10 to female air crew.*
- IN ORDER TO ASSIST MEMBER STATES GUIDANCE HAS BEEN PROVIDED IN A COMMISSION COMUNICATION (30/04/1998)
- THE COMMISSION REFERS TO TECHNICAL RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE TITLE VII OF EUROPEAN BSS in the (RADIATION PROTECTION 88) of 1997

Table 2 Hours exposure for effective dose of 1 millisievert
 Computer based estimates* made at heliocentric potential of 500 MV (towards the minimum of the solar cycle). The uncertainty on these estimates is about $\pm 20\%$

Altitude (feet)	Kilometre equivalent	Hours at latitude 60 °N	Hours at equator
27,000	8.23	630	1330
30,000	9.14	440	980
33,000	10.06	320	750
36,000	10.97	250	600
39,000	11.89	200	490
42,000	12.80	160	420
45,000	13.72	140	380
48,000	14.63	120	350

*using the program CARI - 3; a conservative conversion factor of 0.8 has been used to convert ambient dose equivalent to effective dose.

61 It should be noted that Table 2 is in terms of flying hours at a given altitude. Airlines generally work in terms of «block hours». These start when the aircraft is pushed back from its stand and finish when the engines are switched off after landing.

Apart from the time spent on the ground, the aircraft will take an hour in climbing to cruising altitude and descending again. Cruising altitude may vary during a flight. Block hours will exceed flying time at altitude in a way that depends on the details of the flight - in particular on its duration.

- Riding today the Table 2 we can remark an inaccuracy in the conversion factor of 0.8 to convert $H^*(10)$ to *Effective dose (E)*
- THE RIGHT FIGURE CONVERSION FACTOR IS 1.2-1.3 AT LEVEL ABOVE 30,000 Ft (Pelliccioni et al)

APPLICATION OF AIR TRANSPORT LEGISLATION TO COSMIC RADIATION

- COUNCIL REGULATION EEC 3922/91 ADOPTED IN 1991 TO HARMONIZED TECHNICAL REQUIREMENTS AND ADMINISTRATIVE PROCEDURES IN THE FIELD OF CIVIL AVIATION
- THE COUNCIL REGULATION LISTS REQUIREMENTS TO BE DIRECTLY ADOPTED IN THE JOINT AVIATION REQUIREMENTS (JAR)
- PRODUCED BY JOINT AVIATION AUTHORITY (JAA) FOR SAFETY AND SECURITY IN CIVIL AVIATION SECTOR AS THE JAR-OPS
- JAR-OPS ARE OPERATIONAL PROCEDURES WITH THE FORCE OF LAW IN THE COMMUNITY

• OPS 1.390

Cosmic radiation

- (a) An operator shall take account of the in-flight exposure to cosmic radiation of all crew members while on duty (including positioning) and shall take the following measures for those crew liable to be subject to exposure of more than 1 mSv per year;
 - (1) assess their exposure;
 - (2) take into account the assessed exposure when organising working schedules with a view to reduce the doses of highly exposed crew members;
 - (3) inform the crew members concerned of the health risks their work involves;
 - (4) ensure that the working schedules for female crew members, once they have notified the operator that they are pregnant, keep the equivalent dose to the foetus as low as can reasonably be achieved and in any case ensure that the dose does not exceed 1 mSv for the remainder of the pregnancy;
 - (5) ensure that individual records are kept for those crew members who are liable to high exposure. These exposures are to be notified to the individual on an annual basis, and also upon leaving the operator.
- (b)
 - (1) An operator shall not operate an aeroplane above 15 000m (49 000 ft) unless the equipment specified in OPS 1.680 is serviceable, or the procedure prescribed in OPS 1.680 is complied with.
 - (2) The commander or the pilot to whom conduct of the flight has been delegated shall initiate a descent as soon as practicable when the limit values of cosmic radiation dose rate specified in the operations manual are exceeded.

↪ **JAR-OPS 1.390 Cosmic radiation**

(a) An operator shall take account of the in-flight exposure to cosmic radiation of all crew members while on duty (including positioning) and shall take the following measures for those crew liable to be subject to exposure of more than 1 mSv per year (See ACJ OPS 1.390(a)(1));

(1) Assess their exposure

(2) Take into account the assessed exposure when organising working schedules with a view to reduce the doses of highly exposed crew members (See ACJ OPS 1.390(a)(2));

(3) Inform the crew members concerned of the health risks their work involves (See ACJ OPS 1.390(a)(3));

(4) Ensure that the working schedules for female crew members, once they have notified the operator that they are pregnant, keep the equivalent dose to the foetus as low as can reasonably be achieved and in any case ensure that the dose does not exceed 1 mSv for the remainder of the pregnancy;

(5) Ensure that individual records are kept for those crew members who are liable to high exposure. These exposures are to be notified to the individual on an annual basis, and also upon leaving the operator.

(b) (1) An operator shall not operate an aeroplane above 15 000m (49 000ft) unless the equipment specified in JAR-OPS 1.680(a)(1) is serviceable, or the procedure prescribed in JAR-OPS 1.680(a)(2) is complied with.

(2) The commander or the pilot to whom conduct of the flight has been delegated shall initiate a descent as soon as practicable when the limit values of cosmic radiation dose rate specified in the Operations Manual are exceeded. (See JAR-OPS 1.680(a)(1))

ANALYSIS and PERSONAL CONSIDERATIONS

- EVIDENT INTERVENTION OF “AEA” ON THE REQUIREMENTS (3)
- DIFFERENT TREATMENT OF AIR CREW COMPARED WITH GROUND WORKERS
- VAGUENESS DIRECTIVE FOR ACTIVE MONITORING ON A/C
- “RADIATION PROTECTION 88” HAS FEW GAPS:
- *Not correct conversion factor to convert $H^*(10)$ to (E),*
- *Not clear definition to identify the highly exposed air crew,*
- *No timing for more realistic assessments of dose with active monitoring (4)*
- FINAL RESULT PRACTICALLY DOING NOTHING FOR AIR CREW

MEDICAL SURVEILLANCE OF AIR CREW

- *of exposed workers shall be based on the principle that govern occupational medicine generally. (Art. 30 of Directive)*
- GENERAL RULE CAT “A” WORKER AT LEAST EVERY SIX MONTHS
- EXPOSED WORKER CAT “B” AT LEAST ONCE A YEAR (5)

- CARI 6 SOFTWARE DOES NOT ADEQUATELY DESCRIBE THE RADIATION EXPOSURE from Cosmic and Solar radiation as the other Computing Codes
- (6) ONLY GOOD TO ABOUT 30%, FOR SPE WRONG TO A FACTOR 10
- FOLLOW I. Mc AULAY SUGGESTION ON *realistic assessments are made in order to ensure appropriate protection for crew.....omissis.....*
- WOULD REQUIRE RADIATION MONITORS ABOARD FOR REAL TIME WARNINGS AND ACCURATE ESTIMATES FOR ANY GIVEN ROUTE (7)
- FURTHER, FOR SHORT VARIATIONS MAY ARISE FROM SOLAR FLARES
- CPT RESPONSIBILITY FOR SAFETY AND HEALTH PAX AND CREW TO INITIATE A DESCENT NOT TO EXCEED 1 mSv DURING SPE
- THIS POSSIBILITY seems to widely IGNORED BY THE REGULATIONS

IMAGE OF A SOLAR FLARE



- NEW DESIGN OF A/C for HIGHER ALTITUDE LONGER NON STOP AS FOR ULR ULTRA LONG RANGE FLIGHT OPERATIONS
- *“The increase dose will vary from 20 to 30% for flights conducted in the lower latitudes and significantly higher on polar routes”* Cpt. I. GATLEY Qantas
- BIOLOGICAL EFFECTS DEPEND NOT ONLY ON THE ABSORBED DOSE BUT ALSO ON THE TYPE AND ENERGY RADIATION, TISSUE INVOLVED AND RADIOSENSITIVITY OF THE WORKER
- UNDERESTIMATION OF RELATIVE BIOLOGICAL EFFECTIVENESS OF NEUTRON RADIATION: (8)
- *“Stable chromosome aberrations and ionizing radiation in Airline Pilots”*
Medical University of South Carolina, Sept. 2003
- *“Cromosomal aberrations in long-haul air crew members”* , May 2001
Department of Occupational Medicine and National Research Council, Roma
- *“Increased frequency of chromosome translocations in airline pilots with long-term flying experience”* Dec. 2008
National Institute for Occupational Safety and Health Cincinnati Ohio, USA

- GENERAL CONFERENCE OF “ILO” ADOPTS the C115 RAD. PROT. CONV.
- *All workers directly engaged in radiation work shall undergo an appropriate medical examination prior or shortly after taking up such work and subsequently undergo further medical examination at appropriate intervals.*
- IMPOSSIBILITY TO TOTALLY SHIELD A/C BECOMES NECESSARY TO EXTEND MED. SURV. TO CAT. “B” AIR CREW WORKER
- TO REDUCE COST BURDEN ACCEPT, WITH SMALL ADJUSTMENT AS WE HAVE ALREADY DONE IN ITALY, THE Mc AULAY PROPOSITION:
- *Air crew are already subject in most cases to a medical examination as an occupational requirement and this examination could be used to provide a suitable opportunity to explain the hazards of cosmic radiation and its relevance to air crew.*

CONCLUSIONS

- IF THE TASK OF EUROPEAN COMMISSION IS TO CONTINUE TO WORK WITH NATIONAL AUTHORITIES AND INDUSTRIES TO ENSURE A HARMONIZED APPROACH I HOPE CAN ACCEPT MY SUGGESTIONS:
- **ROUTINE MEDICAL SURVEILLANCE FOR AIR CREW AS FORESEEN FOR GROUND WORKERS BY GENERAL RULES, ILO, OCCUPATIONAL MEDICINE**
- **INSTALLATION OF RADIATION COMPACT MONITORS ON LONG RANGE AIRCRAFTS FOR REAL TIME WARNING AND FOR ACCURATELY ASSESS RADIATION RECEIVED**

- ART. 42 according to my suggestions should be amended as follow:

Article 42

Protection of air crew

Each Member State shall make arrangements for undertakings ...omissis...

- to asses the exposure of the crew concern using the active monitoring for long haul flights and passive monitoring for short haul flights,
- to take into account.....omissis.....
- to inform the workersomissis.....
- to apply Article 10omissis.....
- to apply medical surveillance for both categories A and B workers based on the principle that govern occupational medicine generally.