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European Aviation Safety Agency

COMMENT RESPONSE DOCUMENT (CRD)

CRD TO NPA 2010-14

RMT.0322 (FORMER OPS.055)

**Draft Opinion of the European Aviation Safety Agency
for a Commission Regulation establishing the Implementing Rules
on flight and duty time limitations and rest requirements
for commercial air transport (CAT) with aeroplanes**

and

**draft Decision of the Executive Director of the European Aviation Safety Agency
on Acceptable Means of Compliance and Guidance Material related to
the Implementing Rules on flight and duty time limitations and rest requirements
for commercial air transport (CAT) with aeroplanes**

**'Implementing Rules and Certification Specifications
on flight and duty time limitations and rest requirements
for commercial air transport (CAT) with aeroplanes'**

EXECUTIVE SUMMARY

This Comment Response Document (CRD) provides updated draft rule documents and responses to comments received on the NPA 2010-14 on flight and duty time limitations and rest requirements for commercial air transport (CAT) with aeroplanes.

The objective of task OPS.055, as required by the legislator, was to update the flight and duty time limitations and rest requirements (FTL) for CAT with aeroplanes taking into account recent scientific and medical evidence. To fulfil this objective:

- the flight and duty time limitations and rest requirements specified in EU-OPS¹ Subpart Q have been reviewed;
- the provisions for areas in EU-OPS Subpart Q currently subject to national provisions in accordance with Article 8.4 of Regulation (EC) No 1899/2006 (e.g. extended flight duty periods with augmented flight crew, split duty, time zone crossing, reduced rest and standby) have been suggested; and
- the use and role of fatigue risk management (FRM) and individual flight time specification schemes have been considered.

The Review Group which was set up to give expert advice to the European Aviation Safety Agency (hereafter referred to as the 'Agency') on this task met seven times during the comment review process to discuss the comments received on the NPA. The Agency also contracted three independent scientists to provide scientific input on the questions raised in the NPA and on a number of additional questions agreed upon with the Review Group members. Furthermore, a special meeting with the Advisory Group of National Authorities (AGNA) was convened in accordance with Article 7 of the Rulemaking Procedure².

The Agency has included in this CRD all existing Subpart Q FTL requirements as Implementing Rules (IRs). The changes to Subpart Q have been minimal and limited to issues where scientific evidence had identified a clear need for safety improvement.

As a result of the analysis of more than 49 000 comments received on the NPA, the consultation of the Review Group, the scientists' reports and the conclusions from the ad hoc AGNA meeting, the following changes to the initial proposals of the NPA are proposed:

- Unlike in the NPA, the CRD proposes Certification Specifications (CSs) for all the elements that were at the discretion of the Member States under EU-OPS (the so-called Article 8 provisions).
- The maximum daily flight duty period (FDP) for the most unfavourable starting times has been limited to 11 hours.
- A far more comprehensive set of rules addressing the effect of significant time zone crossing.
- The NPA's Guidance Material recommending spreading out duty periods evenly by including a cumulative duty limit for any 14 consecutive days has been upgraded and a binding limit of 110 hours in any 14 consecutive days has been introduced.
- Provisions to mitigate cumulative fatigue due to disruptive schedules have been added.

¹ Annex III to Commission Regulation (EC) No 859/2008 of 20 August 2008 amending Council Regulation (EEC) No 3922/91 as regards common technical requirements and administrative procedures applicable to commercial transportation by aeroplane.

² Management Board Decision concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ('Rulemaking Procedure'), EASA MB 08-2007, 13.6.2007.

- An additional type of standby — the so-called 'long-call standby' — has been introduced.
- To cater for unforeseen circumstances in actual flight operations arising before crew members have reported for duty, requirements for 'delayed reporting' are replacing the initially proposed rules for 'short-term re-planning'.
- The requirements for the extension of an FDP due to augmented flight crew have been refined. The rules for the extension of an FDP due to in-flight rest for cabin crew have been simplified; the time needed as in-flight rest for cabin crew to achieve the extended FDP is now simply a function of the type of in-flight rest facility and the duration of the planned extended FDP.
- Specific rules concerning home base are addressed in a CS. Initially the proposed rule foresees that the home base is a single airport location; however, deviation from the rule is permitted under Article 22.2 of the Basic Regulation³.
- Finally, reduced rest provisions have been tightened. The CRD proposal mirrors the current national practice of several Member States. Since the provisions are reflected in a CS, deviation will be possible under Article 22.2 of the Basic Regulation.

The Explanatory Note provides detailed information explaining the proposals as a support to potential commentators. Therefore, it should be read before placing reactions.

³ Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p.1), as last amended by Commission Regulation (EC) 1108/2009 of the European Parliament and of the Council of 21 October 2009 (OJ L 309, 24.11.2009, p. 51).

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A. Explanatory Note

I. Introduction

1. This CRD contains a summary of the comments received on the Notice of Proposed Amendment (NPA) 2010-14 on flight and duty time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes, which was published on 20 December 2010. This CRD also contains a revised rule text and an overview of the proposed changes.
2. The text of this CRD has been developed by the Agency, based on the comments received on the NPA, on the input of the OPS.055 Review Group and on the reports from three independent scientists⁴. It is submitted for consultation of all interested parties in accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.
3. When developing rules, the Agency is bound to follow a structured process as required by Article 52(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as the 'Rulemaking Procedure'.
4. The purpose of this Comment Response Document (CRD) is to develop an Opinion on the Implementing Rules on flight and duty time limitations and rest requirements for commercial air transport (CAT) with aeroplanes as well as a Decision on the related Certification Specifications (CSs), Acceptable Means of Compliance (AMC) and Guidance Material (GM). The scope of this rulemaking activity is outlined in the Terms of Reference (ToR) of rulemaking task OPS.055⁵, which is included in the Agency's 2010–2013 Rulemaking Programme.
5. The Agency is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation which are adopted as 'Opinions' [Article 19(1)]. It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process [Article 19(2)].
6. A Review Group of National Aviation Authorities (NAAs), airline, flight and cabin crew representatives supported the Agency in the review of the comments and in the preparation of the CRD. This Group was chaired by an independent advisor and included an observer from the European Commission. It met seven times during the period from April to November 2011. During these meetings the Review Group discussed the comments received on the NPA and the proposed changes to the rule.
7. With a view to receiving scientific input on the NPA 2010-14, the Agency issued a call for tender and contracted three independent scientists who provided three scientific reports on the questions raised in the Explanatory Note of the NPA and on an additional set of questions that had been prepared by the Review Group. The three scientists and the Review Group convened a 3-day meeting in May 2011 where the draft scientific reports (that had previously been sent to all Review Group members) and the scientists' answers to the questions were discussed in detail. Following these discussions, the three scientists submitted their final reports in late September 2011.

⁴ The reports from the three independent scientists are annexed to this CRD in section C.II.

⁵ [http://www.easa.eu.int/rulemaking/docs/tor/ops/EASA-ToR-OPS.055\(a\)_OPS.055\(b\)-00-20112009.pdf](http://www.easa.eu.int/rulemaking/docs/tor/ops/EASA-ToR-OPS.055(a)_OPS.055(b)-00-20112009.pdf)

8. The Agency has taken due account of the scientists' advice contained in their reports. The scientists' advice is separately listed in each of the comment summaries for each of the key topics of Section IV of this CRD.
9. Due to the large number of comments received, this CRD does not follow the traditional format: it was not technically possible to generate a CRD using the Agency's Comment Response Tool (CRT). Therefore, the Agency used the alternative method for processing all comments posted via the CRT: this CRD does not contain a response to each of the comments that have been sent to the Agency. Comments have been grouped according to subject together with a response to the grouped comments in Section IV of this CRD. A copy of the individual comments and a list of the commentators are provided in Section C.II and C.III of this document.

II. Scope

10. This CRD includes a proposal for Implementing Rules (IRs), Certification Specifications (CSs), Acceptable Means of Compliance (AMC) and Guidance Material (GM) on flight and duty time limitations and rest requirements for commercial air transport operations by aeroplanes other than air taxi, emergency medical service (EMS) and single pilot operations. The FTL requirements in general are the same for flight and cabin crew with few marginal differences.
11. Today's FTL requirements for commercial transportation by aeroplane are laid down in Subpart Q of EU-OPS⁶. They are the result of long-lasting negotiations based on operational experience of former national legislation. Therefore, the European Parliament and the Council when adopting Regulation (EC) No 1899/2006 specifically requested the Agency to conduct a scientific and medical evaluation of Subpart Q [ref.: Regulation (EC) No 3922/91, new Article 8(a)] and to assist the Commission in the preparation of regulatory proposals, if required:

'By 16 January 2009, the European Aviation Safety Agency shall conclude a scientific and medical evaluation of the provisions of Subpart Q and, where relevant, of Subpart O of Annex III. Without prejudice to Article 7 of Regulation (EC) No 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, the European Aviation Safety Agency shall assist the Commission in the preparation of proposals for the modification of the applicable technical provisions of Subpart O and Subpart Q of Annex III.'

III. Update on the process

12. The related Notice of Proposed Amendment (NPA) 2010-14, dated 20 December 2010, was open for a 3-month public consultation. By the closing date 20 March 2011, the Agency had received 49 819 comments from 2 715 individuals and organisations, including National Aviation Authorities (NAAs), professional organisations and private companies.
13. 46 957 comments out of the total 49 819 comments were placed by individuals. Of those individual comments some 98.6 % (i.e. 46 340 comments) originated from individual commentators who had identified themselves as crew members in airlines operating

⁶ Annex III of Commission Regulation (EC) No 859/2008 of 20 August 2008 amending Council Regulation (EEC) No 3922/91 as regards common technical requirements and administrative procedures applicable to commercial transportation by aeroplane.

under CAP 371⁷, the United Kingdom of Great Britain and Northern Ireland's (UK) flight and duty time and rest requirements. Of all individual comments 98.0 % (46 057 individual comments) were duplicates or near duplicates and an important number of comments was either assigned several times or to paragraphs not corresponding to the comment.

14. Next to the comments from individuals, 1 518 comments were placed by 28 crew organisations, 748 comments by 30 individual operators, 199 comments by 9 operator organisations and 397 comments by 12 NAAs.
15. All comments received on the NPA 2010-14 were reviewed, analysed for their relevance with regard to the proposed changes and summarised per rule paragraph. Due to the unprecedented high number of comments received, the Agency acquired an electronic text analysis toolkit designed by the University of Massachusetts for government agencies to deal with large amounts of comments on legislative proposals. This tool was used to identify duplicate comments and near duplicate comments and to sort comments according to the relevant paragraph. Comment summaries, related responses to summarised comments and the proposed revised rule text were discussed with the Review Group. The composition of the Review Group was based on the composition of the initial Rulemaking Group as regards the distribution of group members from different stakeholder groups. Group members that had resigned during the review phase were replaced following the rules of procedure for the membership of rulemaking groups. Seven meetings of the Review Group took place on the following dates:
 - 18 and 19 April 2010;
 - 17, 18 and 19 May 2010;
 - 7 and 8 June;
 - 14 and 15 September 2010;
 - 19 and 20 October 2010;
 - 9 and 10 November 2010; and
 - 29 November 2010.
16. A special meeting of the Advisory Group of National Authorities (AGNA) was convened in accordance with Article 7 of the Rulemaking Procedure on 24 October 2010 because some NAAs had expressed concerns in their comments regarding the NPA proposals on the maximum daily flight duty period (FDP) during night hours, the need for an additional 14-day duty limit, the need for additional provisions to compensate the effects of disruptive duty patterns, and on reduced rest provisions.
17. During this meeting representatives of National Aviation Authorities provided guidance to the Agency on the following 12 questions:
 - The maximum allowable daily flight duty period (FDP) at the most favourable time of the day.
 - The maximum allowable daily FDP at night.
 - The need to keep the 1-hour extension versus its integration into the basic maximum FDP.
 - The reduction of the maximum allowable daily FDP for more than 6 sectors (beyond Subpart Q).
 - The impact of the window of circadian low (WOCL) on the extension due to in-flight rest.
 - The impact of the number of sectors on the extension due to in-flight rest.
 - The possibility of using economy seats for in-flight rest.

⁷ CAP 371 The Avoidance of Fatigue In Aircrews, Guide to Requirements.

- The need to put an additional cumulative duty limit every 14 days to mitigate cumulative fatigue.
- The need for extended recovery rest periods to compensate for irregular patterns of work.
- The added value of reduced rest provisions as compared to split duty.
- The maximum duration of home standby and related mitigating measures.
- How to best integrate the need for operational flexibility in this proposal.

IV. Overview of the changes proposed

18. The responses to the comments were drafted by the Agency after consultation with the Review Group. The following paragraphs provide a summary of the comments and conclusions regarding the main topics that have been identified in the consultation process. All changes resulting from these main topics as well as from the other comments are provided in Section B, which includes the newly proposed rule. Given the large number of comments, Section C of this CRD refers to the link placed on the Agency's website which includes a document of all the comments placed. Section C also provides an overview of the commentators who placed their comments in the Comment Response Tool (CRT).

Implementing Rules and Certification Specifications

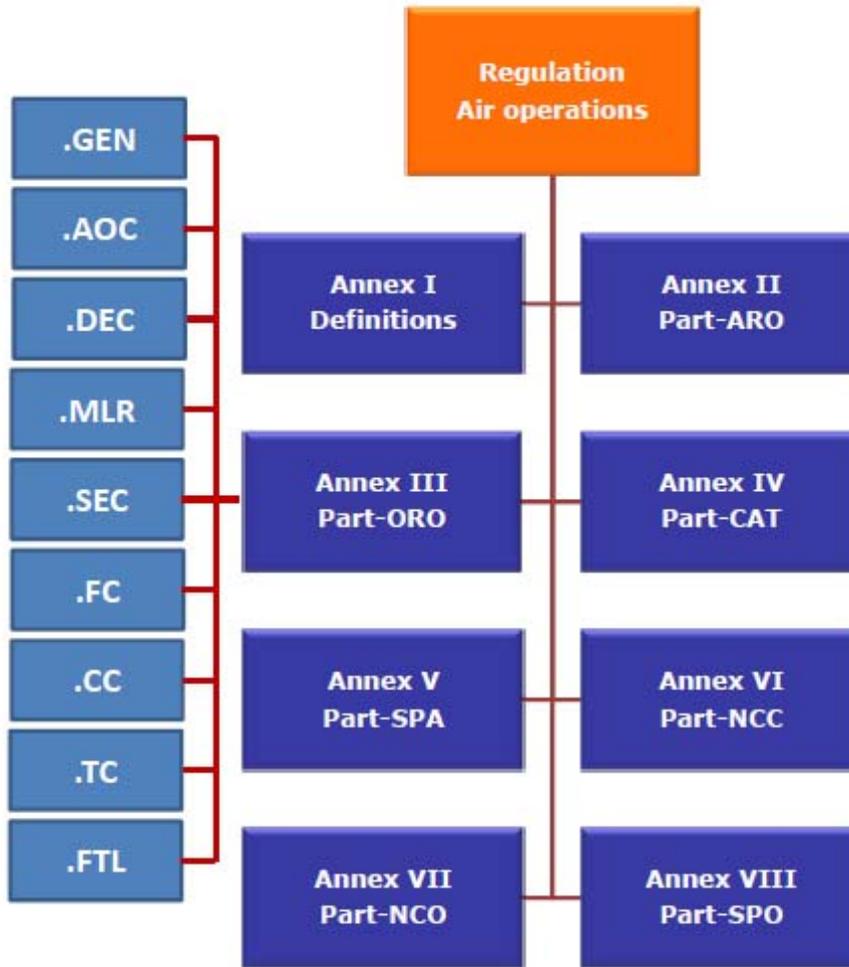
19. In the proposal of this CRD the Agency has included all the elements of the existing FTL requirements under Subpart Q as Implementing Rules (IRs).
20. The changes to Subpart Q have been minimal. The Agency proposed changes only to those parts of Subpart Q where scientific evidence has identified a clear need for safety improvement.
21. Subpart Q of EU-OPS did not harmonise all FTL provisions. Some elements of Subpart Q are currently left by Article 8(4) of EU-OPS to the national legislator 'until Community rules based on scientific knowledge and best practices are established', therefore leading to different national legal provisions across Europe. Unlike in the NPA, the Agency in this CRD proposes Certification Specifications (CSs) for all elements that were governed by national rules under EU-OPS. Therefore, the proposed rule for 'standby other than airport standby' and the definition of the relationship between airport standby and the assigned flight duty, split duty, additional rest to compensate for time zone differences, reduced rest and the extension of flight duty period due to in-flight rest foresees Certification Specifications (CSs) and is inspired by existing national rules, operational experience and scientific principles.
22. Since both Implementing Rules (IRs) and Certification Specifications (CSs) have to be complied with in their entirety, the proposed rule structure promotes a level playing field. Both the IRs and CSs will be the basis of operators' FTL schemes. In those cases where the operator can demonstrate an equivalent level of safety, and provided that the request for individual flight time specification scheme proposed by the operator has been endorsed by its competent authority and has passed the Agency's technical assessment based on a scientific and medical assessment, the CS provides for 'controlled flexibility'. This process is described in detail in Article 22 point 2 of the Basic Regulation.
23. This CRD foresees the CS approach in those areas where European harmonisation did not exist previously and where national rules differ widely. The prescriptive limit contained in a CS must always contain a reference to an Implementing Rule. This approach ensures for the first time a harmonised rule in those areas that were previously governed exclusively by national rules.
24. The CS approach is the result of the discussions of the Review Group and is in principle supported by the majority of the group members, including those representing National Aviation Authorities (NAAs).

Rule structure

25. All Organisation Requirements for Air Operations (Part-ORO) are contained in Annex III to the Regulation on Air Operations⁸. Annex III contains a subpart on flight and duty time limitations and rest requirements (Subpart-FTL).
26. Subpart-FTL, Section 1 of Annex III (Part-ORO) includes general provisions applicable to all commercial operators as well as non-commercial operators with complex motor-powered aircraft. It includes a definition section, addresses general operators' responsibilities and includes provisions on fatigue risk management.
27. Subpart-FTL, Section 2 of Annex III (Part-ORO) includes general provisions applicable to commercial air transport (CAT) operators with all aircraft types. It addresses in particular general requirements on home base, flight duty period, flight times and duty periods, positioning duty, split duty, standby duty, rest periods, nutrition and records.
28. Certification Specification (CS) FTL 1 contains specific flight and duty time limitations and rest requirements for commercial air transport by aeroplane — scheduled and charter operations. It includes the prescriptive details of the requirements contained in Section 2 and covers the requirements for the so-called 'Article 8' provisions.
29. The structure of the AMC and GM follows the structure of the IR; additional AMC and GM are proposed for CS-FTL 1.
30. It is important to note that Subpart-FTL, Section 2, as well as the Certification Specification FTL 1 does not apply to the following CAT operations:
 - a. air taxi operations meaning non-scheduled on demand commercial operations with an aeroplane with a passenger seating configuration of 19 or less;
 - b. emergency medical service operations;
 - c. single pilot operations and helicopter operations.These operations are therefore exempted from the proposed rules. Until the related Implementing Rules are adopted for such operations, Subpart Q of EU-OPS, the related national exemptions, as well as the Member States' national requirements will apply.
31. Additional rulemaking tasks will address detailed requirements for:
 - a. emergency medical services — RMT.0346 [former OPS.071(a)];
 - b. air taxi (including single pilot operations) — RMT.0429 [former OPS.071(b)]; and
 - c. commercial air transport operations with helicopter — RMT.0430 [former OPS.071(c)].
32. Further rulemaking tasks for Sole Night Operations and Ultra Long Range Operations (ULR) will follow.

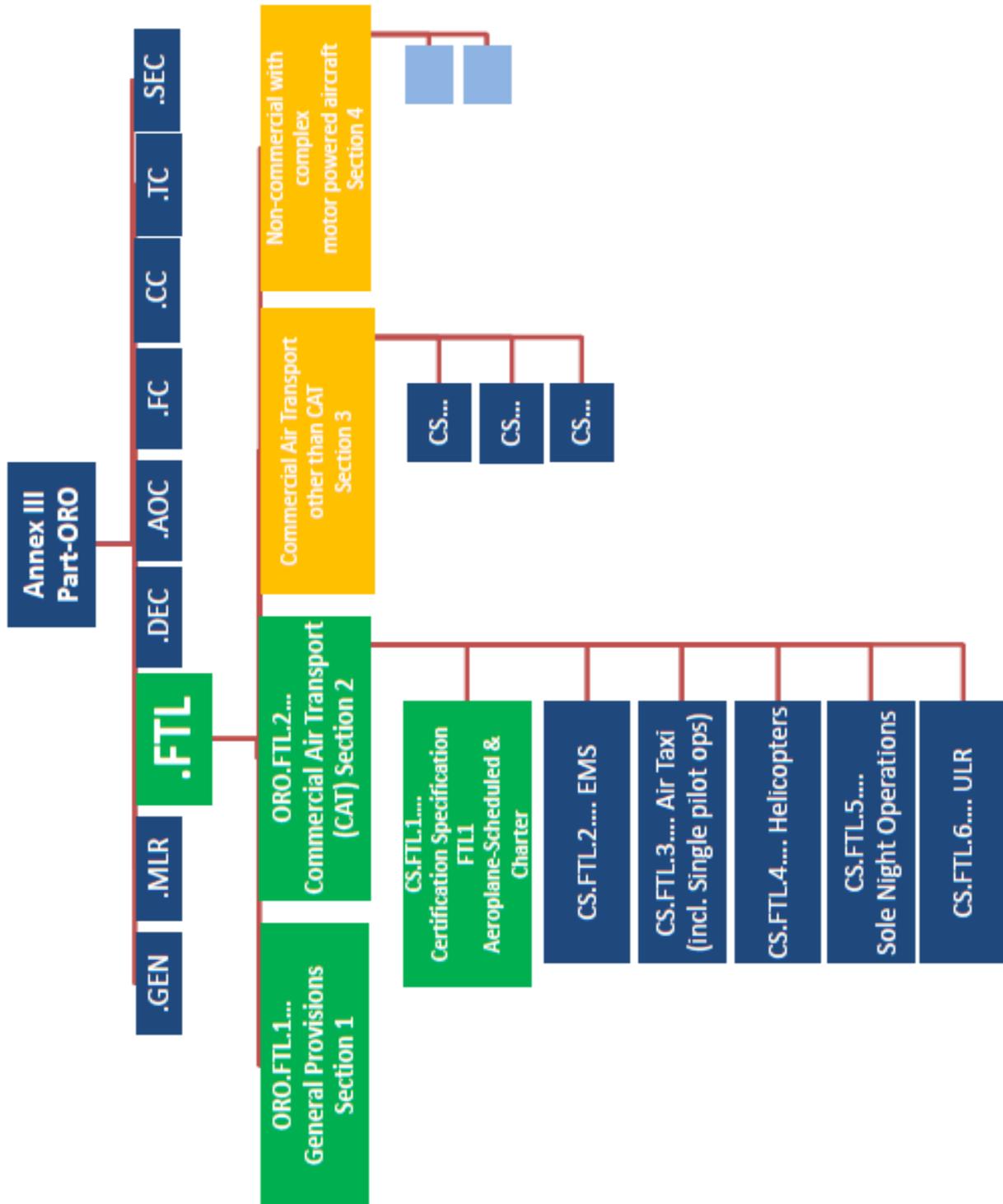
⁸ Opinion No 04/2011 of the European Aviation Safety Agency of 1 June 2011 for a Commission Regulation establishing Implementing Rules for Air Operations.

Table I.1: Overview of the rule structure 'Regulation on Air Operations'



.GEN: General requirements	Part-ARO: Authority requirements
.AOC: Air operator certification	Part-ORO: Organisations requirements
.DEC: Declaration	Part-CAT: Commercial Air Transport operations
.MLR: Manuals, logs and records	Part-SPA: Operations requiring specific approvals
.SEC: Security	Part-NCC: Non-commercial operations with complex motor-powered aircraft (CMPA)
.FC: Flight crew	Part-NCO: Non-commercial operations with other than CMPA
.CC: Cabin crew	Part-SPO: Special operations, e.g. aerial work
.TC: Technical crew in HEMS, HHO or NVIS	
.FTL: Flight and duty time limitations and rest requirements	

Table I.2: Overview of the rule structure 'flight and duty time limitations and rest requirements'



Definitions

33. The paragraphs of the Explanatory Note dedicated to definitions and the definitions themselves attracted many comments by all stakeholder groups. Especially individual commentators and crew organisations requested a number of additional definitions arguing that numerous sections of the proposed rules contained wording that lacked clear definitions. They particularly demanded definitions for the terms 'short-term re-planning', 'operational need', 'unforeseen circumstances', 'sufficiently in advance', 'satisfactorily free from fatigue', 'spread as evenly as possible' and 'satisfactory level of safety'.

Acclimatised

34. Commentators from all stakeholder groups criticised the proposed definition for 'acclimatised' for not being clear enough or not properly describing the phenomenon of circadian misalignment inherent to substantial time zone crossing. Since none of the comments had been substantiated with scientific or medical data, only little conclusions could be drawn from individual commentators' comments, crew organisations' comments or operator organisations' comments.
35. The scientific reports coincided that adaptation to the new time zone would not be complete after spending 36 hours free of duty or 72 hours conducting duties at the layover destination. The three scientists agreed in their reports that acclimatisation occurs gradually and depends on the time difference and the direction of the time zone transition. Normally adaptation to westward time zone transitions is easier.
36. The CRD takes account of the scientists' advice applying conservative maximum FDP limits whenever the state of acclimatisation is unknown.
37. If layovers at one destination are planned to be less than 36 hours it should be possible for crew members to remain acclimatised to their home base time zone.
38. Only for planned layovers of more than 36 hours, and depending on how many time zones have been crossed, un-acclimatisation or acclimatisation to the destination time zone shall be taken as reference for the maximum FDP values. Acclimatisation is only assumed after more than 60 hours of permanence in the case of 4 eastward or 5-6 westward time zone transitions or even longer permanence if more time zones are crossed.
39. If crew members change time zones with every flight and do not spend enough time at one layover destination to become acclimatised to the new time zone, they are assumed to be unacclimatised during the entire rotation.
40. The Agency believes that the complex context of acclimatisation is best reflected in a table that describes the state of presumed acclimatisation after time zone crossing taking into account the duration of the layover, the direction of time zone transitions and the time zones crossed.

Accommodation

41. Diverging views were expressed by commentators as regards the value of having a definition for *accommodation* and the content of the definition itself. While crew organisations insisted on introducing the clarification that an empty aircraft could not qualify as accommodation, operator organisations requested to explicitly include the possibility to use an empty aircraft as accommodation as long as all other criteria are met.
42. Only one Member State expressed that there was a clear need to exclude an empty aircraft as accommodation for the purpose of split duty or standby.
43. Many comments were received requesting to replace the 'possibility' with 'ability'. The intention of the definition is that the place should possess temperature control and the possibility to be obscured or illuminated as a minimum standard.

44. Individual commentators requested clarification that accommodation should be equipped with furniture to allow a comfortable stay of all crew members.
45. The Agency believes that there is no need to exclude an empty aircraft as accommodation as long as all other criteria are met. Accommodation should be equipped adequately to allow a comfortable stay of all crew members making use of the facility at one time. Therefore, the Agency amends the definition including a reference to a minimum standard of furniture in accommodation. The word 'possibility' has been changed to 'ability' in the CRD.

Air taxi operations

46. Very few comments were received regarding the definition of 'air taxi operations'. One operator organisation supported the definition as proposed. Two Member States asked for clarification if the mentioned 19-seat configuration was referring to the manufacturer's certified seating configuration of the aeroplane or the seating configuration in use by the operator. One Member State stated that the seating configuration was not relevant for the type of operation and that therefore the requirement related to the seating configuration should be removed.
47. This CRD does not include proposals for 'air taxi operations'. They will be addressed by the future rulemaking task RMT.0429 [former OPS.071(b)]. Therefore, the Agency does not see the need to change 'air taxi operations' before RMT.0429 starts.

Augmented flight crew

48. Comments regarding the proposed definition of 'augmented flight crew' should be analysed in connection with the definitions of operating crew member and the rules concerning in-flight rest.
49. Crew organisations and one Member State claimed that cabin crew should be included in the definition of 'augmented crew'. They stated that augmented cabin crew had to be carried to allow cabin crew members to leave their assigned post during the flight for the purpose of in-flight rest. They argued that resting cabin crew members should be replaced by suitably qualified cabin crew members and that as a consequence the cabin crew had to be augmented on flights with an extended FDP due to in-flight rest. They reasoned that cabin crew have responsibilities for maintaining safety within the cabin during all phases of a flight and that the minimum number of cabin crew for the operation of an aircraft is established by the aircraft certification.
50. The Agency disagrees that the scope of the proposed definition of augmented crew has to be broadened to include cabin crew. The number and composition of cabin crew is established in Annex III, Organisation Requirements for Air Operations (Part-ORO), ORO.CC.100. Therefore, the proposed definition remains unchanged.

Break

51. Crew organisations and one Member State suggested the word 'duty' in the definition of break to be replaced by the term 'flight duty' for more clarity. The word 'crew' should be complemented by 'member' to make clear that a break might also apply to a single crew member and not to full crews only. It was also suggested that a break should always be pre-planned. The extent to which pre-planning shall be a requirement for a period of time shorter than a minimum rest period to count as a break or flight duty is defined in the sections where rules on split duty use the term 'break'.
52. The Agency agrees and has amended the definition of 'break' for more clarity.

Crew member

53. One crew organisation suggested that the types of crew members, flight, technical and cabin crew should have their specific individual definitions.

54. The terms 'crew member', 'cabin crew member' and 'technical crew member' are defined in Annex I, Definitions for Terms used in Annexes II–IX. Therefore, the Agency concludes that there is no need to repeat the definitions of different types of crew members.

Duty

55. One operator pointed out that a duty a crew member had volunteered for should also count for cumulative limits and should be counted as duty. The word 'required' could be understood to exclude activities a crew member volunteers to perform for the operator.
56. Crew organisations and one Member State suggested the explicit inclusion of 'giving and receiving training' and 'checking' in the list of activities that should be considered as duty. One crew organisation suggested removing completely the list of activities. It was their view that any activity for the operator should be considered duty. Operator organisations and one Member State proposed specifying that only some elements of standby count as duty while crew organisations maintained that all standby types should count in full as duty.
57. The definition of duty has been changed by removing the word 'required' for more clarity. There should not be room for any doubt that a duty a crew member has volunteered for shall count as such.
58. The list of activities that shall count as duty is to be considered enumerative but not restrictive and gives indication of what are the typical tasks that shall be considered as duty. Any task that is not mentioned in the definition will count as duty.
59. The extent to which standby shall be counted as duty is regulated in the paragraphs corresponding to 'standby'.

Duty period

60. No comments were received.

Early start

61. Crew organisations and individual commentators proposed considering a wider time band for the definition of early start. There was no agreement amongst the commentators on the range of such a wider time band; the suggestions covered reporting times between 05:00 and 06:59 or 06:00 and 09:00 at home base and 06:00 and 08:00 out of base.
62. Individual commentators and crew organisations also criticised that the definition of early start was not used to limit the number of early starts in a defined period of time. Operator organisations expressed that the definition was superfluous because the effects of window of circadian low (WOCL) encroachment on the maximum FDP were already addressed.
63. Member States indicated that the definition of early start had to be linked to the time zone where the crew member is acclimatised. It was also suggested to make reference to 'crew member' instead of 'crew'.
64. Two Member States stated that the definition of early start should not only relate to flight duty periods but also to duty periods. They argued that reporting times before 07:00, if not 08:00, should be included to take better account of sleep reduction due to having to rise in the WOCL.
65. The three scientists concurred in their reports that the definition of early start should include reporting times between 05:00 and 06:59.
66. The Agency has amended the definition of 'early start' taking into consideration the scientists' recommendations to include a wider time band.
67. The word 'crew' has been replaced by 'crew member' to make clear that this definition refers to the individual and not to the entire crew.

68. Since the definition should be used to manage fatigue-related risks and not only flight duties that are fatiguing, the amended definition covers all duty periods starting in the defined time band. For more clarity reference is made to the time zone.

Eastward-Westward and Westward-Eastward transition

69. Two crew organisations asked for this definition to be removed. One operator suggested including also a definition for the term 'rotation' used in the definition. One Member State suggested making reference to the time zones crossed and not to the hours of time difference. It was also criticised that the reference point between alternating rotations was not clearly defined. Two Member States and one operator requested defining the home base as reference point between alternating rotations and to clarify that the additional night of rest as a consequence of such a transition should be taken at home base.
70. The Agency agrees that a new definition for the term 'rotation' is useful for better understanding. The definition of 'Eastward-Westward and Westward-Eastward transition' has been changed to make reference to the time zones crossed. Also home base has been introduced as the transition point.

Flight duty period (FDP)

71. Crew organisations requested including a certain amount of time at the end of any FDP for safety tasks to be completed after the end of the last flight. They also suggested including positioning, general training, administrative duties, airport standby and simulator training into the same duty period before a flight as an operating crew member.
72. As regards the relation between FDP and split duty, crew organisations argued that the definition of FDP should also cover the break in a split duty. Operator organisations, Member States and crew organisations expressed that the definition should make clear that an FDP always has to include a flight or series of flights. One Member State suggested aligning the definition with Subpart Q.
73. Post-flight duties are counted as cumulative duty and have an impact on the minimum rest after an FDP. The Agency does not see the need to include post-flight duties in FDP. The Agency also believes that the definition of FDP is in line with the definition in Subpart Q. For more clarity the word 'operating' has been added when referring to the crew member.

Flight time

74. Two Member States requested aligning the definition of 'flight time' with the definition of 'block time' in Subpart Q. They argued that the definition in Subpart Q had been in line with the definition of 'block flying time' in the Council Directive 2000/79/EC (Working Time Directive for Mobile Workers in Civil Aviation). They claimed that any minor change would lead to operators having to keep two sets of records. The change consists in fact that under the NPA definition 'flight time' would only have to be recorded if an actual take-off and landing (a flight) had taken place.
75. Crew organisations recommended establishing a link between 'sector', 'block to block' and 'flight time'. They argued that taxiing for a remote holding position should be regarded equally as taxiing with the purpose of taking off and after landing. They defended that any time during which engines are running should count as flight time for the purpose of cumulative flying time limits.
76. The Agency concludes that an additional administrative burden should be avoided for operators. The definition of 'flight time' should therefore be in line with the definition of 'block time' used in Subpart Q. The definition has been amended.

Home base

77. Crew organisations requested the words 'normally' and 'under normal circumstances' to be removed from the definition. They also requested to mention the permanent character of home base in the definition. They recommended home base to be a 'single airport location'. A number of crew organisations suggested to define 'normal circumstances' through the exception, that means the only case when an operator would have to provide suitable accommodation at home base for so-called back-to-back operations covered under FTL.1.235(b). One operator suggested including that also positioning and not only flight duty could start or end at home base.
78. One Member State proposed home base to be 'a *permanent* single location nominated by the operator from where the crew member starts and ends a duty period or a series of duty periods'.
79. The definition of home base remains unchanged. Conditions as regards permanency and changes of home base are given in the corresponding rules.

Late finish

80. Operator organisations pointed out that there wasn't any reference to 'late finish' in any of the rules in Chapter 2 or Appendix X, Section 1; they therefore recommended deleting the definition. As regards the restrictions that should apply to FDPs encroaching the WOCL, they argued that the reduction of FDP due to reporting time was covering the possible fatigue impact.
81. Crew organisations requested including arrivals between 23:00 and 01:59 at home base and arrivals between 00:00 and 01:59 out of home base into the time window of the late arrival. One crew organisation proposed to widen the window to start at 22:00; they substantiated their suggestion with the fact that the hours between 23:00 and 02:00 are considered to be the most valuable night hours for recuperative sleep.
82. One Member State recommended making reference to a crew member and not to 'the crew' for better understanding.
83. The three scientists agreed in their reports that the definition of late finish should start at 00:00 in order to properly take into account the sleep loss resulting from a late finish.
84. The Agency has amended the definition of late finish in line with the scientists' advice. In order to clarify that the definition refers to individual crew members, 'crew' has been replaced by 'crew member'.

Local day

85. No comments were received regarding the definition of local day.

Local night

86. Crew organisations proposed changing the definition of local night to 10 hours between 22:00 and 10:00. They argued that the intention of defining a local night was to allow for a full night's sleep of 8 hours. A definition of 8 hours between 22:00 and 08:00 would allow for starting times as early as 06:00. Starting as early as 06:00 could lead to a sleep loss of an average of over 90 minutes, reducing the recuperative effect of the night sleep.
87. The term 'local night' is used in rules related to the recurrent extended recovery rest period or in rules related to additional rest requirements related to disruptive schedules. Those rules provide compensation for cumulative sleep loss. The Agency concludes that there is no need to change the definition.

A single day free of duty

88. One Member State pointed out that the Working Time Directive for Mobile Workers in Civil Aviation⁹ (WTD) mandates 98 days off duty. One operator suggested standardising the terminology and avoiding non-defined terms such as 'day off'.
89. Crew organisations claimed that this definition suggested that days free of duty could only be assigned individually. They therefore requested renaming the definition to 'day off' or 'day free from duty'.
90. One operator recommended including a requirement for a number of days off per month or per 28-day period; they also encouraged to follow the CAP 371 model of defining a minimum duration of 34 hours for a day off. It was also requested to somehow combine the definitions of 'local day', 'single day free of duty' and 'minimum recurrent extended recovery period'. A different proposal suggested defining a single day free of duty as 'a time free of all duties consisting of a single day and two local nights and which may include a rest period as part of the day off. The minimum length of which is 30 hours'.
91. The Agency believes that it is helpful to include a reference to the WTD for completeness. The purpose of this proposal is the management of fatigue-related risks. Days off and annual leave are socially negotiated conditions that have an impact on fatigue; therefore, the Agency concludes that it is reasonable to include a reference to a single day free of duty although the rule text itself does not establish further requirements related to a single day free of duty.

Long-call standby

92. A new definition for long-call standby has been included (see also paragraphs 408 to 467 on 'other standby').

Night duty

93. Some crew organisations suggested aligning the definition of night duty with the definition of WOCL, proposing a time window that would overlap with the one defining early start. One operator stated that this definition should somehow make reference to a flight duty. A number of operators requested to delete the definition as it is useless, arguing that the effects of WOCL on FDP were reflected in the limitations of FDP according to the reporting time of an FDP.
94. Fatigue-related risks due to finishing late, starting early or working throughout the night must be managed. The Agency believes that clear definitions of what is an *early start*, a *late finish* or a *night duty* are relevant and should therefore remain in Section 1. In order to enable appropriate fatigue risk management it is also important to clearly distinguish the three different types of duties that might lead to sleep loss. Any night duty will lead to sleep loss, no matter if flight or other duty. Therefore the Agency concludes leaving the definition as proposed initially.

Operating crew member

95. One crew organisation requested that a crew member carrying out any type of training on a flight simulator should be considered as an operating crew member. A number of crew organisations asked for an additional definition of 'resting crew member' to make clear that a crew member during in-flight rest should not be counted as operating crew member.

⁹ Council Directive 2000/79/EC of 27 November 2000 concerning the European Agreement on the Organisation of Working Time of Mobile Workers in Civil Aviation concluded by the Association of European Airlines (AEA), the European Transport Workers' Federation (ETF), the European Cockpit Association (ECA), the European Regional Airline Association (ERA) and the International Air Carrier Association (IACA).

96. The definition, as proposed, covers any type of duty a crew member might be carrying out on board an aircraft. Therefore, the Agency does not see the need to amend the definition. In-flight rest is considered FDP and duty, therefore a crew member is still an operating crew member during in-flight rest. The Agency concludes that the definition as proposed is clear enough.

Positioning

97. Two Member States suggested changing the word 'request' back to the initial word used in the Subpart Q definition 'behest'. They argued that the word *behest* is stronger and does not imply that there is an option as opposed to *request* which implies that compliance is optional. They also proposed including an additional definition for 'travelling time' in order to keep the Subpart Q definition.
98. Crew organisations pointed out that the excluded time for local transfers from a place of rest outside the home base and vice versa should not exceed 1 hour for a round trip. Any time exceeding this 1-hour limit should be counted as positioning and has therefore an impact on the maximum FDP if taking place before the crew member acts as operating crew member and should count as duty if taking place after the last flight of that crew member performing as acting crew member.
99. The Agency agrees that the word 'behest' as in Subpart Q describes more clearly that compliance is not optional. Further details are reflected in the corresponding rule paragraphs.

Rest facility

100. Some Member States suggested clarifying in the definition that only in-flight rest was referred to with the definition of *rest facility* as opposed to 'accommodation' or 'suitable accommodation' for the purpose of breaks in split duty or as used in airport standby. They therefore proposed changing the name of the definition to 'in-flight rest facility'. Another Member State emphasised that reference should be made to in-flight rest specifying that a 'class 2 rest facility' should at least recline 60°, they furthermore requested to exclude the possibility that a 'class 3 rest facility' could be located on the flight deck.
101. Operator organisations explained their need to include a definition for an additional 'class 4 rest facility' to allow for in-flight rest in common tourist class seats, provided they are separated from the passengers by a curtain and the adjacent seats up to the aisle are left un-occupied by passengers. One operator organisation suggested defining 'class 3 rest facilities' as a common economy seat in a special configuration as described and currently in use in one Member State for in-flight rest on board single aisle aircrafts with neither bunks nor business class seats nor any other seats that meet the criteria of class 3 rest facilities. One operator also requested adding that the curtain to separate the rest area from the rest of the cabin was only needed when passengers are carried. Another operator pointed out that in occasions light controls in bunk rest facilities could be unserviceable. They suggested changing the wording in a way that would allow for the flight to operate with an extension if the light control was not available. Operator organisations also stated that the definitions in the proposal were not fully in line with the definitions given in the TNO report.
102. Some operators' comments stated that the Agency had not produced scientific evidence against the use of economy seats for in-flight rest for cabin crew and that such practices could be subject to FRM.
103. Crew organisations criticised that the definition did not include the requirement for the rest facility to be free from any disturbance from passengers or operating crew members. One crew organisation commented that any reference to rest should be avoided for class 2 and class 3 rest facilities because the likelihood to sleep in such a seat is minimal.

104. The scientists agreed in their reports that there was no scientific evidence to support that rest taken in ordinary economy seats would allow for restorative sleep and could therefore justify an FDP extension.
105. In line with the scientists' view the Agency is not convinced that in-flight rest arrangements in economy seat allow for recuperative sleep in order to allow for an FDP extension due to in-flight rest. The Agency revises the definitions to be in line with the TNO report. In the amended definition a reference to the rest facility being on board an aircraft has been included.

Rest period

106. Individual commentators requested clarification of the link between 'a single day of duty and a rest period'. One Member State suggested keeping the wording from Subpart Q, emphasising in the definition that a rest period has to be *uninterrupted*.
107. The definition of a single day free of duty has only been included for completeness and as a reference. The important concept in terms of fatigue risk management is rest. The Agency agrees that rest should be uninterrupted and accepts re-introducing the word 'uninterrupted' as in Subpart Q.

Rotation

108. A new definition for rotation has been added following the request made by a commentator in comments on the definition of Eastward-Westward and Westward-Eastward transition.

Short-call standby

109. A new definition for short-call standby has been added.

Agency's conclusions on definitions

110. A more conservative limit for maximum FDP shall be applied when the state of acclimatisation is unknown. The state of acclimatisation shall be reflected in a table replacing the definition.
111. An empty aircraft is not excluded for use as accommodation as long as all other criteria are met. The criteria for adequate equipment are refined in the revised definition.
112. The definition of 'augmented crew' remains unchanged.
113. Editorial changes have been made to the definition of 'break'.
114. The different types of crew members are defined in Annex I to the Regulation on Air Operations.
115. The extent to which standby shall count as duty is established in the paragraphs describing 'standby'. The definition has been amended for clarity but remains unchanged in substance.
116. The definition of 'early start' has been amended following the scientists' recommendation. Editorial changes have been made for more clarity.
117. A new definition for 'rotation' has been included. The amended definition of 'Eastward-Westward and Westward-Eastward transition' uses the home base as reference point and refers to 'time zones crossed' instead of 'hours'.
118. The word 'operating' has been added to the definition of 'flight duty period' when referring to crew members for more clarity.
119. The definition of 'flight time' has been amended to avoid additional administrative burden for operators.

120. The definition of 'home base' remains unchanged; clarifications as regards the conditions that shall apply are given in the corresponding rule paragraphs.
121. The definition of 'late finish' has been amended according to the scientists' advice. An editorial change has been introduced for clarity.
122. The definition of 'local night' remains unchanged.
123. The definition of a 'single day free of duty' remains unchanged.
124. A new definition for 'long-call standby' has been added.
125. The definition for 'night duty' remains unchanged.
126. The Agency does not see the need for an additional definition of 'resting crew member'; the definition of 'operating crew member' remains unchanged.
127. The word *request* in the definition of 'positioning' is replaced by *behest*.
128. The revised definition of 'rest facility' has been aligned with the specifications given in the TNO report¹⁰. It has also been included that the rest facility is on board an aircraft.
129. The Agency accepts the proposal to re-introduce the word *uninterrupted* in the definition of 'rest period'.
130. The Agency has added a new definition for the term 'rotation'.

Operator responsibility

131. Crew organisations stated that operator responsibilities should be applicable for all types of CAT operations; they therefore suggested deleting 'where applicable to the type of operation'. This view was shared with one Member State. One operator organisation on the other hand endorsed the wording as proposed.
132. Crew organisations also criticised that the Subpart Q binding requirement for operational robustness had been moved to AMC. In addition to their request to upgrade AMC1-OR.OPS.FTL.110 (i) Operator responsibilities to be an IR, they suggested including a new GM stating that flight should be planned allowing for at least a buffer of 30 minutes between the maximum FDP and the planned duration of the flight to ensure that minor delays do not require an excessive and repeated use of commander's discretion. They also stated that the 33 % criterion was not effective; they suggested refining AMC1-OR.OPS.FTL.110 (i) and requiring corrective action to be taken earlier.
133. One crew organisation suggested amending the provisions including a requirement for adequate timing of the rest periods to enable recuperative sleep in point (f) OR.OPS.FTL.110 Operator responsibilities. They furthermore requested extending the obligation to provide appropriate rest to crew members not only before undertaking the next flight duty but also before any other type of duty.
134. Many crew organisations requested operator responsibilities to be regulated more prescriptively. They also suggested including a catalogue of the Agency's sanctions for those operators not fulfilling their responsibilities. Crew organisations found the expression 'sufficiently in advance' vague and proposed replacing it with a prescriptive limit, namely '14 days in advance'.
135. The Agency's proposal for IR and AMC describing operator responsibilities triggered a wide range of operators' comments. Operator organisations stated that the AMC to OR.OPS.FTL.110 Operator responsibilities (a) was driven by a social agenda. They also requested to distinguish between monthly rosters, and rolling weekly and monthly rosters. Another operator claimed that roster changes should be possible with a 72-hour notification period.

¹⁰ Extension of duty period by in-flight relief, M. Simons & M. Spencer, 20007

136. One Member State stated that there was no safety case or scientific evidence to maintain OR.OPS.FTL.110 Operator responsibilities (a), and also requested to keep Subpart Q OPS 1.1090 2.3.
137. Crew organisations and one Member State on the other hand found that the publication of rosters 14 days in advance should be a firm requirement in the IR.
138. Two operators from different countries supported the text of OR.OPS.FTL.110 Operator responsibilities as proposed.
139. One operator recommended using only one definition of 'day off' throughout the entire documents referring to the requirement in OR.OPS.FTL.110 Operator responsibilities (g). They suggested using the CAP 371 definition of single day off as 34 hours including 2 local nights. One Member State suggested replacing 'local days free of duty' by 'extended recovery rest period'.
140. One operator proposed an alternative AMC to AMC1-OR.OPS.FTL.110 (a) to suit their specific type of operation.
141. Another operator claimed that the proposal did not acknowledge the difference between scheduled and on demand operations.
142. One Member State found the expression 'sufficiently free from fatigue' subjective and proposed deleting point (b) OR.OPS.FTL.110 Operator responsibilities to avoid misinterpretation. Another Member State recommended defining the term 'well-rested', used in OR.OPS.FTL.110 Operator responsibilities (f). Member States also stated that 'seasonal period' and 'significant proportion' should be defined or explained in AMC to enable objective regulatory oversight of AMC1-OR.OPS.FTL.110 (i) Operator responsibilities.
143. Another Member State suggested including a requirement for operators to include applicable maxima for FDP and duty in published rosters to facilitate the commander's assessment in the case of commander's discretion.
144. Stakeholders from all stakeholder groups suggested rephrasing OR.OPS.FTL.110 Operator responsibilities (b) for better understanding.

Agency's conclusions on operator responsibility

145. The Agency agrees that operator responsibilities shall apply to all types of CAT operations; however, rules shall be proportionate. Therefore, the first sentence of ORO.FTL.110 Operator responsibilities remains unchanged.
146. ORO.FTL.110 (b) has been amended for better understanding.
147. The Agency does not see the need to define the term 'well-rested'; however, in order to avoid misunderstandings, ORO.FTL.110 Operator responsibilities (f) has been amended and 'well-rested' has been replaced with 'rested'.
148. Although an ORO.FTL.110 Operator responsibility (g) has been transposed from Subpart Q, the Agency agrees that additional undefined terms should be avoided. Therefore, 'local days free of duty' has been replaced by 'recurrent extended recovery rest period'.
149. The prescriptive requirement to change a schedule or a crewing arrangement if the actual operation exceeds the maximum flight duty period on more than 33 % of the flights during a scheduled seasonal period stems from Subpart Q. The Agency has therefore transposed this requirement into an implementing rule. The requirement has been moved from AMC to IR, therefore ORO.FTL.110 (i) has been amended accordingly.
150. The Agency maintains the requirement to publish rosters 14 days in advance as an AMC. The principle of this rule stems from Subpart Q, meaning that this is not a new requirement. The AMC proposes one (but not the only one) means to comply with the rule. AMC1-ORO.FTL.110 (a) Operator responsibilities remains unchanged.

Crew member responsibility

151. Operator organisations criticised that crew member responsibilities had not been mentioned in Chapter 1 of ORO.FTL. They emphasised on the individual responsibility for crew members not to perform duties whilst unfit due to fatigue¹¹.
152. Crew member responsibilities include the obligation to comply with the appropriate flight time limitations of the operator based on paragraph 7.f and 7.g of the Essential Requirements. Crew members are required not to perform duties on an aircraft if they know or suspect that they are suffering from fatigue. At the same time, crew members who are subject to the FTL limitations of more than one operator are required to inform each operator about their activities. Crew member responsibilities have been transposed into CAT.GEN.MPA.100 Crew responsibilities of Annex IV Part-CAT of the Agency's Opinion 04/2011.
153. In addition to the crew member responsibilities established in CAT.GEN. MPA.100, crew members should make optimum use of the opportunities and facilities for rest provided and plan and use their rest periods properly.
154. The Agency accepts that crew member responsibilities should be reflected. Therefore, a new paragraph ORO.FTL.115 *Crew member responsibilities* has been introduced in Chapter 1. This paragraph refers to CAT.GEN.MPA.100 and introduces an additional point transposing the requirement 'to make optimum use of the rest opportunities and facilities for rest provided and plan and use their rest periods properly', stemming from EU-OPS.

Fatigue risk management & fatigue management training

Fatigue risk management

155. The proposed Implementing Rules and corresponding AMC and GM regarding fatigue risk management (FRM) triggered numerous comments from stakeholders. While the general idea of implementing FRM to deviate from prescriptive rules is widely supported, only crew organisations from one Member State reject the use of FRM. It is their view that prescriptive FTL schemes based upon scientific principles and knowledge are supposed to be safe. They do not see the need to additionally monitor the risk(s) arising from crew member fatigue with FRM. They also believe that the provisions laid down in Article 14 of the Basic Regulation provide a sufficient level of flexibility.
156. The majority of operator organisations defended that FRM had no place within operations under a prescriptive FTL scheme. However, stakeholders from all stakeholder groups widely suggested a 'copy-paste' inclusion of the ICAO Annex 6 provisions on fatigue management. Only when deviating from the prescriptive FTL schemes, according to their view, FRM as an integral part of the operator's management system should be used to manage the operational risk(s) of an operator arising from crew member fatigue. Some operator organisations also suggested applying FRM provisions only to the specific elements of the FTL scheme (or specific flights) which deviate from the prescriptive FTL rules.
157. Crew organisations questioned the effectiveness of FRM managing fatigue-related risk(s) applying FRM in isolation to just some of the specific elements proposed in the NPA to be allowed under FRM.
158. Crew organisations and one Member State requested to fully incorporate the ICAO's Annex 6, Part I, Chapter 4, Article 4.10.6 into OR.OPS.FTL.115. Some crew organisations also suggested exactly copying the ICAO Guidance on Fatigue Risk Management System Requirements into the corresponding IRs. Another crew organisation and one operator

¹¹ Point 7.f & g of Annex IV to the Basic Regulation.

criticised that 'self-reporting of fatigue risks' had been omitted when reproducing the possible identification methods of hazards in AMC1-OR.OPS.FTL.115(d)(2)(i).

159. Where the NPA envisaged FRM to manage the potential risks arising from crew member fatigue identified with mathematical fatigue modelling in certain types of operations (e.g. extended FDP overlapping the WOCL), some operator organisations recommended additional mitigating measures such as extended pre and post-flight rest instead of FRM.
160. A number of Member States commented on the proposals concerning FRM. Some of them believe that FRM, as an execution programme of an operator's SMS, should be mandatory. They requested this to be reflected in hard law in order to fulfil the ICAO standards.
161. Member States defending this view agree that an FRM needs to be approved and monitored by the competent authority. Some Member States even propose considering the possibility to enforce the establishment of a *Fatigue Risk Policy* on all CAT operators if a full FRM is not required for operations within the prescriptive limits.
162. The following aspects of a flight time specification scheme were identified by stakeholders as potential areas where FRM would be necessary to operate outside conservative prescriptive limits:
 - consecutive early starts;
 - consecutive night duties;
 - extended duties between 18:00 and 06:59; and
 - deviation from a 100-hour duty in a 14-day limit.
163. In addition, two areas were highlighted where FRM would be a useful tool:
 - extension of FDP due to in-flight rest for cabin crew; and
 - reduced rest.
164. Other Member States insisted on the requirement for FRM only to deviate from the prescriptive limits or as an additional tool to assess complex flight time specification schemes.
165. The scientific assessment of the NPA resulted in general agreement amongst the three scientists that:
 - FRM should play a more important role in FTL; and
 - training for all crew members was a core element of FRM.
166. Two scientists advocated the use of FRM also within the prescriptive limitations as a way to manage safety in the framework of the Airline Safety Management System. They especially highlighted that the following fatigue-related risks could efficiently be addressed through FRM:
 - commander's discretion;
 - short-term re-planning;
 - some aspects of standby;
 - extended FDP due to in-flight rest;
 - time-off-day effects on the effectiveness of in-flight rest in augmented crew operations;
 - number of sectors in augmented crew operations;
 - split duty;
 - reduced rest;
 - extended FDP in general; and

- consecutive early starts and night duties

167. The scientists also supported the ICAO approach of allowing deviations from prescriptive limits only under an authority-approved FRM.

Fatigue management training

168. The NPA requirement for fatigue management training was welcomed by crew organisations and Member States.

169. Crew organisations suggested prescribing a minimum duration of 5 hours for the initial fatigue management training. One crew member organisation also proposed adding a point concerning *responsible commuting* to AMC1-FTL.1.250.

170. Two Member States suggested an additional requirement to keep records of the fatigue management training including a measure of competence. The same Member States also recommended recurrent training at least every 24 months.

171. Operator organisations did not see at all the need for fatigue management training. They stated that fatigue management training was only justified when a deviation from prescriptive FTL made FRM necessary. In that case, they argued, the fatigue management training should be comprised of detailed instructions to crew, operations and rostering staff on the application of the elements of the FTL system for which FRM was applicable. The Agency's proposal to extend fatigue management training to crew rostering personnel and concerned management personnel was also opposed by operator organisations. They stated in their comments that they could not see the safety justification for such a training to be delivered to personnel qualified to apply FTL rules and collective labour agreements in order to produce legal rosters.

172. Other operator organisations suggested re-naming the paragraph concerning fatigue management training to 'fatigue management awareness' in order to avoid false expectations from crew members.

173. One operator found it illogical to mandate comprehensive FRM training for operators operating within the limits of prescriptive FTL without requiring the means to put the knowledge into effective practice.

Agency's conclusions on fatigue risk management and fatigue management training

174. The Agency believes that FRM provisions are an indispensable part of this proposal. Although FRM is only mandatory when operators intend to benefit from more relaxed limits in limited areas of the proposed flight time specification scheme, the conditions that have to be complied with in order to do so have to be described in detail.

175. The Agency accepts that its FRM provisions should assist Member States to comply with the ICAO requirements. ORO.FTL.120 has been amended to reflect the ICAO requirements.

176. The content of the ICAO Appendix 8 is reflected in the AMC. Although the AMC is often referred to as soft law, regulated persons should apply AMC to demonstrate compliance with the IR.

177. Opinion 04/2011 ORO.MLR.115 Record-keeping (c) contains requirements regarding personnel records. Crew member training, checking and qualifications shall be stored for 3 years and the last 2 training records of other personnel for whom a training programme is required shall be stored.

178. Self-reporting of fatigue risks has been included under (a) in AMC1-ORO.FTL.120(d)(2)(i) Fatigue Risk Management (FRM) to match the ICAO requirements.

179. Operators are responsible to manage all operational risks, including those arising from crew member fatigue. The Agency believes that compliance with prescriptive FTL is not always enough to guarantee that crew members remain sufficiently free from fatigue so

that they can operate to a satisfactory level of safety under all circumstances. Fatigue management training will increase awareness and shall help identify possible fatigue-related hazards, even in operations entirely compliant with prescriptive FTL.

180. The wording of ORO.FTL.250 Fatigue management training has been adapted for editorial reasons. A reference to the recurrent character of the training has been included.

Home base

181. The elements on home base and in particular the issue of multiple home bases attracted many comments. The main concerns expressed by the commentators were on the concept of a home base within a multiple airport system as opposed to a single home base and the possibility for operators to change crew members' home base several times per year. Most commentators criticised the possibility of multiple home bases. In their view a single home base would still enable the operator to assign crews to different airports, but this would require crew members to travel in their own time and during their own minimum rest period leading to decreased rest time and increased fatigue. Those commentators did not see any justification for multiple airport systems and are worried about changes of the home base, which in their view would mean that the crew member would have to sacrifice part of their rest time in-between duties to travel to the next home base. This, they argue, would decrease rest time and ultimately increase fatigue.
182. The majority of the commentators requested that there should be a limit of changing a home base of once a year, and that there should at least be an AMC to establish how many changes of home base per year are acceptable. Those commentators referred to the ICAO Annex 6 (4.4.5) which states that the home base should be assigned with a degree of permanence.

Current definition of home base in EU-OPS is sufficient

183. Few commentators from operator organisations argued that the existing definition of a home base contained in *OPS 1.1095* is fully sufficient and that the additions contained in the NPA are of no safety benefit and should therefore be decided by collective bargaining. Member States stated that the current home base definition in EU-OPS is a core element for any FTL regulation and that today's Subpart Q definition is open to diverging interpretations and implementations.
184. All scientists agreed that excessive travelling time combined with early reporting raises safety concerns.

Advantages and disadvantages of multiple home base

185. Those commentators being critical of the concept of a multiple home base were concerned that multiple airport home bases would increase travelling times for crew members and would thus have an impact on fatigue. In some Member States where crew members have a single home base some operators can require crew members to live within a distance of 50 km from the airport so that they can reach the airport at all times within 1 hour. Those commentators argued that in the case of a multiple airport system the home of the crew member could be further away from the second airport, which could lead to travelling times of more than 2 hours. From a safety point of view this would be unacceptable, they argued. One operator, who is applying the multiple airport system approach, proposed that each crew member should be nominated with a main home base and one or more satellite home bases, if necessary, and provided that the travelling time to a satellite home base is less than or equal to the travelling time to the main home. The operator argued that multiple airport systems can be beneficial in terms of reducing travelling time and fatigue from the crew member's point of view.
186. One operator explained their operational need to cater for a pool of volunteer cabin crew members who ordinarily conduct other non-flying duties. They may live and/or work at

places or stations away from the multiple flying bases and commute to their home base in order to commence flying duties. On this particular example the Agency notes that it is a crew member's personal decision on where to establish their residence; however, as stated in the NPA, it is a shared responsibility of the operator and the crew members concerned to ensure that they arrive well-rested for duty. The concept of shared responsibility is described in GM1-ORO.FTL.235 Minimum rest periods, where it is stated that well-rested means physiologically and mentally prepared and capable of performing assigned in-flight duties with the highest degree of safety.

187. The scientists stated that in the case of multiple airport systems the integrity of the home base could be at risk and that excessive travelling times, especially those linked with early starts, are of concern. Multiple airports should not be used to extend the travelling time beyond a reasonable limit (e.g. 1.5 hours). According to the scientists, if this limit is exceeded due to the provision for multiple airports, the additional time (whether before or after the FDP) should count as positioning. The frequency of home base changes should be monitored by FRMS.
188. With respect to Member States, the opinion was split. Some Member States agreed that the safety impact of multiple airport systems is negligible even with a somewhat greater distance, the economic consequences for the operator can be substantial and the possible social consequences for the crew members are compensated by the fact that the repositioning is considered duty time and thus compensated financially and in time.
189. Other Member States are concerned that the impact on fatigue as a result of multiple airport systems and increased travelling times is substantial and that the final proposal should include adequate mitigating measures by including a clearer definition of 'travelling' and 'positioning', to ensure that in the case of multiple home bases travelling time counts as positioning.
190. A third group of Member States stated that for the most normal EU operations a single airport would be a home base rather than multiple airport locations. Nevertheless, the need for an operator, particularly a larger operator, to have the flexibility to ask crew members to report to one of a few nearby airports is understood. While those Member States support the requirements for the distance and travelling time between the multiple airport locations, there is the additional risk of the increased travelling time taken by the crew members to reach all the airports in the multi-airport location.

Role of the competent authority in approving multiple home base

191. Some Member States suggested adding separate Guidance Material which would remind crew members of their responsibilities to report for duty fit and rested. Where the crew members' travelling time to their home base exceeds 90 minutes they should make alternative arrangements for accommodation closer to their base.
192. A considerable number of Member States requested an addition to FTL.1.205(a) to stipulate that where the operator uses a multiple airport location the multiple airport locations are approved by the competent authority. This additional requirement should ensure that multiple airport locations have been realistically assessed and prevent excessive travelling times and journeys to work. In addition, they suggested that where these multiple airport locations are used the operator should only use them for crew members that volunteer for the multi-base as this would ensure that the crew members can reach all the airports within a reasonable travelling time and won't have an excessive journey to work due to having to drive for a further hour to reach the airport for report.
193. Industry stakeholders did not comment on the role of the competent authority in approving a multiple airport home base.
194. One scientist stated that in the case of multiple airport systems the integrity of the home base could be at risk and that further provisions should be included in the regulations to protect the integrity of the home base and to avoid that multiple home bases are used to evade the requirement for a positioning flight.

Distance and travelling time limitations

195. Regarding the distance and travelling time limitations between airports in an airport system, all commentators who agreed with the basic principle of a multiple airport system disagreed with the limit of 50 km and proposed a limit ranging between 75 km and 100 km and a travelling time of 90 minutes in accordance with the UK requirements under CAP 371. Operator representatives felt that the current limitation is too restrictive, has no scientific basis/safety justification, and could jeopardise existing multiple airport systems such as London-Heathrow and London-Gatwick, Milan-Malpensa and Milan-Linate, Brussels-Zaventem and Liege-Bierset, Amsterdam-Schiphol and Rotterdam Airport. Regarding the limit on travelling time, it was stated that by limiting the travelling time to 60 or 90 minutes under normal conditions would lead to a number of disputes since the term 'under normal conditions' would be open to subjective interpretation. For this reason some of those commentators preferred to delete the limit on travelling time.
196. Most Member States in favour of the concept of multiple airport systems argued that there has to be a right limit of those airport systems to avoid abuse, but preferred to maintain a reasonable limit of kilometric distance between those airports (i.e. 50 km as in the NPA or a change to 75 km preferred by some). However, they also opted for the deletion of the limit of 60 minutes of travelling time, as this would be open to interpretation depending on the time of day and traffic situation on the routes concerned.
197. The scientists did not comment on the concrete examples of 50 km and 60 minutes contained in the NPA, but focused on the impact of excessive travelling time on fatigue.

Transfer between airports within one multiple airport system

198. The NPA proposal clarifies that when the home base is a multiple airport location, in case the FDP starts and finishes in different locations within the home base, then the transfer from the final arrival airport back to the initial location of the start of the duty shall count as positioning. Commentators requested that if the arrival airport and the departure airport differ, the difference between the time spent travelling to the departure airport minus the time spent travelling to the arrival airport should be accounted for as positioning.
199. Some commentators requested no change to the current wording, while others, including Member States, requested that there should be a definition for 'travelling time' as well as a clearer definition of 'positioning' included in the rule and that the rule should be amended to ensure that in case the FDP starts and finishes in different locations within a multiple home base system the transfer from the final arrival airport back to the initial location of the start of the duty shall not only count as positioning, but that in those cases the transfer should be provided by the operator.
200. Regarding positioning, one scientist recommended that whenever the travelling time would be excessive (i.e. 90 minutes or more) then the additional time, whether before or after the FDP, should count as positioning duty. The scientist also referred to recommendations included in the UK FTL scheme CAP 371 as a positive example which should be taken into account. One scientist recommended that the operator would have to provide accommodation to mitigate the effect of multiple home bases in case of long travelling time and/or early start.

Limit the number of possible changes to the home base

201. The majority of comments concerned the protection of the integrity of the home base against frequent changes. According to those commentators, the current definition in the NPA is unclear and would allow for abuse by frequent shifting of home bases. As many elements of FTL depend on this, a better, more robust definition would be needed. Commentators from crew organisations requested that the ICAO definition of home base, which states that the home base should be assigned with a degree of permanence, shall be included into the rule.

202. Member States did not comment on limiting the number of possible changes to the home base per year.
203. One scientist referred to the need to monitor the changes of the home base with FRM.

Agency's conclusion on home base

204. The Agency believes that the current national differences in the interpretation of a home base and the different approaches with respect to multiple airport systems lead to ambiguities that should be clarified.
205. Regarding the possibility to assess the distance between the airport and the crew members' home, the Agency believes that while the focus on the actual home of the crew member is understandable, it would be impractical. It would be overly burdensome for a large operator to assess the distance of each crew member's residence with respect to the satellite home base. In addition, the Agency notes that the decision where a crew member resides is a personal decision and cannot be regulated.
206. The Agency revises its proposal and focuses on the concept of a single airport home base, since this is the concept used by the large majority of operators. As a result, the provision on the kilometric distances and the travelling time to allow for a multiple airport system has been deleted in the Implementing Rule. A recommendation to make arrangements for temporary accommodation closer to their home base if the travelling time from their residence to their home base exceeds usually 90 minutes has been transferred to GM1-CS.FTL.1.205.
207. However, the need for some operators to use a home base within a multiple airport system is acknowledged. Therefore, the Agency has placed elements of the rule on home base in a Certification Specification, which provides the possibility of a home base within a multiple airport system under the deviation process of Article 22.2 of the Basic Regulation.
208. The Agency takes note of the concern that changing home base creates additional fatigue and proposes that:
- a) the Home base is a single airport location assigned with a high degree of permanence;
 - b) weekly rest shall be extended to 72 hours once, including 3 local nights if the home base is changed;
 - c) travelling between the former home base and the new home base counts as duty, meaning that this could be done either as positioning or during an FDP;
 - d) assignment of home base has been included in the records requirements to ensure that the competent authority can easily trace changes of home base of crew members.

Flight duty period (FDP)

209. Individual commentators, crew organisations, operator organisations and Member States reacted to the proposals with regard to requirements for flight time specification schemes requiring operators to consider such elements as numbers of sectors flown, starting time of the FDP, encroachment of the Window of Circadian Low, extension of FDP due to commander's discretion, extension of FDP due to short-term re-planning and the question whether and how the Subpart Q provision allowing for periodically extended FDP should be reflected in tables.
210. Individuals, crew organisations and operator organisations stated that the title *Maximum 'daily' Flight Duty Period* could somehow be understood as allowing for only one duty period per calendar day, therefore operator organisations requested to avoid the word 'daily' in the document.

211. The Agency reminds the reader that the term 'maximum *daily* flight duty period' has been copied from Subpart Q. The title of the corresponding paragraphs remains unchanged.

Maximum flight duty period – Use of tables

212. Concerning the calculation of FDP, individual commentators expressed diverging views whether values should be reflected in tables or described with a formula and if those values should be based on the operational experience from Subpart Q. While some operator organisations supported the general principle of reflecting FDP in tables with 30-minute steps, others stated their clear preference for a formula following the Subpart Q philosophy. One operator requested a table with 5-minute steps.
213. Only one crew organisation supported reflecting the maximum FDP in a table.
214. On the other hand, the introduction of tables was welcomed by Member States; some Member States suggested that operators should have the option to either apply the table or the formula given in the GM.
215. Whether it would be better to describe the complex issue of FDP reduction due to sector workload and WOCL encroachment in a formula or to use a formula to produce a table is a question of practicality. The Agency believes that reflecting FDP in a table is the most straightforward way to avoid misinterpretation and will produce an FTL scheme that operators, crew members and other affected personnel can easily use in a day-to-day operational environment. To avoid misinterpretation the GM containing the formula has been deleted.

Maximum flight duty period – Basic values

216. Two crew organisations and a number of individual commentators suggested introducing an additional limit of daily flight hours. All crew organisations stated that the proposed 13-hour limit was excessive; they endorsed the indications of the MOEBUS¹² report. According to their views FDP should be limited to 12 hours during the day and to 10 hours during the night.
217. Operator organisations supported the NPA's basic values for maximum FDP. One operator stated that there were existing national FTL schemes allowing for 14 hours as a basic maximum for FDPs outside the WOCL; in that regulation there was no extension foreseen.
218. One Member State criticised that the NPA proposal for maximum FDP was based on a non-quantified statement that CAP 371 was overly protective for FDPs starting in the early morning. Another Member State supported the 13-hour limit, but suggested reconsidering the interrelation between operational fatigue and human performance degradation and the duration of duty. Other Member States pointed out that the table in FTL.1.210 did not fully reflect the results of calculations made following the formula described in GM1-FTL.1.210(3).
219. The scientists elaborated on the validity of the proposed maximum values for FDP for different reporting times during the day. They agreed that the proposed table 36 would not provide for equivalent levels of alertness for FDPs during the day and during the night. One scientist also stated that to his knowledge the 13-hour limit had not been the result of scientific studies. They agreed that FDPs of 14 hours starting at most favourable times of the day would not lead to excessive alertness degradation predictions.
220. The Agency maintains that the basic maximum FDP rules are best addressed in a table. The table offers values for maximum FDP following the principle that the basic FDP should be reduced by twice the amount of sleep lost due to early rising or late arrival. Sleep loss has been taken into account in a qualitative way for reporting times between

¹² Scientific and Medical Evaluation of Flight Time Limitations, MOEBUS Aviation, 2008.

04:30 and 06:00. For reporting times before 04:15 and after 17:00 the basic maximum FDP is set to a minimum of 11:00 hours of FDP.

Reduction of FDP due to WOCL and number of sectors

221. Clearly conflicting opinions were articulated as regards the method that should be used to calculate the reduction of FDP due to workload and WOCL encroachment. Crew organisations defended that the basic FDP should be reduced first by WOCL encroachment and secondly by the number of sectors starting to deduct 30 minutes for each sector after the first sector.
222. Crew organisations also stated that the values proposed in the NPA under FTL.1.210(1) (a) were not effectively mitigating the sleep loss induced fatigue for reporting times between 13:00 and 15:59 taking into account that a considerable part of the FDP would encroach the WOCL towards the end of the FDP.
223. Operator organisations stated the opposite view and defended that for calculating the reduction of FDP due to WOCL and number of sectors the basic FDP should be reduced first by the number of sectors and secondly by the resulting WOCL encroachment.
224. Operator organisations also recommended calculating the reduction due to WOCL encroachment based on the planned FDP and not on the actual operation according to Subpart Q.
225. One Member State elaborated on the potential impact of safety on operations with many sectors. It was suggested by one Member State, individual commentators and crew organisations to take FDP reduction due to number of sectors further than the sixth sector.
226. One operator with operational experience in short-haul regional flights recommended reducing 30 minutes per sector from the second sector up to the seventh sector including a planning limit for CAT operations with aeroplanes of 10 sectors per duty. The same operator claimed that limiting operations reporting before 05:00 to 4 sectors was too restrictive and would limit some regional operations with very short sectors and starting very early in the morning to only approximately 4 hours of FDP due the restrictions of the number of sectors. This seems to be a misunderstanding. The NPA proposal of maximum daily FDP without extension does not limit the number of sectors.
227. Another Member State suggested simply reducing the FDP whenever a crew member would not have the opportunity to sleep during the entire WOCL either because of an early start, a late arrival or an FDP overnight.
228. One scientist stated that the 13-hour basic limit was not the result of scientific studies but a result of industrial negotiations and had evolved over many years. Another scientist stated that for early starts the FDP should be reduced by twice the number of hours of sleep lost. This would be consistent with the reverse application of the rule as it is used for in-flight rest extensions, where 1 hour of sleep permits an extension of 2 hours. This statement coincided with the FDP values proposed by the other two scientists.
229. All scientists agreed that the proposed mitigating measures related to the number of sectors were insufficient. One scientist suggested two options:
 - a) no reduction for the second sector, then a reduction of 45 minutes for the third and fourth sector; or
 - b) a reduction of 30 minutes for the second, third and fourth sector. He further explained in his report that from the available data it appeared that the trend of alertness degradation from 2 to 4 sectors extended to 5 sectors and beyond.
230. The Agency maintains its position on how the maximum daily FDP should be reduced taking into account the number of sectors. Since neither the scientists' reports nor stakeholders' comments have been able to give a defined conclusion, the Agency opts to maintain the reduction of 30 minutes per sector from the third sector onwards. No FDP

reduction shall apply for the second sector, 30 minutes shall be deducted from the maximum daily FDP for the third and the fourth sector and so forth until reaching the minimum maximum FDP of 9 hours. The reduction shall not lead to an FDP under 9 hours regardless of the number of sectors or the reporting time.

Extended FDP

231. Individual commentators and crew organisations criticised the Agency's proposals as regards the possibility to extend the basic FDP twice in 7 consecutive days by 1 hour. They argued that the accompanying mitigating measure, namely extending the basic minimum rest around or after the extended FDP, was not effective to mitigate transient fatigue occurring towards the end of an extended FDP. They especially highlighted the fatigue-related risks for any FDP starting between 16:00 and 01:59. Crew organisations emphasised that if extended FDPs had to be included in a prescriptive scheme, they should only be under FRM for starting times between 16:00 and 01:59.
232. Operator organisations on the other hand criticised the Agency's proposal to only permit extensions for FDPs starting between 18:00 and 21:59 under FRM. One operator organisation stated that it should be possible to extend FDP without FRM with an additional hour of pre and post-flight rest on top of the foreseen 4 hours of extended rest. Another operator organisation agreed with the principle of allowing extended night duties only under FRM but stated that SAFE modelling had only predicted critically low alertness levels for starting times between 18:00 and 20:59. They therefore asked for the window for extensions with mandatory FRM to be reduced to the reporting times where the SAFE model had actually predicted low alertness levels. Operator organisations also claimed that a different way of calculating the extension should have been used in order to obtain more generous values for the table of maximum FDP with extension. They also suggested simply adding 1 hour to the values in the table reflecting the values for maximum FDP without extension.
233. There was no consensus amongst Member States under what circumstances and to what extent FDP extensions should be allowed. One Member State declared that FDP extensions as proposed in FTL.1.210 table 37 were not supported by scientific research. Two other Member States rejected the use of FDP extension overnight and for FDPs reporting before 06:59. A third Member State suggested allowing FDP extensions only twice in 15 consecutive days and only for specific operational needs outside the normal roster planning and limited in time. This Member State highlighted that any FDP of more than 13 hours should be monitored and the effects of cumulative fatigue should be considered carefully. The same Member State also proposed increasing the additional rest after the second of two consecutive extended FDPs to 6 hours. Another Member State on the other hand criticised that the proposal for extended FDP was taking too much account of the WOCL forbidding operations with three and more sectors for certain reporting times in the afternoon and evening; this Member State expressed that pre-planning of the extension, even overnight and additional rest around or after the extension was a sufficient mitigating measure. One Member State proposed allowing a 14-hour FDP only for a single sector and starting at the best starting time of the day. Member States also suggested an additional local night of weekly rest where extended FDPs were impinging or encompassing night hours or the WOCL to protect against cumulative fatigue associated with long duty periods and shortened sleep periods. It was also suggested to make FRM mandatory when intending to operate extended FDPs in the WOCL or for extended FDPs reporting before 06:59.
234. All scientists agreed that FDPs of 14 hours could only be supported by scientific data for departures between 08:00 and 12:00. Only one scientist expressed that the additional rest after an extended FDP was an acceptable mitigating measure for cumulative fatigue due to extended wakefulness. Another report stated that the proposed additional rest around an extended FDP could not effectively mitigate transient fatigue towards the end of the extension. They all agreed in their reports that FDPs overnight should be limited to a maximum of 10 hours. They also suggested the implementation of FRM whenever

extended FDPs were operated. The Agency believes that those stakeholders against FDP extensions and the three scientists have produced sufficient evidence to stimulate a reflection on this issue. FDPs of more than 11 hours starting or ending at the most unfavourable time of the day are not in line with scientific findings on performance degradation in civil aviation. On the other hand, the Agency does not see any reason for forbidding a more generous limit of 14 hours for FDPs starting at the most favourable time of the day in line with scientific recommendations received. It seems like the circadian factor of fatigue has been underestimated in the former Regulation.

235. The Agency accepts that extensions should not be allowed for FDPs starting between 19:00 and 04:15. Today's Subpart Q requirements and limitations for FDP extensions are maintained and transposed into ORO.FTL.210(c)(1). The values for maximum daily FDP with extension are reflected in a table in the newly created CS.FTL.1.210-2.

Additional limits for night duties

236. Crew organisations found the proposed limits for night duties in FTL.1.210 Flight Duty Period (FDP) 1 (d) too high. They proposed to limit the second of two consecutive night duties to 3 sectors. A number of crew organisations and individual commentators also requested introducing a prescriptive limit for the number of night duties in one block of duties. Crew organisations welcomed the NPA proposal of extending the second extended periodic rest to 48 hours whenever three or more consecutive night duties were operated; however, they suggested specifying that the 48 hours should include two local nights to allow for meaningful restorative sleep.
237. One operator organisation requested removing FTL.1.210, 1 (d); they defended that alternating duties and WOCL encroachment were already effectively mitigated by the applicable rest requirements. Operator organisations also recommended referring the requirement for additional extended periodic rest to rostered night duties and not to performed night duties. One operator suggested that night duties and duties with significant WOCL encroachment should be limited to 10 hours; the same commentator also requested not allowing any extensions for reporting times between 16:00 and 02:00.
238. One Member State stated that there was a significant amount of research showing that operating through the WOCL was extremely fatiguing, especially if it was of an irregular nature; this Member State therefore supported the use of FRM for extended FDPs with WOCL encroachment; the same Member State recommended extending the reporting time window in which extended FDPs should only be permitted under FRM to 18:00–06:59.
239. The Agency revises its position on the maximum daily FDP for FDPs encroaching the WOCL. The amended proposal does not allow for extension during the night and limits the FDP to 11 hours for reporting times at the most unfavourable time of the day. Additional conditions for extensions during the night have become superfluous.
240. The need to mitigate the effects of consecutive night duties remains unchanged. The fatiguing effect of night duties is a result of a crew member's actual duty and not a result of what has been initially rostered. Delays may increase fatigue, especially if they result in an increased sleep loss in a series of consecutive night duties. Therefore, the Agency maintains the proposal to extend the second recovery rest period as defined in CS FTL.1.235-1(b) when four or more consecutive night duties are performed.

Additional limits for early starts

241. Crew organisations and individual commentators proposed considering a wider time band for the definition of early start. There was no agreement amongst the commentators on the range of the time band; the suggestions covered reporting times between 05:00 and 06:59 or 06:00 and 09:00 at home base and 06:00 and 08:00 out of base. Individual

commentators and crew organisations also criticised that the definition of early start was not used to limit the number of early starts in a defined period of time.

242. Operator organisations expressed that the definition was superfluous because the effects of WOCL encroachment on the maximum FDP was already addressed.
243. Member States indicated that the definition of early start had to be linked to the time zone where the crew member is acclimatised. Two Member States stated that the definition of early start should not only relate to Flight Duty Periods but also to Duty Periods. They argued that reporting times before 07:00, if not 08:00, should be included to take better account of sleep reduction due to having to rise in the WOCL.
244. The three scientists concurred in their reports that the definition of early start should include reporting times between 05:00 and 06:59.
245. The definition of early start has been amended. Please see also the comments to the corresponding paragraph ORO.FTL.105 Definitions.
246. Additional rest requirements have been included for early starts and late finishes in ORO.FTL.235 and CS FTL.1.235-1(b).

Maximum flight duty period – Flight time specification schemes

247. A number of crew organisations requested the good principles described in GM1-OR.OPS.FTL.210 to become at least AMC if not IR. They also suggested that other factors described in GM1-OR.OPS.FTL.210 should not be *considered* but *recommended*.
248. One operator requested the GM1-OR.OPS.FTL.210 to be deleted.
249. One Member State suggested introducing two new sub-paragraphs in OR.OPS.FTL.210 Flight Duty Period (FDP)(c) specifying the reduction of the basic FDP when an FDP begins when a crew member is on standby and the applicable reduction of FDP to compensate for a preceding reduced rest.
250. The Agency agrees that flight time specifications schemes should specify how the daily FDP should be reduced when a crew member is requested to report for an FDP when on standby. A new point has been inserted under OR.OPS.FTL.210 Flight Duty Period (FDP)(c).
251. The Agency accepts that rules on the reduction of the maximum daily FDP due to a reduced preceding rest shall be reflected in a flight time specification scheme. An additional point has been introduced under ORO.FTL.235 Rest periods(c) establishing the obligation to define how the maximum FDP shall be reduced to compensate for a preceding reduced rest. The prescriptive details for this requirement are contained in CS FTL.1.235-3(d).

In-flight rest

252. All crew organisations agreed that the findings and recommendations of the TNO study should be fully reflected in the rules for the calculation of the extension according to in-flight rest time given and the type of in-flight rest facility. They also suggested that extended FDPs due to in-flight rest should follow the same principles as FDP in general; circadian rhythms, acclimatisation to a different time zone, number of sectors etc., should be considered when determining the allowable FDP. Many crew organisations also stated that the rules on how to augment the cabin crew complement in order to achieve extended FDP due to in-flight rest should be included.
253. Operator organisations highlighted that there were several Member States that allowed for maximum FDPs up to 18 hours with one additional pilot and up to 20 hours with two additional pilots if in-flight rest was taken in a bunk.
254. One Member State stated that they could not support the Agency's deviation from the TNO study and called for the TNO's reports findings to be reflected in the rules.

In-flight rest – Facilities

255. The questions of whether to give any credit for in-flight rest taken in economy seats triggered numerous, very strong reactions from individual commentators and crew organisations. All comments received from individual commentators and crew organisations rejecting the use of economy seats in order to achieve an extended FDP were based on the findings of the TNO study. Two crew organisations and a number of individual commentators even suggested completely excluding giving credit for in-flight rest taken in facilities other than a bunk. They argued that the likelihood of achieving restorative sleep in any type of seat was minimal.
256. Operator organisations criticised how the NPA proposal had transposed the findings from the TNO report. They defended that in-flight rest in economy seats should be allowed for certain operations and for cabin crew. They also stated that 'class 1' rest facility should be defined as a bunk or rest facilities in an aircraft cabin for flat or *near flat* sleeping position, opposed to the NPA's proposal that 'class 1' rest facilities should allow for a flat sleeping position and be separated from the flight deck and passenger cabin. They also suggested that in-flight rest in economy seats should be allowed for pilots and cabin crew in operations with single aisle aircraft within an area of less than four time zones and subject to additional monitoring as part of an FRM. In their proposal they explained that adjacent seats should be blocked and a curtain should be installed around the rest area to provide for some darkness and sound mitigation. Operator organisations especially opposed that the use of economy seats for in-flight rest for cabin crew should not be allowed.
257. Some Member States declared that they were not in favour of giving any credit for in-flight rest taken in economy seats. It was also highlighted that the Agency had already identified the effectiveness of in-flight rest in economy seats as a subject for which further scientific research might be needed. On the other hand some other Member States requested defining an additional 'class 4' of in-flight rest facilities in order to be able to give some credit for in-flight rest taken in economy seats. Those Member States claimed that setting a limit for extended FDPs due to in-flight rest in economy seats to 14 or 15 hours would be a big step forward since many Member States under their current regulations were allowing far more generous extensions based on in-flight rest in economy seats. Another Member State opposed the general possibility of extension due to in-flight rest in 'class 2' and 'class 3' in-flight rest facilities. This Member State elaborated that extensions due to in-flight rest in 'class 2 and 3' facilities should be subject to a special approval of the competent authority and a strict exception. This exception should be limited to aircraft on which due to cabin size a 'class 1' facility could not be installed. They suggested that the Agency should publish a list of such aircraft. One Member State proposed that operators should be able to use alternative in-flight rest facility configurations under FRM.
258. The scientists explained in their reviews that increasing FDP due to in-flight rest was based on the opportunity to get sleep to recover from the sleep-related fatigue component. They also elaborated on the logic behind the recommendations of the TNO report; the extension of an FDP should be based on a (somewhat conservative) estimate of the typical amount of sleep that crew members would obtain in a specific in-flight rest arrangement, given the time available for rest. All scientists agreed that the available scientific data on the effectiveness of economy seats as in-flight rest facility would not support giving any credit to such an in-flight rest arrangement.

In-flight rest – Minimum duration

259. Individual commentators and crew organisations defended that operations with an extended FDP due to in-flight rest should be limited to one planned sector.
260. Many operator organisations agreed with the NPA proposal to limit operations with an extended FDP due to in-flight rest to three sectors. One operator criticised that the cruise phase above FL 200 should be used to trigger in-flight relief, they suggested defining

times after take-off and before landing. They defended that the time window starting 30 minutes after take-off and ending 45 minutes before landing could be used to determine the time available for in-flight relief. One operator wished for the rule to be amended to only require a consecutive minimum in-flight rest of 60 minutes. They argued that this would be especially important when extended FDPs during the WOCL of duration under 12 hours were operated. They also stated that the requirements for minimum consecutive in-flight rest should only apply to flight crew.

261. One Member State defended that augmented crew operations should be limited to two sectors in order to allow for at least 3 hours of consecutive in-flight rest for each crew member. Another Member State suggested increasing the minimum consecutive in-flight rest period for operating crew members to 3 hours.
262. The analysis of the scientists' reports revealed that they did not come to the same conclusion as regards the length of the minimum continuous in-flight rest. Only one scientist proposed that continuous in-flight rest should be at least 2 hours to cover one entire sleep cycle and allow for 15 minutes to fall asleep and 30 minutes to overcome sleep inertia. Another scientist recommended a case-by-case approach for multi-sector operations with extended FDP due to in-flight rest. He explained that the likelihood of falling asleep depended on the time of the day and that it would therefore be difficult to provide a minimum rest time that would apply whatever the time of the day. The third scientist suggested monitoring multi-sector operations with extended FDP due to in-flight rest with FRM.

In-flight rest – Cabin crew

263. The question whether the same principles should apply to in-flight rest for pilots and cabin crew attracted a high number of comments from individual commentators, crew organisations, operator organisations and Member States. Many of those comments, especially from operator organisations, were focussing on possible economic consequences of not allowing in-flight rest, at least for cabin crew, in economy seats. Many commentators also criticised that the NPA's RIA did not include a detailed analysis of the safety and economic impact for this specific issue.
264. All crew organisations requested the principles for the calculation of in-flight rest for pilots and cabin crew to be the same. They argued that in-flight rest provisions for cabin crew should also follow the indications of the TNO study. They furthermore requested clarification on the minimum cabin crew complement during cruise flight. It was also explained that there was a need to establish requirements for a minimum duration of *consecutive* in-flight rest for cabin crew. Crew organisations defended that there should be rules to augment the cabin crew too whenever FDPs were extended due to in-flight rest. Crew organisations also quoted scientific studies showing that cabin crew were suffering from higher fatigue levels during long flights due to the higher physical activity during the flight. They proposed including provisions for in-flight rest even for unextended FDPs whenever the FDP was greater than 12 hours.
265. Operators and operator organisations expressed diverging views on in-flight rest for cabin crew. One operator asked if cabin crew should also be augmented. Others insisted in their comments on the different safety implications of pilots and cabin crew being fatigued. They argued that extensions of the maximum permitted FDP for cabin crew could be achieved with less in-flight rest or with the same amount of in-flight rest taken in an in-flight rest facility with a lower probability of achieving recuperative sleep. Some operator comments also disapproved that the table for cabin crew was relating permitted extension to duration of in-flight rest and type of in-flight rest facility as opposed to the rules for pilots, giving a maximum permitted FDP according to the type of rest facility and the number of pilots. Other operator organisations supported the NPA's approach, but they suggested introducing an additional element of a 'class 4' in-flight rest facility for certain extensions. It was also proposed linking the requirements to the *planned* in-flight rest instead of the in-flight rest actually taken. In their comments some operator

organisations declared that a requirement of recording in-flight rest times would place an unnecessary additional administrative burden on operators without producing any safety improvements. One operator commented that there was no safety justification whatsoever for in-flight rest for cabin crew at all.

266. One Member State endorsed the table as proposed, but stated that further research was needed. The same Member State suggested clarifying in the corresponding rules the minimum number of cabin crew required for flight safety tasks during cruise flight. Another Member State supported the crew organisations' view that in-flight rest for pilots and cabin crew should follow the same principles.
267. Two scientists confirmed in their reports that cabin crew reached higher levels of fatigue than pilots towards the end of flights. On the other hand one of them acknowledged that there was a lack of clarity concerning the level of alertness which was necessary to perform cabin crew duties. The other scientist explained that alertness of cabin crew for safety was crucial and that any in-flight rest arrangement for cabin crew would have to take account of the physiological sleep requirement of 8 hours sleep within a 24-hour period.
268. As regards the rules that shall apply to FDP extensions due to in-flight rest the Agency believes that the following principles have to be considered:
- any crew member shall have a total of 8 hours sleep opportunity in any 24 hours;
 - the quality of the in-flight rest arrangement plays an important role when determining the probability of achieving recuperative sleep and has to be taken into account;
 - 1 hour of recuperative sleep shall credit for 2 hours of additional wakefulness;
 - the minimum in-flight rest period shall be a consecutive 90-minute period;
269. Commentators from all stakeholder groups and the three scientific reports made reference to the TNO report in their comments regarding in-flight rest. It seems therefore reasonable to use the results of the TNO study as guidance.
270. CAP 371 allows extending the maximum FDP by a period equal to 50 % of the rest taken in a bunk and 33 % in a 'comfortable reclining seat'. When producing the tables for in-flight rest for pilots and cabin crew a period of time equivalent to 33 % of the rest period has been used to calculate the maximum permitted extended FDP in the case the in-flight rest has been taken in a class 3 rest facility. This follows the TNO report qualitatively but not quantitatively. The TNO report recommended only allowing an extension of the maximum permitted FDP of an equivalent of 25 % of the time spent in a class 3 rest facility. The Agency has used a combination of the recommendations of the scientific reports and the operational experience of CAP 371 to produce the rules regarding in-flight rest in a class 3 rest facility. For in-flight rest taken in class 2 and 1 rest facilities the Agency has followed the principle and values described in the TNO report.
271. The Agency maintains that the possibility to extend an FDP due to in-flight rest shall be limited to FDPs with up to three sectors. More conservative limits than initially proposed in the NPA for maximum daily FDP due to in-flight rest values for pilots are proposed. The limits are a function of the type of in-flight rest facility and the number of additional flight crew members. An additional hour of FDP due to in-flight rest shall be allowed for FDPs with up to two sectors and if one sector is of over 9 hours continuous flying time. Similar principles have been used to produce the tables for cabin crew and for pilots.
272. For cabin crew a simple rule relates the type of in-flight rest facility to a percentage of the planned extended FDP that is needed as in-flight rest to achieve the extended FDP. This approach has been chosen because it is the overall duty time that causes fatigue and not the flying time only. With this system the rest requirements for the flight crew limit the maximum daily FDP due to in-flight rest. In comparison with the TNO study or existing national regulations, i.e. CAP 371, the percentages are reduced because FDP

(which includes pre-flight duties, etc.) is the basis for calculation and not the flight time. The approach also allows determining easily how long each cabin crew member needs to rest. It will be easy to determine the duration of in-flight rest for each individual cabin crew member with this system, even if the cabin crew takes the in-flight rest in a different in-flight rest facility than the flight crew. No matter how many sectors are operated, the cabin crew shall rest for the corresponding percentage of the FDP.

273. Point (d) has been removed from the rule itself; the Agency agrees that defining the flight phase above FL 200 is too prescriptive. GM1 CS FTL.1.210(3) and GM1 CS FTL.1.210(3)(c) have been introduced explaining that in-flight rest should be taken during the cruise phase of the flight and that in-flight rest periods should be allocated in order to optimise the alertness for those crew members at control during landing.

Unforeseen circumstances in actual flight operations – Commander’s discretion

274. A high number of individuals from the pilot community and crew organisations commented on the provisions for ‘unforeseen circumstances in actual flight operations’. The possibility to extend an already extended FDP due to commander’s discretion was rejected. They argued that the proposal meant a serious safety regression from Subpart Q and CAP 371. Some organisations quoted the Moebus report and the US FAA’s NPRM where commander’s discretion was proposed to be only possible over more restrictive initial limits and only in cases of emergency; they also stated that rosters should allow for realistic flight, turn around and post-flight duty times. A precise definition of unforeseen circumstances and for the terms ‘shortly before and after reporting time’ was requested. Individual commentators and crew organisations agreed that commander’s discretion should be applied for occurrences during operations and arising after crew members had reported for duty. Crew organisations also suggested including provisions for increased rest after commander’s discretion in analogy to the increased rest provisions after pre-planned FDP extensions to mitigate the possible effects of longer duty hours on cumulative fatigue.
275. The provisions for commander’s discretion and short-term re-planning were generally supported by operator organisations; it was suggested to clarify that flight operations started at the moment a crew member was required to report and not after ‘off-blocks’. Those comments also requested allowing for the commander’s discretion to go as far as being able to further increase the permitted extension due to commander’s discretion beyond the prescriptive limits for the discretion in the case of additional unforeseen circumstances occurring after ‘off-blocks’. They argued that it should always be possible to continue to the flight’s destination. It was suggested to increase commander’s discretion up to 3 hours without the need to augment the flight crew for an un-extended FDP. One operator organisation stated that the provisions for commander’s discretion had no safety impact because the commander could always decide whether to use discretion or not. It was proposed to allow for up to 3 hours discretion in emergency cases.
276. One Member State shared the crew organisations’ view that the provisions on commander’s discretion were excessive and not supported by scientific evidence. Another Member State stated that they could not comment on the safety implications of these provisions, but that they would support the proposal for the sake of operational flexibility. One Member State explained that the maximum permitted commander’s discretion on a 1 hour extended FDP could only be 1 hour instead of the proposed 2 hours.
277. All scientists agreed that good knowledge of fatigue processes was necessary for the commander and all other crew members involved in the operation; they therefore made the general recommendation for FRM training to provide crew members with appropriate decision making tools. One scientist elaborated that any commander discretion should be reported within an FRM or the SMS of an operator. It was also mentioned in two of the

three reports that more conservative FDP limits would result in lower fatigue levels in case of commander's discretion. A strong system for controlling and monitoring the use of discretion was recommended. In this context one scientist declared that the 33 % limit on the number of flights exceeding the maximum was very high. Another scientist recommended a limitation of the use of commander's discretion over 7 days as a means of abuse control.

278. The NPA contains a paragraph establishing mandatory fatigue management training. It seems impracticable to introduce a prescriptive limit for the frequency of commander's discretion. The Agency concludes that the proposed provisions for commander's discretion are adequate.

Unforeseen circumstances in actual flight operations – Short-term re-planning

279. Crew organisations criticised that no clear definition of 'shortly' was given in the rule. They coincided in their comments that fatigue increased as a function of continuous hours of wakefulness and that any additional rest at the beginning of a duty or even before starting a duty would be meaningless for performance and wakefulness towards the end of such a re-planned duty. They also censured that the fatigue impact of the provisions on short-term re-planning had not been thoroughly assessed by the RIA. All crew organisations agreed that the provisions for short-term re-planning should be removed from the proposal. On the other hand they suggested adopting the concept of delayed reporting, providing operators with sufficient flexibility and protecting from excessive levels of fatigue.
280. Operator organisations had diverging views on short-term re-planning; some declared that short-term re-planning should only be recorded by the operator and should only be reported to the competent authority upon demand. Others recommended the CAP 371 provisions on delayed reporting. One operator mentioned that crew members should know the full rostered itinerary of a split duty before they commence it.
281. One Member State requested a clearer text and the meaning of 'shortly' to be defined. It was also commented that the reporting requirement was an unnecessary burden for the Member States; this view was not shared by all the commenting Member States. One Member State suggested that short-term re-planning should be reported within 14 working days. A group of Member States suggested using the CAP 371 provisions for 'delayed reporting'. It was also commented by Member States that it should be clarified if crew schedules could be adjusted at and after the reporting time or also before. One Member State suggested this provision to be moved to the section addressing 'operator requirements'; they also recommended clarification of what the 'unforeseen circumstances' could be. One Member State even suggested removing this provision completely from the proposal.
282. One scientist recommended the use of 'delayed reporting' provisions to cater for situations such as aircraft becoming unserviceable shortly before reporting. According to his report short-term changes of this nature should be accommodated in FRM rather than in a general FTL. Another scientist stated that this is not a problem as long as the overall wakefulness times from the prescriptive scheme are observed; he would see a potential fatigue impact only if FDP needed to be extended. The third scientist found the provisions acceptable as proposed provided they allowed crew members to anticipate rest.
283. Commentators from all stakeholder groups and one scientist suggested replacing the provisions for short-term re-planning with 'delayed reporting'. The Agency accepts the proposal and introduces provisions for delayed reporting in the Certification Specification CS FTL.1.210(4).

Different limits for cabin crew and pilots

284. Crew organisations and individual commentators stated that there was no reason for allowing different maximum FDPs for cabin and flight crew.

285. Although the Agency agrees that pilots and cabin crew are equally affected by fatigue, no clear conclusion could be drawn from the stakeholders' comments or from the scientists' reports as regards the safety impact of performance degradation on cabin crew members due to different FDP limits resulting from the possibility to report up to 60 minutes earlier than the flight crew.
286. The Agency believes that the proposed rule is an improvement to the existing regulations on differences between the reporting time for pilots and for cabin crew. The stakeholders' proposal to delete the rule is therefore not accepted.

FDP table for unacclimatised crew

287. Crew organisations defended the need for an additional table for unacclimatised crew establishing maximum FDP in operations with augmented crew when the crew members were likely to be unacclimatised. They argued that time awake was an important contributing factor in performance degradation. In their comments they connected time awake to the WOCL of the time zone where a crew member was acclimatised.
288. The principle that maximum FDP values for augmented crew operations had been proposed irrespective of the WOCL was supported by operator organisations.
289. The need for an additional table to take due account of the time zone de-synchronisation was supported by one Member State.
290. In their reports the three scientists coincided that the maximum FDP in operations with extended FDP due to in-flight rest should take circadian aspects into account. One scientist elaborated that the assumption that the maximum FDP in extended FDPs due to in-flight rest was irrespective of the WOCL could only be defended if it was possible to guarantee that the pilot at the controls for the landing phase would be sleeping during the WOCL. They concluded that extensions of FDP due to in-flight rest should be based upon the basic FDP according to the reporting time of the day. The scientists also agreed that it was sensible to take acclimatisation into account when determining the maximum FDP; they recommended applying a conservative maximum basic FDP of between 9 and 11 hours whenever the state of acclimatisation of a crew member was uncertain.
291. The Agency takes account of the scientists' advice to apply conservative maximum FDP limits of between 9 and 11 hours whenever the state of acclimatisation of crew members is unknown and they have had less than 30 hours of continuous rest at destination. The 11-hour maximum FDP is consistent with the proposed maximum FDP for night operations out of home base.
292. Whenever the continuous rest at a destination is 30 hours or more, but a crew member has not yet spent enough time at a destination to be acclimatised to the WOCL of the destination, the Agency believes that a more generous limit of 12 hours regardless of the time of the day is safe. In that case crew members should be able to manage their rest to be fully rested before undertaking the subsequent duty of 12 hours.
293. An additional table has been inserted in ORO.FTL.210(b)(2) setting the maximum FDP for crew members when they are in an unknown state of acclimatisation. In line with the maximum FDP limit of 11 hours that is applied for FDPs at home base reporting at the most unfavourable time of the day, the Agency proposes a more conservative limit of 11 hours maximum FDP for an FDP with one to two sectors if the crew member:
- (a) has spent enough time at a destination and is therefore no longer acclimatised to a 2-hour wide time zone surrounding the local time of their point of departure; and
 - (b) has not yet spent enough time at a destination to become acclimatised, being a 2-hour wide time zone surrounding the local time where the crew member has finished his/her duty; and
 - (c) is required to perform duties at the destination and does not have a continuous rest of 30 hours or more.

Agency's conclusions on flight duty period (FDP)

294. The maximum daily FDP is reflected in a table. The GM containing the formula has been deleted.
295. The basic values for the maximum daily FDP have been defined in the table taking into account circadian factors.
296. The maximum daily FDP shall be reduced due to the number of sectors as follows: no reduction for sector one and two; 30 minutes for sector three and beyond. The maximum daily FDP shall never be reduced to less than 9 hours due to sector reduction.
297. The revised proposal takes due account of circadian factors and allows for an FDP of 14 hours at most favourable reporting time, but limits FDP to 11 hours at unfavourable starting times after 19:00 and before 04:15.
298. The Agency amends the proposal as regards the obligation to extend the recovery rest period when four or more consecutive night duties are performed and extends the requirement to consecutive early starts and late finishes. The provisions for additional rest have been moved to Certification Specification CS FTL.1.235(1)(b).
299. An additional point has been inserted in ORO.FTL.230 Standby requiring that flight time specification schemes shall specify the relationship between standby and any assigned flight duty resulting from standby. The prescriptive limits for this requirement are contained in CS FTL.1.230.
300. ORO.FTL.235 Rest periods(c) requires that flight time specification schemes shall specify how an FDP shall be reduced after a reduced rest period. CS.FLT.1.235-3(d) explains how the subsequent FDP shall be reduced after a reduced rest period. In-flight rest provisions have been produced for pilots and cabin crew following qualitatively the recommendations of the scientists' reports.
301. Provisions for short-term re-planning are replaced by a new paragraph describing provisions for delayed reporting in the Certification Specification CS FTL.1.210(4).
302. An additional table for the maximum daily FDP when crew members are unacclimatised has been introduced. This new table does not take circadian aspects into account, but assumes a more conservative limit at any time of the day when crew members have less than 30 hours of continuous rest at a destination.

Flight times and duty periods

303. The section on flight times and duty periods attracted a large amount of comments from all stakeholders and was also part of the scientists' assessment of the NPA.
304. The majority of the comments requested the inclusion of an additional 14-day duty limit of 90 or 100 hours next to the current 7-day limit of 60 duty hours and the deletion of the gliding limit of 1 000 flight hours in any 12 consecutive months.

Limits of total duty period

Daily duty limit

305. Several crew organisations requested to include a daily duty limit of 16 and 17 hours for un-augmented and augmented crews respectively to prevent daily duties with excessive duty hours.

7-day duty limit

306. In addition to the 14-day limit, some crew organisations proposed a limit of 50 hours per 7 days and 550 duty hours in any 6 consecutive calendar months. One crew organisation proposed a maximum duty of 50 hours in 7 consecutive days with a roster limit of

45 rostered duty hours per any 7 consecutive days, which due to unforeseen circumstances could be increased by up to 5 hours in any 28 consecutive days.

307. One operator operating under the UK CAP 371 scheme pointed out that the current scheme permits an increase in the number of duty hours in a week for flight crew to be extended from 55 to 75 hours, provided that the hours worked in excess of 55 are spent on standby duty. The figure for cabin crew is an increase from 60 to 80 for the same scenario. The operator argued that there is no evidence to suggest that these limits have any safety risk associated with them and requested clarification from the Agency whether it can continue operating under these limits that are inclusive of standby duties. The Agency notes that this clarification is included in the section on standby, where standby duty hours are accounted towards cumulative duty hours depending on whether the crew member is on airport standby or on other standby.

14-day limit

308. All crew organisations and individual commentators were in favour of a 14-day duty limit of 100 hours. Only some requested a 14-day limit of 90 hours, while others stated that a 14-day limit would only be necessary for those operators not using an FRM. Such a limit, they argued, is necessary to prevent the possibility of 190 duty hours within a period of 3 weeks, to ensure that duties are spread more evenly, to avoid peaks, and to reduce the high workload intensity after being absent due to holidays or sickness.
309. Those commentators also stated that the Explanatory Note of the NPA in point 110 wrongly stated that 'the impact of a 14-day limit would be significant, not only on charter operators having to face peaks of activity, but also on airlines with regular patterns like 5-days-on/4-days-off, since such a limit would artificially constrain sequences of '5 on-4 off-5 on'. They requested to delete the sentence since according to them during the work of the OPS.055 Rulemaking Group the mentioned effect had not been demonstrated. On the contrary, they stated, it was very clear that there would not be any impact on patterns like 5-days-on/4-days-off or similar.
310. Many crew organisations requested that the Guidance Material on a 14-day limit contained in the NPA's GM1-OR.OPS.FTL.215(a)(2) should be removed and upgraded to the Implementing Rule section.
311. Contrary to crew organisations, all operator organisations and operators are in favour of the NPA proposal and welcomed the confirmation of the fact that there is no safety justification for a 14-day duty limit.
312. Some Member States requested a 14-day limit of 100 hours (one Member State suggested 95 hours in any consecutive 14 days or 95 hours in any 2 consecutive calendar weeks) to manage cumulative fatigue. According to one Member State the allowance of 60 hours in 7 consecutive days is in order to cope with a peak of work and should not be used as a normal limit for rostering purposes. The addition of a 14-day limit would prevent this allowance being used over successive weeks, thereby building up possible cumulative fatigue issues for the crew. The provision of the condition 'spread as evenly as possible' has no weight in practice and the possibility of 3 weeks each of 60 hours has to be regulated against. However, where an operator could demonstrate through a robust FRM and a stable work pattern an equivalent level of safety then maybe this limit could be raised.
313. The Agency presented a separate question on flight times and duty periods to scientists asking them to clarify if there is a need for an additional duty limit of 14 days and/or recovery rest over a series of weeks to counter cumulative fatigue. The answers from the three scientists were split. While two scientists stated there is little scientific evidence to support specific limits for cumulative duty hours, they would prefer a total duty limit of 100 hours in 14 days to ensure that duty times are spread evenly. One scientist stated that such an additional 14-day limit would not be necessary if the 7-day limit applies.

Spreading duty as evenly as possible

314. The NPA requirement taken from *EU-OPS 1.1100* stating that 'the operator is required to spread duty periods within any 28 consecutive days as evenly as practicable' was believed to be too ambiguous, subjective and open to an individual's interpretation. According to crew organisations the only possibility to ensure an even spread is to implement a 14-day limit of 100 hours, which was recommended by the Moebus report and which would allow for legal certainty. According to those commentators a limit of 90 hours within 2 weeks is established in the European Regulation for truck and bus drivers [(EC) No 561/2006]. One operator also suggested to delete any reference to 'spreading duty as evenly as possible' and a second operator questioned the practicalities of the requirement to spread duty as evenly as possible, questioning who would be able to oversee such a vague requirement and if the crew member would have a legal basis in changing the roster even after the planning stage by swapping trips or picking up overtime that groups work together.

Rules for flight and cabin crew

315. Some operators operating under the UK's CAP 371 argued that under their current national scheme the total duty hours per 28 days are prescribed differently for cabin crew and for flight crew leading to the possibility of 210 duty hours for cabin crew and 190 duty hours for flight crew. The limit for cabin crew is higher due to the additional report and debriefing times associated with cabin crew duties. According to those commentators a similar more flexible requirement for cabin crew should be included into the European FTL rules.
316. The Agency notes that neither the NPA nor the CRD foresee different limits for flight and cabin crew. Different cumulative duty hours for cabin crew and for flight crew are currently only foreseen under the UK's CAP 371 requirements, cannot be seen in isolation and have to be assessed in the context of the complete set of FTL rules contained in CAP 371, e.g. how standby times account for cumulative duty times.

Total flight time

317. The NPA added a gliding limit on total flight hours in any 12 consecutive calendar months to the total flight hour limit of 900 hours in 'any calendar year' of Subpart Q. The NPA stated: 'the Rulemaking Group was concerned by the fact that the current Subpart Q limit of 900 Flight (Block) Hours per calendar year could lead to a theoretical peak of 1 200 Flight Hours in twelve consecutive months, and by its consequence on cumulative fatigue. However, it noted that setting this 900-hour limit per any twelve consecutive calendar months would particularly affect charter operators whose activities are very sensitive to holiday peak periods, such peaks varying in time from one year to another'. The NPA argues that the introduction of a limit in 'any 12 consecutive calendar months' is more in line with the ICAO proposed text 'in 365 consecutive days', but does not have a penalty of dissociation with normal alternation of years (every fourth year is a leap year which has 366 days) and is less complex for the operators in respect of calculations of total flight time.

Additional 6-month flight time gliding limit

318. Some crew organisations argued in favour of an additional maximum of 550 hours flight time in 6 months, to avoid a compression of 650 flight hours in half a year, based on the currently required 100 flight hours in 28 days (EU-OPS) and mirrored in FTL.1.215(b)(2). Such requirement exists within the UK, where the CAP 371 scheme allows only 600 hours in 6 months.

Additional gliding limit of 1 000 flight hours in any 12 consecutive months

319. Operator organisations were split. While some are in favour of the flight time limits included in the NPA, others argued that the additional gliding limit is overly prescriptive

and is limiting roster flexibility, particularly in those countries where holiday seasons are not consistent throughout the country and as a result peaks change considerably.

320. Those operator organisations argued against such an additional gliding or rolling limit, since a gliding limit is a 'rule on a rule' and is not supported by scientific evidence. The 900 flight hour limit in a calendar year, they argued, is already the most restrictive but stable limit. The commentators presented scientific advice stating that an additional gliding limit is not necessary and that it would destabilise rosters. They argued that the gliding system would actually create a 'year end' situation of unpredictability and potential instability, which would occur at the end of the year when all of those duty hours have accumulated. This would parallel a flight duty extension when at the end of a planned flight (fatigue may already be an issue) the duty is lengthened, creating an unpredictable and less stable operation'. In addition, the US Federal Aviation Administration's Federal Aviation Regulations allow for an annual limit of 1 000 hours per any 365 days.
321. Some operator organisations requested that the calendar year should be specified by each operator and that it would provide greater control for flight crew to take leave and obtain rest and recovery to fit their individual needs.
322. One Member State stated that the limit of 900 flight hours should be any calendar year nominated by the operator and acceptable to the National Authority.
323. Another Member State stated that the total flight time limits should be on a 12 consecutive rolling month basis. While the Member State appreciates that the Agency has retained the WTD limit of 900 hours in a calendar year, in line with the Moebus recommendations, this 900-hour limit should be in any 12 consecutive months. The Member State recognises that the Agency has introduced a limit of 1 000 hours of flight time in any 12 consecutive calendar months in order to prevent excessive flight time, but feels that the argument for 1 000 hours is weak.
324. The scientists contracted by the Agency were asked whether any need for a 12-month or 365-day rolling limit to counter cumulative fatigue (as opposed to a calendar year limit) would be advisable. All three scientists stated that from a scientific point of view the limit is unknown, but they agreed to the need of a gliding limit to avoid excessive flight hours across a period of 18 months. Two scientists also recommended that it would be better to stipulate continuous periods of time off at regular intervals (for example at least 7 consecutive days off every 3 months) to counter cumulative fatigue.

365-day limit instead of calendar year limit

325. Crew organisations stated that a limit per calendar year, although it is contained in the Working Time Directive 2000/79/EC, is not required in addition to a 12-month/365-day limit. Some crew organisations therefore requested to modify the limit to 1 000 flight hours per 365 consecutive days to keep consistency with the ICAO Annex 6 attachment 4.7.1 and the US proposed rule.

Daily flying time limit

326. Crew organisations also requested to include a further daily limit for the flight time per flight duty period as per ICAO Annex 6 attachment A 4.7.1, while one operator asked for guidance on commencing a sector below the limits and exceeding the limit at the destination.

Proving effectiveness of the rule

327. One operator organisation argued that any requirement for an operator to demonstrate effectiveness of a roster as stated in FTL.1.215(c) of the NPA has no basis in safety and is an entirely unnecessary administrative burden. Rosters must be produced and implemented in accordance with an approved FTL system.

Post-flight duty

328. Some operator organisations stated that there is no safety justification to include post-flight duty into the flight duty period. Therefore, the NPA proposal on post-flight duty should be deleted since any requirement of an operator to 'demonstrate' effectiveness of a roster is not a safety issue. Rosters must be produced and implemented in accordance with the approved FTL system.
329. Crew organisations on the other hand argued that time related to aircraft and passenger safety should be included, such as delayed disembarking. While other crew organisations stated that the proposal should be amended to include a reference to 'the type of plane and layout in relation with seat available'.
330. One Member State stated that as this point is addressed to the operator it should be part of OR and that a minimum of 45 minutes for pre and post-flight duties per day should be established in a separate point (d).
331. The Agency concludes that the wording in (d) refers to post-flight duty only, which shall count as duty and does not refer to flight duty period (FDP) or flight duty, which are clearly defined terms. The definition of duty period has been transposed from Subpart Q and means 'a period which starts when a crew member is required by an operator to report for or to commence a duty and ends when that person is free from all duties', therefore post-flight duty is naturally included in the definition of 'duty period'.

Guidance Material & Working Time Directive

332. Crew organisations stated that the Working Time Directive is a legally binding text. This provision should therefore not be in Guidance Material, as this would give the wrong impression that the applicability of the Directive is optional. Instead reference to the Working Time Directive should be elevated to the level of the Implementing Rule.
333. One Member State agreed stating that GM1-OR.OPS.FTL.215 Flight times and duty periods referring to the Working Time Directive is fundamental and should be part of OR in Chapter 2.

Other Guidance Material

334. With respect to the Guidance Material commentators noted that GM should contain recommendations on how operators can spread duty as evenly a useful mitigation. Account has been taken that this might not always be practical under complex operational circumstances.
335. One operator organisation and one operator stated that the Guidance Material had the sole purpose of imposing further restrictions (albeit through the back door via GM). Any reference to additional limits (e.g. 14 consecutive days, which would not be a legal limit) which have no scientific or safety basis should be removed.

Agency's conclusion on flight times and duty periods

336. The CRD foresees all rules relating to flight times and duty periods to be included in the Implementing Rule (IR).
337. A 14-day limit of 110 hours has been introduced to the rule and as a consequence the GM on the 14-day limit has been deleted.
338. The gliding limit of 1 000 flight hours in any 12 consecutive calendar months has been maintained.
339. The reference to the Working Time Directive has been elevated to the Implementing Rule level and is now included in ORO.FTL.200 of the proposed rule. As a result the reference to the Working Time Directive in the Guidance Material (GM) has been deleted.

340. A new paragraph has been included on post-flight duties ensuring that post-flight duties count as duty and that the operator shall specify in its OPS Manual the minimum time period for post-flight duties.
341. A new operator requirement to specify in its OPS Manual the minimum time period for post-flight duties has been introduced into ORO.FTL.215 and a new GM1-ORO.FTL.215(c) recommends that the post-flight duty times should take account of the type of the operation, type and size of the aircraft and the airport conditions.

Positioning

342. Provisions related to the positioning duty were transposed from OPS.1.1105(5) into OR.OPS.FTL.220 and reflect corresponding requirements of Subpart Q. All commentators from crew organisations wished to clarify the link between positioning in-between two flights to ensure that positioning in-between two flights pertaining to a single FDP shall be included as part of the FDP.
343. Crew organisations declared that the NPA proposal leaves a gap since there is no duty time period limit, but only a flight duty time limit. This could mean that after 14 hours of FDP the crew member could be positioned for an unlimited time. Those commentators requested that there should be a limit to the total duty time period including possible positioning. Some commentators also asked whether cabin crew members positioning on a flight without being operating can be responsible for arming/disarming slides, opening doors, or any other possible in-flight emergency.
344. Crew organisations stated that the definition must be clarified. If the crew is away from their home base and do not go back to the airport they arrived at, the portion of the time that is longer than the transport back to the arrival airport must be regarded and must count as 'positioning'. Otherwise it would be possible to 'hide' positioning time by transporting crew from one airport to a suitable accommodation, but after the adjacent rest time, transport them to a different airport to continue their duty in their rest time.
345. Finally, those commentators also requested to change (a) to read 'positioning prior to operating shall be included as part of the FDP but shall not count as a sector' and to delete 'positioning after reporting but prior to operating', since any positioning prior to operating shall be part of the FDP.
346. Operator organisations requested more flexibility by stating that positioning should not account for 100 % of FDP in case the operator has determined differently in the operator's FRM. On demand operators, who are confronted with long positioning flights to a rest location, requested more flexibility in case the positioning would occur prior to an extended recovery rest period. For those operators the Agency notes that FTL schemes for air taxi operators, which include on demand operators, will be developed as part of a separate rulemaking task.
347. Some Member States stated their approval of the clear definition in (b) that all the time spent in positioning shall count as duty time, since positioning contributes to fatigue. One Member State requested to change the wording of (b) to state that 'all the time spent in positioning shall count as part of the duty period' instead of 'duty time'.
348. Questions on positioning were not included in the questions submitted to scientists, but the answer to home base included a recommendation that the definition of home base should be qualified to ensure that it is not used to evade the requirement for positioning flights to count as duty.

Agency's conclusion on positioning

349. The Agency notes that there is a separate rulemaking task for on demand operators, and proposes no change to the existing proposal.

Split duty

350. The Agency's proposal on split duty attracted a wide range of comments, among which roughly half expressed full support and the other half varied between full disagreement and proposals of more or less significant changes.

Length of the break and maximum FDP

351. Crew organisations proposed increasing the minimum length of the break to 4 hours, while one crew organisation proposed to limit it to 2 hours. In all cases the commentators referred rather to existing national regulations than scientific data.
352. One crew organisation suggested that breaks of less than 3 hours should not be used to extend the FDP. In fact this is already covered by FTL.1.225. Several crew organisations suggested that the maximum length of the break and/or the maximum FDP (or FDP extension) should be specified. This is not deemed necessary as above 10 hours of break (where a suitable accommodation is required) it is the interest of the operators to consider this break as a rest instead of using split duty, as this is less limiting in terms of FDP and subsequent rest.
353. No clear safety arguments could be derived from the comments, therefore the proposed length of the minimum duration of the break remains as proposed.

Number of breaks

354. One crew organisation pointed out that the rule would allow multiple short breaks leading potentially to up to 60 hours of non-stop duty (note: this is not possible). This is clearly not the intent of the provision, therefore the text is modified to authorise only one break within a single FDP.

Break: Duty period vs FDP

355. Two operators and one Member State suggested that the break on the ground should count as DP instead of FDP. They argued that if the break was counted as FDP the subsequent rest would be too long to plan any duty on subsequent days. This argument is not valid because rest is based on duty and not on FDP. The same commentators also argued that by counting the break as FDP it would sometimes be impossible to complete a planned series of flights. It is correct that counting the break as FDP has an impact on the cumulative flight duty time. The intention of these provisions is to allow for an extension of an FDP due to a break on the ground avoiding at the same time excessive flight duty times. Therefore the text is unchanged.
356. One crew organisation suggested that the NPA proposal in OR.OPS.FTL.225(b) should read: 'The break on the ground shall count as FDP in full'. This comment is accepted as it may remove some ambiguities, knowing that current national regulations permit a 'discount' on the time spent in a ground rest facility during split duties.
357. One crew organisation suggested limiting the number of split duties to 3 in 7 consecutive days, and another to 2. This proposal is based upon an existing national regulation. This is however not deemed necessary under this proposal, as the additional rest period provided (the break counts as FDP) is considered to mitigate the fatigue created by the extended FDP. The text remains unchanged.

Suitable accommodation

358. Crew organisations suggested allowing that the break should only be taken in a suitable accommodation, thereby providing a sleep opportunity (in order to recover from the homeostatic sleep pressure accumulated). In relation to this, some crew organisations also suggested setting the minimum break to 4 hours to ensure at least 2 hours of sleep. One crew organisation also suggested providing suitable accommodation for breaks of

more than 4 hours. All those comments show that there can be different valid approaches to split duty. There is no clear evidence that the current proposal (based upon CAP 371) itself based on scientific and significant operational experience should be questioned. The definition of accommodation has been amended. Facilities equivalent to class 3 in-flight rest facilities are now a requirement, therefore the Agency believes that the proposed rule improves CAP 371 and most existing national regulations regarding split duty.

Break on board the aircraft

359. Operator organisations and one Member State suggested that the break could be taken on board the aircraft. Some clarify that there should be no passengers on board, and that the APU or ground power unit should be running. The Agency agrees that it should be possible to allow for breaks on board the aircraft as long as the aircraft fulfils the requirements of accommodation. AMC material is added to clarify this point.

Pre and post-flight duties, and travelling

360. One crew organisation suggested extending the duration of pre and post-flight duties to 1 hour. Some crew organisations and one Member State suggested that travelling time should not be included in the break. Some also suggested a minimum duration for the travelling time.

Combination with reduced rest

361. Conflicting views were expressed by commentators regarding the possibility to combine split duty and reduced rest. While crew organisations rejected any combination, the majority of operator organisations supported allowing any combination of both concepts. One operator suggested that split duty should not be allowed after reduced rest and one crew organisation recommended forbidding the use of split duty before reduced rest.

Combination with extensions

362. Crew organisations suggested that split duty should not be combined with FTL.1.210(b) extensions.

Other combinations

363. The same commentators also suggested that split duty should not be allowed for FDPs that involve extensive time zone crossing (four or more time zones) and extensions due to in-flight rest.

Prescriptive rules

364. One crew organisation suggested that split duty be approved under the operators' scheme in association with FRMS, instead of being addressed by prescriptive rules. The Agency thinks on the contrary, based on CAP 371 experience, that split duty can be addressed through prescriptive rules.
365. One Member State observed that the NPA's proposal in FTL.1.225(c) does not need to repeat 'of 3 hours or more' as (a) already stipulates that all breaks are 'of 3 hours or more'. One operator suggested that the anomaly of splitting rest between 3–10 hours as stated in CAP 371 and 3–11 hours as it should read needs to be addressed. One operator pointed out that the case of breaks planned under the 6-hour limit or planned outside the WOCL but which, for operational reasons (like delays), exceed the 6-hour limit or encroach the WOCL is not addressed.
366. The three scientists showed a rather different approach to split duty. One stated that CAP 371 was an acceptable basis but makes suggestions for improvement, although not based on specific research. One considered that split duty and in-flight rest should have the same rules. The third scientist considered the opposite. One suggested that suitable

accommodation should be provided and that split duty should be limited to daytime, while this is not recommended by the two others. Overall, there was no clear scientific indication that the approach, based on CAP 371, should be changed.

Agency's conclusion

367. The Agency believes that commentators have not presented plausible evidence to justify increasing the minimum of 30 minutes for pre and post-flight duties and travelling time. General requirements that shall apply to split duty establish that a flight time specification scheme shall specify relevant factors. CS FTL.1.225(b) prescribes a minimum of 30 minutes for pre and post-flight duties and travelling time. Additional GM1 CS FTL.1.225(b) has been introduced recommending that the operator should take into account the type of aircraft, type of operation and airport conditions when defining the pre and post-flight duty and travelling times.
368. The Agency continues to believe that split duty may be followed by reduced rest. Since split duty counts in full as FDP, it generates a rest period as long as the split duty period itself. According to the proposed reduced rest rules, this rest period could be reduced up to a minimum of 12 hours at home base or 10 hours out of home base, leading to a shortfall of the subsequent FDP equal to the shortfall of the rest period. That means that a reduced rest period after a long split duty period would either lead to a rather long reduced rest period or a rather short FDP following the reduced rest. In any case a sleep opportunity of 8 hours is protected.
369. This is not the case if split duty would be allowed after a reduced rest, therefore the text remains unchanged and split duty shall not be allowed after a reduced rest period.
370. The Agency accepts that split duty should not be combined with FDP extensions due to in-flight rest. Commentators did not present scientific data substantiating such a practice and it seems unlikely that enough recuperative sleep can be achieved in two shorter breaks. This is also in line with the provisions for split duty which only allow for a single break during the FDP.
371. The Agency does not see why the combination of split duty and time zone crossing should be excluded. The effects of circadian de-synchronisation are mitigated by the rules addressing acclimatisation. A break on the ground during an FDP crossing several time zones should be as effective as in-flight rest during an FDP crossing the same amount of time zones for the purpose of achieving recuperative sleep.

Standby

372. Requirements for the assignment of crew members to standby duty reflect corresponding requirements of Subpart Q.
373. Operator organisations argued that the NPA proposal in OR.OPS.FTL.230(a) should be clarified to make it clear that this should not apply to re-planning in actual flight operations. Airlines often need to re-plan crew (for example crew who were originally assigned to conduct a flight which has been cancelled and who are therefore re-planned into standby). The operator organisation therefore suggests amending this paragraph to read '(a) Standby shall be rostered and the affected crew members shall be notified in advance, except when re-planned into standby'. The Agency notes that the NPA and this CRD contain a separate provision for unforeseen circumstances in actual flight operations, which allows adjusting crew schedules in the event of unforeseen circumstances.
374. One operator welcomed the proposal to harmonise standby across EU Member States and lamented the fact that standby is currently regulated differently across Europe and that the Working Time Directive (Council Directive 2000/79/EC) allows different countries to apply different criteria for the counting of standby time towards the annual total limit of 2 000 duty hours. According to the operator this gives an unfair advantage to competing

operators from different countries especially where standby availability is part of the contract.

375. Several crew organisations proposed to roster standby (including defined start and end time) rolling 14 days in advance as any other duty or days free of duty. Rest around standby duty should be as predictable as rest around any other FDP.
376. Another crew organisation stated that the wording of OR.OPS.FTL.230(c)(3) is confusing and could give the wrong impression that the rest period following standby, which does not lead to assignment on a flight duty, could be specified without applying the basic minimum rest period requirements in FTL.1.235. The Agency notes this concern and will propose an amendment to the proposed rule to ensure that if standby does not lead to assignment on a flight duty minimum rest requirements as in FTL.1.235 apply.
377. Finally, one crew organisation stated that the NPA proposal in OR.OPS.FTL.230(a), which states that standby shall be rostered and the affected crew members shall be notified in advance, should be changed into a certification specification (CS) and that the text should be changed to read: *'Standby duty shall be rostered by the publication of the 28 consecutive day roster with 7 days in advance or due to contingences at the operator with at least 48 hours including 2 local nights, and the affected crew members shall be notified in advance'*.
378. The Agency has amended the proposal accordingly to include Certification Specifications. With regard to the text proposal to publish standby rosters 7 days in advance, the Agency refers to OR.OPS.FTL.110(a) Operator requirements, which requires the operator to *'publish duty rosters sufficiently in advance to provide the opportunity for crew members to plan adequate rest.'*

Agency's conclusions on general elements of standby

379. The Agency proposes new wording to align with GM1-OR.OPS.FTL.235 Minimum Rest periods point(b) by stating that *'Standby shall be rostered and the affected crew members shall be notified sufficiently in advance to provide the opportunity for crew members to plan adequate rest'*.
380. For the case of re-planning into standby the proposed rule already includes a separate provision for unforeseen circumstances in actual flight operations. Therefore the text remains unchanged.

Airport standby

381. The Agency received a large number of comments regarding airport standby. However, the comments do not present a coherent approach against or in favour of the proposed rule, but mirror the wide array of different national provisions that are currently in place due to Article 8 of Subpart Q, which leaves it to the national regulator to regulate on standby.
382. Regarding airport standby in many Member States the maximum FDP counts for 100 % from the standby reporting time, whereas in other Member States standby only counts towards FDP after a certain time of airport standby ranging from 2 hours to 6 hours. In addition, in very few Member States airport standby does not account at all for subsequent FDP. Several Member States have no existing regulation on maximum hours for airport standby, whereas others limit the maximum time allowed from 8 hours to 13 hours with a general average of 12 hours.

Limit of airport standby duty hours

383. All individual commentators and crew organisations, as well as some Member States, referred to the need to limit duties involving airport standby duty, suggesting limits ranging from 12 hours to 16 hours. The NPA proposal does not include such a limit. The Explanatory Note to the NPA explained that the maximum time for airport standby is self-limiting since any subsequent FDP with a preceding airport standby of more than 6 hours

would have to be decreased accordingly. The commentators raised the concern that a crew member could still go on a 4-hour duty after having spent 16 hours on airport standby (in accommodation), of which 6 hours would be unaccounted for FDP and 10 hours would be accounted for. This would mean that 20 hours would have elapsed between reporting for airport standby and end of final FDP duty. Therefore, they argued that airport standby should not be considered as any less fatiguing than flight duty and reference was made to the US proposal on Flight Duty Rules and Rest Requirements (US NPRM), which states that *'because of the unique nature of these assignments, and the fact that the flight crew member is not resting, an airport/standby reserve assignment is considered to be an FDP, regardless of whether a flying assignment is ultimately received by the flight crew member'*.

384. One Member State voiced fundamental disagreement with the proposal due to concerns of excessive FDP as a result of long airport standby. By citing the Moebus report (Q. 14) and the US NPRM proposal, this Member State proposed that as a general rule 100 % of the airport standby duty should count towards a subsequent flight duty when calculating the maximum FDP.
385. Another Member State requested that there should be a limit of 20 hours to airport standby to prevent duty period lengths unacceptable for safe operations and physiological limits. The Member State argued, through an example, that without a limit it could happen that a crew member is called for an extended FDP after a 6-hour standby. In such a case the total service would be (6 + 18 hrs) 24 hours, which would be excessive. In addition, the same Member State requested that the word 'immediately' in FTL.1.230(1)(c) should be deleted. Since a crew member on airport standby could be called to start an FDP either immediately after the reporting time or later, the word 'immediately' should be deleted.
386. Regarding the overall limit of airport standby duty hours, the Agency continues to believe that the maximum time for airport standby and subsequent FDP is self-limiting. The example given by one Member State (6 + 18 hrs) would only be possible under augmented crew provisions, which would include a mandatory sleep opportunity during the FDP.

Airport standby buffer

387. Next to those calling for a limit on the maximum standby duty, many crew organisations stated that airport standby, including that in accommodation, requires a constant state of semi-preparedness and therefore presents a potential cause of fatigue. FTL.1.230(1) establishes two cases depending on whether an accommodation (as defined in ORO.FTL.105) is provided to the crew or not: in the NPA proposal standby time counts as FDP where no accommodation is provided, but a 6-hour buffer is granted where accommodation is provided.
388. Some Member States requested this buffer to be reduced to 4 hours and to be scientifically assessed, while crew organisations and individual commentators stated that accommodation (e.g. in a crew room) does not allow the crew to rest properly prior to the duty and therefore 100 % of the time spent in an accommodation should be accounted for FDP.
389. One operator requested clarification if airport standby takes place in a suitable accommodation and asked if in this case the rules regarding 'Other standby' would apply. The Agency responds that this is indeed the case, since the proposal on 'Other standby' applies to standby either at home or in a suitable accommodation irrespective of whether the suitable accommodation is at the airport or at home.
390. The operator also stated that the NPA lacks any guidance on those cases where the crew has been notified at least 8 hours before the reporting time, allowing them sufficient time to rest before the start of the FDP. The Agency takes note of this request and has

changed the proposal on 'Other standby' to include a provision where the crew is notified at least 10 hours before the reporting time.

Airport standby vs split duty

391. Some Member States stated that airport standby should mirror the provisions on split duty. They proposed that if accommodation is provided to the crew member the allowable FDP shall be calculated from the reporting time of the airport standby and can be increased by 50 % of the time the crew member is in accommodation up to a total increase of 3 hours. This calculated increased FDP shall start from the reporting time of the airport standby. The justification given for this change is the avoidance of excessive FDP. As the crew members have already reported, this requirement would mirror the duty calculation in split duty. Therefore, if the crew member is in accommodation the duty could be increased by 50 % of the time in accommodation where the crew member is undisturbed.
392. The Agency disagrees with the proposal to use the same provisions for airport standby and split duty. Both duties differ; split duty allows predicting when the duty starts and finishes and when the break is going to take place whereas standby is unpredictable.

Adjustment of airport standby

393. Regarding the rostering of standby and the duty length of airport standby, the NPA transposed Subpart Q, which states that *'the crew member shall be considered on standby from reporting at the reporting point until the end of the notified ___ standby period'*. Operator organisations requested flexibility to adjust those airport standby hours in case the crew member is released earlier than planned from airport duty, e.g. in the event that no subsequent FDP takes place. They argued that the current wording is a likely source of debate/conflict in advances of crew duties and would require significant changes to the operators' electronic crew rostering and control systems.
394. The Agency notes that as in Subpart Q the proposed rules will require all standby to be rostered. In those cases where airport standby is reduced by the operator and where no subsequent FDP takes place, the crew member's minimum rest requirements, as stipulated in FTL.1.235 Minimum Rest Periods, apply.

Minimum rest and airport standby

395. Crew organisations stated that airport standby shall be followed by a minimum rest period as foreseen in the proposed rules on minimum rest requirements. They argued the NPA lacks a clear link between airport standby duty and minimum rest, which could mean that airport standby could be immediately followed by other standby or training, etc. Therefore, it should be explicitly written into the rule that any type of standby must be followed by a rest period or that airport standby should be limited to a maximum of 12-16 hours.
396. The Agency notes that since airport standby is considered to be duty, if the airport standby is not immediately followed by FDP, the basic minimum rest requirements are applicable. This would also apply in those cases where airport standby is followed by training, since the definitions also include training as duty. The Agency strongly believes that the safety concern, which addresses rest before any subsequent FDP, is fully covered by the provisions on minimum rest periods. According to those provisions, even in those cases where airport standby plus training would lead to duties of more than 12 hours, the rest before any subsequent FDP would have to be at least as long as the preceding duty (airport standby + training).
397. One Member State referred to the need to link airport standby duty with general rest requirements to ensure that if airport standby is not immediately followed by FDP the minimum rest requirements are applicable.

398. The Agency will include new Guidance Material (GM) to clarify that standby is considered as duty and that therefore in case of standby not followed by an FDP the minimum rest requirements apply.

Airport standby in-between two FDP duties

399. Crew organisations raised their concern that airport standby could take place between two FDP duties.

400. The Agency notes that airport standby cannot take place between two FDP duties. Airport standby can only take place at the beginning of the FDP. For all other cases, split duty provisions apply.

Confusion about calculation of maximum FDP

401. Most commentators stated that FTL.1.230 (1)(c)(2) and (3) contradict each other. FTL.1.230 (1)(c)(2) states that *'if accommodation is provided to the crew the FDP shall count from the start of the FDP'*, while FTL.1.230(1)(c)(3) states that *'the maximum FDP shall count from the standby reporting time'*. The Agency agrees and has deleted FTL.1.230(1)(c)(3) and amended FTL.1.230(1)(c)(1), which now reads: *'if no accommodation is provided to the crew, the FDP shall count in full from the start of the standby reporting time'*.

402. The scientists contracted by the Agency noted that there is no coherent scientific evidence regarding airport standby duty.

403. One scientist stated that if a comfortable, quiet environment is not available for rest, or if a crew member is on immediate readiness, it is unlikely that much benefit would be derived from the standby period. In this case, it is reasonable that the FDP should count in full from the start of the standby, as is foreseen in the NPA. The other two scientists based their advice on the different provisions when suitable accommodation is available (either at home or at the airport) and when no suitable accommodation is provided, e.g. at the airport. According to their view the only distinguishing factor for standby should be whether suitable accommodation is provided or not.

404. The Agency notes that there is not sufficient scientific evidence available. Depending on the timing of the airport standby, a crew room (which would satisfy the definition of 'accommodation') might not provide the recuperative rest required to avoid fatigue during the subsequent FDP. Therefore, the Agency has included a new provision which does not provide for a 6-hour buffer in case standby takes place during the period 23:00 to 07:00.

Agency's conclusion on airport standby

405. Airport standby provisions have been included in Certification Specifications and a new CS FTL.1.230(1)(d) now states that *'if no accommodation is provided to the crew, the FDP shall count in full from the start of the standby reporting time'*.

406. A new provision has been included into the Certification Specification which states that if airport standby is immediately followed by an FDP, the following shall apply:

- if no accommodation is provided to the crew, the FDP shall count in full from the start of the standby reporting time;
- if accommodation is provided to the crew, the FDP shall count from the start of the FDP. The maximum FDP shall be reduced by any time spent on standby in excess of 4 hours or during the period 23:00 to 07:00.

407. The Agency maintains the requirement that all standby should be rostered and notified as per Subpart Q and where crews are released earlier from standby, minimum rest provisions apply.

Other standby

408. Regarding other standby at home or in a suitable accommodation, Member States' approaches differ even more than on airport standby. This explains the large amount of comments received from Member States. The limit in most Member States for the maximum allowable hours for this type of standby is between 12–24 hours. As an example, in one Member State the maximum time for standby in a suitable accommodation is 24 hours with no impact on the maximum allowable FDP or on cumulative duty totals. In another Member State all standby duty is accountable in full towards cumulative duty totals and is limited to 12 hours.
409. The proposed rules in this NPA are based on the wide variety of existing national rules and operational practices and will create a level playing field. As for airport standby, other standby provisions are currently regulated at national level and considerable variations exist across EU Member States. While in some Member States standby at home does not count at all towards cumulative duty limits and the time spent in home standby is not limited, on the other hand in other Member States home standby accounts towards cumulative duty limit and is limited.

Limit of other standby to 12 hours

410. Comments varied widely regarding the limit of other standby.
411. All crew organisations strongly supported the 12-hour limit. They argued that since standby is immediate readiness to operate, and the crew member is expected to be able to take a call to conduct an FDP either at the very start or at the very end of the standby period, it is essential that this period is limited in order to allow the crew member the possibility to plan their rest for the standby and the range of possible duties arising from it.
412. All operator organisations and most of the operators proposed to extend the 12-hour limit either to 14 or 16 hours, stating that the NPA proposal is far more restrictive than some national rules (i.e. France and Germany) which have been proven to be safe and which allowed for 24-hour standby with no impact on the flight duty period and cumulative duty limits. In order to prevent an unjustified increase in crew cost without safety justification (due to doubling of standby shifts), the maximum time for standby at home should be raised to 16 hours as a minimum (in case the notification time is less than 8 hours). In addition, it should still be possible to have a 24-hour standby in case of an 8-hour notification time. Such a requirement would still cater for the Agency's desire to allow for an 8-hour sleep opportunity.
413. One operator organisation and its Member State did not see any merit in limiting the maximum time of home standby since they argued that there is no difference between a crew member reporting for a pre-notified duty and a crew member on home standby. This operator organisation and its Member State used the example of a first crew member being on standby between 6AM and 6PM, a second crew member (not on standby) is scheduled to report at 10PM. In terms of fatigue and alertness exposition, they argued that there would be no difference between the crew member on standby if they were allowed to report at 10PM and the second crew member scheduled at 10PM. There would therefore be no rationale to exclude the standby between 6PM and 10PM. The operator organisation argued that the crew member not on standby would probably have more fatiguing activities than the one on standby who know they can be called at any time, provided that the preceding rest is adequate. The operator organisation and its Member State proposed a provision which would ensure an adequate preceding sleep opportunity and to extend the maximum time for standby up to 16 hours if standby begins after 05:00 and ends before 24:00. Provided that an adequate sleep opportunity is protected, the operator organisation and its Member State recommended allowing the possibility to plan another 16-hour standby the day after.

414. Another operator organisation stated that the limit should be 16 hours, which would ensure an 8-hour mitigating rest opportunity in any 24-hour period.
415. One operator stated that a 12-hour standby duty limit is acceptable, but should be able to be extended under FRM/fatigue mitigation provisions.
416. Two Member States requested that in all cases standby duty should be a maximum of 12 hours.
417. One Member State argued that a limit of 14 hours would be more reasonable.
418. Scientists did not comment on the 12-hour limit.

Cumulative duty limits

419. Opinions were split with respect to how 'Other standby' could be accounted towards cumulative duty limits. Most crew organisations requested that 100 % (instead of the NPA proposal of 25 %) of duty times should be taken into account when calculating cumulative duty limits. According to crew organisations the NPA does not distinguish between 'immediate readiness' and 'reserve for other standby'; in the worst case a crew member could be scheduled to 72 hours of immediate readiness in 7 days and only 25 % would count as cumulative duty. However, they also proposed to count less towards cumulative duty and to permit more allowable FDP when the period between call and report is longer. This period should be made known to the crew member before starting the standby period. Similar comments requested the Agency to adopt a similar position as the US NPRM with respect to other standby, since the US NPRM's point of departure is a lack of predictability, which means that a crew member on standby at home cannot schedule naps or otherwise control his/her sleep opportunities to assure that he/she is adequately rested when reporting for duty.
420. On the other hand, some operator organisations stated that although the NPA proposal of a 25 % impact on cumulative duty limits is more stringent than the limits in some previous national rules (which had 0 % impact), they could accept this limitation as a compromise as long as it remains 25 % in relation to cumulative duty limits. They requested that if the standby is planned at home, and if there is at least 8 hours between the call and the reporting time, the 25 % duty calculation (for cumulative purposes) should be removed.
421. One operator organisation stated that any accounting of other standby towards 25 % of cumulative duty limits is not logical, overly burdensome and creates a likely source of debate and conflict in advance of crew duties, whereas following minimum rest crews are able to undertake maximum FDP; this should also be the case for crews that had minimum rest plus non-airport standby, which is also restful.
422. One Member State stated that standby duty counting as only 25 % of duty time is not representative of the stress of being on standby. There is a possibility for excessive cumulative duty totals especially when combined with flying duty periods within the working week. The Member State suggested amending the requirements to allow for standby to be calculated as 25 % of the time spent on standby between the hours of 22:00 and 06:00 and 50 % for all other times.
423. For the purpose of calculating duty time when a crew member is required to report for a flight duty when on standby at home or in a suitable accommodation, two Member States suggested that 50 % of the length of the time spent on standby should count towards the calculation of total duty time. For the purpose of calculating duty time when on standby duty at home or in a suitable accommodation, and the crew member is not required to report for a flight duty, duty time should be calculated as follows: Standby duty time less than 6 hours, 25 % of the time spent on standby will count towards the total duty time. Standby duty time of 6 hours or more — 25 % of the first 6 hours of standby time plus 50 % of standby time in excess of 6 hours will count towards total duty time.

424. Another Member State stated that the question of accounting home or hotel standby is not related to safety. Standby compensation is a real issue but a social one. This statement is true and important for CAT regulated by the future NPA. This is true and even more important for air taxi operations where much time is spent on standby.
425. Scientists' opinion differs with respect to the counting of standby hours towards cumulative duty limits. One scientist states that the proposed contribution of 25 % of standby to duty limits appears reasonable based on general considerations. However, as stated in the Moebus report, there is no scientific evidence available that addresses this question. Another scientist proposes a sliding scale if suitable accommodation is provided or in case of standby at home. According to this sliding scale, from 0 to 3 hours standby there would be 25 %, from 3 to 6 hours 37 %, and from more than 6 hours of standby there would be 50 % of standby duty accounted for in cumulative duty limits. The scientist argues that when compared with the NPA's 6-hour cut off proposed for airport standby, this sliding scale has the advantage to be more progressive than a single value.
426. The third scientist presents the 'focus-on-sleep approach'. Standby may interfere with regular sleeping times and this approach takes into account the influence of standby on regular sleep (e.g. from 23:00 to 7:00 hours). This approach differs largely from that followed in the NPA. According to the third scientist, the consideration of standby as duty may be subject to industrial contracts and may depend on the proportion of standby of all duty time. According to the scientist, the proposed NPA rules (100 % airport, 25 % home standby) are right from a scientific point of view but they could be negotiated with a different result.

Limit the length of subsequent FDP following other standby

427. The NPA proposal on other standby proposed to reduce the subsequent FDP following other standby of more than 4 hours, provided that the flight duty is within 8 hours after the call.
428. As with airport standby, most of the comments expressed concerns about excessively long FDPs following other standby, e.g. at home. According to one crew organisation the proposal would allow starting a home standby at 06:00 hours for the duration of 12 hours. At 17:55 hours the flight crew member, after being awake for the entire day, would get called for a duty at 22:00 hours with a following flight duty period of 11 hours. As a result the flight crew member would get off duty at 09:00 hours the next morning after not having slept for about 28 hours. According to the commentator the crew member could not rest at home and the proposal is therefore highly unsafe, since the flight crew member needs a chance to rest adequately before the flight. Therefore, they argued that standby times should count as 100 % of duty unless sufficient notification is given to the crew member to rest before the duty, in which case a reduction in the percentage attributed to duty calculation would be acceptable. They are concerned that the Agency's focus is on the operators' need for productivity and flexibility rather than on safety considerations and that the proposed rules cater for the airlines' commercial interests rather than for safety.
429. One crew organisation stated that to prevent abuse and severe fatigue the total of standby and FDP must be limited to 16 hours for a non-augmented crew and to 17, 18 or 20 hours for augmented crew with class 3, 2 and 1 rest facilities respectively. To prevent abuse and severe fatigue, after being called for duty and without an intervening rest period (FTL.1.235), the remaining standby should still count as standby and duty, and cannot be used to plan the 2-hour pre-flight rest for an FDP with extension.
430. Crew organisations stated that the proposed other standby provision does not distinguish between 'immediate readiness' and 'reserve'. In the worst case where a crew member could be scheduled to 72 hours of immediate readiness in 7 days, only 25 % would count as cumulative duty. According to their view scientific studies (Torsvall L. & Åkerstedt T., 1988) have established that sleep on standby is shorter and of poorer quality. The limitation of cumulative duty is a mitigating measure for cumulative fatigue. The

possibility for immediate readiness would therefore not allow for optimal rest during the standby period.

431. Therefore, all crew organisations rejected the table proposed in the NPA in paragraph (d), but stated that the proposed reductions to the subsequent FDP following other standby have not been discussed in the OPS.055 Rulemaking Group. The paragraph should also distinguish between immediate readiness (i.e. reporting up to 4 hours after call) and being called to report between 4 and 10 hours after call. According to their view, a crew member cannot plan for rest during the standby period and the fact of possibly being called to immediately go to the airport will not even allow for a nap during the standby period. Accounting for this only reducing by 15 to 60 minutes the maximum FDP seems unreasonable. The Explanatory Note fails to explain how the table has been drafted and on what scientific knowledge it is based. The questions in the Explanatory Note do not address the issue. Question 11 mentions the commercial background. The RIA does not consider or explain what rationale has led to the table. The time awake before being called out must be taken into account when calculating the maximum FDP on standby.
432. All operator organisations also opposed the table contained in paragraph (d) and the reduction of the subsequent FDP. One operator organisation argued that any reduction of the FDP depending on the length of the standby is an unnecessarily complex provision, would generate disproportionate administration, is a likely source of debate/conflict in advances of crew duties and would require unnecessary and significant changes to the operators' electronic crew rostering and control systems.
433. Other operator organisations stated that the 4-hour limit is far too restrictive and has no safety justification. Therefore, paragraph (d) should be deleted since there is no safety justification to reduce the maximum FDP following standby at home given that several previous national rules did not consider any FDP reduction.
434. Two Member States stated that the current Agency's proposal does not take account of the time spent on standby prior to a call-out on FDP (e.g. standby report time 06:00 FDP, report time of 16:00, this would permit maximum FDP 11 hours and 25 minutes). This would result in a total duty period of 21 hours and 25 minutes and could lead to a period where the crew member could be awake for 21 hours and 25 minutes. The Member States consider this to be fatigue-inducing and therefore unsafe. They proposed that there should be some system of standby time accrual as FDP prior to being called out on FDP. The Member States proposed that the maximum allowable FDP when required to report for a flight duty when on standby at home or in a suitable accommodation should be as follows: If a crew member is required to report for a flight duty before completing 6 hours of standby duty, the maximum allowed FDP is as prescribed in FTL 1.230; if a crew member is required to report for a flight duty after completing 6 hours or more of standby duty, the maximum allowed FDP is that prescribed in FTL 1.230 minus the length of the time on standby in excess of 6 hours.
435. Other Member States equally concerned about an excessively long FDP following other standby voiced their concern that the current proposal allows for excessive total duty, potentially with inadequate rest due to the nature of rostered standby times. According to those Member States this could mean a crew member being on standby from 05:00 and being called at 12:00 for a report at 17:00 with an FDP of 10 hours plus extension, leading to an 11-hour FDP finishing at 04:00, i.e. a possible 23-hour duty ending in the WOCL.
436. One Member State stated that the method for reduction of the FDP allowed should be based on the total time allowed and the report time to protect the pre-flight rest opportunities afforded to the crew. This could be done either by setting a total duty time limit on the standby and FDP of a total of 18 hours or by requiring that the allowable FDP limit is reduced by any standby over 6 hours in duration.

437. Another Member State stated that the table with reductions of FDP according to the reporting times is acceptable, provided that a call to report for a duty occurs after the first 6 hours (instead of the NPA's proposed 4 hours) of the standby period, and the reporting time of the flight duty is within 8 hours after this call. This Member State also argued that there should be no reduction to the maximum FDP if flying under augmented crew provisions, since in this case fatigue mitigation is provided on board.
438. Another Member State stated that the table included in paragraph (d) has no safety justification. For flights with FDPs close to the legal limit this reduction of FDP would make standby inoperative and the only solution for the operator would be to cancel the flight. Therefore, according to this Member State, the reduction proposed in paragraph (d) should be removed for reporting times between 05:00 and 24:00 (in other words, for standbys of 16 hours). The Member State argued that when comparing the situation of a crew member who is scheduled and a crew member on a 16-hour standby, it is inconsistent to consider a reduction of the maximum FDP for the latter, not for the former, since the crew member on standby might be even more rested than the scheduled crew member.
439. Scientists agreed that there is very little scientific data available on standby followed by FDP. However, scientists also agreed that there is some evidence that individuals who are on call suffer a degree of sleep disturbance, while there is no direct evidence from aircrew studies in favour or against. This should be further investigated. One of the key issues in standby duty according to the scientists is the schedules' unpredictability and the associated difficulties to plan an appropriate sleep-wake schedule such as a nap. According to one scientist, the shorter the notice the higher the potential impact on sleep.
440. A third scientist presented a different approach to the NPA with a 'focus-on-sleep' approach. This approach distinguishes whether standby interferes with regular sleeping times (i.e. from 23:00 to 7:00 hours) or not. This approach differs largely from that followed in the NPA and the subsequent reduction of FDP does not correspond to the table in the NPA proposal of paragraph (d), in which reductions are listed dependent on reporting time. The scientist emphasizes on sleep during standby and does not consider whether standby should be considered duty or not.

Maximum number of standby hours per any 7 consecutive days

441. All operator organisations rejected the additional limit of 72 hours of standby hours in any 7 consecutive days stating that it is purely social and has no safety justification at all and should therefore be deleted and that the Agency should refrain from devising rules on hours 'not spent flying'. One operator stated that paragraph (e) prevents the use of standby blocks, which are commonly used to avoid disruption of rosters for the benefit of both crew and operator.
442. Another operator proposed to increase the limit to 84 hours in any 7 consecutive days. One operator organisation argued that if someone is planned for standby a whole week there should not be any safety implication. If called to perform a series of flights, he/she will have to rest afterwards anyway. If not called, there should not be a problem in planning 5 consecutive standbys of 16 hours each from a safety perspective. The Agency notes that fatigue-mitigating measures should be based on ensuring adequate pre-flight rest. While rules around post-flight rest are important and take into account the length of the previous FDP or duty period, the Agency is focusing on ensuring adequate pre-flight rest to make sure that the crew member is not starting an FDP fatigued.
443. Some Member States stated that the limit of 72 hours of standby in any 7 consecutive days should be reduced to 60 hours, as is currently applied in the Netherlands; this approach would be supported as the crew member should not be on standby for more hours than they could have worked in a week. According to this Member State crew members are unable to adequately plan their rest periods when working blocks of

standby duties. Therefore, excessive amounts of duty that are not being fully accounted for could lead to cumulative fatigue.

444. One Member State requested to increase the limit to 84 hours in any 7 consecutive days.

Credit for longer notification prior to other standby (long-call)

445. Crew organisations as well as operator organisations and Member States asked for a different approach to other standby depending on the length of the notification period and therefore on the availability and readiness of the crew member. They argued that the time awake before being called out must be taken into account when calculating the maximum FDP after standby.
446. Most commentators deplored the fact that the proposal on other standby does not distinguish between standby requiring a short reporting time (the so-called 'short-call') and standby applying a notification period of 8 hours or 10 hours before reporting time (the so-called 'long-call' or 'contactable period'). Yet, there is no single proposal on how credit should be given to those operators who allow for sufficient time and an opportunity of rest before reporting time. On the one hand commentators from crew organisations propose a phased approach depending on whether notification is given within 8 or 10 hours before reporting time. This would mean that if the time between notification and reporting time for a flight duty is less than 10 hours, the maximum time between end of duty and the beginning of standby shall not exceed the maximum applicable flight duty period plus 4 hours. Where the time between notification and the reporting time for a flight duty is 10 hours or more, the maximum FDP at the reporting time shall be applied. However, the reporting time for a flight duty period must be within the pre-notified standby period.
447. Some crew organisations requested to adopt the concept of a reserve status, as proposed in the US NPRM proposal, and to be incorporated by the Agency into its standby regulation. They argued that the key issue of reserve or standby is whether there is a minimum rest period in-between the notification of the flight duty and the reporting time for it. According to those commentators, the US NPRM proposal recognizes the importance of a notification well in advance of the start of the FDP and includes it in the proposed FTL Regulation by proposing to count less cumulative duty and more allowable FDP when the period between call and report is longer. However, this period must be made known to the crew member before starting the standby period.
448. On the other hand commentators from European operator organisations deplore that the proposal is far more restrictive than some national rules (i.e. France and Germany) which have been proven to be safe and which allow for a 24-hour standby with no impact on the flight duty period and cumulative duty limits. Some UK operators and operator organisations request that the UK system of 'contactable' described in CAP 371 should continue to be available. According to them such a means of 'standby' does not impose any obligation on the crew and hence should not count towards cumulative duty.
449. Operators requested that schemes which do not account as duty period and enable crew to obtain sufficient and undisturbed rest during the WOCL prior to commencing a duty (e.g. the UK's contactable scheme or 'reserve period' scheme or 'time assignability' scheme) should be continued to be applied. According to those commentators this would enable a 24-hour standby pattern with no impact on cumulative duty limits. In the UK 'reserve periods' for instance of up to 28 days in duration are possible under the current CAP 371 scheme. These days have no duties on them until at the latest the evening before. Operators use a 'contactable period', i.e. a window of 2 hours during the day, to inform pilots and crew about their duties — be it flying, ground or home/airport standby — on the next day. The operator does not allocate defined home or airport standbys at the roster publication stage and argues that this has no safety implications and therefore requests clarification whether this practice will be allowed to continue. According to the operator the use of this system actually increases roster stability by preventing

assignments on standby days scattered throughout rosters clashing out existing allocated duties. This allows better planning of days off and rest, thus reducing cumulative fatigue.

450. One operator stated that 24-hour standby periods are usual but they are not considered to be 'standby' since they include a long notification time of 8 hours or more, depending on the length of the assigned flight duty. The possibility to assign such reserve patterns is considered to be beneficial for employees as well, because it reduces the number of such events throughout the year. In Germany it is well received by employees as it reduces personal calendar periods just being 'blocked' by single day standby. Crew members could stay at home for some days, even a week, but have it done then for the rest of the year. As long as pre-flight rest is protected (which is the case), there should be no safety justification to prohibit such a practice. Therefore, the operator proposes to distinguish between long-call reserve and short-call standby (similar to the German and US NPRM concept), but generally allow for 24-hour reserve patterns. Also, there should be no cumulative limit for weekly standby as this proposal ensures an adequate preceding sleeping opportunity, comparable to crews whose flight would be scheduled in advance in the same window.
451. Some Member States supported this approach and requested a possible addition of a contactable regulation, which would allow the operator to roster a short (2 hours) window of time other than on an extended recovery period, on a day where the crew member has no other rostered duties but would be required to take a call giving them at least 10 hours' notice of a report time.
452. One Member State stated that the FDP limits proposed in the NPA could be excessive from a standby duty given the allowances in FTL 1.230(2) afforded to the operators when calling crew from standby. The reduction proposals do not go far enough to limit the total allowable duty from a standby start to end of duty after completing an FDP since airport and home standby require the crew member to be ready to receive a call to operate immediately, and therefore the start point and the reduction in the allowable FDP needs to be reduced to limit the possible excessive total duty periods. The Agency should therefore consider setting regulations for other forms of call to duty allowing the crew member to take a rest period before operating. This would afford flexibility for the operator while still protecting the crew's ability to be rested for the FDP. The Member States proposed that the method for reduction of the FDP allowed should be based more on the total time allowed and the report time to protect the pre-flight rest opportunities afforded to the crew. This could be done either by setting a total duty time limit on the standby and FDP of a total of 18 hours or by requiring that the allowable FDP limit is reduced by any standby over 6 hours in duration.

Minimum rest and other standby

453. As with airport standby most crew organisations stated that it should be explicitly written in the rule that any type of standby must be followed by a rest period. Those commentators want to ensure that two periods of other standby shall be separated by a minimum rest period. They are concerned that without such a provision a standby of 12 hours with no call-out could immediately be followed by another 12-hour standby. The Agency notes the concern and will include additional Guidance Material (GM) in the link between minimum rest and standby.
454. One operator stated that the minimum rest period after a standby period which does not lead to assignment on a flight duty should be 8 hours.
455. One Member State referred to the need to link airport standby duty with general rest requirements to ensure that if airport standby is not immediately followed by FDP the rest requirements of FTL.1.235 are applicable.
456. The Agency notes that since other standby is considered to be duty, if the standby is not immediately followed by FDP, the rest requirements of FTL.1.235 are applicable. This would also apply in those cases where home standby is followed by another home

standby, since OR.OPS.FTL.105 Definitions also includes standby as duty. Whether duty is accounted for 100 % as in airport standby or 25 % as in home standby of cumulative duty limits does not have an impact on the basic minimum rest provisions of FTL.1.235 and rest before any subsequent FDP would have to be at least as long as the preceding duty.

457. The Agency will include new Guidance Material (GM) to clarify that standby is considered as duty and that therefore in case of standby not followed by an FDP the minimum rest requirements apply.

Setting of a minimum response time

458. Individual commentators requested that other standby shall have a reporting time of minimum 90 minutes at home base after being called out for flight duty. They also propose that the response time can be reduced to 60 minutes, but then the belonging standby duty shall count as 50 %. The commentators have experienced cases where the operator assigned crew on other standby, but at the same time required that the aircraft would be airborne 30 minutes after call-out. The commentators argued that the operator would not require the crew to be at the airport as long as crew were airborne 30 minutes after called out from standby. This would lead to extremely short reporting times and to cases where the pilots would be sitting in their cars on the terminal parking lots or in the passenger terminals when on 'other standby'.
459. The Agency notes that the definition of other standby clearly states that standby must be either at home or in a suitable accommodation. Since the car seat in the crew member's car neither qualifies as his/her home nor does it present a suitable accommodation, such practices would not be possible under the proposed rule. However, the Agency believes there might be some merit in including appropriate Guidance Material to ensure that operators apply realistic reporting times when calling out crew members from other standby.

Agency's conclusion on home standby

460. According to the scientists' reports there is little scientific evidence available on home standby.
461. The CRD proposal foresees Certification Specifications (CS) for airport and other standby and introduces the concept of short-call and long-call standby. Short-call standby at home or in a suitable accommodation is limited to 12 hours, with a reduction of the subsequent FDP after the first 6 hours and accounts for 25 % for cumulative duty limits. Long-call standby is also at home or in a suitable accommodation, does not limit the subsequent FDP, is not limited in length, does not account for any duty time, but requires a pre-notification of at least 10 hours to ensure adequate rest before reporting for duty.
462. The CRD proposal introduces a new requirement for operators to establish a response time between call and reporting that takes into account that crew members can arrive from their place of rest to the designated reporting place within a reasonable time.
463. The maximum standby hours that were in paragraph (e) of the NPA have been deleted.
464. The new rule includes a clarification when standby duty will cease, i.e. when the crew member reports at the designated reporting point.
465. A new rule has been inserted in the CS sections on short-call and long-call standby to ensure that minimum rest periods apply where there is no assignment for a flight following standby or if there are other duties following standby, e.g. training, office work, etc.
466. New GM has been included to state that if airport or short-call standby is adjusted by the operator during standby which does not lead to an assignment to a flight duty period, the crew member's minimum rest requirements stipulated under ORO.FTL.235 apply.

467. A clarification has been introduced that standby provisions do not apply in case the crew member has received basic minimum rest before commencing an FDP.

Rest periods

468. A wide range of individual comments were received on the proposals regarding provisions for minimum rest; some of the commentators expressed full support while others disagreed. Commentators proposed more or less significant changes.

Minimum rest period at home base

469. Crew organisations stated that rest should be provided before any duty, not only before FDP. However, by limiting the amount of cumulative duty and providing rest equal to the preceding duty when longer than 12 hours, the proposed provisions (identical to those from Subpart Q) should adequately compensate long or excessive duty hours. One crew organisation gave the example of an 11-hour FDP followed by an 11-hour positioning duty back to home base, which would lead to only 12 hours of rest at home base. The Agency notes that this example is not fully correct because the 11-hour FDP followed by an 11-hour positioning back, plus probably 2 hours turnaround time, would mean a duty of 24 hours. Therefore, the minimum rest provided to the crew following such a duty would be 24 hours, not 12 hours.
470. Operators proposed to allow reducing cabin crew members' rest by 1 hour from that provided to flight crew. They argued that this was necessary for operational flexibility reasons, while the impact on fatigue is claimed to be negligible. In fact the NPA's FTL.210 (1)(c) already provided the possibility to extend cabin crew FDP by 1 hour allowing cabin crew to report up to 1 hour earlier than flight crew and this provision has been transferred to the CRD's proposed rule. The Agency believes that the combination of allowing for a 1-hour longer FDP and reducing the rest by 1 hour is excessive.
471. One operator suggested clarifying the wording by adding that rest shall be taken 'directly' before the FDP in order to avoid any 'undefined time period' between the rest and the FDP. In fact this is not necessary because there cannot be by definition any 'undefined time period': if the time period before the FDP is not rest, then it is duty and this duty is regarded as FDP.
472. Crew organisations stated that rest away from base should be as long as rest at home base. In reality the difference in duration is due to the fact that when at home base the crew member is supposed to fulfil certain social and family obligations, which is not the case away from base. The minimum of 12-hour rest at home base and the minimum of 10-hour rest away from base are both intended to protect the 8-hour sleep opportunity, but in different contexts.
473. One operator, while supporting the paragraph, stated that the minimum rest period should be the planned rest period, and should not refer to the actual rest period. The Agency disagrees because this could lead to significant rest reductions, e.g. in case of long delays out of base. Furthermore, the so-called 'commander's discretion' provisions already foresee the possibility for the commander to reduce the crew rest under certain conditions and in unforeseen circumstances.
474. Scientists did not comment on minimum rest periods.

Minimum rest period away from home base

475. Commentators from all stakeholder groups requested a better definition of physiological needs and asked for clarification on the time needed for those physiological needs. Some of them argued that if the minimum time for physiological needs was not defined it could be reduced to allow for longer travelling times to the suitable accommodation.
476. Crew organisations also recommended that the suitable accommodation be available to the crew for a minimum of 10 hours but did not state the reason for this request.

Recurrent extended recovery rest periods

477. Some operators suggested reinstating the Subpart Q exemption allowing a reduction of the second night while extending the rest to 40 hours. The Agency notes that this exemption was removed because there was no scientific evidence that the lack of a second local night could be compensated by only 4 additional hours of rest.
478. One crew organisation noticed that the provisions as proposed could lead to as little as 3 instances of a 36-hour break in a calendar month. The Agency notes that the proposal does not repeat the provision of the EU Working Time Directive, which requires 7 days free of duty per 28 days. The reference to the EU Working Time Directive, which takes precedence over the FTL rules described in this CRD, has been included in the Implementing Rules of the CRD's proposed rules.
479. Some Members States suggested increasing the length of the extended recovery rest period to include 3 local nights, either systematically or twice in every 28 days.
480. A number of crew organisations proposed including the extended recovery rest within the 168-hour period to avoid the possibility of an extended recovery rest period after 168 hours.
481. A number of commentators proposed either to increase the recurrent recovery period or to decrease the interval between 2 rest periods.
482. One scientist recommended a period of continuous time off at regular intervals, e.g. at least 7 consecutive days off every 3 months to mitigate against cumulative fatigue.

Disruptive schedules

483. Some commentators supported the text without any change.
484. Crew organisations requested to extend the definition of early starts and late finishes. Respectively the periods for early starts between 05:00–06:59 and 00:00–01:59 are also supported by the three scientists. The Agency agrees and has changed the proposed rule accordingly.
485. Commentators from all stakeholder groups also noted that the term 'late arrival' is not defined and should be replaced by 'late finish'. The Agency agrees and has changed the proposed rule accordingly.
486. Operator organisations suggested clarifying that the text addresses only transition at home base, while crew organisations suggested this should apply to any location. In fact the original intent of the text was to address home base transitions only and the Agency has clarified the proposed rule text accordingly.
487. One operator organisation noted that the provision should apply to 'planned transitions' in order to maintain roster stability. The Agency agrees and has changed the text accordingly.
488. Crew organisations also remarked that transitions from late finishes to night starts should also be addressed. This is accepted; however, those cases are already covered by the provisions on night duties and therefore do not require a change in the proposed rule.
489. Some crew organisations suggested a similar provision for transitions from early start to late finish. However, this is not necessary as this type of transition automatically includes a local night.
490. Two Member States also recommended requiring extended recovery rest periods to include 3 local nights when more than 3 early/late/night duties occur between 2 such periods. This change is also supported by the three scientists and is therefore accepted and the text of the proposed rule has been changed accordingly.
491. The scientists consulted by the Agency stated that critical times are around midnight for a late finish and at 07:00 for an early start. One scientist stated that the definition of the late finishes is less critical, but the same scientist also recommended advancing the

period to 00:00 instead of 01:00 to be more consistent with the physiological rhythms. All scientists recommended advancing 1 hour for a late finish and delaying 1 hour for an early start.

Back-to-back operations

492. The practice of 'back-to-back' operations attracted numerous comments.
493. Crew organisations highlighted the potential social impact of the proposal and the Agency takes note of these comments.
494. Crew organisations suggested that the crew should have the choice between suitable accommodation provided by the operator and rest to take place at home. This is not accepted as the reduction of rest is in essence linked to the rest not being taken at home, but in a suitable accommodation, where the crew member's rest is less likely to be disturbed.
495. One Member State and some crew organisations expressed concerns on the possible combination of the proposal with circadian disruption. Crew organisations therefore suggested limiting the number of back-to-back operations to e.g. 1 per 28 days, while a few crew organisations also recommend deleting all back-to-back operations but failed to provide clear justification.

Time zone crossing

496. On paragraph (a)(1) *Rest at home base* some crew organisations and one Member State commented that the minimum rest at home base should be increased, in particular for more than 3 time zone crossings. Commentators from all stakeholder groups also pointed towards the complexity of the issue: since fatigue is not only caused by the number of the time zones crossed but also depends on the degree of acclimatisation of the crew and e.g. on the time at which the crew had their rest during the time away from home base. The Agency acknowledges that the variety of scenarios cannot be possibly addressed in a single rule and a simple requirement. Therefore, the Agency proposes amending the proposal in order to address both issues:

- how many time zones have been crossed during a rotation; and
- the duration of the rotation.

The Agency also proposes to reword paragraph (b) to cover the monitoring not only of the combination of rotations, but also of single rotations.

497. On paragraph 2 (a)(2) *Rest away from base* two Member States noted that a series of sectors encompassing less than 4 time zones within 1 FDP could lead to significant time zone crossing. The Agency agrees and the text is changed to read 'FDP' instead of 'sector'.
498. One Member State proposed to further increase the rest by 1 hour per time zone above 3 zones, with a limit of 6 hours. However, in case of disrupted sleep patterns, 14 hours of rest should be sufficient to provided adequate rest.
499. On paragraph (a)(3) *Eastward-Westward and Westward-Eastward transition* one operator suggested clarifying that the provision applies only at home base. This is agreed as this was the original intent of the text. The commentator also pointed out that reference should be made to paragraph (a)(1). The Agency also agrees to this.
500. A few crew organisations proposed increasing the number of local nights at home base. The Agency considers that as a minimum 3 local nights should be sufficient, also bearing in mind that paragraph (b) applies and could result in an increase of the rest at home base.
501. Commentators from all stakeholder groups proposed a clarification of the definition, in particular of the term 'rotation'. This is agreed and the definition has been added.

502. Some operator organisations disagreed with the requirement to apply FRM requirements. However, FRM would only be required in case of deviation from the requirement. Another operator organisation supported the approach in the NPA while pointing out that this may not apply to flights with intermediate stopovers with rest periods; typically this would concern cargo operations. In fact, the intent of the Agency was rightly to provide the possibility to implement alternative mitigating measures, as written in the second part of the paragraph (intermediate stopovers with rest periods might be a mitigating measure). Therefore, in essence, the text does not need to be amended. The Agency proposes moving the detailed requirement to a Certification Specification. The approach taken by the Agency is indeed to include any provision including a degree of flexibility in a Certification Specification.
503. The requirements to monitor the combination of rotations in paragraph 2(b) raised three types of comments:
- full support;
 - support with a note that the purpose of the monitoring (e.g. adapt the schedules, provide additional rest, etc.) should be specified;
 - no support, considering there is no need to monitor something that is already covered by prescriptive rules.
504. The Agency disagrees that the rules dealing with a combination of rotations are prescriptive enough. A combination of rotations is a very complex subject in terms of possible impact to the crew fatigue, which cannot possibly be addressed by a simple set of requirements. It is well known that some routes are more fatiguing than others, as this arises from a combination of start of the FDP at home base and lay-over, length of the FDP, number of time zones crossed, rest at layover, etc. Hence the requirement that operators shall monitor fatigue risks arising from the combination of rotations combining multiple time zone crossings. Therefore, the Agency agrees that the purpose of the monitoring should also be clarified.

Reduced rest

505. A wide range of comments were received on the reduced rest provisions of the NPA proposed rule. Comments varied from full support to strong opposition or support with more or less significant changes. Commentators from all stakeholder groups expressed concerns that a rule would virtually allow *any* operator to implement reduced rest not allowing the minimum 8-hour sleep opportunity. A number of commentators also criticised the complexity of the proposal.
506. The concerns regarding reduced rest provision not allowing the minimum 8-hour sleep opportunity were also shared by the three scientists consulted by the Agency. One scientist stated that reduced rest provisions as proposed in the NPA do not fit into a general FTL scheme and depend on the types of schedules and the types of operations. A second scientist stated that reduced rest may be acceptable as a variation for a specific operation and studied then accordingly, but should not be included in a general FTL scheme.
507. A third scientist stated that reduced rest would be acceptable provided that the combination of reduced rest with other disruptive schedules is avoided and that a number of mitigating measures apply, such as:
- no other reduced rest or early starts in the same week;
 - limit the number of sectors to 1 after the reduced rest;
 - no FDP extension should be used;
 - no extension of FDP due to augmented crew;
 - limit the time zone crossing to 2 time zones from home base;

- suitable accommodation should be provided;
- monitor these operations through an FRMS and use of mitigating measures if necessary (accommodation, meal, etc.);
- ensure specific aircrew training about sleep management and fatigue.

508. Therefore, the Agency has proposed simplified reduced rest provisions that ensure the minimum 8-hour sleep opportunity and contain a number of limitations such as:

- the requirement to use FRM provisions;
- an extension of the subsequent rest period by the shortfall of the basic minimum rest;
- as well as a limit of a maximum of 2 reduced rests between 2 recurrent extended recovery rest periods.

509. By placing reduced rest provisions in a Certification Specification the possibility to go below the 8-hour minimum remains an option and provides for 'controlled flexibility' for some operators through the approval of an individual scheme by the Agency. However, the operator would have to demonstrate an equivalent level of safety via proven fatigue mitigating measures. This should allow those regional airlines currently using such provisions to continue this operation insofar the individual scheme demonstrates an equivalent level of safety and is approved by the Agency.

AMC and Guidance Material

510. Commentators from all stakeholder groups criticised the related Guidance Material, mainly pointing to a lack of clarity, little added value and redundancies with the proposed rules on operator's responsibility (ORO.FTL.110) and CAT.GEN.MPA.100 on crew responsibility. See also paragraph 151 to 154 of the Explanatory Note on new paragraph ORO.FTL.115.

511. Two crew organisations required in particular the material to be upgraded to the level of Implementing Rules, especially concerning the guidance to 'prepare the roster sufficiently in advance' in GM1-OR.OPS.FTL.235. In fact this is already the case as this wording is already included in ORO.FTL.110 (a).

512. Other specific comments suggested requiring rosters to be prepared 14 days in advance; upgrading the 'non-punitive process' to the level of the Implementing Rule; pointed towards the difficulty for an operator to monitor that crew report well-rested; the difficulty for crews to assess the fatigue level of other crew; etc.

Agency's conclusions on rest periods

513. Regarding minimum rest requirements, the Agency will not propose minimum rest requirements before any duty nor will reduce the minimum rest of cabin crew by 1 hour.

514. The Agency confirms that rest requirements apply to actual rest.

515. The Agency maintains different rest requirements at home and out of home base. The purpose of a minimum rest period is to protect the sleeping opportunity of 8 hours; this is the case because the operator provides suitable accommodation and transportation from the airport to the suitable accommodation. The Agency agrees that the time needed for physiological needs should be indicated. However, flexibility should be given to the operators to adjust this time depending on the conditions of their operations. Therefore, the text is proposed in AMC.

516. Regarding extended recovery rest periods, the CRD proposal increases the extended recovery rest period to 2 days twice in every 28 days.

517. With respect to disruptive schedules the Agency changed the definition of early starts (05:00–06:59) and delayed the start of the early start by 1 hour. With respect to late

finishes the Agency has changed the definition of late finishes (00:00–01:59) and advanced the late finish by 1 hour.

518. Regarding disruptive schedules, the new term 'late finish' has been used instead of 'late arrival'.
519. The new rule text clarifies that the provisions on disruptive schedules apply only to home base and to planned transitions.
520. Regarding back-to-back operations, the potential social impact of the proposal is acknowledged to a certain extent. However, from a safety point of view undisturbed rest for back-to-back operations is ensured since the operator is responsible for a suitable accommodation. Therefore, the Agency maintains its proposal and does not agree to limit the number of times of back-to-back operations.
521. Regarding time zone crossings, the criterion for significant time zone crossing should be the full time zone span of the full FDP and not of the individual sectors, and the Agency has changed the text to read 'FDP' instead of 'sector'.
522. After considerable time zone crossings, the 14-hour minimum rest away from base is maintained.
523. The Eastward-Westward and Westward-Eastward transition provisions apply to home base, and the definition includes a clarification of the term 'rotation'. The additional local night is maintained.
524. The purpose of monitoring combination of rotations is clarified, and the requirement to monitor is extended to single rotations.
525. With respect to reduced rest, the Agency acknowledges that the proposed text of the NPA was not mature and redundant. Therefore, the Agency has removed the reduced rest provisions of the NPA from the IRs. This CRD contains a new section with reduced rest provisions in a Certification Specification (CS) that ensures a minimum 8-hour sleep opportunity.

Nutrition

EU-OPS requirement is sufficient

526. Operator organisations argued that the current EU-OPS wording (OPS 1.1130: A meal and drink opportunity must occur in order to avoid any detriment to a crew member's performance, especially when the FDP exceeds 6 hours) is sufficient and that the additional requirement to specify crew member's nutrition in the Operations Manual is too prescriptive, does not have a safety justification, creates potentially significant limitations, and is purely an industrial issue. The great variety of flights, operations and rotations prohibit the use of such a prescriptive requirement.
527. Operator organisations also requested deleting the AMC text since the NPA proposal is unworkable especially for low cost operators with mainly short-haul flights and very short turnaround times which would require a minimum duration of the meal break to be included in the Operations Manual. Operators stated that the NPA would mandate a particular style of meal that is to be provided, which is impossible for an industry with huge cultural differences, and also huge differences in on-board catering facilities.
528. In addition, while meals are provided by some operators other operators choose to provide meal allowances for crew (which according to those commentators many crew prefer), or indeed, simply factor in the *terms and conditions* that no meals are provided. In addition, commentators pointed to the fact that the provision of crew meals is seen by some government agencies as forming part of their remuneration.
529. One operator stated that the responsibility for correct nutrition to avoid detriment in crew performance cannot rest on the operator only. Crew members are responsible for ensuring that they commence an FDP having had suitable nutrition to avoid detriment in

their performance for up to the first 6 hours of the FDP. For FDPs greater than 6 hours, the opportunity to eat a regular meal will occur within the first 6 hours of the FDP in accordance with the criteria laid down in the Operations Manual.

NPA proposal is too vague and ambiguous

530. Crew organisations argued that the current proposal, which requires a 'meal and drink opportunity' is too vague and ambiguous when compared with the existing EU-OPS requirement and that the AMC material cannot be enforced due to the fact that Guidance and AMC material is not mandatory.
531. Many crew organisation and one operator stated that a clear 20-minute opportunity in every 6 hours of duty must be guaranteed. This 20-minute break should be designated/rostered in advance of the flights or series of flights. Commentators from Swedish crew organisations stated that such a 20-minute break should occur after 5 hours of duty in accordance with the national working time requirements.

Quality of food in accordance with WHO standards

532. Crew organisations also stated that food and drink should meet the quality standards according to official recommendations (e.g. World Health Organisation) to support sufficient nutrition and vitamins to ensure a healthy diet and shall be provided in accordance with the appropriate circadian timings even if the FDP does not exceed 6 hours. According to those commentators meal timings and conditions are an essential factor to body clock synchronization, health promotion and human performance conservation. Bad practices should be avoided, e.g. if a crew member reports for duty at 10.30 local time and ends his/her FDP after 5 hours and 30 minutes at 16.00 local time he/she may not have the chance to consume any meal and the operator will not be required to provide any meal and drink opportunity.
533. The proposed AMC material by crew organisations suggested expanding the AMC material to ensure that the operator shall specify in its operating manual procedures, requirements and limitations for directly before, during and, if so required, directly after an FDP that ensure that operating crew members do not suffer from decreased performance due to under-nutrition and dehydration, including: (a) length of each meal and drink opportunity; (b) suitable location for each meal and drink opportunity; (c) frequency of each meal and drink opportunity; (d) easy availability of adequate types and quantities of food and drinks.

Expanded Guidance Material & rule structure

534. One Member State requested that the Operations Manual should contain, at least, guiding material to address the points included in the AMC text.
535. Another Member State stated that the text included in FTL.1.240 is superfluous and that all aspects regarding nutrition should be included in the operator requirements under Chapter 2.
536. The issue of nutrition was not presented to scientists for comments.

Agency's conclusion on nutrition

537. The original wording of Subpart Q of EU-OPS has been reinserted.
538. The different operational realities are acknowledged. Therefore, the Agency proposes that the possibility to cater for different operational realities is available under Article 22 of the Basic Regulation and consequently the nutrition requirement is placed in a Certification Specification.
539. The AMC material has been amended to cater for those operators who do not provide meals as such, but supply vouchers or factorise this into other conditions.

540. The requirement to specify in its Operations Manual how the crew member's nutrition is ensured during FDP is removed since the complete set of FTL rules must be included into the Operations Manual in any case.
541. No further extension of the AMC material to specify nutrition according to WHO standards is deemed necessary.

Records

542. Requirements related to the records of flight duty time limitations and rest requirements are laid down in paragraph OR.OPS.245.FTL. It is explained what kind of records should be kept and for how long they shall be kept by the operator. These requirements correspond to those of *OPS 1.1135*.
543. OR.OPS.245.FTL (b) requires the operator to provide individual FTL records for crew members concerned and other operators in the case when crew members are employed by them.
544. Comments received during the public consultation period stated that those crew members who are irregularly employed by the operator shall provide their employers with up-to-date records and that these records have to be checked by the operator before they offer duty to the crew member. For newly hired crew, some commentators requested that the operator would have to include records for 365 days of newly employed or contracted pilots to control the related cumulative limits.
545. Operator organisations requested that not only the operator should be responsible for the record of duty time. Therefore, in the case of freelance pilots and for crew members who perform functions for more than one operator, they shall maintain and present their records to any operator who employs their services before they commence a flight duty period (EU-OPS 1.1135). This concept was supported by Member States who also stated that there needs to be a requirement on the operator to request these records and to check them before offering a duty.
546. Finally, crew organisations requested that operators shall maintain an individual and permanent record that tracks and documents home base assignment to each crew member. They also requested that roster planning be included in the records.
547. Member States also requested that standby times be included in the records requirements.

Storage of records

548. Crew organisations also commented on the length of time that records should be kept, arguing that today's low cost of data storage would justify a general requirement for operators to store records for up to 2 years, instead of the 15-month period stipulated by OPS 1.1135. According to those commentators records for truck and bus drivers must be kept for 2 years in accordance with Regulation (EC) No 561/2006.
549. Regarding the content of records, some commentators requested to add standby duties as well as records related to home base assignment for each crew member.

Agency's conclusion on records

550. The Agency agrees that records shall be maintained for a period of 24 months.
551. Requirements for irregularly employed crew members already exist under CAT.GEN.MPA.100 Crew responsibilities, requiring crews to inform each operator about their activities. Therefore, there is no need to reiterate this requirement.
552. The Agency decided that no further reference of standby duty is needed in the records requirements. Standby is considered to be duty, has to be rostered and is therefore included in the records requirements under ORO.FTL.245 (a)(1)(ii).

553. The Agency has amended the records requirement to be maintained, to include assigned home base under ORO.FTL.245 (a)(1)(iv).

V. How to submit reactions

554. The Agency accepts reactions to this CRD and to the responses given in this CRD.

555. Following the closing date for reactions, the Agency will conduct a final review and will subsequently issue the Executive Director Decision/Opinion related to this task.

556. Reactions to this CRD should be received by the Agency not later than **19 March 2012** and should be submitted using the Comment Response Tool at <http://hub.easa.europa.eu/crt>.

*When submitting their reactions, stakeholders are kindly invited to follow the recommendations stipulated in the **Guidelines on how to submit reactions** document (which is to be found under <http://easa.europa.eu/rulemaking/comment-response-documents-CRDs-and-review-groups.php>).*

B. Proposed rule

I. Draft Opinion — Draft Cover Regulation to Regulation on Air Operations**DRAFT COMMISSION REGULATION (EU) No .../...****of [...]****amending Commission Regulation (EU) No .../... laying down technical requirements and administrative procedures related to air operations**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the functioning of the European Union,

Having regard to Regulation (EC) No 216/2008⁽¹³⁾ of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC, and in particular Articles 8(5) and 10(5) thereof,

Whereas:

- (1) Commission Regulation (EU) No .../... is amended to include a new Subpart on Flight and Duty Time Limitations and rest requirements (Subpart-FTL) in Annex III laying down Requirements for Air Operations (Part-ORO).
- (2) The European Aviation Safety Agency prepared draft implementing rules and submitted them as an opinion to the Commission in accordance with Article 19(1) of Regulation (EC) No 216/2008.
- (3) The measures provided for in this Regulation are in accordance with the opinion of the Committee established by Article 65 of Regulation (EC) No 216/2008,

HAS ADOPTED THIS REGULATION:

Article 1

Commission Regulation (EU) No .../... is amended as follows:

1. In article 2, the following definition is added:

“Air taxi operation” means, for the purpose of flight time and duty time limitations, non-scheduled on demand commercial operations with an aeroplane with a passenger seating configuration of 19 or less.’

⁽¹³⁾ OJ L 79, 13.3.2008, p. 1.

2. Article 7 is amended as follows:

'Article 7

Flight time limitations

1. The following CAT operations shall not be subject to compliance with Subpart FTL of Annex III to this Regulation:
air taxi operations by aeroplane;
emergency medical service operations by aeroplane;
single pilot aeroplane operations; and
helicopter operations.
2. Until the related implementing rules are adopted for such operations, the following shall apply:
 - (a) In the case of operations referred to in (1)(a) to (c), Article 8(4) and Subpart Q of Annex III to Regulation (EEC) No 3922/91 and related national exemptions based on safety risk assessments carried out by the competent authorities;
 - (b) In the case of operations referred to in (1)(d), national requirements.'
3. A new paragraph ARO.OPS.230 is included in Annex II (Part-ARO) to this Regulation.

Article 2

This Regulation shall enter into force on the day following that of its publication in the *Official Journal of the European Union*.

It shall apply as from [the day following that of its publication in the *Official Journal of the European Union*].

This Regulation shall be binding in its entirety and directly applicable in all Member States.
Done at Brussels, [...]

For

the Commission

The

President

II. Annex III, PART-ORO (ORGANISATION REQUIREMENTS)

Subpart – Flight and duty time limitations and rest requirements

Section 1

General

ORO.FTL.100 Scope

This section establishes the requirements to be met by an operator on flight and duty time limitations and rest requirements for crew members.

ORO.FTL.105 Definitions

For the purpose of this subpart, the following definitions shall apply:

'Acclimatised': a crew member is considered to be acclimatised to a 2-hour wide time zone surrounding the local time of his/her point of departure. Where the local time of the place where the duty commences differs more than 2 hours from that at the place where the duty ends the crew member is considered to be acclimatised in accordance with the values in the table below for the calculation of the maximum daily FDP.

time zone transitions		Time spent (h) in the same time zone					
East-ward	West-ward	<36	36–59:59	60–83:59	84–107:59	108–131:59	132<
< 3	< 4	B	D	D	D	D	D
3–4	4–6	B	X	D	D	D	D
5–6	7–8	B	X	X	D	D	D
7–8	9–11	B	X	X	X	D	D
9–12	12	B	X	X	X	X	D

'B' means acclimatised to the local time of the departure time zone,

'D' means acclimatised to the local time where the crew member's duty finishes, and

'X' means that a crew member is in an unknown state of acclimatisation.

'Accommodation' means, for the purpose of standby and split duty, a quiet and comfortable place not open to the public with the ability to control light and temperature, equipped with adequate furniture comparable to a 'class 3' in-flight rest facility, with enough capacity to accommodate all crew members present at the same time and with access to food and drink.

'Augmented flight crew' means a flight crew which comprises more than the minimum number required to operate the aircraft, allowing each flight crew member to leave his/her assigned post and be replaced by another appropriately qualified flight crew member for the purpose of in-flight rest.

'Break' means a period of time within an FDP, shorter than a rest period, during which a crew member is free of all tasks within a flight duty period. A break counts as duty.

'Crew member' means a flight crew, cabin crew or technical crew member.

'Delayed reporting' means the postponement of a scheduled FDP by the operator before a crew member has left his/her place of rest.

'Duty' means any task that a crew member performs for the operator, including flight duty, administrative work, giving or receiving training, checking, positioning, and some elements of standby.

'Duty period' means a period which starts when a crew member is required by an operator to report for or to commence a duty and ends when that person is free from all duties.

'Early start' means a duty period starting in the period between 05:00 and 06:59 hours in the time zone to which a crew member is acclimatised.

'Eastward-Westward and Westward-Eastward transition' means the transition at home base between a rotation crossing 6 or more time zones in one direction and a rotation crossing 4 or more time zones in the opposite direction.

'Flight duty period (FDP)' means a period which commences when a crew member is required to report for duty, which may include a flight or a series of flights, and finishes when the aircraft finally comes to rest and the engines are shut down, at the end of the last flight on which he/she acts as an operating crew member.

'Flight time' means, for aeroplanes and touring motor gliders, the time between an aircraft first moving from its parking place for the purpose of taking off until it comes to rest on the designated parking position and all engines or propellers are shut down.

'Home base' means the location, assigned by the operator to the crew member, from where the crew member normally starts and ends a duty period or a series of duty periods and where, under normal circumstances, the operator is not responsible for the accommodation of the crew member concerned.

'Late finish' means a duty period finishing in the period between 00:00 and 01:59 hours in the time zone to which a crew member is acclimatised.

'Local day' means a 24-hour period commencing at 00:00 local time.

'Local night' means a period of 8 hours falling between 22:00 hours and 08:00 hours local time.

'A single day free of duty' means, for the purpose of complying with the Council Directive 2000/79/EC of 27 November 2000, a time free of all duties consisting of a single day and two local nights and which may include a rest period as part of the day off.

'Night duty' means a duty period encroaching any portion of the period between 02:00 and 04:59 hours in the time zone to which the crew is acclimatised.

'Operating crew member' means a crew member carrying out his/her duties in an aircraft during a flight.

'Positioning' means the transferring of a non-operating crew member from one place to another, at the behest of the operator, excluding the time from home to the designated reporting place at home base and vice versa, as well as the time for local transfer from a place of rest to the commencement of duty and vice versa.

'Rest facility' means a bunk or seat that provides a crew member with a sleep opportunity on board an aircraft:

1. 'Class 1 rest facility' means a bunk or other surface that allows for a flat or near flat sleeping position. It reclines to at least 80° back angle to the vertical and is located separately from both the flight crew compartment and the passengers cabin in an area that allows the crew member to control light, and provides isolation from noise and disturbance;
2. 'Class 2 rest facility' means a seat in an aircraft cabin that reclines at least 45° back angle to the vertical, has at least a pitch of 55 inches (137,5 cm), a seat width of at least 20 inches (50 cm) and provides leg and foot support. It is separated from passengers by at least a curtain to provide darkness and some sound mitigation, and is reasonably free from disturbance by passengers or crew members;

3. 'Class 3 rest facility' means a seat in an aircraft cabin or flight crew compartment that reclines at least 40° from the vertical, provides leg and foot support and is separated from passengers by at least a curtain to provide darkness and some sound mitigation, and is not adjacent to any seat occupied by passengers.

'Rest period' means a continuous, uninterrupted and defined period of time, subsequent to and/or prior to duty, during which a crew member is free from all duties.

'Rotation' is a duty or a series of duties, including at least one flight duty, and rest periods out of home base, starting at home base and ending when returning to home base for a rest period where the operator is no longer responsible for the accommodation of the crew member.

'Standby' means a pre-notified and defined period of time during which a crew member is required by the operator to be available to receive an assignment for a flight, positioning or other duty, as follows:

- airport standby means a standby performed at the airport, which may lead to an assignment of duty without an intervening rest period;
- short-call standby means a standby either at home or in a suitable accommodation, which may lead to an assignment of duty without an intervening rest period;
- long-call standby means a standby during which a crew member receives a notification at least 10 hours before the start of the assigned duty.

'Suitable accommodation' means, for the purpose of standby, split duty and minimum rest, a separate room with appropriate facilities for each crew member located in a quiet environment, equipped with a bed, sufficient ventilation and a device for regulating temperature and light intensity and access to food and drink.

'Ultra long range operations (ULR)' means long range flights having a planned flight duration greater than 16 hours or a flight duty period that exceeds 18 hours.

'Window of Circadian Low (WOCL)' means the period between 02:00 and 05:59 hours in the time zone to which the crew is acclimatised.

ORO.FTL.110 Operator responsibilities

An operator shall, where applicable to the type of operation:

- (a) publish duty rosters sufficiently in advance to provide the opportunity for crew members to plan adequate rest;
- (b) ensure that flight duty periods are planned in a way that enables crew members to remain sufficiently free from fatigue so that they can operate to a satisfactory level of safety under all circumstances;
- (c) specify reporting times to allow sufficient time for ground duties;
- (d) take into account the relationship between the frequencies and pattern of flight duty periods and rest periods and give consideration to the cumulative effects of undertaking long duty hours combined with minimum rest periods;
- (e) allocate duty patterns which avoid practices that cause a serious disruption of established sleep/work pattern, such as alternating day/night duties;
- (f) provide rest periods of sufficient time to enable crew members to overcome the effects of the previous duties and to be rested by the start of the following flight duty period;
- (g) plan recurrent extended recovery rest periods and notify crew members sufficiently in advance;
- (h) ensure that flights are planned to be completed within the allowable flight duty period taking into account the time necessary for pre-flight duties, the flight and turnaround times;

- (i) change a schedule and/or crewing arrangements if the actual operation exceeds the maximum flight duty period on more than 33 % of the flights in that schedule during a scheduled seasonal period.

ORO.FTL.115 Crew member responsibilities

Crew members shall:

- (a) comply with CAT.GEN.MPA.100 of Annex IV (Part-CAT); and
- (b) make optimum use of the opportunities and facilities for rest provided and plan and use their rest periods properly.

ORO.FTL.120 Fatigue risk management (FRM)

- (a) When FRM is required by an applicable certification, the operator shall establish, implement and maintain FRM as an integral part of its management system. FRM shall ensure compliance with the Essential Requirements 7.g. and 8.f. of Annex IV to Regulation (EC) No 216/2008.
- (b) When FRM is required by this Regulation, the operator shall establish it in the Operations Manual.
- (c) The FRM shall:
 - (1) incorporate scientific principles and knowledge;
 - (2) manage the operational risk(s) of the operator arising from crew member fatigue on an ongoing basis;
 - (3) ensure that remedial actions, necessary to effectively mitigate the operator's risk(s) arising from crew member fatigue, are implemented promptly;
 - (4) correspond to the roster system or flight time specification scheme used by the operator;
 - (5) provide for continuous monitoring and regular assessment of the mitigation of fatigue risks achieved by such actions; and
 - (6) provide for continuous improvement to the overall performance of the FRM.
- (d) The FRM shall contain the following components in proportion to the type, size and complexity of the operations and the applicable flight time specification scheme:
 - (1) FRM policy and documentation;
 - (2) FRM processes addressing:
 - (i) hazard identification,
 - (ii) risk assessment,
 - (iii) risk mitigation;
 - (3) FRM safety assurance processes;
 - (4) FRM promotion processes.
- (e) The operator shall take mitigating actions when the FRM safety assurance process shows that the required safety performance is not maintained.

Section 2

Commercial Air Transport Operators

ORO.FTL.200 Flight time specification schemes

- (a) Without prejudice to Council Directive 2000/79/EC of 27 November 2000 concerning the European Agreement on the Organisation of Working Time of Mobile Workers in Civil Aviation, operators shall establish, implement and maintain flight time specification schemes which are appropriate for the type(s) of operation performed, which comply with Regulation (EC) No 216/2008 and this Subpart.
- (b) Before being implemented, flight time specification schemes shall be approved by the competent authority.
- (c) In establishing compliance with Regulation (EC) No 216/2008 and this Subpart, the operator may follow the applicable Certification Specifications developed by the Agency. If the operator wants to deviate from these Certification Specifications when establishing its flight time specification scheme, it shall provide the competent authority with an assessment demonstrating that the requirements of Regulation (EC) No 216/2008 and of this Subpart are met.

ORO.FTL.205 Home base

An operator shall assign a home base for each crew member.

ORO.FTL.210 Flight duty period (FDP)

- (a) The operator shall:
 - (1) define reporting times appropriate to the operation;
 - (2) establish procedures specifying how the commander shall — in case of special circumstances which could lead to severe fatigue, and after consultation with the crew members affected — reduce the actual FDP and/or increase the rest period in order to eliminate any detrimental effect on flight safety; and
 - (3) require the commander to submit a report whenever an FDP is increased beyond the maximum at his/her discretion, or when a rest period is reduced below the minimum, in actual operation. Where the increase of an FDP or the reduction of a rest period exceeds 1 hour, the operator shall send a copy of the report, together with its comments, to the competent authority, no later than 28 days after the event.
- (b) Basic maximum daily FDP.
 - (1) The maximum daily FDP without the use of extensions for acclimatised crew members shall comply with the following table:

Maximum daily FDP – Acclimatised crew members

Start of FDP	1-2 Sectors	3 Sectors	4 Sectors	5 Sectors	6 Sectors	7 Sectors	8 Sectors	9 Sectors	10 Sectors
0600-1329	13:00	12:30	12:00	11:30	11:00	10:30	10:00	09:30	09:00
1330-1359	12:45	12:15	11:45	11:15	10:45	10:15	09:45	09:15	09:00
1400-1429	12:30	12:00	11:30	11:00	10:30	10:00	09:30	09:00	09:00
1430-1459	12:15	11:45	11:15	10:45	10:15	09:45	09:15	09:00	09:00
1500-1529	12:00	11:30	11:00	10:30	10:00	09:30	09:00	09:00	09:00
1530-1559	11:45	11:15	10:45	10:15	09:45	09:15	09:00	09:00	09:00
1600-1629	11:30	11:00	10:30	10:00	09:30	09:00	09:00	09:00	09:00
1630-1659	11:15	10:45	10:15	09:45	09:15	09:00	09:00	09:00	09:00
1700-0414	11:00	10:30	10:00	09:30	09:00	09:00	09:00	09:00	09:00
0415-0429	11:15	10:45	10:15	09:45	09:15	09:00	09:00	09:00	09:00
0430-0444	11:30	11:00	10:30	10:00	09:30	09:00	09:00	09:00	09:00
0445-0459	11:45	11:15	10:45	10:15	09:45	09:15	09:00	09:00	09:00
0500-0514	12:00	11:30	11:00	10:30	10:00	09:30	09:00	09:00	09:00
0515-0529	12:15	11:45	11:15	10:45	10:15	09:45	09:15	09:00	09:00
0530-0544	12:30	12:00	11:30	11:00	10:30	10:00	09:30	09:00	09:00
0545-0559	12:45	12:15	11:45	11:15	10:45	10:15	09:45	09:15	09:00

- (2) The maximum FDP when crew members are in an unknown state of acclimatisation shall comply with the following table:

Maximum daily FDP – Crew members in an unknown state of acclimatisation

Duration of continuous rest at destination	Maximum daily FDP according to sectors							
	1-2	3	4	5	6	7	8	
Below 30 hours	11:00	10:30	10:00	09:30	09:00	09:00	09:00	
30 hours or more	12:00	11:30	11:00	10:30	10:00	09:30	09:00	

- (3) FDP with different reporting time for flight crew and cabin crew.
In cases where cabin crew require more time than the flight crew for their pre-flight briefing for the same flight or series of flights, the FDP of the cabin crew may be extended by the difference in reporting time between the cabin crew and the flight crew as long as the difference does not exceed 60 minutes. The maximum daily FDP for cabin crew shall be based on the time at which the flight crew report for their FDP, but the FDP shall start at the reporting time of the cabin crew.

- (c) Maximum daily FDP with the use of extensions without in-flight rest.

- (1) The maximum daily FDP may be extended by up to 1 hour up to two times in any 7 consecutive days. In that case:
- (i) the minimum pre-flight and post-flight rest periods shall be increased by 2 hours; or
 - (ii) the post-flight rest period shall be increased by 4 hours.

- (2) The use of the extension shall be planned in advance, and shall be limited to a maximum of:
 - (i) 5 sectors; or
 - (ii) 4 sectors, when the WOCL is encroached; or
 - (iii) 2 sectors, when the FDP encroaches the WOCL by more than 2 hours.
 - (3) Extension of the maximum basic daily FDP without in-flight rest shall not be combined with extensions due to in-flight rest or split duty in the same duty period.
 - (4) Where the extensions are used for consecutive FDPs, the additional pre and post-flight rest between the two extended FDPs shall be provided consecutively.
 - (5) Flight time specification schemes shall specify the limits for extensions of the maximum basic daily FDP in accordance with the Certification Specification applicable to the type of operation, taking into account:
 - (i) the number of sectors flown; and
 - (ii) WOCL encroachment.
- (d) Maximum daily FDP with the use of extensions due to in-flight rest.
- (1) Flight time specification schemes shall specify the conditions for extensions of the maximum basic daily FDP with in-flight rest in accordance with the Certification Specification applicable to the type of operation, taking into account:
 - (i) the number of sectors flown;
 - (ii) the minimum in-flight rest allocated to each crew member;
 - (iii) the type of in-flight rest facilities; and
 - (iv) the augmentation of the basic flight crew.
- (e) Unforeseen circumstances in flight operations — commander's discretion
- (1) The conditions to modify the limits on flight duty, duty and rest periods by the commander in the case of unforeseen circumstances in flight operations which start at the reporting time shall comply with the following:
 - (i) the maximum basic daily FDP which results after applying (b) and (c) and ORO.FTL.225 may not be increased by more than 2 hours unless the flight crew has been augmented, in which case the maximum flight duty period may be increased by not more than 3 hours;
 - (ii) if on the final sector within an FDP unforeseen circumstances occur after take-off and result in the permitted increase being exceeded, the flight may continue to the planned destination or alternate;
 - (iii) the rest period following an FDP may be reduced but never below 10 hours.
 - (2) The commander shall, in case of unforeseen circumstances which could lead to severe fatigue, reduce the actual flight duty period and/or increase the rest period in order to eliminate any detrimental effect on flight safety.
 - (3) The commander shall consult all crew members on their alertness levels before deciding these modifications.
 - (4) The operator shall require the commander to submit a report to the operator when an FDP is increased or a rest period is reduced by his/her discretion.
 - (5) Where the increase of an FDP or reduction of a rest period exceeds 1 hour, a copy of the report, to which the operator shall add its comments, shall be sent to the competent authority not later than 28 days after the event.

- (6) The operator shall implement a non-punitive process for the use of the discretion described under this provision and shall describe it in the Operations Manual.

ORO.FTL.215 Flight times and duty periods

- (a) The total duty periods to which a crew member may be assigned shall not exceed:
- (1) 60 duty hours in any 7 consecutive days;
 - (2) 110 duty hours in any 14 consecutive days; and
 - (3) 190 duty hours in any 28 consecutive days, spread as evenly as practicable throughout this period.
- (b) The total flight time of the flights on which an individual crew member is assigned as an operating crew member shall not exceed:
- (1) 100 hours of flight time in any 28 consecutive days; and
 - (2) 900 hours of flight time in any calendar year; and
 - (3) 1 000 hours of flight time in any 12 consecutive calendar months.
- (c) Post-flight duty shall count as duty. The operator shall specify in its Operations Manual the minimum time period for post-flight duties.

ORO.FTL.220 Positioning

If operators assign crew members to positioning, the following shall apply:

- (a) Positioning after reporting but prior to operating shall be counted as FDP but shall not count as a sector.
- (b) All time spent on positioning shall count as duty time.

ORO.FTL.225 Split duty

- (a) Flight time specification schemes shall specify the following elements for split duty in accordance with the Certification Specification applicable to the type of operation:
- (1) the minimum duration of a break on the ground;
 - (2) by derogation from ORO.FTL.210 (b), the possibility to increase the FDP taking into account the duration of the break on the ground, and facilities provided to the crew member to rest and other relevant factors.
- (b) The break on the ground shall count in full as FDP.
- (c) Split duty shall not follow a reduced rest.

ORO.FTL.230 Standby

If operators assign crew members to standby, the following shall apply in accordance with the Certification Specification applicable to the type of operation:

- (a) Standby shall be rostered and the start and end time of standby shall be defined and notified in advance to the affected crew members to provide them with the opportunity to plan adequate rest.
- (b) Flight time specification schemes shall specify the following elements:
- (1) the maximum duration of any standby;
 - (2) the impact of standby on the maximum FDP that may be assigned resulting from standby, taking into account facilities provided to the crew member to rest, and other relevant factors such as the need for immediate readiness of the crew member, the interference of standby with sleep and/or sufficient notification to protect a sleep opportunity between the call for duty and the assigned FDP;

- (3) the basic minimum rest period following standby which does not lead to assignment on an FDP;
- (4) how time spent on standby shall be counted for the purpose of cumulative duty hours.

ORO.FTL.235 Rest periods

- (a) Minimum rest period at home base.

The minimum rest period provided before undertaking an FDP starting at home base shall:

- (1) be at least as long as the preceding duty period, or 12 hours, whichever is greater; or
- (2) comply with (b), if the operator provides a suitable accommodation to the crew member.

- (b) Minimum rest period away from home base.

The minimum rest period provided before undertaking an FDP starting away from home base shall be at least as long as the preceding duty period, or 10 hours, whichever is greater. This period shall include an 8-hour sleep opportunity in addition to the time for travelling and physiological needs.

- (c) Reduced rest

By derogation from (a) and (b), flight time specification schemes may reduce the minimum rest periods taking into account the following elements in accordance with the Certification Specification applicable to the type of operation:

- (1) the minimum reduced rest period;
- (2) the increase of the subsequent rest period; and
- (3) the reduction of the FDP following the reduced rest.

- (d) Recurrent extended recovery rest periods

Flight time specification schemes shall specify recurrent extended recovery rest periods to compensate for cumulative fatigue. The minimum recurrent extended recovery rest period shall be 36 hours, including 2 local nights, such that there shall never be more than 168 hours between the end of one recurrent extended recovery rest period and the start of the next. The recurrent extended recovery rest period shall be increased to 2 days twice every 28 days.

- (e) Flight time specification schemes shall specify additional rest periods to compensate for:

- (1) the effects of time zone differences and extensions of the FDP;
- (2) additional cumulative fatigue due to disruptive schedules; and
- (3) a change of home base.

ORO.FTL.240 Nutrition

- (a) A meal and drink opportunity shall occur in order to avoid any detriment to a crew member's performance, especially when the FDP exceeds 6 hours.
- (b) An operator shall specify in its Operations Manual how the crew member's nutrition during FDP is ensured.

ORO.FTL.245 Records of flight and duty times and rest periods

- (a) Operators shall maintain, for a period of 24 months:
 - (1) Individual records for each crew member including:
 - (i) flight times;
 - (ii) start, duration and end of each duty period and FDP;
 - (iii) rest periods and days free of all duties; and
 - (iv) assigned home base.
 - (2) Reports on extended flight duty periods and reduced rest periods.
- (b) Upon request, the operator shall provide copies of individual records of flight and duty times and rest periods to:
 - (1) the crew member concerned; and
 - (2) to another operator, in respect of a crew member who is or becomes a crew member of the operator concerned.
- (c) Records referred to in CAT.GEN.MPA.100 (b)(5) in relation to crew members who perform functions for more than one operator shall be kept for a period of 24 months.

ORO.FTL.250 Fatigue management training

- (a) The operator shall provide initial and recurrent fatigue management training to crew members, crew rostering personnel and concerned management personnel.
- (b) This training shall follow a training programme established by the operator. The syllabus for the training shall cover the possible causes and effects of fatigue, and fatigue countermeasures.

Section 3

Commercial Operators other than CAT

(Reserved)

Section 4

Non-Commercial Operators of Complex Motor-Powered Aircraft

(Reserved)

III. Draft Opinion – Annex II, PART-ARO (AUTHORITY REQUIREMENTS)**SUBPART OPS – AIR OPERATIONS****SECTION I – CERTIFICATION OF COMMERCIAL AIR TRANSPORT OPERATORS****Insert:****ARO.OPS.230 Approval of individual flight time specification schemes**

- (a) The Agency shall develop Certification Specifications on flight time limitations to ensure compliance with Regulation (EC) No 216/2008 and this Regulation.
- (b) The competent authority shall approve flight time specification schemes proposed by operators when compliance with Regulation (EC) No 216/2008 and this Regulation has been demonstrated by the operator.
- (c) Whenever a flight time limitation scheme proposed by an operator deviates from the applicable Certification Specifications developed by the Agency, the competent authority shall apply the procedure established in Article 22(2) of Regulation (EC) No 216/2008.

IV. Draft Decision – Certification Specifications, flight time specification schemes

Certification Specifications FTL 1

Commercial Air Transport by Aeroplane – Scheduled and Charter Operations

CS FTL.1.200 Applicability

These Certification Specifications are applicable to commercial air transport operations by aeroplanes other than emergency medical service (EMS), air taxi and single pilot operations.

CS FTL.1.205 Home base

- (a) The home base is a single airport location assigned with a high degree of permanence.
- (b) In the case of a change of home base, the recurrent extended recovery rest period prior to starting duty at the new home base is increased once to 72 hours, including 3 local nights. Travelling time between the former home base and the new home base is positioning or FDP.

CS FTL.1.210 Flight duty period (FDP)

1 – Night duties

For consecutive night duties, the number of sectors is limited to 4 sectors per duty.

2 – Extension of FDP without in-flight rest

The extension of FDP without in-flight rest under the provisions of ORO.FTL.210(c)(5) is limited to the values specified in the table below.

Maximum daily FDP with extension

Start of FDP	1–2 sectors	3 sectors	4 sectors	5 sectors
0600–0614	N/A	N/A	N/A	N/A
0615–0629	13:15	12:45	12:15	11:45
0630–0644	13:30	13:00	12:30	12:00
0645–0659	13:45	13:15	12:45	12:15
0700–1329	14:00	13:30	13:00	12:30
1330–1359	13:45	13:15	12:45	12:15
1400–1429	13:30	13:00	12:30	12:00
1430–1459	13:15	12:45	12:15	N/A
1500–1529	13:00	12:30	12:00	N/A
1530–1559	12:45	12:15	11:45	N/A
1600–1629	12:30	12:00	11:30	N/A
1630–1659	12:15	N/A	N/A	N/A
1700–1729	12:00	N/A	N/A	N/A
1730–1759	11:45	N/A	N/A	N/A
1800–1829	11:30	N/A	N/A	N/A
1830–1859	11:15	N/A	N/A	N/A
1900–0359	N/A	N/A	N/A	N/A
0400–0414	N/A	N/A	N/A	N/A
0415–0429	N/A	N/A	N/A	N/A
0430–0444	N/A	N/A	N/A	N/A
0445–0459	N/A	N/A	N/A	N/A
0500–0514	N/A	N/A	N/A	N/A
0515–0529	N/A	N/A	N/A	N/A
0530–0544	N/A	N/A	N/A	N/A
0545–0559	N/A	N/A	N/A	N/A

3 – Extension of FDP due to in-flight rest

- (a) The extension of FDP with in-flight rest under the provisions of ORO.FTL.210(d) complies with the following:
- (1) the FDP is limited to 3 sectors;
 - (2) the minimum in-flight rest period is a consecutive 90-minute period for each crew member and 2 consecutive hours for those flight crew members at control during landing.
- (b) The maximum daily FDP may be extended due to in-flight rest for flight crew:
- (1) with one additional flight crew member:
 - (i) up to 14 hours with class 3 rest facilities;
 - (ii) up to 15 hours with class 2 rest facilities;
 - (iii) up to 16 hours with class 1 rest facilities;
 - (2) with two additional flight crew members:
 - (i) up to 15 hours with class 3 rest facilities;
 - (ii) up to 16 hours with class 2 rest facilities;
 - (iii) up to 17 hours with class 1 rest facilities;

- (c) The limits in (b) may be increased by 1 hour for FDPs that include 1 sector of over 9 hours continuous flight time and a maximum of 2 sectors.
- (d) The minimum in-flight rest for each cabin crew member is:
 - (1) 33 % of the planned extended FDP if the in-flight rest is taken in class 3 rest facilities;
 - (2) 25 % of the planned extended FDP if the in-flight rest is taken in class 2 rest facilities; and
 - (3) 20 % of the planned extended FDP if the in-flight rest is taken in class 1 rest facilities.
- (e) All time spent in the rest facility is counted as FDP.
- (f) The minimum rest at destination is at least as long as the preceding duty period, or 14 hours, whichever is greater.
- (g) A crew member does not start a positioning sector to become part of this operating crew on the same flight.

4 – Unforeseen circumstances in actual flight operations – Delayed reporting

- (a) The operator may delay the reporting time in the event of unforeseen circumstances, if procedures for delayed reporting are established in the Operations Manual. In such a case, if the crew member is informed of the delayed reporting time before leaving his/her place of rest, the FDP is calculated as follows:
 - (1) when the delay is less than 4 hours, the maximum FDP is calculated based on the original reporting time and the FDP starts counting at the delayed reporting time;
 - (2) when the delay is 4 hours or more, the maximum FDP is calculated based on the more limiting of the original or the delayed reporting times and the FDP starts 4 hours after the original reporting time;
 - (3) when the delay is 10 hours or more, the time between the original and the delayed reporting time counts as a rest period.

CS FTL.1.225 Split duty

The increase of limits on flight duty, under the provisions of ORO.FTL.225, complies with the following:

- (a) The break on the ground within the FDP has a minimum duration of 3 consecutive hours.
- (b) The break excludes the time for post and pre-flight duties and travelling time which are counted for a minimum of 30 minutes.
- (c) The maximum FDP specified in ORO.FTL.210(b) may be increased by up to 50 % of the break.
- (d) Suitable accommodation is provided for a break of 6 hours or more, and for a break that encroaches the WOCL.
- (e) In all other cases:
 - (1) accommodation is provided; and
 - (2) any time of the actual break exceeding 6 hours or any time of the break that encroaches the WOCL does not count for the extension of the FDP.
- (f) Split duty cannot be combined with in-flight rest.

CS FTL.1.230 Standby

The modification of limits on flight duty, duty and rest periods under the provisions of ORO.FTL.230 complies with the following:

1 – Airport standby

- (a) A crew member is considered on airport standby from reporting at the reporting point until the end of the notified airport standby period.
- (b) Where airport standby does not lead to assignment on a flight duty, it is followed by a rest period as specified in ORO.FTL.235.
- (c) Airport standby counts in full as duty time.
- (d) If an assigned FDP starts during the airport standby, the following applies:
 - (1) if no accommodation is provided to the crew member, the FDP counts in full from the start of the standby reporting time;
 - (2) if accommodation is provided to the crew member, the FDP counts from the start of the FDP. The maximum FDP is reduced by any time spent on standby in excess of 4 hours or between 23:00 hours and 07:00 hours.

2 – Other standby

- (a) For short-call standby the following applies:
 - (1) the maximum time for short-call standby is 12 hours;
 - (2) short-call standby times count as 25 % of duty time for the purpose of ORO.FTL.215;
 - (3) a short-call standby that does not lead to assignment of a duty is followed by a rest period in accordance with ORO.FTL.235;
 - (4) if a call to report for a duty occurs within the first 6 hours of the short-call standby the maximum FDP counts from reporting;
 - (5) if a call to report for a duty occurs after the first 6 hours of the short-call standby the maximum FDP is reduced by the amount of short-call standby time exceeding 6 hours; and
 - (6) the standby ceases when the crew member reports at the designated reporting point;
 - (7) the response time between call and reporting time established by the operator allows the crew member to arrive from his/her place of rest to the designated reporting place within a reasonable time.
- (b) For long-call standby an assigned FDP counts from the reporting time. Standby times do not count as duty time for the purpose of ORO.FTL.215 and ORO.FTL.235.

CS FTL.1.235 Minimum rest period**1 – Disruptive schedules**

- (a) When a transition at home base is planned from a late finish/night duty to an early start, the rest period between the 2 FDPs includes 1 local night.
- (b) For a crew member performing 4 or more night duties, early starts or late finishes between 2 extended recovery rest periods as defined in ORO.FTL.235(d), the second extended recovery rest period is extended to 60 hours.

2 – Time zone differences

- (a) The operator monitors rotations and combinations of rotations in terms of their effect on crew fatigue, and adapts the crew schedules if necessary.
- (b) Time zone differences are compensated by additional rest, as follows:
 - (1) At home base, if an FDP encompasses 4 time zones or more, the minimum rest is as specified in the following table and includes at least 2 local nights.

Minimum rest at home base to compensate for time zone differences

Maximum TZ crossed during rotation	Duration of rotation (hours)	
	< 60	≥ 60
5	36	36
6	36	36
7	36	42
8	36	48
9	36	54
10	40	60
11	44	66
12	48	72

- (2) Away from home base, if the FDP encompasses 4 time zones or more, the minimum rest provided is at least as long as the preceding duty period, or 14 hours, whichever is greater. Notwithstanding (b)(1), this provision may also apply to home base if the operator provides suitable accommodation to the crew.
- (3) In case of an Eastward-Westward or Westward-Eastward transition, a local night of rest at home base in addition to the rest periods established in (b)(1) is provided between alternating rotations.

3 – Reduced rest

- (a) The minimum reduced rest periods under reduced rest arrangements are 12 hours at home base and 10 hours out of base.
- (b) Reduced rest is used under fatigue risk management.
- (c) The rest period following the reduced rest is extended by the difference between the minimum rest period specified in ORO.FTL.235(a) or (b) and the reduced rest.
- (d) The FDP following the reduced rest is reduced by the difference between the minimum rest period specified in ORO.FTL.235(a) or (b) as applicable and the reduced rest.
- (e) There is a maximum of 2 reduced rest periods between 2 recurrent extended recovery rest periods as specified in ORO.FTL.235(d).

Certification Specification FTL 2

Commercial Air Transport by Aeroplane – EMS Operations
[Reserved]

Certification Specification FTL 3

Commercial Air Transport by Aeroplane – Air Taxi Operations
(including Single Pilot Operations)
[Reserved]

Certification Specification FTL 4

Commercial Air Transport by Helicopter
[Reserved]

Certification Specification FTL 5

Commercial Air Transport by Aeroplane –
Alternative Scheme for Sole Night Operations
[Reserved]

Certification Specification FTL 6

Commercial Air Transport by Aeroplane – Ultra Long Range Operations
[Reserved]

V. Draft Decision — Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Part ORGANISATION REQUIREMENTS (PART-ORO)

Section VIII — Flight and duty time limitations and rest requirements

AMC1 ORO.FTL.110(a) Operator responsibilities

Rosters should be published 14 days in advance.

AMC1 ORO.FTL.120(d)(1) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS FRM POLICY

The operator should define its FRM policy, with all the elements of FRM clearly identified.

- (a) The FRM policy should define the scope of FRM in terms of the operations to which it applies.
- (b) The FRM policy should:
 - (1) reflect the shared responsibility of management, flight crew, cabin crew and technical crew, and other involved personnel;
 - (2) clearly state the safety objectives of FRM;
 - (3) be signed by the accountable manager;
 - (i) be communicated, with visible endorsement, to all the relevant areas and levels of the organisation;
 - (ii) declare management commitment to effective safety reporting;
 - (iii) declare management commitment to the provision of adequate resources for FRM;
 - (iv) declare management commitment to continuous improvement of FRM;
 - (v) require that clear lines of accountability for management, flight, technical and cabin crews, and all other involved personnel are identified; and
 - (vi) require periodic reviews to ensure it remains relevant and appropriate.

AMC2 ORO.FTL.120(d)(1) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS FRM DOCUMENTATION

An operator should develop and keep current FRM documentation that describes and records:

- (a) FRM policy and objectives;
- (b) FRM processes and procedures;
- (c) accountabilities, responsibilities and authorities for these processes and procedures;
- (d) mechanisms for ongoing involvement of management, flight crew, cabin crew and technical crew members, and all other involved personnel;
- (e) FRM training programmes, training requirements and attendance records;
- (f) scheduled and actual flight times, duty periods and rest periods with deviations and reasons for deviations; and
- (g) FRM outputs including findings from collected data, recommendations, and actions taken.

AMC1 ORO.FTL.120(d)(2)(i) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS IDENTIFICATION OF HAZARDS

An operator should develop and maintain three fundamental and documented processes for fatigue hazard identification:

1. Predictive

The predictive process should identify fatigue hazards by examining crew scheduling and taking into account factors known to affect sleep and fatigue and their effects on performance. Methods of examination may include, but are not limited to:

- (a) operator or industry operational experience and data collected on similar types of operations;
- (b) evidence-based scheduling practices; and
- (c) bio-mathematical models.

2. Proactive

The proactive process should identify fatigue hazards within current flight operations. Methods of examination may include, but are not limited to:

- (a) self-reporting of fatigue risks;
- (b) crew fatigue surveys;
- (c) relevant flight, technical and cabin crew performance data;
- (d) available safety databases and scientific studies; and
- (e) analysis of planned versus actual time worked.

3. Reactive

The reactive process should identify the contribution of fatigue hazards to reports and events associated with potential negative safety consequences in order to determine how the impact of fatigue could have been minimized. At a minimum, the process may be triggered by any of the following:

- (a) fatigue reports;
- (b) confidential reports;
- (c) audit reports;
- (d) incidents; and
- (e) flight data analysis events.

AMC1 ORO.FTL.120(d)(2)(ii) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS RISK ASSESSMENT

An operator should develop and implement risk assessment procedures that determine the probability and potential severity of fatigue-related events and identify when the associated risks require mitigation. The risk assessment procedures should review identified hazards and link them to:

- (1) operational processes;
- (2) their probability;
- (3) possible consequences; and
- (4) the effectiveness of existing safety barriers and controls.

AMC1 ORO.FTL.120(d)(2)(iii) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS RISK MITIGATION

An operator should develop and implement risk mitigation procedures that:

- (1) select the appropriate mitigation strategies;
- (2) implement the mitigation strategies; and
- (3) monitor the strategies' implementation and effectiveness.

AMC1 ORO.FTL.120(d)(3) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS FRM SAFETY ASSURANCE PROCESSES

The operator should develop and maintain FRM safety assurance processes to:

1. provide for continuous FRM performance monitoring, analysis of trends, and measurement to validate the effectiveness of the fatigue safety risk controls. The sources of data may include, but are not limited to:
 - a. hazard reporting and investigations;
 - b. audits and surveys; and
 - c. reviews and fatigue studies;
2. provide a formal process for the management of change which should include, but is not limited to:
 - a. identification of changes in the operational environment that may affect FRM;
 - b. identification of changes within the organisation that may affect FRM; and
 - c. consideration of available tools which could be used to maintain or improve FRM performance prior to implementing changes; and
3. provide for the continuous improvement of FRM. This should include, but is not limited to:
 - a. the elimination and/or modification of risk controls have had unintended consequences or that are no longer needed due to changes in the operational or organisational environment;
 - b. routine evaluations of facilities, equipment, documentation and procedures; and
 - c. the determination of the need to introduce new processes and procedures to mitigate emerging fatigue-related risks.

AMC1 ORO.FTL.120(d)(4) Fatigue risk management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS FRM PROMOTION PROCESS

FRM promotion processes support the ongoing development of FRM, the continuous improvement of its overall performance, and attainment of optimum safety levels.

The following should be established and implemented by the operator as part of its FRM:

1. training programmes to ensure competency commensurate with the roles and responsibilities of management, flight, technical and cabin crew, and all other involved personnel under the planned FRM; and
2. an effective FRM communication plan that:
 - a. explains FRM policies, procedures and responsibilities to all relevant stakeholders; and

- b. describes communication channels used to gather and disseminate FRM-related information.

GM1 ORO.FTL.210 Flight Duty Period

- (a) Scheduling has an important impact on a crew member's ability to sleep and to maintain a proper level of alertness. When developing a workable roster, the operator should strike a fair balance between the commercial needs and the capacity of individual crew members to work effectively. Rosters should be developed in such a way that they distribute the amount of work evenly among those that are involved.
- (b) Schedules should allow for flights to be completed within the maximum permitted flight duty period and flight rosters should take into account the time needed for pre-flight duties, taxiing, the flight and turnaround times. Other factors to be considered when planning duty periods should include:
 - (1) the allocation of work patterns which avoid undesirable practices such as alternating day/night duties, alternating eastward-westward or westward-eastward time zone transitions, positioning of crew members so that a serious disruption of established sleep/work patterns occurs;
 - (2) scheduling sufficient rest periods especially after long flights crossing many time zones;
 - (3) preparation of duty rosters sufficiently in advance with planning of recurrent extended recovery rest periods and notification of the crew members well in advance to plan adequate pre-duty rest.

AMC1 ORO.FTL.235(b) Minimum rest periods

The time allowed for physiological needs should be 1 hour. Consequently, if the travelling time to the suitable accommodation is more than 30 minutes, the operator should increase the rest period by twice the amount of difference of travelling time above 30 minutes.

AMC1 ORO.FTL.240 Nutrition

The operations manual should specify the minimum duration of the meal opportunity, when a meal opportunity is provided, in particular when the FDP encompasses the regular meal windows (e.g. if the FDP starts at 11:00 hours and ends at 22:00 hours two meals should be provided and two meal opportunities should be given).

It should define the time frames in which a regular meal should be consumed in order not to alter the human needs for nutrition without affecting the crew member's body rhythms.

AMC1 ORO.FTL.250 Fatigue management training

The training syllabus should contain the following:

- (a) Applicable regulatory requirements for flight, duty and rest;
- (b) The basics of fatigue including sleep fundamentals and the effects of disturbing the circadian rhythms;
- (c) The causes of fatigue, including medical conditions that may lead to fatigue;
- (d) The effect of fatigue on performance;
- (e) Fatigue countermeasures;
- (f) The influence of lifestyle, including nutrition, exercise, and family life, on fatigue;
- (g) Familiarity with sleep disorders and their possible treatments;
- (h) Where applicable the effects of long range operations and heavy short range schedules on individuals;

- (i) The effect of operating through and within multiple time zones;
- (j) The crew member responsibility for ensuring adequate rest and fitness for duty.

GM1 ORO.FTL.210(a)(1) Flight Duty Period (FDP)

The operator should specify reporting times taking into account the type of operation, the size and type of aircraft and the reporting airport conditions.

GM1 ORO.FTL.1.210(3) Flight Duty Period (FDP)

UNFORESEEN CIRCUMSTANCES IN ACTUAL FLIGHT OPERATIONS — COMMANDER'S DISCRETION

- (a) As general guidance when developing a commander's discretion policy, the operator should take into consideration the shared responsibility of management, flight crew and cabin crew in the case of unforeseen circumstances. The exercise of commander's discretion should be considered exceptional and should be avoided at home base and/or company hubs where standby crew members should be available. Operators should assess on a regular basis the series of pairings where commander's discretion has been exercised in order to be aware of possible inconsistencies in their rostering.
- (b) The operator's policy on commander's discretion should state the safety objectives, especially in the case of an extended FDP or reduced rest and should take due consideration of additional factors that might decrease crewmember's alertness levels, such as:
 - (1) WOCL encroachment;
 - (2) weather conditions;
 - (3) complexity of the operation and/or airport environment;
 - (4) aeroplane malfunctions or specifications;
 - (5) flight with training or supervisory duties;
 - (6) increased number of sectors;
 - (7) circadian disruption; and
 - (8) individual conditions of affected crew members (time since awake, sleep-related factor, workload, etc.).

GM1 CS FTL.1.210(3) Flight Duty Period (FDP)

In-flight rest should be taken during the cruise phase of the flight.

GM1 CS FTL.1.210(3)(d) Flight Duty Period (FDP)

In-flight rest periods should be allocated in order to optimise the alertness of those crew members at control during landing.

GM1 CS FTL.1.210(4) Flight Duty Period (FDP)

Operator procedures for delayed reporting should:

- (a) specify a contacting mode;
- (b) establish minimum and maximum notification times; and
- (c) avoid interference with sleeping patterns when possible.

GM1 ORO.FTL.215(c) Flight times and duty periods

The operator should specify post-flight duty times taking into account the type of operation, the size and type of aircraft and the airport conditions.

GM1 CS FTL.1.205 Home Base

Crew members should consider making arrangements for temporary accommodation closer to their home base if the travelling time from their residence to their home base usually exceeds 90 minutes.

GM1 CS FTL.1.225(b) Split duty

The operator should specify post and pre-flight duty and travelling times taking into account aircraft type, type of operation and airport conditions.

GM1 CS FTL.1.230 Standby

- (a) If airport or short-call standby initially assigned is reduced by the operator during standby that does not lead to an assignment to a flight duty period, the minimum rest requirements specified in ORO.FTL.235 should apply.
- (b) If a minimum rest period as specified in ORO.FTL.235 is provided before reporting for the duty assigned during the standby, this time period should not count as standby duty.

AMC1 CS FTL.1.235(2)(b)(i) Minimum Rest periods

The monitoring of rotations and combinations of rotations should be conducted under the operator's safety management system.

AMC1 CS FTL.1.235(2)(c) Minimum rest periods

The monitoring of combinations of rotations should be conducted under the Operator's Safety Management provisions.

VI. EU/JAR-OPS reference – EASA reference

Note: This cross-reference table lists EU-OPS rules (SUBPART Q – FLIGHT AND DUTY TIME LIMITATIONS AND REST REQUIREMENTS) which have a direct reference to the EASA rules.

EU-OPS reference	Subject	EASA reference	Subject
EU-OPS 1.1090(1)	Objective and scope	ORO.FTL.100 CS FTL.1.200	Scope
EU-OPS 1.1090(2)	Objective and scope	ORO.FTL.110 AMC1-ORO.FTL.110(a)	Operator responsibilities
EU-OPS 1.1090(3)	Objective and scope	ORO.FTL.205 ORO.FTL.110	Operator responsibilities/Home Base
EU-OPS 1.1090(4)	Crew members' responsibility	ORO.FTL.120 GM1 ORO.FTL.210 GM1 ORO.FTL.1.210(3) GM1 ORO.FTL.235(b) GM1 ORO.FTL.235(2)(2)	Crew members' responsibility
N/A	N/A	ORO.FTL.115 AMC1 ORO.FTL.120(d)(1) AMC2 ORO.FTL.120(d)(1) AMC1 ORO.FTL.120(d)(2)(i) AMC1 ORO.FTL.120(d)(2)(ii) AMC1 ORO.FTL.120(d)(2)(iii) AMC1 ORO.FTL.120(d)(3) AMC1 ORO.FTL.120(d)(4)	Fatigue risk management (FRM)
EU-OPS 1.1090(5)	Objective and scope	N/A	N/A
EU-OPS 1.1095	Definitions	ORO.FTL.105	Definitions
EU-OPS 1.1100(1.1)	Flight and duty limitations (cumulative duty hours)	ORO.FTL.215(a)	Flight times and duty periods

EU-OPS reference	Subject	EASA reference	Subject
EU-OPS 1.1100(1.2)	Flight and duty limitations (Limit on total block times)	ORO.FTL.215(b)	Flight times and duty periods
EU-OPS 1.1105	Maximum daily flight duty period (FDP)	ORO.FTL.210(b) CS FTL.1.210(1) CS FTL.1.210(2)	Flight duty period (FDP)
EU-OPS 1.1110	Rest	ORO.FTL.235 CS FTL.1.235	Minimum rest periods
EU-OPS 1.1115	Extension of flight duty period due to in-flight rest	ORO.FTL.210(d) CS FTL.1.210(3)	Flight duty period (FDP)
EU-OPS 1.1120	Unforeseen circumstances in actual flight operations — commander's discretion	ORO.FTL.210(a)(2);(3) ORO.FTL.210(e)	Flight duty period (FDP)
EU-OPS 1.1125(1)	Standby (Airport Standby)	ORO.FTL.230 CS FTL.1.230(1) GM1 CSFTL.230	Airport standby
EU-OPS 1.1125(2)	Standby (other forms of standby)	ORO.FTL.230 CS FTL.1.230(2) GM1 CSFTL.230	Other standby
EU-OPS 1.1130	Nutrition	ORO.FTL.240 AMC1 ORO.FTL.240	Nutrition
EU-OPS 1.1135(1) & (2)	Flight duty, duty and rest period records	ORO.FTL.245(a) ORO.FTL.245(b)	Records of flight and duty times and rest periods
EU-OPS 1.1135(3)	Flight duty, duty and rest period records	ORO.FTL.245	Records of flight and duty times and rest periods
EU-OPS 1.1135(4)	Flight duty, duty and rest period records	ORO.FTL.245	Records of flight and duty times and rest periods

EU-OPS reference	Subject	EASA reference	Subject
EU-OPS 1.1135(5)	Flight duty, duty and rest period records	ORO.FTL.245	Records of flight and duty times and rest periods

EASA reference — EU-OPS reference

Note: This cross reference table lists the Agency's rules which have a direct reference to the EU-OPS rules (SUBPART Q — FLIGHT AND DUTY TIME LIMITATIONS AND REST REQUIREMENTS).

EASA reference	Subject	EU-OPS reference	Subject
ORO.FTL.100 CS FTL.1.200	Scope	EU-OPS 1.1090(1)	Objective and scope
ORO.FTL.105	Definitions	EU-OPS 1.1095	Definitions
ORO.FTL.110 AMC1-ORO.FTL.110(a)	Operator responsibilities	EU-OPS 1.1090(2)	Objective and scope
ORO.FTL.115 AMC1 ORO.FTL.120(d)(1) AMC2 ORO.FTL.120(d)(1) AMC1 ORO.FTL.120(d)(2)(i) AMC1 ORO.FTL.120(d)(2)(ii) AMC1 ORO.FTL.120(d)(2)(iii) AMC1 ORO.FTL.120(d)(3) AMC1 ORO.FTL.120(d)(4)	Fatigue risk management (FRM)	N/A	N/A
ORO.FTL.200 FTL.1.200	Flight time specification schemes	EU-OPS 1.1090(1)	Objective and scope
ORO.FTL.205 CS FTL.1.205 GM1 CS.FTL.1.205	Home base	EU-OPS 1.1090(3)	Objective and scope
ORO.FTL.210 (b) CS FTL.1.210(1);(2) GM1 ORO.FTL.210	FDP — Maximum daily FDP	EU-OPS.1.1105(1.3)-(1.5) EU-OPS.1.1105(2)	Maximum daily flight duty period

EASA reference	Subject	EU-OPS reference	Subject
ORO.FTL.210(d) CS FTL.1.210(3)	FDP — Extension of FDP due to in-flight rest	EU-OPS 1.115	Extension of flight duty period due to in-flight rest
ORO.FTL.210(a)(2);(3) ORO.FTL.210(e)	FDP — Unforeseen circumstances in actual flight operations — commander's discretion	EU-OPS 1.1120	Unforeseen circumstances in actual flight operations — commander's discretion
CS FTL.1.210(4)	FDP — Unforeseen circumstances in actual flight operations — delayed reporting	N/A	N/A
ORO.FTL.2159(a)	Flight times and duty periods	EU-OPS 1.1100(1.1)	Flight and duty limitations
ORO.FTL.215(b)	Flight times and duty periods	EU-OPS 1.1100(1.2)	Flight and duty limitations
ORO.FTL.220	Positioning	EU-OPS.1.1105(5)	Maximum daily flight duty period
ORO.FTL.225 CS FTL.1.225	Split Duty	EU-OPS.1.1105(6)	Maximum daily flight duty period
ORO.FTL.230 CS FTL.1.230(1) GM1 CS.FTL.230	Airport standby	EU-OPS 1.1125(1)	Standby
ORO.FTL.230 CS FTL.1.230(2) GM1 CS.FTL.230	Other standby	EU-OPS 1.1125(2)	Standby
ORO.FTL.235	Minimum rest periods — Basic Minimum Rest	EU-OPS 1.1110(1.1), (1.2) EU-OPS 1.1110(2)	Rest
ORO.FTL.235 CS FTL.1.235(2)	Minimum rest — Time zone differences	EU-OPS 1.1110(1.3)	Rest
ORO.FTL.235 CS FTL.1.235(3)	Minimum rest periods — Reduced rest	EU-OPS 1.1110(1.4.1), (1.4.2)	Rest

EASA reference	Subject	EU-OPS reference	Subject
ORO.FTL.240 AMC1 ORO.FTL.240	Nutrition	EU-OPS 1.1130	Nutrition
ORO.FTL.245(a) ORO.FTL.245(b)	Records of flight and duty times and rest periods	EU-OPS 1.1135(1) and (2)	Flight duty, duty and rest period records
ORO.FTL.245	Records of flight and duty times and rest periods	EU-OPS 1.1135(4)	Flight duty, duty and rest period records
ORO.FTL.245	Records of flight and duty times and rest periods	EU-OPS 1.1135(5)	Flight duty, duty and rest period records
ORO.FTL.245	Records of flight and duty times and rest periods	EU-OPS 1.1135(3)	Flight duty, duty and rest period records
ORO.FTL.250 AMC1 ORO.250	Fatigue management training	N/A	N/A

C. Appendix

I. Commentators

II. Comments received

Please note that due to the size of the comments received, the file which contains all the commentators and their comments is published under the Agency's **Comment Response Documents (CRDs) and Review Groups** webpage (<http://easa.europa.eu/rulemaking/comment-response-documents-CRDs-and-review-groups.php>).

III. Scientists' Reports



Provision of Scientific Expertise to submit an
assessment of the NPA on Flight Time Limitations
(FTL) and to provide guidance and advice to the FTL
Review Group



Final Report
Version 1.0



Warning

**This document is confidential.
It has been prepared for EASA exclusively.**

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1 Introduction

The context of this work concerns the update and amendment of the current Flight Time Limitations regulations (Subpart Q of the EU-OPS) taking into account recent scientific and technical evidence and focusing on the applicable technical provisions. The proposed update and amendment has been published in a Notice of Proposed Amendment (20 December 2010) 'Implementing Rules on Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes'. This NPA is now open to comments for a period of 3 months. This NPA contains explanatory note that identified some questions for which it was not possible to reach a consensus and therefore, for which a scientific input is needed.

The objective of the work is the provision of a scientific expertise to EASA regarding the aspects raised by the questions. A first series of 14 questions was initially raised in the NPA. Then an additional series of 8 questions was provided by EASA by the end of April.

This document is the final report that was prepared after the review meeting held in Cologne from May 17 to 19, 2011. Therefore, this report takes into account some remarks that were raised during the meeting and some of the answers to some questions were completed on the basis of the meeting discussion.



2 Background and method

The 22 questions raised by EASA have various impacts on aircrew fatigue but also on social and economic aspects. The expertise provided in this work is however limited to the issues associated with sleep and fatigue regardless of the social and economic impacts.

Each of the questions was reviewed regarding the available scientific data on sleep, fatigue and biological rhythms published in peer-review journals and scientific reports. For some questions, no direct or scarce data was available. In these cases, as far as safety is concerned, conservative assumption was taken.

Most of the knowledge accumulated over the last years has addressed mainly one of the components of fatigue, namely sleepiness that is related to 3 main underlying processes (Akerstedt and Folkard, 1997):

- the process C (Circadian), regulated by the so-called biological clock. This circadian factor initiates sleep every 24 hours.
- a homeostatic process, the process S (Sleep) associated with the amount of prior wake and amount of prior sleep. That means that sleep is initiated after a certain length of wake (around 16 hours for most individuals)
- a process W (Waking) which reflects sleep inertia, ie. "a transitional state of lowered arousal occurring immediately after awakening from sleep and producing a temporary decrement in subsequent performance" (Tassi and Muzet, 2000). The amount of sleep inertia is related to the amount of deep sleep (stages 3 and 4).

In normal sleep-wake conditions (daytime duty), process C and S are synchronised, i.e. sleep is initiated in the circadian low and when the process S reaches a threshold. Under these conditions, sleep inertia is relatively short upon waking up (around 30 minutes). However, with disruptive schedules (morning or night duties or after a rapid transition of time zone), these processes are desynchronised leading to sleep disturbances and fatigue. Sleep inertia dissipation can be very long (up to 4 hours after waking up) in case of previous sleep loss (Dinges, 1987).

The above processes describe clearly fatigue resulting from an acute sleep loss. However, fatigue is known to build in a cumulative manner over consecutive days. This means that repetitive slight sleep reduction will produce similar effects than a single large sleep deprivation (Van Dongen, 2003). However, there are fewer scientific data describing cumulative fatigue that is therefore more difficult to predict.

It has been demonstrated that the impact of disruptive schedules such as night duties or morning duties or the rapid transition of time zone lead to objective signs of sleepiness during flight measured by electrophysiological data (Nicholson et al, 1986, Cabon et al, 1993, Samel et al, 1997).



This low alertness state has been shown to be a contributing factor of a number of accidents (NTSB, 1999). A recent research (Goode, 2003) has demonstrated an increased risk of aircraft accident with long duty hours.

As for many aspects of Human Factors scientific data often refer to average trends. However, the examination of the data distribution reveals large inter-individual variability generally associated with large differences in individual sleep needs or differences in the circadian type (morningness or eveningness type). This practically means that an early start will produce a larger sleep deprivation for an evening type person than for a morning type person. As FTL should apply to everyone, a conservative approach is to set the limitations according to the least favourable profile.

Even if most of the laboratory researches show that fatigue produces cognitive impairment and that several aircraft accidents has been partially attributed to fatigue, it does not mean that there is a linear link between fatigue and safety in complex systems like aviation. Indeed, several studies (Foushee et al, 1986, Thomas and Petrelli, 2006) suggest that with an increasing level of fatigue, pilots develop strategy to protect safety (e.g. increase ofr cross check, use of automation,...). This means that, paradoxically, safety could be more impaired at moderate level of fatigue (when fatigue awareness is low) than for high level (when fatigue awareness is high).

Therefore, the complexity of the underlying mechanisms of fatigue and the complexity of the link between fatigue and safety suggest that a prescriptive approach only based on duty time limitations will not be sufficient to manage this specific risk. It emphasises the need of managing fatigue and safety globally and therefore the relevance of a Fatigue Risk Management System fully integrated into the airline Safety Management System.



3 Comments to questions

For the consistency of the report, the answers to the questions have been gathered into 9 different topics :

- 1- Home Base
- 2- Maximum FDP
- 3- Augmented crews
- 4- Unforeseen circumstances
- 5- Cumulative fatigue
- 6- Split duty
- 7- Standby
- 8- Disruptive schedules
- 9- Reduced rest and split duty.

3.1 Home base

Question 1: *The definition of a Home Base — especially with multiple airports — could not reach a consensus within the Rulemaking Group. One open item was related to the above limitation of 50km distance/60min travelling time, the safety impact of allowing multiple airports is probably negligible, but the social and economical impacts of the proposal are difficult to assess. In this respect the RIA needs further consideration. Stakeholders are invited to comment and provide justification elements on the possible safety, social and economic impact of the proposal, as well as on the proposed **related definitions of positioning, travelling, etc.***

The definition of a home base with multiple airports set a limitation of 50km/60 min travelling time. When FDP starts and finishes in different locations within the home base, then the transfer from the final point of landing back to the initial location of the start shall count as positioning. The impact of travelling time in terms of fatigue and safety will vary considerably as a function of two main factors: the reporting time and the commuting time.

The reporting time could be especially critical for early start given the physiological difficulty to advance sleep pattern. For an early start (i.e. duty starting between 05:00 and 05:59 in the proposed definition), the additional travelling time (up to 60 min) will significantly reduce the prior sleep length. Scientific researches (Simons and Valk, 1997) have shown that the earlier the duty start, the greater the sleep reduction (1 hour of reduction for duties starting between 07:00 and 08:00 and 2 hours for duties starting between 06:00 and 07:00). Therefore adding travelling time for the early start will increase the risk of significant sleep loss and of low alertness levels during the subsequent FDP.



Another factor that might impact this definition is the long commuting time, which is common in aircrews. In case of long commuting time, home base with multiple airports can significantly reduce sleep and increase fatigue. Therefore it is recommended that accommodation should be provided to mitigate the effect of multiple home bases in case of early start.

Additional question 8: *Comment on the potential safety impact of multiple airports as home base, including effects on safety of additional travelling not accountable as duty time, and the need for a definition of 'designated reporting point'.*

The additional travelling not accountable as duty time should be considered with care as the amount of additional travelling time may increase the cumulative fatigue especially with early starts.

During the review meeting, the discussion on this question was focused on the risk of instability of the home base. Therefore a designated reporting point appears to be necessary.

3.2 Maximum FDP

Additional question 1 - Maximum FDP: *Comment on the provisions for the maximum daily flight duty period (FDP), including:*

- a) The effectiveness of the mitigating measures in the NPA for the one hour extensions (transient and cumulative effects),*
- b) The effectiveness of the mitigating measures in the NPA for the 2 or 3 hours commander discretion (transient and cumulative effects),*
- c) Any need for additional mitigating measures for consecutive early starts and for consecutive night duties,*
- d) The effectiveness of the mitigating measures in the NPA for the WOCL encroachment and for the number of sectors*

a) The maximum daily FDP with extensions as proposed in the table 37 raises several issues:

- the cumulative effects of the time on time and time of the day for extensions of FDP's starting in the evening (see question 2)
- extensions of FDP's starting between 0600 and 1259. In case of reporting time at 0600, this will induce a large reduction of sleep due to a very early waking time. This is associated with the definition of early start (see question 13).

The increase of 2 hours of pre and post-flight rests or the increase of 4 hours of the post-flight rest is deemed acceptable although we consider that post-flight rest is the most important to prevent fatigue for the next FDP. However, the limitation to 2 extensions in



any consecutive days could be critical as it could allow 2 consecutive extensions. Provisions shall be taken to ensure that the rest between 2 extensions includes at least one local night (if no time zone crossing) or one "base night" (in case of time zone crossing).

b) Provisions for the 2 or 3 hours extension due to commander discretion should not allow reduced rest after the extended FDP. To avoid cumulative effects of FDP extension, only 2 extensions due to commander discretion shall be used in any 7 consecutive days with at least one local night (if no time zone crossing) or one "base night" (in case of time zone crossing) during the rest between 2 extensions.

c) As morning and night duties are known to be associated with significant sleep disruptions, it is necessary to take provision to mitigate the cumulative effects of these disruptive duties. Figure 1 shows sleepiness data collected upon at bed time and get up time for pilots on multi-sectors short haul flights (Bourgeois-Bougrine et al, 2003a). Each aircrew was either working on consecutive "early starts" or "late starts" (up to 7 consecutive days). The data clearly show that after 3 consecutive days the bedtime and getup time sleepiness values were no longer significant suggesting that the rest was not enough to recover from the sleepiness.

- For duties starting before 0600, only 2 consecutive early starts should be allowed
- For duties starting after 0600, only 3 consecutive early starts should be allowed
- For consecutive duties starting between 0400 and 0900, the duty start should not advance. Ideally, consecutive morning duties should be delayed of 1 hour per day.
- After consecutive early starts, rest should include at least one local night (if no time zone crossing) or one "base night" (in case of time zone crossing)
- A maximum of 2 consecutive night duties should be allowed.

- After 1 night duty, rest should include at least one local night (if no time zone crossing) or one "base night" (in case of time zone crossing) (Todderdell et al, 1995, Akerstedt et al, 2000)

- After 2 consecutive night duties, rest should include at least two local nights (if no time zone crossing) or 2 "base nights" (in case of time zone crossing)

In order to prevent circadian disruption, it is generally admitted that working with blocks of early and late duties is better than working with mixed schedules.

d) Night FDP's or FDP's that encroach the WOCL should be limited to 10 hours as scientific data collected on aircrew suggest (Powell et al, 2008). As there is a clear interaction between the time on the day and the number of sectors, it is recommended to limit the FDP as a function of the number of sectors. A reduction of 30 minutes per sector for every sector after the first is would be a reasonable value. Our study on short haul flights (Bourgeois-Bougrine et al, 2003a) has shown a significant increase of fatigue after the third sector, therefore it would be sensible to set a greater limit after the third sector.



No scientific data are available for FDP's with more than 4 sectors.

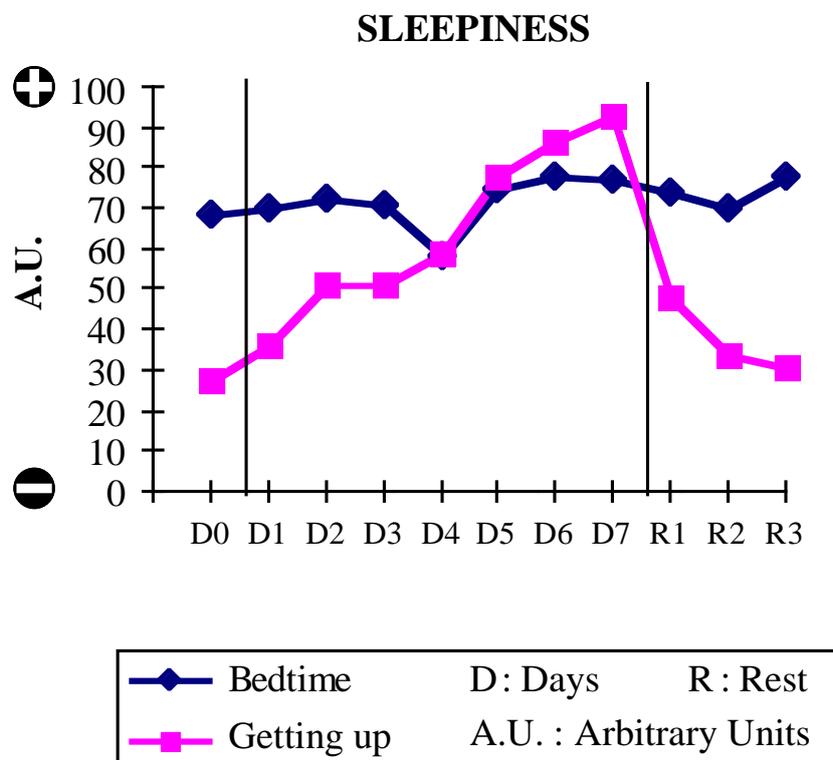


Figure 1. Mean evaluation of sleepiness at bedtime and on getting up on consecutive early and late starts (N=134).



Question 2: FDP extension for duties starting in the evening. While the Group could not agree on the tables and values, and in particular on the possibility to use FDP extensions, the Agency decided to keep the Subpart Q provision on the basis of operational experience and also due to the fact that additional mitigating measures (such as 4 hours of additional rest) are used to compensate the longer FDP. Also, CAP 371 uses a similar provision. However, simulations conducted with the SAFE model indicated that extended FDP starting in the evening lead to low alertness levels. The proposal to authorise such extension only in conjunction with FRM did not reach consensus. Stakeholders are invited to comment on the potential safety impact of FDP extensions considering the associated mitigating measures, and make proposals for further/other possible mitigating measures for extension on FDP starting in the evening.

The SAFE simulations presented in the NPA predict that fatigue levels at the end of FDP's starting from 1400 to 2000 would reach a value of 5 or above. Therefore, considering the required alertness for the aircrew at the end of the duty, there is no reason to allow extension of FDP starting in the evening.

We do not recommend any extension of FDP for any duty start time and to allow them only in the framework of a FRMS. Simulations with the model Sleep Wake Predictor (Akerstedt) have shown that extensions up to are only possible this assumption is true hours 08:00 to 10:00. After 10:00, the end of the FDP of 14 hrs falls after 00:00 and results in excessive fatigue levels. The reason why we think FDP extensions should be allowed only in the framework of FRMS is because even still in an acceptable level of fatigue we are approaching close to excessive value. Taking into account the inter and intra individual variability we do not consider 14hrs as a conservative value.

3.3 Augmented crews

Question 4: In flight rest facilities. The three classes of rest facilities introduced in this proposal reflect the conclusions of the TNO study, which is to date the most comprehensive study conducted on in-flight rest. This study does not recommend the use of economy class seats for in-flight rest, although it admits that data is scarce on this subject. While some charter operators can claim years of operating experience on the use of economy seats as rest facility, among the serious incident records related to fatigue discussed in paragraph 23 above, one is related to the use of economy class seats as a rest facility. Finally, the RIA identified that not allowing anymore the use of such rest facilities would have a certain economic impact on charter operators. Stakeholders are invited to comment and provide justification elements on the safety and economic aspects of the possible use of economy class seats as a rest facility.



The issue related to in-flight rest facilities may be a critical issue as a poor on-board sleep might reduce subsequent aircrew alertness and hence safety. Roach et al, 2010 has recently shown that in-flight sleep (in bunk) provides airline pilots with 70% as much restoration as duration-matched bed sleep. As stated in the NPA, one serious incident involving in-flight rest in an economy seat has been reported. In line with the TNO study, the NPA does not allow for in-flight rest in an economy seat, but the NPA argues that the incident data is statistically insufficient. We do consider that one serious incident related to a specific issue has to be taken into account given the very high safety level that reaches aviation. In fact, even if no scientific data are currently available for rest on economic seat, the TNO study (Simons et al, 1994) suggests having a conservative approach that no extension should be permitted with economic seats. The results showed that rest in a flight deck seat is only 33% effective compared to bunk rest. Therefore it can be extrapolated from these data that economic seat will not provide a sufficiently restorative sleep because of the environmental factors associated with these facilities (noise and seat comfort).

Question 5: Extension of FDP and WOCL. Stakeholders are invited to comment on the validity of the principle that maximum FDP with augmented crew could be irrespective of the WOCL.

We understand that maximum FDP could be irrespective of the WOCL due to the fact that sleeping in the WOCL would increase sleep efficiency. However, this could be only true for the crew responsible of the landing phase (i.e. the captain). Therefore, the only condition that would allow ignoring the WOCL in the extension of FDP with augmented crew would be to guarantee that the captain will be sleeping in the WOCL, which is, from a practical point of view, difficult to consider. Therefore, we recommend limiting the maximum FDP for augmented crew taking into account the time of the day.



Question 6: In Flight Rest *The question of what the minimum consecutive in-flight rest should be is not an easy one. According to national practices and scientific studies, this may vary from 1 hour to 3 hours. Stakeholders are invited to comment on the more appropriate and safety effective measures to limit the fragmentation of sleep. Their views are also requested on the need to limit augmented crew operations to 3 sectors.*

This question raises the issue of the minimum rest period that induces a recuperative sleep.

Available scientific data show that sleep efficiency (i.e. the percentage of time in bed that a person sleeps) varies significantly as a function of the time of the day. Therefore, a given rest time will not produce the same amount of sleep. In fact, if rest is taken in a period favourable for sleep (i.e. close to the WOCL or in the early afternoon) sleep efficiency is likely to be high. On the contrary if rest is taken in an unfavourable period for sleep (i.e. the forbidden zone for sleep in the late afternoon) sleep efficiency will be low. Prediction by a biomathematical model obtained for the Singapore Airlines ULR study (Robertson et al, 2002) shown that the average amount of sleep during a 6-hour rest period can vary between approximately 2 hours in the early afternoon to over 4.5 hours at midnight. Therefore, it seems difficult to provide a minimum rest time that would apply whatever the time of the flight. As a general rule, and in order to maximise sleep, minimum in-flight rest should not be equal depending on the time of the day. In-flight rest should be longer in the periods when sleep is less likely to occur and could be shorter in the periods favourable for sleep.

Of course multi-sectors duties increase the complexity for the crew to plan their in-flight rest as it will depend both on the length of each individual sectors and the time of the day of those sectors. Therefore, it is extremely difficult to give a limit on the number of sectors and a case by case approach should be adopted.



Question 7: Minimum In Flight Rest for cabin crew. *The in-flight rest table for Cabin Crew was not subject to a detailed analysis in the RIA, in terms of safety and economic impact. Stakeholders are invited to comment on the appropriateness of the values proposed in the table on minimum in-flight rest duration for Cabin Crew.*

Alertness of cabin crew for safety is crucial, especially during the take off and landing phase where the need for passengers evacuation require an optimal performance. A possible way to address what might be the minimum in-flight rest for cabin crew is to take into account the average physiological sleep requirements of 8 hours within a 24 hours period (Dinges et al, 1996). Therefore, the values presented in the table are insufficient for FDP extension higher than 4:00. In fact, an extension of 4:00 could lead to a FDP of 17:00, thus only 7 hours can be allocated to sleep. Taking into account an average of 2 hours of time for commuting, physiological and social needs, only 5 hours are remaining (7:00-2:00) for sleep. As a consequence, a minimum of 3:00 should be allowed rather than 2:30 for class 1 crew rest to obtain asleep opportunity of 8 hours. The same augmentation should apply to the other value to keep the 8 hours requirement of sleep within 24 hours.

FDP extension	Minimum In-flight rest		
	Class 1	Class 2	Class 3
00:00 – 01:00	01:30	01:30	01 :30
01:00 – 02:00	01:45	01:50	01 :55
02:00 – 03:00	02:00	02:10	02 :20
03:00 – 04:00	03:00	03:20	03 :40
04:00 – 05:00	04:00	04:30	05 :00
05:00 – 06:00	05:00	05:40	06 :20
06:00 – 07:00	06:00	06:50	Not allowed



Additional Question 2 Augmented Crew: Comment on the provisions regarding extended FDP operations with in-flight rest, in particular:

- a) the maximum allowable FDP with one or two additional flight crew members;*
- b) the need to address sleep inertia prior to returning to the controls*
- c) any need for additional mitigation measures to address the non-acclimatisation of crew members.*

- a) Two factors are taken into account to set the maximum allowable FDP : the rest facilities and the number of additional flight crew members (1 or 2). Regarding the rest facilities, in accordance with the answer to question 4, we do not recommend to allow any extension using economic seats. The values given for class 1 and 2 rest facilities and the number of additional flight crew members are given irrespective of the duty start. As mentioned in the answer to question 5, ignoring the WOCL for the extension of FDP in augmented crew would be only valid if we can guarantee that the captain or the landing crew will be sleeping in the WOCL. In other situations, ignoring the WOCL will increase the risk of having short sleep in the least unfavourable period of the flight and, as a consequence, unacceptable alertness level during the landing phase. Therefore, we would rather recommend reducing FDP limitation when WOCL is encroached.
- b) Sleep inertia is a real concern as its effect might impact subsequent aircrew performance while returning in the flight deck. Scientific researches (Dinges, 1985) show that sleep inertia is essentially associated with the quantity of deep sleep which is directly linked to the cumulative sleep loss. Therefore, the greater the sleep loss, the higher the deep sleep and the higher the risk of sleep inertia. However, this would be very difficult to take into account in the regulation as the amount of prior sleep loss may widely vary from one individual to another. Therefore it seems sensible to address sleep inertia by educating aircrew in the context of the airline FRMS by helping them to plan in-flight rest duration as a function of the individual sleep. Another important mitigation procedure will be to allow a sufficient time between the waking up and the return (minimum 30 min) in the flight deck, and to give practical means for the aircrew to evaluate her/his fitness for duty before returning in the flight deck. In case of unexpected sleep inertia, additional time should be given to the crewmember before resuming her/his duty
- c) We recommend reducing the extension for non-acclimatized crews as fatigue is clearly increased by sleep disturbances associated with the non acclimatization.



3.4 Unforeseen circumstances

Question 8: Commander's discretion. *With the commander's discretion provisions, the maximum basic FDP when added to the FTL.1.210 1(b) 1 hour extension, may reach 16 hours for flight crew, and possibly 17 hours for Cabin Crews when applying FTL.1.210 1(c). Stakeholders are invited to comment on the safety implications of this provision.*

The proposed extension of basic FDP with the commander's discretion might have significant impact on safety as suggested by the statistical study of Goode (2003). This study shows that the relative risk was over 5.5 times higher for duties of 13 hours or more.

Therefore, it seems extremely important that mitigation measures should be taken when commander's discretion is used:

- the consultation by the commander of all the crew on their alertness. As self-rating of alertness is subject to a large inter-individual variability this process could be supported by practical tools (questionnaires, scales, check list) to help the crew to make the appropriate decision
- the training of aircrew in the context of the airline FRMS to ensure that aircrew are aware of the impact of fatigue and possible countermeasures. As the use of commander's discretion can be critical in terms of fatigue and safety, it is crucial that the decision to extend the FDP could be based on the most accurate assessment of the fatigue by the crew (and not only the commander's fatigue).
- limitation of the frequency of the use of commander's discretion over 7 days period to avoid accumulation of long duty hours
- a careful monitoring of the impact of these extension in the framework of the airline FRMS.



Question 9: Provision on short-term replanning. *Those provisions are clearly included for the sake of operational flexibility and as said above, the Group could not review the potential safety impact of the proposal. Stakeholders are invited to comment on the potential safety impact of the proposal on short-term re-planning.*

Short term re-planning raises the issue of aircrew preparation and sleep planification. The proposed rules applying to split duty and reduced rests seems to be acceptable as they allow the crew to anticipate on her/his rest preparation. However, the frequency of these short term re-plannings should be limited and carefully monitored in the framework of the FRMS.

3.5 Cumulative fatigue

Additional question 3 Cumulative fatigue: *Comment on the provisions regarding cumulative fatigue, in particular:*

- a) Any need for an additional duty limit of 14 days limit and/or recovery rest over a series of weeks to counter cumulative fatigue*
- b) Any need for a 12 months or 365 day rolling limit to counter cumulative fatigue (as opposed to a calendar year limit)*

As discussed in the Cologne meeting, there is a limited number of scientific data on cumulative fatigue. However, a conservative and practical approach would suggest to set provision to avoid cumulative duty time.

- a) The principle of a duty limit of 14 days seems to be an adequate provision to ensuring that the duty period is spread as evenly as practicable. It is therefore proposed to add this limitation to the current FTL
- b) The 12 month or 365 days rolling limit has the advantage to avoid cumulative fatigue with 900 hours to be worked in the final 9 months (9X28 days) of one calendar year and 900 hours in the first 9 months of the following calendar year.

Other possible approach to avoid cumulative fatigue would be also to require days off at regular periods.



3.6 Split duty

Question 10: Split duty. *As other provisions currently covered by Article 8 provisions, national regulations significantly differ on the subject and it was not possible to reach a consensus on a proposal within the Rulemaking Group. However, a majority of Group members agreed that current CAP 371 provisions, which form the basis of this proposal, should be used, as they are supported by both operational experience and scientific evidence. Stakeholders are invited to comment on the proposed Split Duty provisions.*

The use of split duty raises the issue of long duty hours that increase the risk of fatigue at the end of the duty and therefore create problems that can be similar of long duties. In fact, fatigue due to the extension of duty can only be partially overcome by sleep if the break is falling in an unfavourable period of sleep (e.g. in the morning). Therefore, split duties need special provision to ensure that they do not produce excessive fatigue:

- split duty should be limited to daytime duties (from 06 to 10 pm) to avoid excessive sleep loss since there is the risk for the crew to not have enough sleep before the next duty if the first FDP falls in the WOCL and the break in the early morning which is less favourable for sleep.
- split duty should not be permitted with non acclimatized aircrew
- suitable accommodation should be provided
- split duty should be carefully monitored by a FRMS.



3.7 Standby

There were a total of 4 questions raised on standby duty. The answers to these 4 questions were merged in two different parts, the first part dealing with the maximum FDP, the second with cumulative duty.

Question 11: Limit of Standby Duty. A key issue concerning standby is that for the sake of crew productivity Operators want to benefit from the maximum possible available FDP associated with the longer possible standby duty period. With this constraint in mind, what criteria could be used in order to guarantee that crew can be properly rested when taking on their flight duty after standby duty? This proposal includes a limit for standby duration of 12 hours. The Rulemaking Group is aware that national regulations ensuring that crew are properly rested before reporting differ widely. Stakeholders are invited to comment on the more appropriate limit for standby duty duration and, if limits above 12 hours are proposed, to make suggestions on appropriate mitigating measures to ensure that crew are properly rested before reporting.

Additional question 4 Airport Standby: Comment on the provisions in the NPA for the calculation of maximum FDP when called out from airport standby in terms of acceptable level of alertness throughout the FDP.

Additional question 5 Home Standby: Comment on the provisions for the calculation of maximum FDP when called out from home standby; in particular when a crew member is being callout at the end of standby for a full FDP.

One of the key issues in Standby Duty is the schedules unpredictability and the associated difficulties for the aircrew to plan their sleep periods including naps. Of course, the shorter the notice, the higher the potential impact on sleep.

Only a few scientific data are available on the effect of standby duty on sleep and fatigue and, to our knowledge, none was carried out on aircrew. A survey on 198 train engineers showed that those working on-call had greater difficulty falling asleep while on-call versus when they were not on-call (Pilcher, 2000). Furthermore, engineers slept less when at home than "away". The authors explained this difference by the presence of family and social obligation when at home.

A second study has shown with objective measures of sleep on 5 ship engineers, that sleep taken when on standby is shorter and of poorer quality than normal sleep (Torsvall and Åkerstedt, 1988).

Other researches also found that standby duty negatively impact mental health with an increase of anxiety and depression (Chambers et al, 1996).



The proposed provisions for standby duty are different for airport standby and home standby. Within airport standby, the availability of accommodation is considered to define the amount of standby counting in the FDP. We would consider more relevant not to distinguish airport and other standby but rather to have different provisions when suitable accommodations are available (home or airport) and when no suitable accommodation are provided in the airport.

In the latest case standby duty should count in full as duty time.

If suitable accommodation is provided or in case of standby at home we would recommend to use a sliding scale. There is no accurate scientific data to set the values, but we recommend the following values for the contribution of standby duty towards the maximum FDP are proposed :

- from 0 to 3 hours : 25%
- from 3 to 6 hours : 37%
- >6 hours : 50 %.

Compared to the 6 hours cut off proposed for the airport standby, this sliding scale has the advantage to be more progressive.

Question 12 : Standby Duty at home. *The level of fatigue following standby at home or in a suitable accommodation is also a question where the Rulemaking Group was not able to reach a consensus. Current national regulations account this form of standby from 0% to 100% of duty time for the calculation of duty cumulative limit. The NPA proposal of 25% can be seen as a compromise, though not based on scientific evidence, between the two more common values currently used by Member States: 0% and 50%. Stakeholders are invited to comment on how much they consider Standby Duty at home or in a suitable accommodation should count for the calculation of duty cumulative limits.*

To our knowledge, there is no scientific evidence to set a precise value and we would recommend further investigation on this specific issue. However the 25 % proposed in the NPA seems to be a conservative value.

3.8 Disruptive schedules

Question 13: Early start and late finish definition. *The definitions used in this NPA for early start and late finishes are respectively an FDP starting in the 05:00–05:59 hr period and an FDP finishing in the 01:00–01:59 hr period (see paragraph 70). The Rulemaking Group members could not agree upon a common definition for early starts and late finishes, therefore the Agency proposed a non-consensual definition, based on the airlines' suggestions. Stakeholders are invited to comment whether they consider*



those definitions are pertinent in the context of the proposed provisions for disruptive schedules.

The definition of early start is critical, as it would not consider a duty starting at 0600 as an early start although with an actual waking time of 0400, the physiological impact of this duty will be significant. As already mentioned in the answer to question 1, Simons and Valk (1997) shown that duties starting between 07:00 and 08:00 induce in average a 1 hour of sleep reduction. Therefore we recommend to define an early start as an FDP starting in the 05:00-06:59 period.

The definition of the late finishes is less critical but we would recommend advancing the period to 00:00 instead of 01:00 to be more consistent with the physiological rhythms.

Another issue that is related to early start and late finishes is the transition between these disruptive schedules. In order to prevent sleep loss, we recommend to not allowing transition between early and late without a night off.



Question 3: FDP and acclimatisation. *Other regulations, such as CAP 371, and the FAA NPRM use secondary tables for non-acclimatised crew and also some, for partly acclimatised crew. This certainly allows describing the phenomenon of acclimatisation more accurately, but it may also complicate the calculation of FDP. Stakeholders are invited to comment whether they consider the proposal to keep the Subpart Q criterion, with the refined definition of 'Acclimatised' accurate enough, to describe the phenomenon of acclimatisation and to effectively counter fatigue-related risks.*

In the scientific literature, acclimatisation refers to the adaptation of the biological clock to a rapid time zone transition after a transmeridian flight. During the adaptation phase, specific troubles appear due to the misalignment between the circadian phase and the external cues. These troubles known as the jet lag syndrome include fatigue due to sleep-wake disorders, mood troubles and performance impairment. There is a large body of scientific data that show that several factors may impact the intensity of jet lag and the speed of adjustment. Some of these factors are related to inter-individual differences (age, gender) and others are directly related to the features of the travel:

- the number of time zone crossed. It is generally considered that 3 time zones are the minimum to produce a significant jet lag
- the direction of travel. Adaptation is slower after eastward transitions than after westward transition due to the natural trend of the biological clock to delay its phase
- the duration of the stay in the new time zone. It is considered that adaptation rate is 1 hour per day for eastward layover and 1.5 hour per day for westward transition.

The NPA assumes that acclimatisation is obtained when a crewmember spent at least 36 hours free of duty or 72 hours conducting duties in an area of 3 hours of time zone difference.

Therefore, this definition assumes that adaptation will be complete after 36 or 72 hours irrespective of the number of time zones crossed. Taking into account available scientific data, it can be predicted that this would certainly be not the case for most of long-haul flights that crossed more than 5 time zones. Applying the speed of adjustment it can be assumed that this definition will only be true for time zone transition of 3 hours.

Furthermore, for large time zone transition, because of the above-mentioned speed of adjustment, it seems that 36 or 72 hours are probably a zone where the jet lag troubles will be maximum. Therefore we recommend using a speed of adjustment of 1 hour per day to determine the acclimatisation.

Furthermore, to our knowledge, giving a different value when crew are conducting a duty is not supported by any data. Being free of duty might even produces a slower rate of adjustment as individuals would tend to keep their biological clock on their home base time in the absence of social constraints.



Additional question 6 TZC: *Comment on any need to take into account – for the calculation of FDP and minimum rest :*

- a) a non-acclimatised FDP table, depending on the length of time spent away from home base*
- b) the effect of continual disruption of the circadian rhythm in east-west / west-east transitions*

a) It seems very sensible to take into account acclimatisation for the calculation of FDP and minimum rest. Indeed, the use of local time for reporting time and the WOCL will be totally irrelevant for non-acclimatised crews. Therefore, it would be preferable to reduce the FDP for non-acclimatised crews. For the calculation of minimum rest for non acclimatised-crews, the table provided by the Moebus report (page 24) is sensible. However, it should be keep in mind that such a table is based on "average" values and does not take into account the large inter-individual variability observed in the speed of adjustment as already mentioned in the answer to question 3. For the definition of acclimatisation, see the answer to question 3.

b) As mentioned in the answer to question 3, the effect of time zone crossing and the adjustment to a new time zone is a continuous and progressive process. Therefore we recommend taking a more realistic definition of acclimatisation for the purpose of the calculation of FDP and minimum rest (see response to question 3) This definition should at least take into account the fact that the effects of time zone transition will be greater the higher the number of time zones and that the acclimatisation will take more time for large time zone transitions.



3.9 Reduced rest and split duty

Question 14: Reduced rests and split duties. *Group members' views on reduced rest were split, in particular as regards its combination with split duty. In particular Operators' representatives supported it, while Flight and Cabin Crew representatives were against it. Stakeholders are invited to comment on the proposal on Reduced Rest, and especially on the lower limit of 7h30 rest, the limitation to Regional Operations and the combination with other provisions such as split duty.*

To our knowledge, the only scientific research conducted on reduced rests is the STARE project. In the STARE study, the data collection included :

- Assessment of schedules by the means of biomathematical models
- Evaluation of sleepiness during actual flights by the means of a standardized sleepiness scale (Karolinska Sleepiness Scale) filled at the end of every flight,
- Measure of sleep length by the means of actigraphy recording and sleep diary during the rest periods.

The results from this research raised the following results regarding reduced rest :

- Analysis of the fatigue risk level using predictive models for morning duties following a reduced rest shows that this risk varies widely from one schedule to another. However, only 6% of these duties showed a probability higher than 30% of resulting in the so-called critical fatigue level.
- The variability of the fatigue risk level observed on analysing the schedules using the same predictive models shows that this risk should be managed at schedule level (cumulative aspect of fatigue). It is therefore important to evaluate how reduced rests are combined with other duties likely to induce a significant sleep debt.
- It can be seen that the relative sleep debt is significantly higher during reduced rests than for morning duties (figure 2), a phenomenon inherent in the limited duration of these rests. In contrast, sleep quality during a reduced rest is reported as good, or even very good by the great majority of crewmembers.

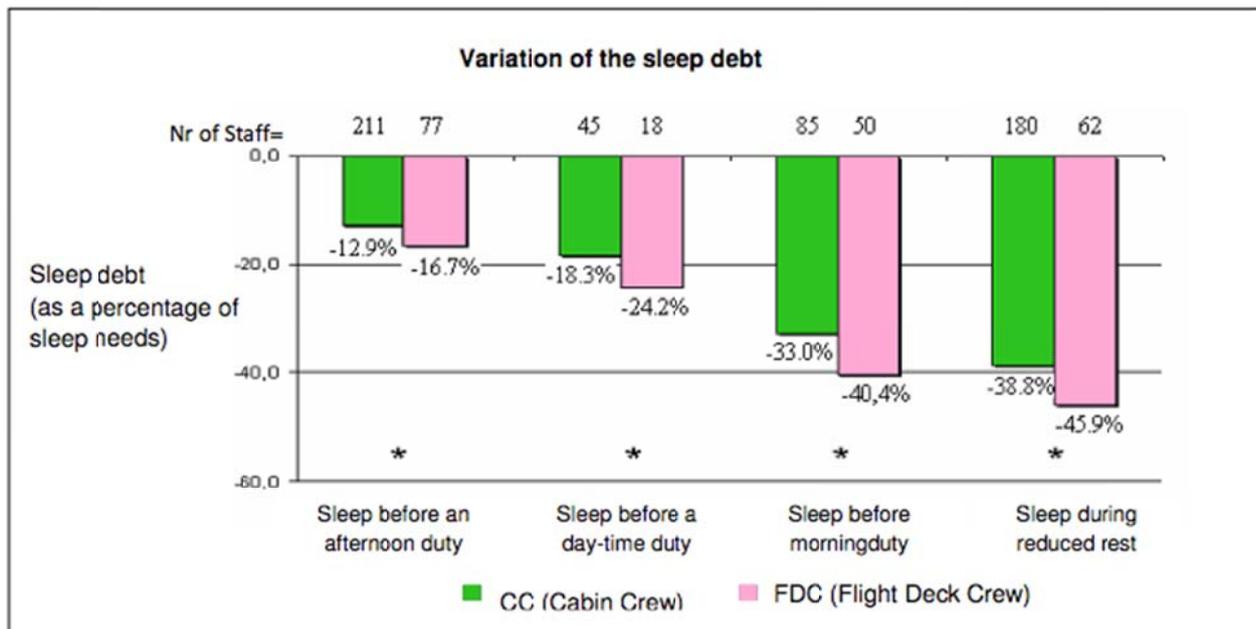


Figure 2. Comparison of sleep debt during rests prior different duties.

- For rosters including a reduced rest, it can be seen that the average sleepiness level during morning flights after a reduced rest is close to that observed on the last flights of the day (figure 3), prior to reduced rest, indicating a poor recovery during the rest. Furthermore, the standard deviation for the third flight of the morning flight on the 5/3 rosters exceeds the level 7 meaning that some individuals reached a high level of sleepiness on this very last flight.

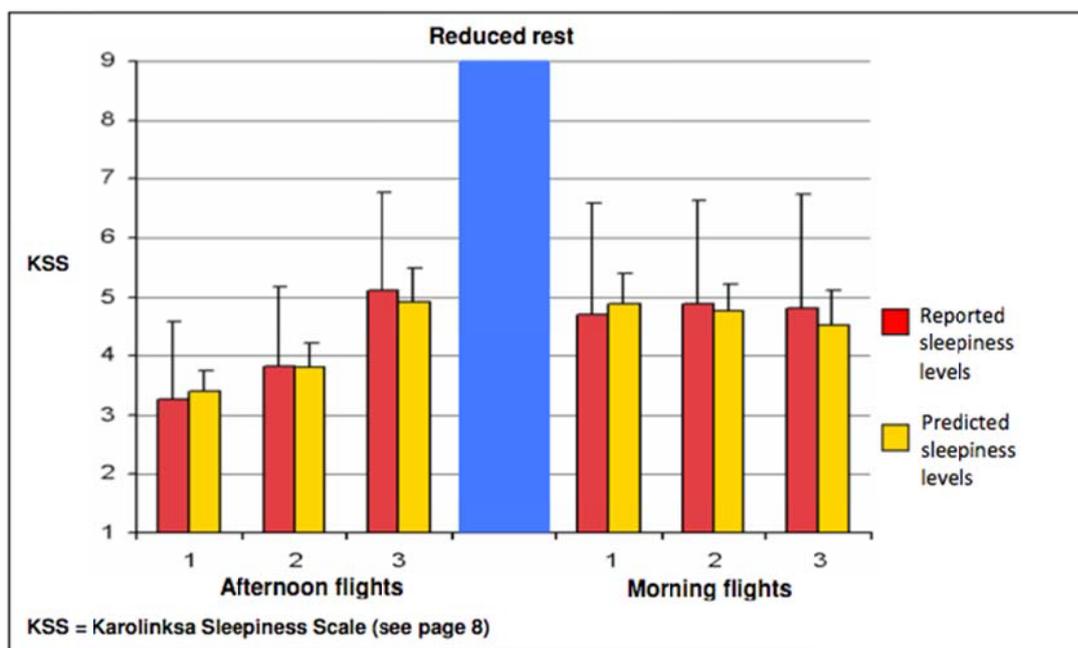
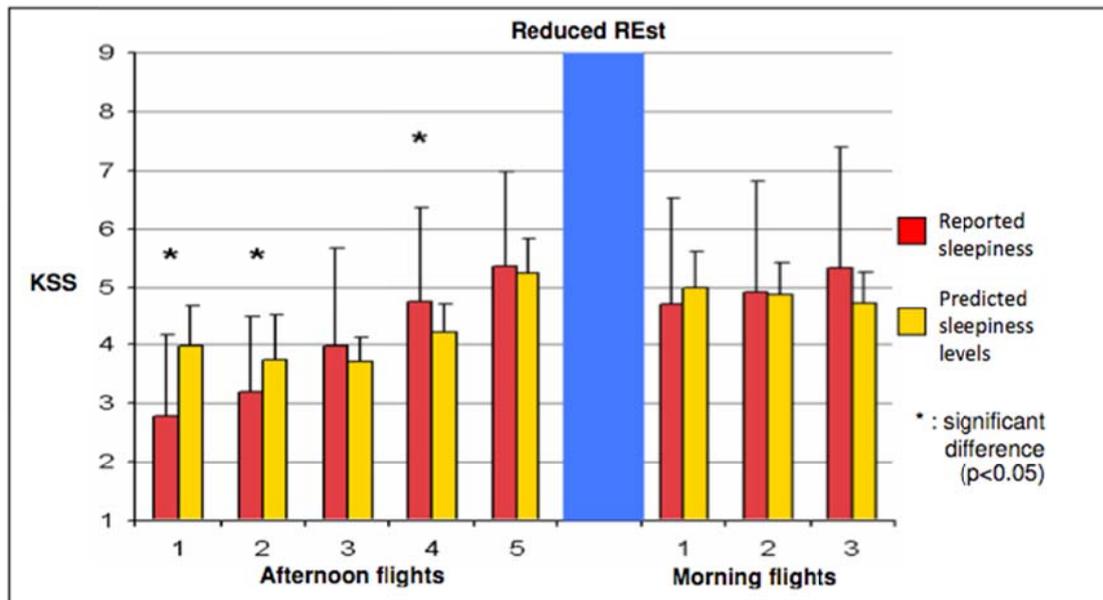


Figure 3. Predicted and reported sleepiness during reduced rest duties. 5/3 (N=45) and 3/3 rosters (N=57)

Therefore, these results suggest that reduced rests might be considered as acceptable if they are « isolated » from other risk factors with the following provisions:



- the combination of reduced rest with other disruptive schedules should be avoided. Therefore, no other reduced rest or early starts should be used in the same week
- limit the number of sector to 1 after the reduced rest
- no FDP extension should be used
- no extension of FDP due to augmented crew
- limit the time zone crossing to 2 time zones from home base
- suitable accommodation should be provided
- specific aircrew training should be provided about sleep management and fatigue
- monitor these operations through a FRMS and use mitigation measures if necessary (accommodation, meals availability,...).

Additional question 7 Reduced Rest with Split Duty: Does the STARE study fully justify the NPA's proposed provisions on combining reduced rest with split duty

Whereas the research has covered a large amount of crews for reduced rests (more than 100), data on combination of split duty and reduced rest was only limited to 10 crew members as the airlines were using this pattern only in very specific cases at the time of the study. The studied reduced rest with split duty were only limited to the following pattern:

- 1 morning flight
- a mid-day break
- 2 evening flights
- a reduced rest
- 1 single morning flight after the reduced rest (day 2).

Therefore the impact of FDP's with more than 1 sector after the reduced rest has not been evaluated.

The table below shows the average duty starts and ends time for the flights on which the data were collected.

	Start	End
Reporting time (Day 1)	07:14	
Flight 1	10:24	11:37
Break		
Flight 2	19:24	20:46
Flight 3	21:28	22:45
Reporting time (Day 2)	06:03	
Flight 3	08:16	09:43



The results on figure 2 shows that the reported sleepiness level increase slightly at the end of the last flight of the day 1 and stay at the same level after the reduced rest.

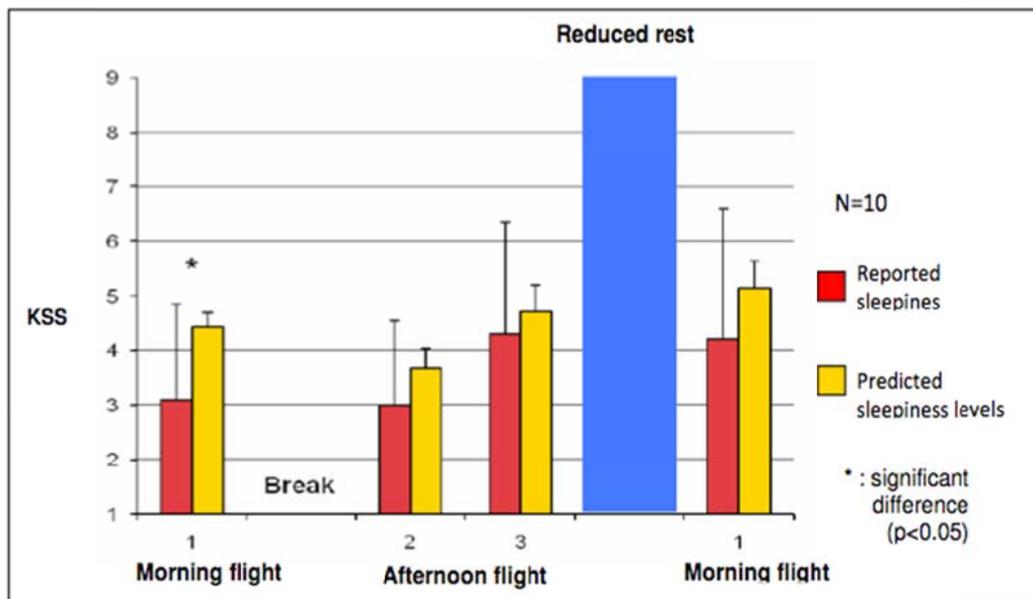


Figure 2. Predicted and reported sleepiness during split duties and reduced duties. 5/3 (N=45) and 3/3 rosters (N=57)

With the limitations due to the limited sample in mind, the data reported in the STARE project suggest however that the proposed limitation of the FDP to 1 sector after a combination of split duty and reduced rest would be efficient to prevent unacceptable level of fatigue.



4 Summary of key points and conclusions

This report has answered the 22 questions with an estimation of the potential impact on aircrew fatigue regardless of the social and economic impact. The responses were based on the available scientific knowledge. When no available knowledge was directly available, conservative assumption was taken.

From these responses, several issues were identified and discussed at the review meeting regarding the proposed rules:

- the length of the basic FDP (13h) with regards to available scientific data
- the use of scheduled extension and/or due to commander's discretion without a FRMS
- a definition of acclimatisation that does not reflect the physiological mechanisms
- the use of economic seats for in-flight rest for cabin crew
- the extension of FDP due to in-flight rest irrespective of the WOCL
- the definition of early start.
- the integration of reduced rest and split duty into the FTL scheme or in the framework of a FRMS

While not directly linked to a specific question, other issues were also discussed in Cologne.

One of the key issues that relates to the FTL is the development of FRMS and how it could be integrated into the future regulation. As it was reminded at the meeting, several countries have already moved towards the use of FRMS to manage deviation from prescriptive rules. ICAO has recently developed Standardised and Recommended Practices (SARPS) as well as guidance materials based on scientific principles and operational experiences. The ICAO council has just approved these documents that should be applicable in December 2011. One of the acknowledged advantages of FRMS is that it takes a broader perspective on fatigue than any prescriptive rule, it manages risk under specific circumstances while offering more flexibility to operators. In the context of the NPA, FRMS could be viewed as a way to manage any deviation from the prescriptive FTL rules, like reduced rests, extensions of FDP. However, FRMS should be also promoted within the prescriptive limitations as a way to manage safety in the framework of the airline Safety Management System. Therefore we consider FRMS both as a useful means to control the deviation from prescribed limitations but more generally as a crucial approach to manage the risk associated with operations that may disrupt the normal aircrew sleep-wake cycle, even when they are in the prescribed limitations. Of course, FRMS has to be adapted to the specificity of each operator (size, resources, complexity of operations...) and a single model would not be realistic. Furthermore, its implementation requires time for the organisation to learn and develop the most adapted indicators and mitigation measures to their specific operations.



The need for specific rules for commuting was discussed, as it is a well-known factor that can potentially reduce aircrew sleep opportunity and increase fatigue before reporting for a duty. The Colgan Air flight 3407 accident in Buffalo has recently emphasised the issue of long commuter pilot. Even if commuting is a real concern in terms of safety, it is very unlikely that a regulation would be able to prevent long commuting regarding the complexity of this issue. One of the problem of a commuting regulation will be to set a limitation while the actual commuting time could vary very much as a function of the traffic conditions. Furthermore, a long commuting using public transportation is probably less tiring than a shorter commuting using a personal car. The STARE project has shown that there were no significant differences in sleep duration before a duty between long and short commuter. This is explained by the fact that long commuter use accommodation close to their base to ensure a sufficient rest before reporting for the duty. Therefore a more sensible approach to the issue of commuting would be enhancing aircrew responsibility through education and training.

Controlled rest in the cockpit was also discussed as it is a commonly used strategy by aircrew to either prevent fatigue or to alleviate unexpected fatigue (Bourgeois-Bougrine et al, 2003). Most of airlines allow this practice and provide standard procedure or guidance to manage controlled rest. However, even if controlled rest has been shown to be efficient to reduce sleepiness (Rosekind et al, 1994, Cabon et al 2003a), it may also have some drawbacks. One of the main risk associated with controlled rest is the sleep inertia that can result from short nap that include deep slow wave sleep. Limiting the length of the rest and providing enough time after the rest can mitigate this risk. Another risk is the alertness decrement of the non-resting pilot due to the lack of interaction (Cabon et al, 2003b). Therefore, the management of controlled rest should be considered in the regulation to define some general principles about the use of controlled rest within the FTL as an emergency procedure or as a preventive means.



5 References

- Akerstedt, T. and S. Folkard (1997). "The Three-Process Model of Alertness and Its Extension to Performance, Sleep Latency, and Sleep Length." *Chronobiology International* **14**(2): 115-123.
- Akerstedt, T, Kecklund, G, Gillberg, M, Lowden, A, Axelsson, J, (2000). Sleepiness and days of recovery. *Transportation Research Part F: Traffic Psychology and Behaviour*, Volume 3, Issue 4, p. 251-261.
- Bourgeois-Bougrine, S., Cabon, P., Mollard, R., Coblantz, A., & Speyer, J.J. (2003a). Fatigue in aircrew from short-haul flights in civil aviation: the effects of work schedules. *Human Factors and Aerospace Safety: An International Journal* **3**(2), 177-187.
- Bourgeois-Bougrine, S., Cabon, P., Gounelle, C., Mollard, R., & Coblantz, A. (2003b). Perceived fatigue for short- and long-haul flights: A survey of 739 airline pilots. *Aviation, Space, and Environmental Medicine*, **74**(10), 1072-1077.
- Cabon P, Coblantz A, Mollard R, Fouillot JP (1993) : Human vigilance in railway and long-haul flight operation. *Ergonomics*, **36**, 1019-1033.
- Cabon, P., Bourgeois-Bougrine, S., Mollard, R., & Speyer, J.J. (2003a). Crew sleep patterns of cockpit napping during transtalantic flights. In *Proceedings of the XVIth International Symposium on Night and Shiftwork "Equity and Working Time : A challenge to be achieved"*, Santos, Brésil, 17-21 November 2003. *Shiftwork International Newsletter*, **20**(2), 50.
- Cabon, P., Bourgeois-Bougrine, S., Mollard, R., Coblantz, A., & Speyer, J.-J. (2003b). Electronic Pilot-Activity Monitor: a countermeasure against fatigue on long-haul flights. *Aviation Space Environment Medicine*, **74**(6) 679-682.
- Chambers R, Campbell I: Anxiety and depression in general practitioners: associations with type of practice, fund-holding, gender and other personal characteristics. *Fam Pract.* 1996, **13**:170-173.
- Dinges DF, Orne MT, Whitehouse WG, and Orne EC. Temporal placement of a nap for alertness. Contributions of circadian phase and prior wakefulness. *Sleep*, **10**(4):313-329, 1987.
- Foushee, H. Clayton, J.K. Lauber, M.M. Baetge and D.B Acomb (1986). Crew factors in flight operations. Part 3: The operational significance of exposure to short-haul air transport operations. Moffett Field, CA Ames Research Center, National Aeronautics and Space Administration: 67.
- Goode JH (2003). Are pilots at risk of accidents due to fatigue? *Journal of Safety Research*, **34**: 309-313.
- Nicholson AN, Pascoe PA, Spencer MB, Stone BM, Green RL (1986) : Nocturnal Sleep and Daytime Alertness of Aircrew after Transmeridian Flights. *Aviation, Space and Environmental Medicine*, **57**, (12 suppl.) B43-B52.



- Pilcher JJ, Coplen MK: Work/rest cycles in railroad operations: effects of shorter than 24-h shift work schedules and on-call schedules on sleep. *Ergonomics* 2000, 43:573-588.
- Powell D, Spencer MB, Holland D, Petrie KJ (2008). Fatigue in two-pilot operations: implications for flight and duty time limitations. *Aviat. Space Environ. Med*, 79(11), 1047-1050.
- Roach, G. D., D. Darwent, et al. "How well do pilots sleep during long-haul flights?" *Ergonomics* 53(9): 1072-5.
- Roberston KA, Cabon P, Gundel A, Simons R, Åkerstedt T, et al. (2002). Predicting alertness in future long-range operations: a validation study by ECASS. QinetiQ report N° QINETIQ/CHS/CR0219119/2.0.
- Rosekind MR, Graeber RC, Dinges DF, Connell LJ, Rountree MS, Spinweber CL, Gillen KA (1994). Crew factors in flight operations IX: effects of planned cockpit rest on crew performance and alertness in long-haul operations. NASA Technical Memorandum NASA Technical Memorandum 108839. Moffat Field, CA, National Aeronautics and Space Administration.
- Samel A, Wegmann HM, & Vejvoda M (1997). Aircrew fatigue in long-haul operations. *Accident Analysis and Prevention*, 29(4): 439-52.
- Simons M, Valk PJJ, Early Starts: Effects on Sleep, Alertness, and Vigilance. Paper presented at the AGARD AMP Symposium on « Aeromedical Support Issues in Contingency Operations », held in Rotterdam, The Netherlands, 29 September – 1 October 1997.
- Simons M, Valk PJJ, de Ree JJD, Veldhuijzen van Zanten OBA & D'Huyvetter K (1994). Quantity and quality of onboard and layover sleep: effects on crew performance and alertness. Report RD-31-94. Netherlands Aerospace Medical Centre, Soesterberg, Netherlands.
- Tassi, P.; Muzet, A. (2000). "Sleep inertia". *Sleep Medicine Reviews* 4 (4): 341
- Thomas, M.J.W., Petrilli, R.M., Lamond, N., Dawson, D., & Roach, G.D. (2006). Australian Long Haul Fatigue Study. In *Enhancing Safety Worldwide: Proceedings of the 59th Annual IASS*. Alexandria, Virginia, U.S.: Flight Safety Foundation.
- Totterdell, P., Spelten, E., Smith, L., Barton, J., Folkard, S. *Journal of Applied Psychology*, Vol 80(1), Feb 1995, 43-57.
- Torsvall L, Åkerstedt T: Disturbed sleep while being on-call: an EEG study of ships' engineers. *Sleep* 1988, 11:35-38.
- Van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep* 2003;26:117-26.

Final Report

Provision of Scientific Expertise to Submit an Assessment of the NPA on Flight Time Limitations (FTL) and to Provide Guidance and Advice to the FTL Review Group

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1 Introduction

This report deals with the 14 problem areas identified and outlined in the NPA-2010-14 and 15 additional questions that were separately provided to the scientists. The questions are dealt with in the order as they were discussed in the meeting in Cologne from May 17 to May 19, 2011.

The discussion during the meeting, in particular the contribution from the other scientists, is reflected under the heading "Addendum" in connection with my answers to the questions. In general, the three scientists who produced their "Interim Reports" independently agreed remarkably well in their assessments of the NPA. The important points of the discussion are summarized on page 24.

Science as I understand it may deliver input to these questions in a varying extent. During the last 20 years scientific knowledge about fatigue in aviation has been accumulated in fatigue prediction software, e.g. in SAFE (CAA UK) or in DLR's Alert. This accumulated knowledge is my basic instrument to look at the questions. It allows the identification of different discernible components in fatigue whose importance may be different in dealing with a particular question. Since these components are influenced by different physiological and behavioural systems risk assessment or mitigation measures may be based on a particular fatigue component.

Alert (and comparable software) consider the following factors causing fatigue:

- Circadian component
- Sleep related component (amount of sleep, quality of sleep, time since last sleep, sleep inertia)
- Task-related component (time-on-task, nature of task, number of sectors)

Each of the components can be influenced in a different way. Furthermore, the circadian and the sleep-related parts of fatigue are practically independent, i.e. they can be manipulated independently; the sleep related component e.g. by introducing additional sleep or the circadian component e.g. by shifting the exposure to light.

The expertise is provided roughly spoken on two levels, on a qualitative and on a quantitative level. Qualitative statements are e.g. the description of the existence of a circadian variation namely the alertness low in the early morning or e.g. the fact that in-flight rest must provide the opportunity to sleep.

Quantitative statements go beyond qualitative ones, e.g. a rest period should provide the opportunity to get 8 h of uninterrupted sleep, or FDP are reduced by 30 min for each sector from the third sector on.

In addition, a scientifically educated expert will always look at the consistency across different rules and some statements take consistency of rules into account.

It is attempted to use a similar table that was used in the RIA (page 41 ff.). Each of the inputs to the table is commented subsequently. In some cases, the liberty has been taken to comment also on the context of the questions.

2 Assessment tables

Table 1: Fatigue components affected and mitigation measures with respect to the 14 questions of NPA-2010-14.

Reference	Short name	Relevant operation	Fatigue component (c.) affected	Mitigation measure	Efficiency	Combined efficiency
Q1	home base	commuting, all operations	sleep related c.	accommodation closer to airport	useful	good
				FRM training	good	
Q2	extension	long-haul, multiple sectors	sleep related c. circadian c.	restriction of extension	good	good
				FRM	good	
Q3	acclimatisation	transmeridian	circadian c.	FRM (rest times)	depending on goal; to be studied	good
		all	sleep related c.	rest times	good	
Q4	rest facilities	in-flight rest (split duty)	sleep related c.	improving rest facilities	good	good
				FRM training	good	
Q5	FDP with augmented crew	in-flight rest (split duty)	sleep related c.	limiting FDP extensions	good	
Q6	minimum consecutive in-flight rest	in-flight rest (split duty)	sleep related c.	minimum 2 h	good	good
				FRM training	good	
Q7	in-flight rest for cabin crew	in-flight rest (split duty)	sleep related c.	obtaining sleep	good	good
				FRM training	good	
Q8	commander's discretion	long-haul, multiple sectors	sleep related c. circadian c.	FRM		
Q9	short-term re-planning	all	all	FRM		
Q10	split duty	split duty (in-flight rest)	sleep related c.	limiting FDP extensions	good	good
				adequate rest facilities	good	
Q11	standby duty duration	standby	sleep related c. circadian c.	appropriate rostering	good	good
				FRM training	good	



Q12	standby and cumulative limits	standby	sleep related c. circadian c.	appropriate rostering	good	good
				FRM training	good	
Q13	early starts and late finishes	all	sleep related c.	FDP reduction	good	
Q14	reduced rest	all	sleep related c.	minimum 10 h	good	

Table 2: Fatigue components affected and mitigation measures with respect to the additional questions provided to scientists.

Reference	Short name	Relevant operation	Fatigue component (c.) affected	Mitigation measure	Efficiency	Combined efficiency
AQ 1a)	FDP extension	long-haul, multiple sectors	sleep related c. circadian c.	additional rest	may mitigate cumulative fatigue	possibly not sufficient
				no acute measures	none	
AQ 1b)	commander's discretion	all	all	reporting		
				FRM	good	
AQ 1c)	consecutive early starts or night duties	multiple sectors, night cargo	sleep-related component	focussed reduction of FDP	good	good
				FRM	good	
AQ 1d)	WOCL number of sectors	long-haul, multiple sectors	circadian c. sleep-related c.	levelling integrated fatigue, FDP reduction by 30 min (starting with 3 sectors)	possibly good	
AQ 2a)	augmented crew Maximum FDP	long-haul, multiple sectors	sleep-related c.	in-flight rest, limiting FDP	good	
AQ 2b)	sleep inertia	in-flight rest (split duty)	sleep related c.	minimum in-flight rest 2 h	good	good
				FRM training	good	
AQ 2c)	non-acclimatized crew	long-haul transmeridian	sleep-related c.	in-flight rest	possibly good	good
				FRM training	good	
AQ 3a)	cumulative fatigue	all		no action necessary		
AQ 3b)	cumulative fatigue	all		gliding limit	good	
AQ 4)	airport standby	standby	sleep related c.	rostering "sleep-in-focus"		good
				FRM education		
AQ 5)	home standby	standby	sleep related c.	rostering "sleep-in-focus"		good
				FRM education		



AQ 6a)	TZC non-acclimatized table	transmeridian operations	circadian c.	FRM education Reduction of FDP		good
AQ 6b)	TZC continual disruption	transmeridian operations	circadian c.	additional rest	good	
AQ 7)	reduced rest with split duty	split duty	all	see comments		
AQ 8)	home base	all	sleep related c.	accommodation closer to airport FRM training		good

3 Comments to questions and assessment tables

3.1 Home base

Question 1 – Definition of home base

I do not know of any evidence that the fact of multiple airports as home base directly influences fatigue.

With respect to home base I am more concerned with fatiguing effects of commuting in the case of single and of multiple airport home bases. Commuting may shorten sleep periods. In this case the sleep related component in fatigue does not show full recovery at the time of reporting.

In general, long commuting times may compromise the opportunity for sleep, in particular if scheduled rest is close to minimum rest.

Long commuting times in combination with early reporting times present a problem since the sleep regulation system is not flexible enough that pilots can shift sleeping times to earlier times of the day. As a consequence pilots cannot be fully rested with long commuting times and early starts.

As a mitigation measure pilots may sleep in a location closer to the airport where duty begins. This should be considered if a pilot cannot get 8 hours of sleep in the usual accommodation at home base before commencing flight duty.

Additional Question 8) Home base

Please, compare Question 1.

Any special definition like “designated reporting point” makes rules more complicated, more difficult to read and may lead to more misunderstandings. Therefore, they should be avoided. Another example for this is the definition of “accommodation” versus “suitable accommodation”. Of course, this comment is not based on science, rather on experience with scientific writing.

Addendum

Mick Spencer showed in his report a study of commuting and fatigue. Fatigue at the end of a FDP increases the more the longer commuting times are. The data are not specific to air crew since commuting has become very common in the work force. Since FDP may be longer than the maximum working hours in other industries the effect of commuting on the sleep-related fatigue component should be considered in aviation in particular.

While it would be very difficult to regulate commuting it should be part of a FRM with shared responsibilities between air crew and employer for the decision whether air crew is accommodated closer to the airport before flight duty.

Another question was raised concerning the stability of home base. Operations that rely on seasonal business may shift home base together with operations to another airport. The



influence on safety is not a direct one but it is mediated by the burden that temporarily moving home base puts on other aspects of life. This has to be carefully monitored by the SMS and by FRM. This means changing home base would require FRM.

3.2 Maximum FDP

Additional Question 1a) Extensions

Additional rest of 2 to 4 hours following or preceding extended FDP may possibly mitigate cumulative effects on fatigue. However, the transient effect i.e. increased fatigue at the end of a FDP is not mitigated by the provisions of the NPA.

Extensions seem to be a questionable and strange element in FTL regulations. Safety concerns do not allow increasing the basic maximum FDP but these concerns are not expressed with regular extensions.

Furthermore, the extension of FDP by 1 hour during night is certainly less safe than during daytime.

Additional Question 1b) Commander's discretion

Airlines cannot operate without the possibility of commander's discretion. The NPA does not provide mitigating measures.

Commander's discretion could be used under FRM. If commander's discretion is used to operate outside FDP and rest limits it should be reported to the competent authorities. This could enforce that commander's discretion to operate outside limits remains the exception.

Additional Question 1c) Consecutive early starts and consecutive night duties

A study has shown that fatigue in consecutive night duties is highest for the first FDP and for the last one if it is the sixth or seventh (unpublished report for DHL Leipzig). In the beginning of the consecutive duties pilots have to adapt their sleeping times resulting initially in shortened sleep. At the end of the block of the consecutive duties a cumulative effect can be measured. The same observation has been made with aircraft maintenance workers (unpublished report for Lufthansa Technik).

An appropriate mitigating measure is the reduction of the first and seventh of consecutive night FDP to 8 hours.

The scientific data are less clear with consecutive early starts. It seems that crew does not adapt to earlier bed times easily. Since the effect of consecutive early starts does not only depend on the number but also on the patterns in the schedule preceding or following consecutive early starts the effect should be watched under FRM.

The definitions of late finishes and early starts may be extended by one hour each to the intervals 5:00 to 6:59 and 00:00 to 01:59.

Additional Question 1d) WOCL encroachment

In the answer to Question 2 (see below) I have provided simulations that show that the reduction of FDP that encroach the WOCL does not lead to the low fatigue levels of daytime

flights. Therefore, the table seems to be based on an unspoken agreement that night flights are less safe than daytime flights.

Another way to construct the table may lead to higher safety. For that purpose levelling of integrated fatigue for the entire FDP could be considered.

According to scientific studies by TNO FDP should be reduced by 30 minutes for each sector beginning with the third sector. A remark on consistency: the reduction of FDP due to sectors is not always 30 minutes in the NPA-table.

Question 2 – FDP extensions

Before I comment on the question I would like to state that to my knowledge the 13-hour limit is not the result of scientific studies but has been negotiated in the industry and evolved over many years. It is almost impossible to scientifically assess the accident risk due to fatigue during the 13th hour of a FDP. This would need the observation of a larger number of accidents and would take many years. Every indirect method to assess this limit, laboratory studies or flight performance analysis, may be debatable.

To deal with question 2 I have simulated the effect of 1-sector FDP allowed in Table 36 of NPA 2010-14 (page 224) on fatigue. As a measure of fatigue simulated Karolinska Sleepiness Scale (KSS) scores are used averaged for a FDP (Figure 1). The time between 23:00 hours and 7:00 hours was allotted for sleep if possible. If this sleep was shortened by early reporting the start of sleep was set to 22:30 hours. The absolute mean values are of lesser importance than the relative difference caused by reporting times.

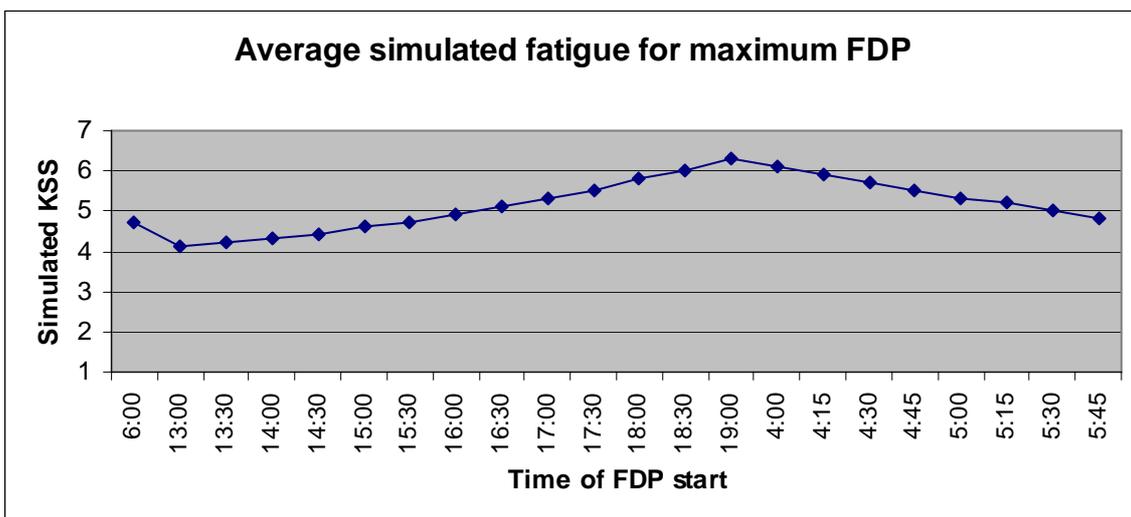


Figure 1: Average simulated fatigue for allowed maximum FDP (NPA page 224). For each row of the FDP table one simulation was conducted. Therefore, the time axis is not linear.

Fatigue levels of mean KSS 6.0 and higher are reached for FDP starting between 18:30 and 4:00 hours, i.e. the reduction of maximum FDP to 11 h does not level simulated fatigue. The fatigue found for starts between 19:00 and 3:59 hours is highest with a value of 6.3. To reach a value of 6.0 in this case FDP would have to be reduced to 9:45 h.

The amount of FDP reduction from 13 h does not follow the results of simulation. The rationale for reducing FDP to 11 h is based on science only qualitatively not quantitatively.

Extensions of 1 h would mean different things at different times of the day with respect to fatigue levels. I think there is no scientific evidence to grant these extensions. Again, they have evolved and have been negotiated over many years in those countries where they apply. In general it can be said that the more conservative the maximum FDP is the more flexibility is provided to grant extensions rules.

The proposed mitigating measures, i.e. increasing rest periods around an extended FDP does not reduce fatigue during the extension period.

Addendum

Mick Spencer pointed out that an extension of basic FDP to 14 h may be justified for reporting times between 8:00 and 12:00 hours in the morning. On the other hand basic FDP should be reduced to 10 h for reporting times at which it is reduced to 11 h now. This would lead to a more equal fatigue risk throughout the FDP table. This assessment is the result of modelling using SAFE (QinetiQ). Modelling using Alert (DLR) produces very similar results. The differences to the FDP table of Subpart Q result from the circadian effect on fatigue. Therefore, I can support to increase FDP to 14 hours when it starts between 8:00 and 12:00 hours in the morning and at the same time a reduction of FDP to 10 hours for reporting times between 17:00 and 03:59 hours.

Furthermore, Mick Spencer reported a newer study that indicates that already the second sector in a multiple sector FDP leads to an increase in fatigue. Consequently FDP should be reduced by 30 min for each sector beginning with the second sector.

Also a DLR study on night cargo flights (DHL Leipzig) showed an increase of fatigue already with the second sector, supporting the results Mick Spencer has presented.

3.3 Augmented crews

Question 4 – Economy class seats as rest facility

The NPA does not allow FDP extensions if in-flight rest is spent in an economy class seat. Since there are no data on the use of economy class seats for sleep a study should be conducted to collect data if there are claims that crew is actually obtaining sleep in economy class seats. The authors of the relevant TNO report do not think that pilots will get much sleep in a single economy class seat. Factors that prevent from sleeping in such a seat are the lack of privacy, disturbing noise and discomfort.

The combination of several economy class seats and shielding them from passengers might present a solution for getting some sleep but should be subject to a scientific study.

It is my understanding that increasing FDP by in-flight rest periods or by breaks in split duty is based on the opportunity to get sleep to recover the sleep-related fatigue component.

Question 5 – Maximum FDP for augmented crews irrespective of WOCL

Maximum FDP for augmented crews are extended without a consideration of the time of day when a FDP starts. This is different from the relevant TNO report that suggests extensions by twice the average sleeping time up to a maximum FDP.

In my opinion the extension of FDP for augmented crew should be based on average sleep duration during in-flight rest that has been observed in studies. Certainly, time of day influences the duration of sleep during in-flight rest. However, each crew member has to get in-flight rest but only one member of an augmented crew will have the opportunity to sleep during the WOCL. Consequently, an extension should be based on average sleep during in-flight rest.

NPA 2010-14 proposes maximum FDP dependent on the kind of rest facility and on minimum in-flight rest duration. I understand the TNO report in a way that FDP should be extended based on actual in-flight rest durations up to a maximum FDP. As an example, for class 1 rest facilities and in-flight rest of two hours for all pilots it could be increased by 1.5 hours. The TNO report also gives maximum extensions different from the NPA. That means that the in-flight rest extensions of the NPA are not taking available science into full account.

Question 6 – Minimum consecutive in-flight rest

Consecutive in-flight rest should allow for 15 minutes to fall asleep, one full sleep cycle of 70 to 100 minutes (compare Figure 2) and a 30-minute break following sleep to take sleep inertia into account. According to this rationale two hours are the minimum for consecutive in-flight rest.

This would ensure that pilots who are really tired get an optimum out of their rest period.

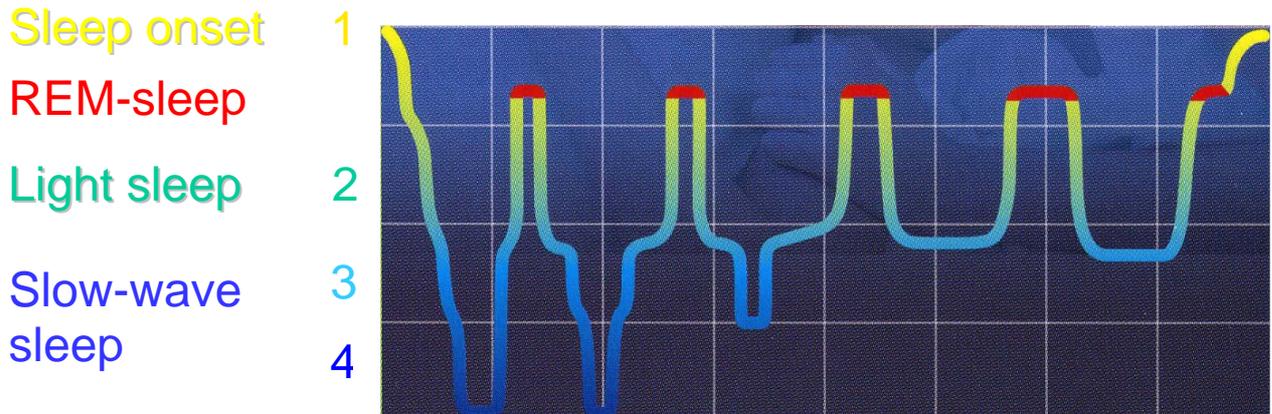


Figure 2: Schematic illustration of sleep cycles in a sleep period. Slow-wave sleep is the most recuperating sleep. The first time for a natural awakening occurs after 70 to 90 minutes after sleep onset.

If the duration of consecutive rest can be accommodated in each of the first three sectors I would not have an argument against a fourth sector, relaxing the limit given in the NPA.

In any case a FRM training could help crew to obtain the maximum benefit from in-flight rest.

Question 7 – In-flight rest of cabin crew

There is no scientific basis for handling in-flight rest for cabin and cockpit crews differently if in-flight rest is expected to be equally recuperative for both groups (Vejvoda et al).

Additional Question 2a) Augmented crew – maximum FDP

The rules on FDP extensions with in-flight rest make use of the widely accepted “TNO Report”. Therefore, the definitions of rest facility classes should mention the average percentage of in-flight rest time that is spent sleeping. It is this number that leads to the differences in maximum FDP for different classes of rest facilities. The calculations of Maximum FDP are straightforward if based on the rules suggested in the report.

These rules result e.g. in maximum FDP of 16.3 h for 3-crew operations and bunk facilities on board and 19 h for double crew operations with bunk facilities.

I do not understand why the numbers in the NPA are different and the rationale behind that difference.

Additional Question 2b) Augmented crew - sleep inertia.

Sleep inertia following sleep during in-flight rest is a problem that has to be addressed in FTL regulations. In answering Question 6 (minimum duration of consecutive in-flight rest) I have allowed 30 min of the minimum duration of 2 h to overcome sleep inertia. The recovery from

sleep inertia is part of an in-flight rest period, i.e. crew suffering from sleep inertia is not in the cockpit.

Additional Question 2c) Augmented crew - non-acclimatized

An in-flight rest of consecutive 2 hours will be used by crew members according to their need to sleep with varying benefit. Those who suffer from sleep pressure will benefit more from the rest period than those who are not fatigued when they have to take their in-flight rest. Some crew members will not sleep at all since they are not tired, others can use rest to get a full sleep cycle. Non-acclimatized crew members may be more fatigued and may benefit more from rest.

I do not think that additional mitigating measures are necessary. The issue of a separate FDP table for non-acclimatized crews is discussed in Chapter 3.8 (pages 21 and 22).

3.4 Unforeseen circumstances

Question 8 – Commander’s discretion

Without commander’s discretion an airline cannot operate. But there is no scientific basis for extending FDP at commander’s discretion. As with other extensions commander’s discretion will lead to less fatigue if FDP limits are more conservative.

In terms of SMS and FRM, commander’s discretion may be considered an incident and should be reported.

Addendum

After the meeting with the NPA Review Group, ECA made a proposal concerning commander’s discretion. This proposal seems to be too prescriptive.

Question 9 – Short-term re-planning

There is no scientific study about short-term re-planning by introducing split duty or reduced rest. If short-term re-planning stays within the provisions of Subpart Q there should be no problem. In that case there might be no need to regulate re-planning. If however, these provisions are not followed, re-planning should be reported as suggested in the NPA and crew should be asked whether they feel fit to fly the extended FDP.

I am strictly arguing against reduced rest shorter than 10 hours (compare Chapter 3.9, page 23). An operator can hardly assess the consequences of reducing rest by short-term re-planning.

Addendum

The discussion showed that there are many very different situations in which commander’s discretion or short-term re-planning are used. Crew could benefit in these situation from an application of FRM principles and from training in FRM.

3.5 Cumulative fatigue

Additional Question 3a) Cumulative fatigue – 7-day duty limit

If the gliding duty average across 7 days is limited to 60 hours an additional limit for 14 days is not necessary since there is no firm scientific evidence to support such a limit.

Additional Question 3b) Cumulative fatigue – 12-month flight hours limit

The Moebus report has proposed a gliding limit of flight hours across 12 months as a replacement for the calendar year limit.

Depending on the kind of operation and his industrial contract a pilot could accumulate about 650 flight hours within 6 months leading to the possibility of accumulating 1300 hours in the 12 months from July to June. A gliding limit should prevent that similar to the gliding rule for 60 duty hours within 7 consecutive days.

Since only a gliding limit restricts flight hours effectively the regulation need not to consider a calendar year limit. The number of hours should be chosen according to operational experience. To my knowledge there are no scientific data to specify this number.

3.6 Split duty

Question 10 – Split duty

Here I would like to draw the attention to the similarity in the concepts of “split duty” and “in-flight” rest. With split duty FDP breaks take place between flights, with in-flight rest FDP during flight. Extensions can be granted if the sleep-dependent component in fatigue and a possibly existing workload component are influenced in a positive direction. The sleep-related component can be improved by sleep only.

The minimum break should allow to spend two hours in a rest facility (compare Question 4 on page 13), which should be classified comparable to in-flight-rest facilities. The extension can be calculated: $\text{extension} = 2 \times \text{break duration} \times \text{percentage sleep}$. There is no firm scientific evidence for extending FDP by twice the sleep duration; but it seems reasonable since during 24 hours 8 hours of sleep are usually followed by 16 hours awake.

The maximum extensions and the combination with reduced rest should be the same for in-flight rest and split duty operations. There seems to be no scientific reason and need to introduce different rules for in-flight rest and split duty FDP extensions.

Addendum

Facilities for rest and sleep during breaks could be classified comparable to in-flight rest facilities.

3.7 Standby

Additional Question 4) Airport standby

In answering Questions 11 and 12 I have developed an approach that focuses on the impact of standby on sleep. This approach presents a different view on standby.

If no suitable accommodation is provided FDP counts from two hours prior to regular bed time (21:00 hours) and the regular FDP table is applied. If the last regular sleep period has been shortened by the circumstances of standby Maximum FDP is reduced by twice the amount of lost sleep.

If suitable accommodation is provided and crew has the opportunity for an afternoon sleep the regular FDP table can be applied.

Question 11 and 12 - Standby

The scientific principles for the regulation of airport or other standby do not differ and therefore I am combining the answers to Questions 11 and 12.

Standby may interfere with regular sleeping times and I would like to discuss the influence of standby on regular sleep (e.g. from 23:00 to 7:00 hours). This approach differs largely from that followed in the NPA. The discussed maximum FDP depends on the interference of standby with sleep. I am considering four different cases:

- 1 If start of standby duty does not interfere with regular sleeping times (e.g. 23:00 to 7:00) and if crew has suitable accommodation to get regular sleep during standby the table for maximum FDP can be applied. Crew is encouraged to prepare for a possible duty by additional short sleep in the afternoon (FRM).
- 2 If start of standby duty does not interfere with regular sleeping times (23:00 to 7:00) and if crew does not have suitable accommodation FDP for a possible flight and for cumulative limits begins to count from two hours prior to regular bed time taking into account that crew cannot prepare for a late start by additional afternoon sleep.
- 3 If the start or end time of standby interferes with regular sleeping times and lead to later bed times or earlier wake-up times flight duty time limits have to be reduced by two times the lost hours of sleep applying the equivalent rationale used for in-flight rest extensions.
- 4 If standby immediately follows FDP split duty regulations are effective. Standby should be counted regarding cumulative limits.

The reduction of FDP that is discussed above does not correspond to the table in the NPA in which reductions are listed dependent on reporting time. The situation of standby may not allow preparing for a certain reporting time e.g. by taking an additional short sleep. Therefore, it is even more important for a pilot to assess fitness for flight.

This discussion of standby emphasizes sleep during standby and does not consider whether standby as duty. However, it is clearly described when standby is FDP.

The rating of standby as duty may be subject to industrial contracts. The rating may depend on the proportion of standby of all duty time. From a scientific point of view the rules (100% airport, 25% home) in the NPA are right but they could be negotiated with a different result.

AQ 5) Home standby

In answering Questions 11 and 12 I said that the table for maximum FDP can be applied since the impact of standby on sleep does not differ from FDP following rest, i.e. additional reduction of maximum FDP would not be necessary.

The main difference in the “focus-on-sleep” approach and the NPA approach is the consideration of interference with regular sleep. I cannot think of any example in which home standby interferes with the possibility to get regular sleep if crew is not called out.

Addendum

I understand the loose term standby as any method that an airline adopts to be able to continue operations with reserve pilots. In the Review Group meeting another mode of standby was discussed. With this form of standby crew has at least minimum rest after being notified of reporting time. In this case regular sleeping times may be compromised as well. However, crew has the opportunity to try to get additional sleep to prepare for duty as under point 1 (above). Therefore, this mode of standby can be subsumed under point 1. A “focus-on-sleep” approach would allow regulating standby without specifying the standby method (home, airport standby, reserve, on call etc.).

3.8 Disruptive schedules

Question 13 – Early starts and late finishes

If regular sleep is considered necessary to be adequately rested for a FDP then any duty leading to reduced sleep is an early start or a late finish. In the case of early starts FDP should be reduced by twice the number of hours of lost sleep applying the reverse of the rule as it is used for in-flight rest extensions.

Late finishes have to be followed by sufficiently long rest periods to get more than 8 hours sleep that is usually necessary following sleep loss.

Since the scientific basis is not firm enough to support the regulation of consecutive early starts and late finishes it is suggested to allow consecutive early starts and late finishes under FRM only. Assembling more data of such schedules may lead to allowing a certain number of consecutive early starts or late finishes later.

Question 3 - Acclimatisation

I would like to comment on the definition of an acclimatised pilot. There are two components of acclimatisation referring to two different physiological systems. One is the recovery after sleep loss (sleep deprivation) that may be connected to a transmeridian flight. The other one is the adaptation of the body clock to a new time zone.

During a 36-hour period free of duty one can expect that the pilot may have recovered from sleep loss and may be fit for the next FDP. Of course, this is more difficult starting FDP in the new time zone and possibly 72 hours are enough then.

But the body clock adapts slower than sleep. The average daily adaptation rate ranges from 1 to 2 hours and is very much dependent on light exposure. E.g. after crossing 6 time zones and a layover of 36 hours the body clock of a pilot can be anywhere between home base and new time zone. Consequently, the pilot cannot be called acclimatised.

In the FRM training that I have developed, pilots learn to decide first whether they want to adapt to the new time zone or stay on home base time. Then they learn to use light and darkness to try to achieve their goal. For layovers of 36 hours I always recommend to stay on home base time.

There are pairs of cities (e.g. Frankfurt, New York) for which it would be best to return after minimum rest if it covers the home base WOCL and gives the opportunity to sleep 8 hours. The problem is that the airline may not have a flight at that time.

As a consequence of this brief discussion I am suggesting to make it completely clear which of the two systems (sleep, body clock) is meant and specify mitigating measures accordingly. In the present form the definition of acclimatisation is unclear.

The state of the body clock is uncertain when crew starts another FDP following a transmeridian flight. The degree of non-acclimatisation cannot be determined. An additional table of maximum FDP cannot solve the problem. A conservative mitigating measure would be the reduction of FDP to 11 h assuming the most unfavourable position of the body clock.

Additional Question 6a) TZC non-acclimatized FDP table

I have already detailed my difficulties with the definition of “acclimatized” in answering Question 3. Here, in Additional Question 6, clearly the desynchronisation of the circadian body clock is meant.

Time zone crossings result in a dilemma; usually the state of the clock after a transmeridian flight is not known. Therefore, I am suggesting that pilots learn during fatigue risk management training how to keep their body clock on home base time.

Pilots who cannot control their body clock for some reason will be “non-acclimatized” to an unknown degree. To take this into account FDP could be reduced as for a flight during WOCL, i.e. to 11 hours. However, a separate detailed table for non-acclimatized crew would suggest that the state of pilots is known.

Additional Question 6b) TZC – continual disruption

Continual disruption of circadian rhythm cannot be tolerated. Therefore, sufficient rest at home base following transmeridian flights has to be implemented 8 hours for each time zone crossed more than two time zones away (48 hours rest for 6 time zones). The rest period should include at least two local nights. This is part of the current German FTL regulation and is based on studies of recovery from time zone transitions by DLR (Samel et al).

Addendum

The discussion on the transition between night duty and early starts was extended to cover disruptive schedules in general. Clearly, there are disruptive patterns of FDP possible within Subpart Q. Rules would have to be very detailed to exclude all possible disruptive schedules, and even then optimizing software still may find loopholes in the rules that allow unfavourable disruptive schedules.

FRM software should be used to avoid unwanted schedules. In general, FRM is most useful when dealing with disruptive schedules.

Mick Spencer raised the topic of controlled rest. Probably controlled rest is mostly used in disruptive schedules. Controlled rest is defined as sleep on the flight deck with one pilot remaining at the controls.

While napping in the cockpit, the so-called power nap, is restricted in time in order to prevent crew from sliding into deep sleep and from subsequent sleep inertia, controlled sleep is longer and will usually be followed by sleep inertia.

In terms of FRM principles, controlled rest is a fatigue incident that should be reported. If more than one report hints at a particular schedule the schedule should be scrutinized and possibly changed accordingly.

3.9 Reduced rest

Question 14 – Reduced rest

The absolute minimum for rest is 8 h for sleep, plus 60 minutes for preparation of sleep including winding down after work, plus 30 minutes for taking sleep inertia into account, plus twice commuting time. This adds up to a minimum of 10 h for accommodation at the airport.

FTL.1.235 – 3 – Reduced Rest does not allow for 8 hours of sleep but provides specific rules for subsequent FDP and rest periods and other operational circumstances creating a very complex pattern. This may be formulated as variation for a specific operation and studied accordingly.

Additional Question 7) Reduced rest with split duty

The executive summary of the STARE study cannot be taken as basis of rulemaking that claims to be based on science. Figures 15, 16 and 17 (pages 208 and 209) do not give the information that is needed to review the study. Fatigue (or sleepiness) during duty and the recuperative effect of rest depend on the time of day, the length of duty, the length of rest which are not given for these figures. Furthermore, information about conditions during breaks and rest is not provided. This makes it impossible to fully understand results and their possible implications.

Figure 17 is based on 10 subjects only which is a sample size that is not sufficient for the study of a complex question.

4 Important points

In the following important points arising from the discussion in Cologne from May 17 to 19, 2011 are summarized:

- 1) It is more consistent with regard to preventing and controlling fatigue that FDP is reduced to 10 hours during night while an extension to 14 hours is justified for starts of FDP in the morning between 8:00 and 12:00 hours.
- 2) FDP extensions beyond the basic FDP table should not be allowed.
- 3) Commuting is a matter of great concern. It is not specific to air crew but common in the entire work force. Commuting can hardly be regulated but should be dealt with under FRM with shared responsibilities between pilots and airlines.
- 4) An important aspect in regulating standby is the consideration and protection of regular sleeping times. A scheme has been proposed that fulfils these requirements.
- 5) Acclimatization is a very difficult concept and is very much dependent on individual behaviour. FDP tables for so-called non-acclimatized crew do not seem to be adequate to take this into account.
- 6) Operations under Subpart Q and the NPA comprise a variety of disruptive schedules, e.g. flights across time zones. Disruptive duties should be followed by an extended rest period at home base.
- 7) The absolute minimum rest should be 10 hours to ensure the opportunity for an 8-hour sleep.
- 8) The topic of controlled sleep contrasting short naps (power nap) in the cockpit is not mentioned in the NPA though it is of great concern. Controlled sleep should be handled by a FRM reporting system as a fatigue incident.
- 9) In general, the discussion suggested that FRM should play a more important role in new European FTL regulations. In particular FRM principles and methods should be used for
 - operating disruptive schedules including time zone transitions, early starts and late finishes
 - night operations
 - commander's discretion
 - extension of FDP
 - in-flight rest, crew augmentation
 - split duty
 - commuting at home base

5 Closing remarks

With the proposal of harmonized European FTL regulations EASA has the unique chance to draft innovative and simple regulations.

Though some national regulations may be acceptable to be used as European regulations they lack simplicity. They have evolved in a long period of time adding new rules to existing ones but the existing part has usually not been touched.

The initial approach of EASA to design new FTL regulations comprised of a limited set of rules backed by mandatory fatigue risk management has not been retained. It would have provided more flexibility for airlines and the possibility to make operations continuously safer by encouraging adopting scientific input from new research.

In particular, NPA does not consider the advance in software methods, e.g. the possibility for all partners to make use of optimizing software to find loopholes in the regulations.

At some places in this report I have stated that a specific rule is not based on scientific results. The NPA sometimes goes into great detail presenting many numbers. This may lead to the impression of high accuracy. This accuracy is certainly not based on scientific studies. Regulation principles become sometimes unclear with respect to the different components of fatigue. The exact numbers provided are usually the result of operational experience and industrial negotiations.

In this brief report I have tried to compile advice from a scientific perspective and to provide some technical details about sleep research and chronobiology. Most advice has been given in a qualitative way by attempting to bring FTL rules and physiological regulation systems together.

Even if a mandatory fatigue risk management will not be implemented I strongly suggest introducing education and training in fatigue risk management. This training aims not only at pilots and cabin crew but equally important at management and scheduling personnel. Pilots already have basic knowledge about fatigue risk but in other professional groups the knowledge is sparse.

6 References

DLR (2006) unpublished report on aircraft maintenance to Lufthansa Technik.

DLR (2006) unpublished fatigue risk management training.

DLR (2011) unpublished report on night cargo flights to DHL Leipzig

Samel A, Wegmann HM, Summa W, & Naumann M (1991). Sleep patterns in aircrew operating on the polar route between Germany and East Asia. *Aviation, Space and Environmental Medicine*, 62(7): 661-669.

Samel A, Wegmann HM, & Vejvoda M (1997a). Aircrew fatigue in long-haul operations. *Accident Analysis and Prevention*, 29(4): 439-52.

Samel A, Wegmann H-M, Vejvoda M, Drescher J, Gundel A, Manzey D, & Wenzel J (1997b). Two-crew operations: Stress and fatigue during long-haul night flights. *Aviation, Space and Environmental Medicine*, 68 (8): 679-687.

Vejvoda M, Samel A, Maaß H, Luks N, Linke-Hommes A, Schulze M, Mawet L & Hinninghofen H. (2000). Untersuchung zur Beanspruchung des Kabinenpersonals auf transmeridianen Strecken. Report DLR-ME-FP-32-2000, Cologne, Germany.

**Provision of Scientific Expertise to submit an assessment of the
NPA on Flight Time Limitations (FTL) and to provide
guidance and advice to the FTL Review Group:
Final Report**

Mick Spencer

Cover + ii + 31 pages

June 2011

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1 Introduction

- 1.1 This report has been prepared by Mick Spencer for the European Aviation Safety Agency (EASA) under the terms of contract number R.2011.C03.
- 1.2 A previous interim report provided an assessment of the 14 top issues identified in the Notice of Proposed Amendment (NPA), and of 15 additional issues, formed into eight questions, that were submitted for consideration at a later date. The substance of that earlier report has been carried across, with a few minor changes, to the present report. However, the original order has been amended at the suggestion of EASA in order to keep together questions that covered similar topics. This has necessitated some reorganization and rewording of the original text.
- 1.2 Other changes and additions have been made to cover some further issues arising from the three-day meeting of the FTL Review Group in Cologne 17-19 May 2011, and to clarify some of my previous answers. The main changes are the following:
 - i. the discussion relating to the definition of a home base has been slightly extended (Section 2.2);
 - ii. the section on commander's discretion (5.1) has been expanded at the request of EASA, in response to additional material provided by ECA;
 - iii. Section 5.2 on short-term replanning has been completely rewritten;
 - iv. the discussion of rolling 12-monthly limits (Section 6.3) has been extended to address a specific issue raised during the Review Meeting;
 - v. the discussion of disruptive schedules (Section 9.1) has been broadened to include transitions from earlies to nights;
 - vi. some changes have been made to the sections on acclimatization (9.2 and 9.3), for the purpose of clarification;
 - vii. two additional topics raised during the Review Meeting are discussed in Section 11;
 - viii. the key issues identified and discussed during the Review Meeting have been summarized in a separate section.
 - ix. an Appendix has been added to provide a more detailed discussion of time-zone changes and acclimatization.
- 1.3 In responding to many of these questions, it has been possible to draw on the results from a large number of studies that have been carried out into the sleep, circadian rhythms and fatigue of aircrew related to their patterns of work. On some issues, however, there is very little information that is directly available from studies. Where this is the case, it has generally been possible to provide some limited guidance based on a broad understanding of the issues involved. The overall objective has been to present, from an independent standpoint, a critical evaluation of the various topics to assist EASA in the evaluation and further development of the proposal.
- 1.4 In the following text, the 14 original issues / questions) are represented by the abbreviations Q1, Q2,..., Q14, and the additional questions by AQ1, AQ2,..., AQ8.

2 Home Base

2.1 The definition of a Home Base (Q1)

2.1.2 The proposed definition allows a home base to be a multiple airport location, provided that (i) the distance between any two airports does not exceed 50km and (ii) the relevant travelling time does not exceed 60 minutes in normal conditions. There is also provision for the time to return to the initial airport from the final point of landing to count as positioning.

2.1.3 Although there are no studies that have investigated this question specifically, there are possible fatigue implications related to the additional travelling time that may be required between the two airports or between home and a more distant airport. Travelling time is a factor that can affect subsequent levels of fatigue by reducing the time available for rest and extending the continuous period of wakefulness associated with the Flying Duty Period (FDP).

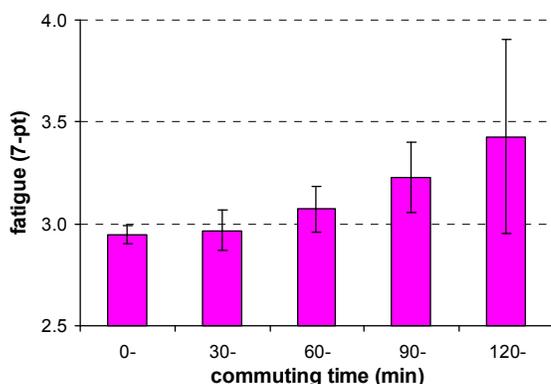


Figure 1: The effect of commuting time on fatigue (7-pt Samn-Perelli)

2.1.4 The effect of commuting time on subsequent levels of fatigue has been shown in a diary study of 158 pilots on short-haul routes between the UK and the continent of Europe [Spencer & Robertson, 2000]. After correcting for other significant factors such as the length of duty and the time of day, their fatigue rating at the end of each flight was positively correlated with commuting time ($p < 0.001$). The increase in fatigue associated with one hour of commuting was roughly equivalent to the increase associated with an extra hour of flying (Figure 1). Similar effects have been reported in studies of railway workers, where it has been recommended that alternative arrangements be made if the travelling time exceeds 90 minutes [Robertson et al., 2010].

2.1.5 These results lend support to the guidance contained in CAP 371 that ‘if the journey time from home to [the] normal departure airfield is usually in excess of 1½ hours, crew members should consider making arrangements for temporary accommodation nearer to

base'. However, the proposed definition of a home base could then allow potentially for a further hour of travelling time, up to a total of 2½ hours, which would be excessive.

- 2.1.6 This question, therefore, needs to be addressed alongside the issue of travelling time, and the current proposal should be amended to ensure that, if multiple airports are permitted, additional provision is made to restrict excessive commuting times. The proposed provision for the return time to the original airport to count as positioning should be retained as a necessary protection for the subsequent rest period.

2.2 Home Base (AQ8)

- 2.2.1 Based on the conclusions of the previous section, multiple airports should not be used to extend the travelling time beyond a reasonable limit (e.g. 1.5 hours). If this limit is exceeded due to the provision for multiple airports, then the additional time, whether before or after the FDP, should count as positioning.

- 2.2.2 There was some concern expressed at the Review Meeting that the intentions behind the definition of a home base could be circumvented if an operator were able to change a crew member's home base frequently or without adequate notice. In extreme cases, this could be used to evade the requirement for a positioning flight. It may therefore be necessary to include further provisions in the regulations to protect the integrity of a home base.

3 Flight Duty Period (FDP)

3.1 Maximum FDP (AQ1)

- 3.1.1 It is well recognized that duties of the same duration starting at different times of day can have a differential effect on the development of fatigue and sleepiness. In particular, alertness levels overnight cannot be sustained for as long as they can during the day. The Haj operation (see Paragraph 3.6.3) has provided a unique opportunity to make a direct comparison between this time-of-day effect, as exactly the same flight was carried out at times equally spaced around the 24-hour clock.

- 3.1.2 Table 1 is based on the results from that operation, extrapolated where necessary, and shows the length of duty at different times of day, rounded to the nearest hour, associated with similar levels of fatigue. The cut-off point corresponds approximately to a probability of 10% that both pilots in a two-crew operation would record a level of eight or more on the Karolinska Sleepiness Scale [Åkerstedt & Gillberg, 1990]. Scores of eight or more are known to be associated with a high frequency of microsleeps [Gillberg et al., 1994].

- 3.1.3 These results are broadly consistent with those from both laboratory studies of irregular work-rest patterns [Minors et al., 1986] and other aircrew studies. However, higher

levels of fatigue have been reported for overnight flights, especially those departing late in the evening [Powell et al., 2008]. For this reason, many would argue that the overnight limit of 10 hours should apply equally to duties starting earlier in the evening.

report time	23-1	1-3	3-5	5-6	6-7	7-8	8-12	12-14	14-17	17-23
duration of duty (h)	10	9	10	11	12	13	14	13	12	11

Table 1: Limits for maximum FDP based on the Haj operation

3.1.3 Figure 2 shows a comparison between these limits and those proposed in the NPA (Table 36) without any extension. There is close agreement throughout most of the 24-hour period, and they only differ by more than an hour for a two-hour period during the very early morning. The Haj limits are more generous for duties starting in the late morning, allowing 14 hours, rather than 13 hours. However, they would strongly support a limit of no more than 10 hours for late evening and early morning start times.

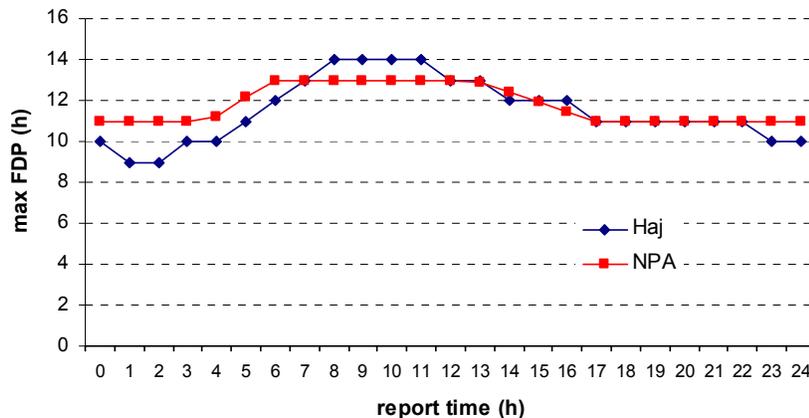


Figure 2: Maximum FDPs based on the Haj results compared with the current proposal

3.2 Mitigating measures for one-hour extensions (AQ1a)

3.2.1 A one-hour extension from 13 to 14 hours for morning departures after 08:00 would be supported by the above discussion, but this would apply irrespective of any mitigating measures. Having established an appropriate maximum limit for FDPs, the regular (up to twice a week) use of extensions would be difficult to justify without further studies. A logical approach would be to allow extensions, together with any mitigating measures, as part of Fatigue Risk Management (FRM). There is further discussion of this issue below (see Section 3.6).

3.3 Commander discretion (AQ1b)

3.3.1 If measures are in place to protect the integrity of schedules and of individual duty patterns, and if reasonable limits are set for maximum FDPs, then the current provisions should be adequate (see Section 5.1). However, there would be a concern if a

considerable portion of the 10-hour minimum rest period could not be used for rest, for example because of the location of the hotel at the final destination. One way of protecting against this possibility would be to stipulate that the rest period should provide for at least an eight-hour sleep opportunity.

3.4 Consecutive early starts and consecutive nights (AQ1c).

3.4.1 There are a priori reasons for supposing that both consecutive nights and consecutive early starts would lead to increasing levels of fatigue. These arise from the loss of sleep associated with both types of duty (Section 9.1), and the difficulty of adapting to the unusual working hours. For example, it appears that most shift workers do not adapt to a pattern of night working [Folkard, 2008]. In support of this, there is some evidence from aircrew studies of an increase in fatigue over consecutive early starts [Spencer & Robertson, 2002] (Figure 3) and consecutive nights [Robertson & Spencer, 2003] (Figure 4).

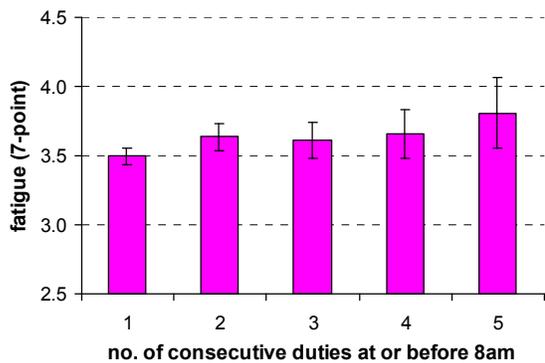


Figure 3: Effect of consecutive early starts

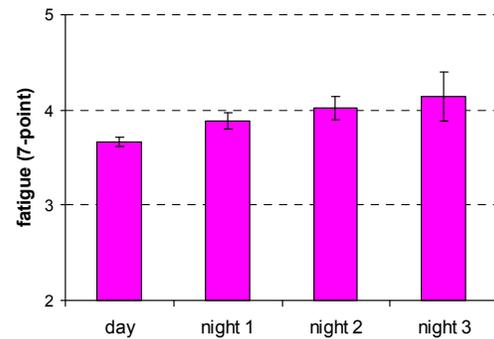


Figure 4: Effect of consecutive nights

3.4.2 However, there are other studies which do not show fatigue increasing on consecutive days. In a recent study of cargo operations, not yet published, fatigue decreased steadily after the first night, and only began to increase again after the fourth night. EasyJet found that pilots could work five consecutive early starts with less fatigue than on a system which was restricted to three consecutive early starts: putting the early starts in a single block was better than combining them in a mixed schedule.

3.4.3 It may be, therefore, that in operations which involve a large percentage of nights or a large percentage of earlies, it is better if they are operated as a block rather than as one or two at a time. This would depend also on the regularity of the pattern of work, and the arrangements for rest. For example, there are advantages for the cargo crews when they are able to spend their rest periods away from home in a hotel within close proximity of the airport. However, problems may arise when the start time, particularly for early starts, varies considerably from one day to the next. For these reasons, it would be sensible to include a restriction, say of three consecutive early starts or night duties, but to allow extensions to this based on FRM.

3.5 Mitigating measures related to the WOCL and number of sectors (AQ1d)

3.5.1 Many of the issues relating to the WOCL encroachment are addressed elsewhere in this report. In particular, the restrictions in the number of sectors for duties encroaching the WOCL would not apply if, as recommended in Section 3.2, extensions are not permitted without FRM.

3.5.2 In studies of the short-haul operations of three separate airlines, it has been possible to determine levels of fatigue associated with multiple sectors, after correcting for time on duty and time of day [Spencer & Robertson, 2000; Spencer & Robertson 2002; Spencer & Robertson, 2003]. The increasing trends in fatigue are shown in Figure 5. In one of the three studies there was no significant difference between one and two sectors. With this exception, they all showed a steady increase, from one sector to the next, equivalent to between 30 and 45 minutes per sector, when compared with the increase in fatigue with length of duty.

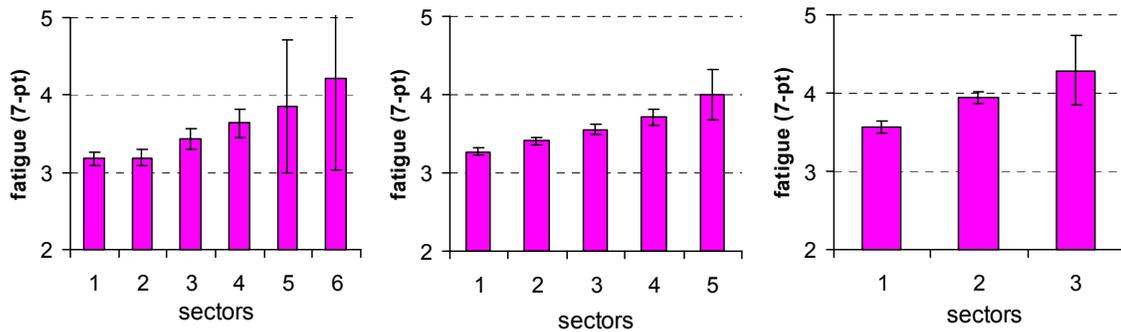


Figure 5: Changes in fatigue with multiple sectors: results from three different airlines

3.5.3 There are several ways in which the maximum FDP might be modified to take this effect into account. For example:

- no reduction for the first sector, then a reduction of 45 minutes for each subsequent sector;
- a reduction of 30 minutes for each sector after the first.

The proposal for no reduction for the second sector and 30 minutes for each additional sector does not adequately reflect the results from these three studies.

3.5.4 Relatively little information has been collected from these studies or elsewhere on the effects of more than four consecutive sectors. From the data that are available it appears that the trend from two to four sectors may extend to five sectors and beyond. Until further studies are carried out it would be reasonable, therefore, to base the duty-hour limitations on this assumption.

3.6 Extensions to FDPs for early evening reporting (Q2)

- 3.6.1 The issue raised by this question is whether the one-hour extension can be applied to the maximum FDP table irrespective of time of day, or whether extensions for duties starting between 18:00 and 21:59 should be allowed only in conjunction with FRM.
- 3.6.2 There are several studies that have investigated the development of fatigue in long duty periods starting at different times of day. These were considered in the Moebus report which recommended that ‘FDPs for minimum crew should not exceed 10 hours overnight’. Information obtained more recently tends to support this conclusion. For example, fatigue levels reported by pilots at top of descent on Air New Zealand regional operations with start times between 21:00 and 00:00 were shown to be particularly fatiguing [Powell et al., 2008]. In addition, in a study, which has yet to be completed, of crews on freight operations, where almost all duties were overnight, there was evidence of a marked increase in fatigue when the duty period extended beyond 10 hours.
- 3.6.3 The most extensive investigations of duties starting at different times of day were the three studies of fatigue on the Haj operation, carried out in 1998, 1999 and 2000. On each of the legs between Indonesia and Saudi Arabia, the crews were asked to rate their level of fatigue on the seven-point Samn-Perelli scale, and this was done on six separate occasions during each duty period. The FDPs were generally between 11 and 11.5 hours, and flights departed round the clock. The trend lines in Figure 6 are based on data from the 1998 operation [Spencer & Robertson, 1999], as the other two operations involved many augmented flights. In addition, only the outward flight was used, as the crews were then considered to be fully adapted prior to departure.

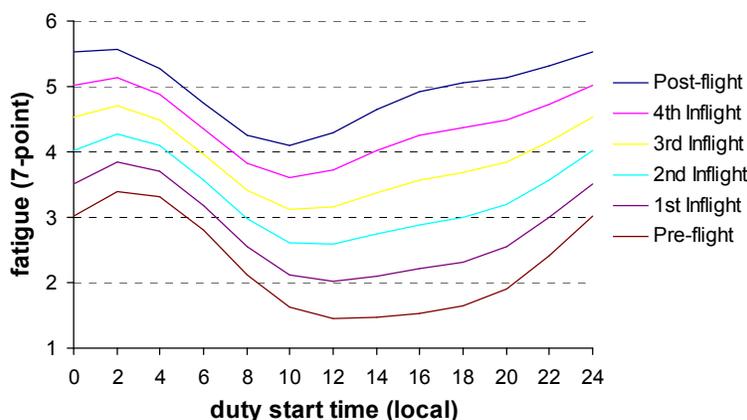


Figure 6: Trends in fatigue based on the Haj 98 operation.

- 3.6.4 The most fatiguing duties on the Haj operation were those starting in the late evening and early morning. Limits for unaugmented operations based on these results would match very closely with those in the FAA NPRM (e.g. Table A(2)), rather than those in the NPA. In particular, these results, taken together with those from the other studies

mentioned above, would strongly suggest that FDPs as long as 12 hours overnight should not be operated with an unaugmented crew.

- 3.6.5 Therefore an extension of one hour should not be permitted in any circumstances for duties starting between 18:00 and 21:59, or for duties starting between 22:00 and 03:59 which, contrary to the statement in the NPA (paragraph 89), are also at a critical time. This is without prejudice to the recommendation that the use of extensions to the basic FDP table proposed in the NPA should not be permitted outside the period 08:00 to 12:00 (Section 3.2).

4 Augmented Crews

4.1 Economy seats for in-flight rest (Q4)

- 4.1.1 The TNO report into the value of in-flight relief [Simons & Spencer, 2007] did not recommend any increase in maximum FDP when rest was taken in an economy class seat. In the absence of further studies, there is no reason to change this recommendation.

4.2 The WOCL and in-flight rest (Q5)

- 4.2.1 This question relates to the proposed extensions of FDP for in-flight rest and, specifically, that they should be independent of time of day.
- 4.2.2 The logic behind the recommendations of the TNO report was that the extension should be based on a (somewhat conservative) estimate of the typical amount of sleep that crews would obtain, given the time available for rest. This was taken to be 25% of time spent in a bunk (not 75% as stated in the NPA (Section 5.6.2d)), irrespective of the time of day. The decision not to include time of day was made for simplification, also taking into account that different individuals would be sleeping at different times.
- 4.2.3 In this context, it should be noted that the assumption that a flight encroaching the WOCL would benefit from more recuperative sleep is difficult to justify. The early evening, when many individuals may be attempting to rest prior to a duty in the WOCL, is not a good time to initiate sleep, to the extent that it has even been termed the 'forbidden zone' by some sleep researchers.
- 4.2.4 At the most favourable times of day (i.e. when the maximum FDP is normally 13 hours), the limits proposed in the NPA are generally slightly higher than in the TNO report. For example, the limit is raised to 16 hours, compared with 14:25 hours, for a class 3 rest facility with a double crew. However, as the proposals are independent of time of day, the main differences are at the least favourable times of day, when the maximum unaugmented FDP is 11 hours. At these times, the proposed limits in the NPA are more generous throughout by between two and four hours.

- 4.2.5 The evidence from studies of aircrew suggests that time of day is still an important factor in augmented operations. On 14-hour flights from London to Singapore with a crew of four, fatigue on the Samn-Perelli 7-point scale immediately after landing averaged 4.8 for the main crew and 5.0 for the relief crew on flights landing in the night, compared with 4.2 for the main crew and 4.6 for the relief crew on afternoon landings [Robertson et al., 2002].
- 4.2.6 In a study that is currently being prepared for publication, Air New Zealand has used an automated system to collect large amounts of fatigue estimates from aircrew close to top of descent. This has enabled direct comparisons to be made between flights of similar duration at different times of day. In one such comparison, based on returns from over 600 crew members, fatigue levels on a three-crew overnight flight with an FDP of approximately 12½ hours were significantly higher than on a similar flight that was mostly during daylight (4.7 on the Samn-Perelli scale, compared with 3.8).
- 4.2.7 Based on these results, which are consistent with model predictions, it would be unwise to assume that time-of-day effects are considerably reduced, or even eliminated, when in-flight rest can be taken. A reduction in the maximum FDP limits for duties that extend into the WOCL would therefore be appropriate. FRM provisions should be used to justify overriding such a reduction on the basis of ‘operational experience’.

4.3 Augmentation in multi-sector (Q6)

- 4.3.1 The recommendations in the TNO report were based on the assumption of a single-sector FDP. In a two-sector operation, the overall time available for sleep will be reduced by the extra take-off and landing, together with the turnaround time. After allowing for this and, depending on the length of the individual flights and the number of crew, it is likely that the time available for each pilot to rest would be reduced by up to an hour. On this basis, and following the same argument as in the TNO report, the maximum FDP for a class 1 facility should be reduced by approximately 45 minutes, and by 90 minutes for a three-sector operation.
- 4.3.2 However, two-sector operations can vary, and it is useful to consider three separate cases: (i) two sectors of equal length, (ii) a short sector followed by a long sector and (iii) a long sector followed by a short sector. When both sectors are of approximately the same length, then, providing that the turnaround time is sufficiently short, the cruise phase of both flights taken together should provide sufficient time for all the pilots to rest. In this case, a small reduction in the FDP limit, as suggested above, would be appropriate. A similar reduction might be considered when a short sector is followed by a long sector, providing that the second sector is sufficiently long (and therefore the first sector sufficiently short), to afford sufficient rest for all pilots. The case of a long sector followed by a short sector is likely to be more fatiguing, as crews will generally be able to rest less in the later part of the duty period, when the workload is also higher.

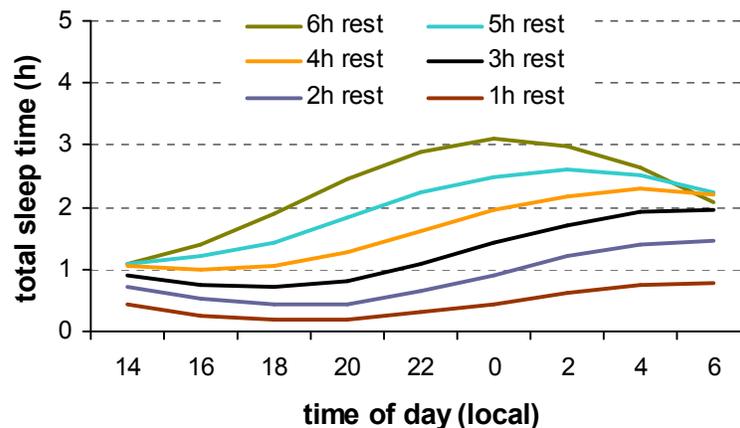


Figure 7: Model of sleep duration as a function of the length of the rest period and the time of day

4.3.3 The question of minimum in-flight rest is not one for which there is a simple answer. The model of in-flight rest for an acclimatized pilot, derived from aircrew studies [Pascoe, Johnson et al., 1994], which was applied in the TNO report (see Figure 7) illustrates the extent to which typical amounts of sleep obtained during a rest period depend on the time of day. Within a one-hour rest period, it is normally possible to obtain at least 45 minutes in the middle of the night, but less than 10 minutes during the early evening. There are times, therefore, when such a rest would be very useful, and others when it would have very little value.

4.3.4 With these considerations in mind, it is not possible to provide clear limits for many multi-sector operations, that will adequately cover every situation. This suggests that an approach based on FRM would be required, and models such as the one illustrated above could be used to provide an initial assessment of any proposed multi-sector FDP.

4.4 In-flight rest for cabin crew (Q7)

4.4.1 As with other aspects of FTL related to cabin crew, the establishment of appropriate requirements for their in-flight rest is complicated by two main issues. The first of these is a lack of clarity concerning the level of alertness which it is necessary for them to maintain. It is generally recognized that take-off and landing are critical phases of the flight for pilots. However, it is unlikely that cabin crew would need to maintain the same level of alertness required by those in control of the aircraft during the landing. This would apply even though they are acknowledged to have important responsibilities for the safety of the aircraft and its passengers.

4.4.2 The second complicating issue is the limited amount of information that is available on the work and rest of cabin crew. In a comprehensive study of their workload and stress levels, Vejvoda et al. [2000] reported that the crews experienced high levels of fatigue towards the end of the flights. This has since been confirmed in several unpublished

studies where the fatigue levels of cabin crew have reached levels considerably higher than those of pilots.

4.4.3 In 2005, ECASS (European Committee for Aircrew Scheduling and Safety), carried out a review for the Hong Kong Civil Aviation Department of the requirements for the in-flight rest of cabin crew in future Ultra-Long-Range (ULR) operations. It recommended six hours of horizontal rest in a flight of 19 hours, which could, if certain mitigating measures were in place, be reduced to between four and five hours. The proposals in the NPA for class 1 rest facilities would appear to be broadly consistent with this recommendation. However, the proposed requirements for class 2 and class 3 do not provide for equivalent levels of rest, and, when compared with the class 1 requirements, are not consistent with the conclusions of the TNO report, although these were, of course, based on data from pilots.

4.5 Maximum FDP (AQ2a)

4.5.1 The TNO report is the most comprehensive scientific assessment of the requirement for extending FDPs with augmented crew. Its conclusions are based on the assumption that the additional duty time allowed should be determined by the time available for in-flight rest, as well as by the type of rest facility provided.

4.5.2 The increases proposed in that report are considerably at variance with those implicit in the current proposal. This is particularly so because no distinction is made in the proposal between daytime and overnight flights (see section 4.2). Thus a daytime flight of 13 hours can be increased by four hours to 17 hours with class 1 rest facilities, whereas an overnight flight can be increased by six hours, also to 17 hours.

crew complement	type of rest facility	basic FDP limit (h)		
		13h	12h	11h
2+1	class 3	14	13	12
	class 2	15½	14	13
	class 1	16½	15	14
2+2	class 3	14½	13½	12½
	class 2	17	15½	14
	class 1	18*	17	16

Table 2: Limits for augmented crew based on the TNO report

4.5.3 If there is a preference for specific FDP limits for augmented flights, then it would be possible to derive suitable limits based on approximations to the TNO formulae. These limits would be based on the maximum FDP at specific times of day, plus the calculated extension. Table 2 shows the maximum FDP calculated in this way for daytime (basic maximum 13 hours), intermediate (12 hours) and overnight (11 hours) duties. The values have been rounded to the nearest half-hour. The value of 18 hours, which has

been marked with an asterisk, replaces the calculated value of 19 hours, as FDPs over 18 hours are defined as ULR and are subject to separate controls based on FRM.

4.6 Sleep inertia (AQ2b)

4.6.1 Sleep inertia is a transient state of impaired alertness that occurs during the first few minutes after waking. Although its effects are most severe after waking from a period of deep (slow-wave) sleep, it can still occur after a nap [Dinges, 1992]. Indeed, it has been shown that the effects of sleep inertia can persist even after naps shorter than an hour, and that it takes approximately 30 minutes before levels of alertness are recovered and the beneficial effects of the nap start to be felt [Robertson & Stone, 2002]. It is therefore sensible precaution to allow a period of at least 15-20 minutes after waking before a crew member relieves a colleague on the flight deck [Simons et al., 1994].

4.7 Mitigation for non-acclimatization (AQ2c)

4.7.1 Previous studies have shown that in-flight sleep tends to be less restful on a return flight when crews are unacclimatized, than on an outward flight. It was therefore recommended in the TNO report that the extension for unacclimatized crews should be 80% of that applicable to acclimatized crews. However, this requirement may be unnecessary if the basic FDP has already been reduced for unacclimatized crews (see below).

5 Unforeseen circumstances

5.1 Commander's discretion (Q8)

5.1.1 To allow for unexpected events beyond the operator's control, it is reasonable to permit extensions to the maximum FDP as proposed in the NPA. This is provided that the integrity both of the schedule itself and of specific duty patterns (crew pairings) is protected by the regular reporting of the use of such extensions, and by the thorough auditing of the reports by the regulator.

5.1.2 The question as to whether an FDP of 16 hours for flight crew or one of 17 hours for cabin crew is too high is one that should be asked about the basic maximum FDP, rather than about the use of commander's discretion. If the basic limits are reasonable and adequate safeguards are in place to protect its abuse, then the occasional application of commander's discretion can be tolerated.

5.1.3 Subsequent to the Review Meeting, guidance material on commander's discretion, produced by ECA has been forwarded to me by EASA, with an invitation to comment. It contains a proposal that each operator should develop a policy for commander's discretion based on a number of requirements designed to ensure that an operator takes full responsibility for the safe application of commander's discretion.

- 5.1.4 From a purely scientific viewpoint, it might be considered that the application of any form of discretionary powers in contravention of the basic regulations is undesirable, on the grounds of an increased fatigue risk. However, such a rigid stance is unacceptable in practice. There are then two overriding requirements: firstly, that discretion should only be used in response, if not to an emergency, then at least to an event that could not reasonably have been anticipated; and secondly, that the commander should have sufficient understanding of fatigue and the risks associated with fatigue to make the correct decision.
- 5.1.5 To address the first point: there is a risk that operators might rely too heavily on commanders using their discretion, and even put undue pressure on commanders. This must be prevented as it would pose a severe strain on the integrity of the basic regulations and on the safety of the operations themselves. A strong system for controlling and monitoring the use of discretion is required. The proposed 33% limit on the number of flights exceeding the maximum is very high. However, the precise limit is not a matter for scientific discussion. It should be based on an assessment by the industry of what it is reasonable to allow, considering the normal uncertainties implicit in passenger flights. To assist such an assessment, it may be necessary to collect more information from current operations. The aim should be to ensure that sufficient margins are included in schedule design so that commanders are not expected to operate discretion as a matter of routine.
- 5.1.6 The second point raises the issue of training. Commanders cannot be expected to exercise discretion without an understanding of all the issues. Other members of the crew also need to be trained to recognize the symptoms of fatigue, and to evaluate the risks associated with their own mental and physical state. Training would ideally be included as part of an FRM system, and such a system would also provide the best framework for developing the operator's requirements, such as those outlined in the ECA document.

5.2 Short-term re-planning (Q9)

- 5.2.1 Short-term re-planning may be required in a variety of different circumstances, for example in response to severe weather conditions or other emergency situations. The most common requirement, as mentioned during the Review Meeting, tends to be to cater for flight delays associated with aircraft becoming unserviceable.
- 5.2.2 The consequences of such delays for the aircrew involved will depend on the notification they can be given and on whether they have already left their place of rest. Although such events should occur infrequently (and records should be kept and checked to ensure that this is the case), some restrictions are required to ensure that the risks arising from aircrew fatigue in these situations are limited.

- 5.2.3 In the absence of scientific evidence, it is only possible to provide advice based on general considerations and on operational experience. For example, under CAP371, there is provision for ‘delayed reporting’ when a crew member is informed of the change before leaving the place of rest. However, the current proposal relates to the introduction of split duty and reduced rest shortly before or after reporting. It is difficult too envisage how short-term changes of this nature can be accommodated satisfactorily into a general FTL scheme, rather than as part of FRM.

6 Cumulative fatigue (AQ3)

6.1 Introduction

- 6.1.1 There is very little scientific evidence to support specific limits for cumulative duty hours. The main issue is that sufficient time for recovery sleep or sleeps should be provided at regular intervals to overcome the effect of schedules that disrupt the normal pattern of sleep. The limits of 60 hours in seven days and 190 in 28 days are very high when crews are subject to continual disruption of the sleep and circadian rhythms. However, it is recognized that the long-haul limit over 28 days is effectively restricted by the 28-day limit on flying hours.

6.2 A 14 day limit and recovery rest (AQ3a)

- 6.2.1 The present proposal would allow 120 hours’ duty in 14 days. I have seen no data from civil aviation on work rates of this level of intensity, although I am aware of problems that have arisen in military transport operations at these very high rates of working. It would seem wise to apply a lower level of say 100 hours in 14 days, to provide some extra protection. If rates higher than this are achieved on a regular basis, it would be extremely valuable to study their effects.

6.3 Rolling 12-monthly limits (AQ3b)

- 6.3.1 Again, it is difficult to comment on this from a scientific viewpoint. The rolling limit was recommended in the Moebus report to prevent the possibility of 1800 hours being flown in 18 consecutive months, against the presumed intention of the yearly limit
- 6.3.2 However, if the intention of this rule is to limit the accumulation of fatigue over long periods, this could be better achieved in other ways. One possibility would be to stipulate a continuous period of time off at regular intervals (for example at least seven consecutive days off every three months).

7 Split duty (Q10)

- 7.1 The provisions for split duty closely follow those of CAP 371. Therefore, although there is very little direct scientific evidence to justify them, they have the advantage of being supported by operational experience.
- 7.2 It could be argued that the scientific justification can be derived by analogy with the extensions provided for augmented flights by in-flight relief. In that case, the proposed changes to maximum FDP could be justified provided that the 'suitable accommodation' was at least equivalent to a class 1 rest facility, and that the accommodation available in other cases was at least equivalent to a class 2 rest facility. It would also be necessary to ensure that the accommodation is not in a remote location. If it is, the duration of the break used in the calculation should be reduced by the additional travelling time.
- 7.3 However, there are differences between in-flight relief and a break within a split duty that have implications for the alertness of the crews. In an augmented flight, the crews are able to arrange the timing of their rest periods, and different individuals are able to rest at different times. The same does not apply to split duty, where the break may occur at an unfavourable time for both members of the crew (it is assumed that the split duty rules will only apply to unaugmented FDPs, although that is not stated explicitly).
- 7.4 If the break occurs during the evening, and the remainder of the FDP extends into, or through, the WOCL, there is a risk that crews will not rest well enough prior to the time when they would be naturally most tired (see Paragraph 4.2.3). Similarly, if the first part of the FDP overlaps the WOCL and the subsequent break covers the later morning period, a time which is less conducive to sleep, they may not be well-prepared for duty later in the day. It was for these reasons that the Moebus report suggested that split duty be limited to between 06:00 and 22:00. However, if the time is unrestricted, it is recommended that the requirement to provide suitable accommodation be extended to cover all split duties where any part of the duty encroaches into the WOCL.
- 7.5 It is important that, if the overall FDP is extended, the alertness of the crews during the final landing phase is not compromised. For that reason, and to ensure that the break is not too far removed from the end of the FDP, it would be sensible to ensure that the break is not positioned too soon within the duty period (e.g. within the first 33%). This would be analogous to the timing of the first rest period in a single-sector three-crew operation.

8 Standby

8.1 Airport standby (AQ4)

8.1.1 No direct scientific evidence is currently available on this issue. However, if a comfortable, quiet environment is not available for rest, or if a crew member is on immediate readiness, it is unlikely that much benefit would be derived from the standby period. In this case, it is reasonable that the FDP should count in full from the start of standby.

8.2 Limits for standby duty (Q11)

8.2.1 There are very few studies that address this issue, apart from those mentioned in the RIA of the NPA (section 5.11.2). There is operational experience of the 12-hour limit for standby not at the airport, both from both the UK (CAP 371) and overseas, which appears to be favourable. However, the effect on sleep and the alertness levels of the crews will depend on factors other than its duration, such as how and when standby is scheduled, the probability of being called out from standby, etc. These are aspects of an operation that are difficult to regulate, but which can be addressed within the framework of FRM.

8.3 Standby and cumulative limits (Q12)

8.3.1 The proposed contribution of standby to duty limits would appear reasonable based on general considerations. However, as stated in the Moebus report, there is no scientific evidence available that addresses this question.

8.4 Home standby (AQ5)

8.4.1 There is some evidence that individuals who are on call may suffer a degree of sleep disturbance [Torsvall & Åkerstedt, 1988]. The proposed small reductions in maximum FDP allow for the difficulty in obtaining sufficient rest prior to duty, particularly when the standby period is at a time when sleep is not normally taken. However, there is no direct evidence from aircrew studies either in favour or against such a provision. This is an issue that would be suitable for future investigation.

9 Disruptive schedules

9.1 Disruptive schedules and the definition of earlies/lates (Q13)

9.1.1 Although several large studies have been carried out of short-haul operations involving both early starts and late finishes, little information has been obtained on the effect of a rapid transition from lates to earlies. However, the disruption of sleep associated with

both types of duty has been extensively researched, and this provides indirect evidence of the extent of the disruption that might arise.

- 9.1.2 Figure 8 shows the sleep loss associated with duties ending late in the day (redrawn from Robertson & Spencer, 2003), and that associated with duties starting in the early morning (redrawn from Spencer & Robertson, 2002). Both trends are broadly consistent with results obtained from shift workers more generally.

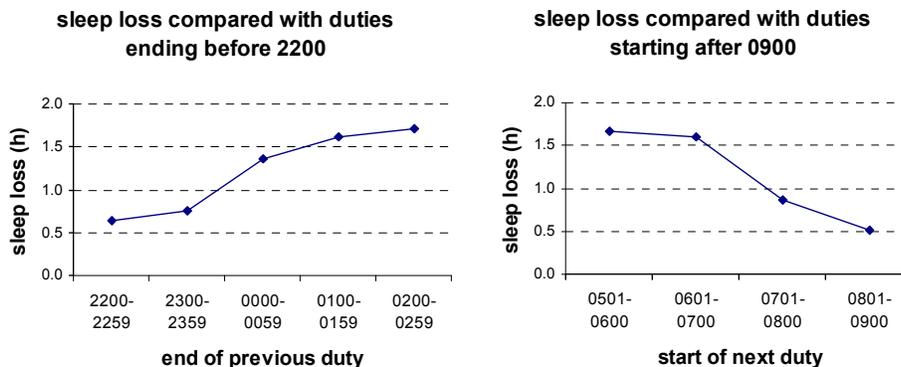


Figure 8: Length of sleep after late finishes and before early starts

- 9.1.3 The duration of sleep following a late finish gradually reduces with progressively later duty-end times. After waking, individuals tend to remain in bed for around 20 minutes, possibly in an attempt to obtain more sleep, before finally getting up. The end of sleep generally occurs in the late morning, when the circadian rhythm of body temperature is on an upward trend, and when sleep is more difficult to sustain. Prior to an early start, the amount of sleep obtained reduces with progressively earlier start times. Individuals advance their bedtime, but normally take over a half an hour to fall asleep, because the early to mid-evening is a particularly difficult time at which to initiate sleep (see Paragraph 4.2.3).
- 9.1.4 A transition from a late finish to an early start without an intervening night's sleep will inevitably involve some sleep disruption and, without direct information, it is difficult to speculate on how aircrew would adjust their sleep pattern. However, these results from individual late finishes and early starts provide a strong argument for a redefinition of both, in order to limit the overall loss of sleep. The critical times appear to be around midnight for a late finish and 07:00 for an early start. Compared with the current definitions, this would entail an advance of an hour for a late finish and a delay of an hour for an early start. Thereby the combined sleep loss from consecutive duties, based on Figure 8, would be limited to approximately three hours.
- 9.1.5 These results have been obtained from studies of aircrew based in the United Kingdom. It is possible that, because of cultural differences related to time of day, some adjustment to the definitions would be required in other European states.

9.1.6 There was some discussion during the Review Meeting of other disruptive schedules, particularly ones in which an early start is followed, after a minimum rest period, by a night duty. Such a pattern of duty would be permitted under the current proposal, although the loss of sleep is likely to be even greater than for the late-early combination. It is therefore recommended that additional provision be included to restrict such disruptive scheduling. A simple way of achieving this would be to prevent an early start from being followed by a duty that overlaps the WOCL without an intervening night off. This would have the additional advantage of limiting the disruption caused by advancing schedules, by preventing an early start from being followed by a ‘super-early’ (i.e. a duty starting within the WOCL).

9.2 Acclimatization (Q3)

9.2.1 This question concerns the adequacy of the proposed definition of acclimatization, which is based on 72 hours or 36 consecutive hours free of duty in an area of three hours time difference. It is acknowledged in the NPA that this is an attempt to keep the regulations simple, as more accurate definitions would introduce what is perceived to be too much complexity.

9.2.2 When considering the issue of acclimatization, it is useful, at the outset, to distinguish between the resynchronization of the circadian rhythm, and the recovery of sleep. These two processes, though they are interrelated, are not the same. The proposed definition would seem to be related to the recovery of sleep, because it allows for a longer period of time when there are duties which might interfere with the timing of sleep. If the view is taken that ‘acclimatization’ should be considered as ‘recovery’, then this definition has some merit.

9.2.3 However, the definition of acclimatization is used to determine the maximum FDP based on start time. It is necessary, therefore, to consider the resynchronization process also, as this determines the phase of the circadian rhythm, including the timing of the WOCL.

9.2.4 Trends in resynchronization rates based on estimates of core body temperature rhythms suggest that about three days may be required to adjust to a five-hour westbound transition, and a day or two longer for a similar eastward transition [Pascoe, Spencer et al., 1994]. However, after large time-zone transitions, particularly in an eastward direction, the recovery times are considerably less predictable. Figure 9 shows the pattern of recovery for 10 individuals (not pilots) after a 10-hour eastward transition from London to Sydney [Spencer et al., 1995].

9.2.5 Similar trends were observed in pilots (Figure 10) after a nine-hour eastward transition [Spencer et al., 1991]. Some individuals adapted by a phase advance, and some by a phase delay, as if the body clock were responding to a westward shift. There was also considerable variation in the rates of adaptation. However, even where the adaptation was relatively quick, this appeared to be achieved by a reduction in the amplitude of the

rhythm lasting for several days. During this period, it was very difficult to determine the phase of the rhythm, and hence to identify the presence of a WOCL.

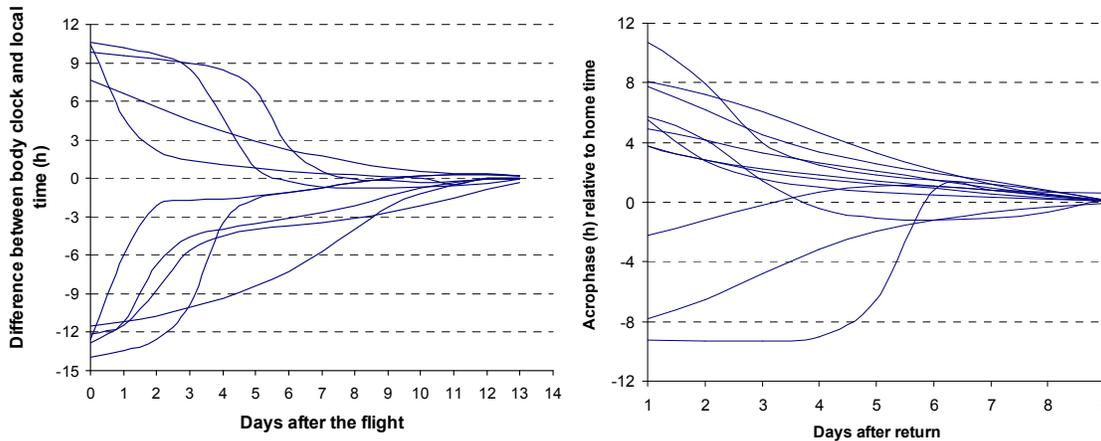


Figure 9: Adaptation to a 10h eastward transition Figure 10: Adaptation of pilots to a 9h eastward transition

9.2.5 Therefore, although the proposed definition of acclimatization may possibly offer an acceptable practical solution for short transitions, it does not adequately address the issues associated with longer transitions, i.e. those over five or six hours. For example, at least on the third and fourth days after a long time-zone transition, the position of the WOCL, even if present, would be indeterminate. If a table for maximum FDP based on start time were used, errors of up to 12 hours would be possible in the timing of the WOCL.

9.2.6 It is for this reason that it is necessary to introduce the concept of the unacclimatized crew member. This would apply for a period of one, two or three days, two days after a long time-zone change (e.g. five or more eastward, six or more westward), when a single maximum FDP, irrespective of start time, would be appropriate. The maximum value would need to be set conservatively to allow for the unknown timing of the WOCL. After this period, crews would then be assumed to be acclimatized to local time. This approach is discussed in more detail below in the following section.

9.3 TZC non-acclimatized FDP table (AQ6a)

9.3.1 Table 3 illustrates how the FDP limits might be adjusted to accommodate different time-zone transitions and different layover periods. It is based on typical rates of acclimatization, though it is acknowledged that rates can vary considerably between individuals. It takes into account that the process of acclimatization depends on the duration of the period of adjustment as well as on the number of time zones crossed.

9.3.2 After any significant time-zone shift there will be a period of about two days (indicated by B) when the crew member might be considered to be ‘partially acclimatized’ to home time. During this period, the application of the FDP limits based on home time

might be justified on the grounds of simplicity, although it would be preferable to use partially acclimatized tables. These are discussed more extensively in the Appendix.

- 9.3.3 After this initial period, and depending on the size and direction of the transition, there would be a period of one, two or three days (indicated by X) when both the amplitude and phase of the circadian rhythm would be difficult to predict. This is the time when the crew member would be considered to be unacclimatized. During this time, a cautious approach would be to set a limit consistent with the most unfavourable time of day. Finally, there would be a period of about a day (indicated by L) when it might be reasonable to assume that the crew member would be partially acclimatized to the new local time.
- 9.3.4 At the Review Meeting, the complex question of acclimatization following multiple time zone transitions was raised, and I promised to address this in my final report. A possible approach is outlined in the Appendix.

time-zone transitions		duration of layover (h)						
eastward	westward	24	48	72	96	120	144	168+
3-4	5-6	B	B	L				
5-6	7-8	B	B	X	L			
7-8	9-11	B	B	X	X	L		
9-12	12	B	B	X	X	X	L	

Table 3: Scheme for non-acclimatisated FDPs (see text for details)

- 9.3.5 The other issue that needs to be addressed is that of minimum rest. After a transition of four hours or more, the desynchronization of the body clock with the local environment may make it more difficult to obtain adequate sleep. It would therefore be sensible, in these circumstances, to impose a minimum rest of 14 hours, irrespective of the time of day, as is currently proposed.

9.4 TZC - continual circadian disruption (east-west / west-east transitions) (AQ6b)

- 9.4.1 Problems associated with continual circadian disruption can often arise with alternating east-west schedules. However, they may also be associated with long time-zone transitions more generally, including repeated ‘back-of-the-clock’ operations, such as those between Europe and Australasia. The origin of these problems is often the requirement to undertake a long-haul tour of duty when sleep and circadian rhythms have not recovered from the effects of the preceding duties. It would seem inconsistent for regulations to cover one specific type of schedule and not others in which similar issues arise.

- 9.4.2 To address this issue, simulations have been carried out, using the model for circadian adaptation included within the SAFE program, to determine the recovery period that would be required for aircrew to readapt to within an hour of home time. The original table based on the results of those simulations was somewhat complicated, and the authors of the Moebus report decided to recommend a simplified and shortened form, which is shown here as Table 4.
- 9.4.3 The numbers in the table are the recovery nights expressed as a function of the maximum time difference from home base during the time away, and the total time away (layover duration). They represent the approximate average recovery time that would be necessary to ensure that crews have re-adjusted close to home time before undertaking another duty schedule.

Layover (h)	Maximum time difference (h)		
	<5	5-7	8-12
<36	1	2	2
36-60	2	3	3
60-84	3	3	3
84-132	3	4	5
>132	3	5	6

Table 4: Recovery nights following return to base

- 9.4.3 The authors of the Moebus report recommended that the above table should be amended in the event that any part of the FDP for the return flight overlapped the WOCL (on home base time). In this case, to ensure sufficient time for the recovery of sleep, it was recommended that at least two local nights free of duty should be provided.

10 Reduced rest

10.1 Reduced rest (Q14)

- 10.1.1 The requirements for minimum rest are designed to provide crew members with the opportunity to report for duty in a fully rested state. This is not possible if the rest period is reduced to 7½ hours when, as shown in the STARE report, the impact on sleep is more severe than that associated with early morning start times.
- 10.1.2 The only information on the impact of reduced rest on aircrew alertness has recently been made available through the STARE report, for which the executive summary has been included within the NPA documentation. In this report there are some interesting general observations on the relationship between fatigue and aircrew performance, including information from Flight Data Management (FDM). Of the results that relate

specifically to reduced rest, the most worthy of note are the following:

- i. approximately 5% of morning duties following reduced rest exceeded a critical value on the Fatigue Risk Index (FRI). It is claimed that this was due to the pattern of duty preceding the reduced rest;
- ii. the frequency of air safety reports from all three airlines studied was greater after reduced rest than after a normal night, during a period from three to five hours of flight duty. This trend was reversed in one airline after more than five hours;
- iii. reduced rest was associated with a large sleep debt (see above);
- iv. assessments of sleepiness were obtained from aircrew on three duty schedules with reduced rest overnight: three flights + rest + three flights (n=57); five flights + rest + three flights (n=45); and flight + split duty break + two flights + rest + one flight (n=10). On all the flights following the reduced rest, sleepiness remained at an acceptable level and was broadly consistent with model predictions.

10.1.3 These results represent an interesting first step in the investigation of the impact of reduced rest, but they cannot, as they stand, justify the full extent of the current proposal, as they do not explore the provisions of the proposal to the limit. If, as claimed, the pattern of previous duty may be crucial, then this would need to be investigated in more detail, and further limitations added as appropriate. In particular, the combination of split duty and reduced rest raises serious concerns, which the limited data so far collected do not fully address.

10.1.4 Reduced rest is an issue, rather like ultra-long-range operations, which does not seem to fit very easily within an FTL scheme. Much depends on the types of schedule within which it is included, and how frequently it is used. It is therefore proposed that, similarly to ultra-long-range, those operators who wish to use it have to demonstrate its acceptability within tightly controlled limits using an FRM approach. The data so far collected are inadequate to justify more general guidelines at present but, as more information becomes available from different operators operating different schedules, it may be possible to develop an acceptable regulatory scheme at a later date.

10.2 Reduced rest with split duty (AQ7)

10.2.1 The STARE report presents one set of results for reduced rest following split duty, where the levels of sleepiness during the flight after the period of reduced rest were within acceptable limits. These results are interesting, but cannot be used in general to support the combination of split duty and reduce rest, for a number of reasons:

- i. the results are based on only 10 responses;

- ii. there is no indication in the report of the duration of the reduced rest period, in particular whether it corresponded to the minimum value of 7.5 hours;
 - iii. there is no indication in the report of the duration of the split duty or of the duration and timing of the duty period, except whether they were in the morning or the afternoon;
 - iv. as predicted sleepiness after the reduced rest was relatively low, the schedule studied cannot be representative of the most demanding schedules with reduced rest, such as those highlighted earlier in the report (STARE report, figure 1-3);
 - v. there are general grounds to be concerned about reduced rest, arising both from the drastic reduction in sleep duration (STARE report, figure 8) and the increase in air safety reports during the first five hours of flight duty (STARE report, figure 4).
- 10.2.2 While it is recognized that reduced rest followed by split duty may be acceptable *in some circumstances*, there are no grounds for its inclusion in a general FTL scheme.

11 Other issues

11.1 Rest on the flight deck

- 11.1.1 There is evidence to support the view that controlled rest on the flight deck is being widely used, particularly as a way of managing fatigue on long overnight duties. This was discussed as an additional topic towards the end of the Review Meeting, where the opinion was expressed that the generous FDP limits for overnight flights in the current provisions could not be sustained by a minimum crew without extensive use of in-flight rest.
- 11.1.2 It is necessary to distinguish between two uses of controlled rest on the flight deck. It may be used as a preventative measure in anticipation of high levels of sleepiness later in the flight, or as an emergency measure when levels of sleepiness have already reached a high level. Purely from the scientific viewpoint, its use as a preventative measure is to be encouraged. Indeed, sleepiness would be minimised if crews alternated periods of rest throughout the cruise phase, allowing only sufficient time to recover from sleep inertia (Section 4.6). Whether it is operationally acceptable for a two-crew aircraft to be operated for long periods with only one pilot awake is a question for the regulator, not the scientist.
- 11.1.3 A concern associated with the use of controlled rest, which I have heard expressed by airline safety managers, is that crews often use it as a substitute for obtaining adequate rest prior to a flight. The situation might arise, as with some shift-workers, where

aircrew come to regard long periods of continuous duty as an opportunity to catch up on sleep they have chosen not to take during their previous off-duty period.

- 11.1.4 Its use as an emergency measure is somewhat different. Even with sympathetic rostering, and even when the limits on overnight duties are reasonably set, there will be times when a crew member needs to rest briefly to overcome the sudden pressure for sleep. For this reason, several operators employ controlled rest as an emergency measure in the form of the 'NASA nap' [Rosekind et al., 1994], a 60-minute sleep opportunity, including a final 20-minute period to overcome the effects of sleep inertia.
- 11.1.5 Given the widespread current use of napping on the flight deck, there are strong grounds for the regulator to provide general guidance, whether as part of the FTL scheme itself or elsewhere. This is particularly the case when long duty periods overnight, which are known to be extremely demanding, are permitted. The possible risks need to be addressed, and these will include ensuring that adequate measures are in place to ensure the alertness of the one pilot who remains awake.

11.2 FTL and Fatigue Risk Management

- 11.2.1 The role of an FTL scheme in relation to Fatigue Risk Management was discussed during the Review Meeting. The problem now arising with FTL schemes is that they are more likely to be exploited to the limit. In the past, schedules have been protected either by industrial agreements or by operators working in a less competitive environment and not under pressure to push their schedules to the limits of what is permitted.
- 11.2.2 A standalone FTL scheme will be seen as defining the limits of what is safe, as any operation will be permitted that lies within the confines of that scheme. I am concerned that this may be one of the risks arising from the current approach. The opportunity will arise for any ambiguities and loopholes in the regulations to be exploited. Indeed, it is impossible to envisage a simple scheme that could address adequately the detailed and complex nature of the relationship between roster design and aircrew fatigue. This is in addition to the problems of regulating for the unexpected events that are an inevitable feature of actual operations.
- 11.2.3 With FRM, the airlines themselves can take a greater share of the responsibility for the safety of their own operations, instead of simply relying on the rules to protect their crews from undue levels of fatigue. It can also provide a more flexible framework for handling emergency events and other unusual situations. However, I would not advocate the use of FRM alone, but would rather see the role of an FTL scheme as providing the overall framework or envelope, by defining the general limits for a safe operation.

12 Summary of key points

12.1 The following is a list of the most important issues, from my perspective, which have arisen from the discussions in Cologne, and from the review of the proposal in general:

- i. The proposed limits for maximum FDPs are too generous for many overnight duties.
- ii. The one-hour extensions should not be permitted, except possibly for duties starting between 08:00 and 12:00.
- iii. The provisions for augmented crews should follow more closely the recommendations of the TNO report, particularly with respect to overnight flights.
- iv. The definition of acclimatization does not allow adequately for the effect of time-zone changes. This applies both to the FDP limits on layover at a remote destination, and to the recovery time on return to home base.
- v. More protection is required for disruptive schedules, particularly those involving late finishes followed by early starts and early starts followed by night duties. The definition of earlies and lates should be extended.
- vi. The definition of a home base should be qualified to ensure that it is not used to evade the requirement for positioning flights to count as duty;
- vii. Provisions for reduced rest should not be included.
- viii. The safety concerns arising from the extensive use of in-flight rest on the flight deck should be addressed.
- ix. The use of commander's discretion should be regulated and monitored to ensure that it is not used on a routine basis.
- x. It is not possible for an FTL scheme to cover every eventuality. Fatigue Risk Management can provide a more flexible approach in many situations.

12.2 In conclusion, it is my opinion that the current provisions, viewed in their entirety, do not provide sufficient protection against the risks of fatigue, particularly in an environment where competitive pressures may become increasingly powerful. Therefore, I strongly recommend that careful consideration be given to the various issues addressed here, and that further changes are made to ensure that the proposed scheme is a more accurate reflection of current scientific knowledge.

13 References

Åkerstedt T and Gillberg M (1990). Subjective and objective sleepiness in the active individual. *Intern. J Neuroscience*, 52, 29-37.

Dinges DF (1992). Adult napping and its effect on ability to function. In: C Stampi (Ed) *Why we nap. Evolution, chronobiology, and functions of polyphasic and ultrashort sleep*, 118-134.

Folkard S (2008). Do permanent night workers show circadian adjustment? A review based on the endogenous melatonin rhythm. *Chronobiology International*, 25(2): 215-224.

Gillberg M, Kecklund G, Åkerstedt T (1994). Relations between performance and subjective ratings of sleepiness during a night awake. *Sleep* 17(3), 236-241.

Pascoe PA, Johnson MK, Montgomery JM, Robertson KA, Spencer MB (1994). Sleep in rest facilities onboard aircraft: Questionnaire studies. IAM Report no 778, August.

Pascoe PA, Spencer MB, Nicholson AN (1994) Adaptation after transmeridian flights: studies of sleep and circadian rhythms. IAM Report no 759.

Powell D, Spencer MB, Holland D, Petrie KJ (2008). Fatigue in two-pilot operations: implications for flight and duty time limitations. *Aviat. Space Environ. Med*, 79(11), 1047-1050.

Robertson KA, Cabon P, Gundel A, Simons R, Åkerstedt T, et al. (2002). Predicting alertness in future long-range operations: a validation study by ECASS. QinetiQ report QINETIQ/KI/CHS/CR021119/2.0.

Robertson KA and Spencer MB (2003). Aircrew alertness on night operations: an interim report. QinetiQ Report No QINETIQ/KI/CHS/CR021911/1.0.

Robertson KA, Spencer MB, McGuffog A, Stone BA (2010). Fatigue and shiftwork for freight locomotive drivers and contract trackworkers: Implications for fatigue and safety. RSSB research document T699, www.rssb.co.uk.

Robertson KA and Stone BM (2002). The effectiveness of short naps in maintaining alertness on the flightdeck: a laboratory study. QINETIQ/CHS/P&D/ CR020023/1.0.

Rosekind MR, Graeber RC, Dinges DF, Connell LJ, Rountree MS, Spinweber CL, Gillen KA (1994). Crew factors in flight operations IX: effects of planned cockpit rest on crew performance and alertness in long-haul operations. NASA Technical Memorandum NASA Technical Memorandum 108839. Moffat Field, CA, National Aeronautics and Space Administration.

Simons M and Spencer MB (2007). Extension of flying duty period by in-flight relief. TNO Report TNO-DV 2007 C362, TNO Defence and Security, Soesterberg, the Netherlands.

Simons M, Valk PJJ, de Ree JJD, Veldhuijzen van Zanten OBA, D'Huyvetter K (1994). Quantity and quality of onboard and layover sleep: effects on crew performance and alertness. Report RD-31-94. Netherlands Aerospace Medical Centre, Soesterberg.

Spencer MB and Robertson KA (1999). The Haj operation: alertness of aircrew on return flights between Indonesia and Saudi Arabia. DERA Report No DERA/CHS/PPD/CR980207.

Spencer MB and Robertson KA (2000). A diary study of aircrew fatigue in short-haul multi-sector operations. DERA Report No DERA/CHS/PPD/CR00394.

Spencer MB and Robertson KA (2002). Aircrew alertness during short-haul operations, including the impact of early starts, QinetiQ Report No QINETIQ/CHS/PPD/CR010406/1.0.

Spencer MB, Rogers AS, Pascoe PA (1995). The effect of a large eastward time zone change on sleep, performance and circadian rhythms, DRA Report No DRA/CHS/A&N/CR/95/011.

Spencer MB, Stone BM, Rogers AS, Nicholson AN (1991). Circadian rhythmicity and sleep of aircrew during polar schedules, Aviation Space and Environmental Medicine, 62, 3-13.

Torsvall L & Åkerstedt T (1988). Disturbed sleep while being on-call: an EEG study of ships' engineers. Sleep, 11: 35-38.

Vejvoda M, Samel A, Maaß H, Luks N, Linke-Hommes A, Schulze M, Mawet L, Hinninghofen H. (2000) Untersuchungen zur Beanspruchung des Kabinenpersonals auf transmeridianen Strecken. DLR-Forschungsbericht 2000-32.

Appendix: Time-Zone Changes and Acclimatization

A1 Introduction

- A1.1 The definition of acclimatization and the incorporation of provisions to cover unacclimatized aircrew present particular difficulties. This is due both to the complexity of the acclimatization process and its impact on sleep and fatigue, and also to the wide variation between different individuals and, indeed, between the same individual on different occasions.
- A1.2 An approach to this problem was discussed in Section 9, which included definitions for the FDP limits for unacclimatized crews (Table 3) and for the duration of the recovery period after return to base (Table 4). Although these definitions might be considered to be fairly complicated, they already involve some degree of simplification. They have been proposed as a compromise that avoids some of the extra complexity that would be required to represent the acclimatization process more fully.
- A1.3 This Appendix provides an example of how the subject of acclimatization might be addressed in more detail. In particular, it covers the extension of the definition to cover periods away from home base involving multiple duties and layovers at different locations. This is in response to a request made at the Review Meeting.
- A1.4 The following section (A2) introduces the issue of partial acclimatization, with an indication of how a table for maximum FDP might be constructed for partially acclimatized aircrew. This table is one of the components used in the calculation of maximum FDP on layover, which is the subject of Section A3. Section A4 covers the detailed calculations that are necessary to cater for multiple layovers.

A2 Partial acclimatization

- A2.1 During a relatively short layover (i.e. one of no more than 60 hours), it is likely that the phase of the body clock will remain close to base time. This would be the case particularly if the crews are mindful of the quick return and do not try to adapt to the local environment. In Section 9, it was suggested that the basic FDP table could be applied with some adjustment, to account both for some sleep disruption and for some small change in the circadian rhythm.

report time	23-1	1-3	3-5	5-6	6-7	7-8	8-12	12-14	14-17	17-23
acclimatized	10	9	10	11	12	13	14	13	12	11
partially acclimatized	9	9	9	10	11	12	13	12	11	10

Table A1: Limits (h) for acclimatized and partially acclimatized crews

A2.2 A simple way of implementing this would be to allow a reduction of say an hour in the limits for acclimatized crews, subject to the same overall minimum value. In Table A1, the limits in hours, calculated in this way, are shown alongside those of Section 3 (Table 1), based on the results of the Haj study. Tables involving a similar one-hour adjustment could be derived in the same way from any other acclimatized table.

A3 Maximum FDP on layover

A3.1 When the duration of the layover is longer than 60 hours it is unreasonable to assume that little adaptation has occurred, even if the crews then return immediately to base. After large time-zone transitions, there is likely to be a period during which the rhythm is changing rapidly, when its phase is uncertain and when, in some instances, its amplitude is significantly reduced. The greatest uncertainty arises after long eastward flights, when the sleep patterns of aircrew tend to be considerably disrupted.

A3.2 In these circumstances, it would be reasonable to limit the maximum FDP to its minimum value (based on the Table 1, this would be nine hours for a single-sector duty) for a number of days, until such time as the partially acclimatized table could be applied, based on local time. The exact number of days would depend on the number of time zones crossed and the direction of travel.

A3.4 Table A2 shows a scheme for calculating maximum FDP using this approach. It is essentially a more comprehensive version of Table 3 in Section 9. The various abbreviations are as follows:

- AL acclimatized limits based on local time;
- PB partially acclimatized limits based on base time
- PL partially acclimatized limits based on local time
- X minimum limit (e.g. nine hours).

time-zone transitions		duration of layover (h)							
eastward	westward	12-36	36-60 (returning to base)	36-60 (not returning to base)	60-84	84-108	108-132	132-156	156+
2	3-4	PB	PB	PL	AL	AL	AL	AL	AL
3-4	5-6	PB	PB	X	PL	AL	AL	AL	AL
5-6	7-8	PB	PB	X	X	PL	AL	AL	AL
7-8	9-11	PB	PB	X	X	X	PL	AL	AL
9-12	12	PB	PB	X	X	X	X	PL	AL

Table A2: Scheme for calculating maximum FDP (see text for details)

A3.5 A natural definition of acclimatization follows immediately from Table A2. A crew member can be considered to be ‘acclimatized’ when the table indicates that the acclimatized limits based on local time can be applied (i.e. where AL appears in the

table). It should not be assumed that all aircrew will have adapted completely within that time, and indeed some will adapt more rapidly. However, this definition and these limits should provide reasonable protection against the worst effects of circadian desynchronization.

A4 Layovers at multiple locations

- A4.1 Table A2 is only directly applicable to a single location on layover. However, aircrew may undertake a sequence of duties involving time-zone transitions before finally returning to home base. If they become acclimatized to local time while on layover, then that location can be treated at their new ‘base’ for the purpose of calculating maximum FDP. However, some provision is required to cover for consecutive layovers in which a crew member has not become acclimatized at any point. A possible way of addressing this problem is outlined in the remainder of this section.
- A4.2 If a crew member becomes partially acclimatized at any location before undertaking the next FDP, then it would be reasonable to base the calculations during the following layover on the assumption that they had been fully, not partially, acclimatized. However, if they are still unacclimatized when they start the next flight, then the basis for the calculation of maximum FDP during the subsequent layover period needs to be determined.
- A4.3 With the proviso that any set of rules is likely to give rise to anomalies and inaccuracies, I would propose the following:
- a) If the time-zone change on the second flight is less than two hours in either direction, then the additional effect of the second flight may be ignored: the duration of the second layover should be added to the first, and the maximum FDP should be based on the combined layover time, based on the first flight alone.
 - b) Otherwise, there will be a period of time during the second layover period when the minimum limit will need to be applied. This time should be based on two quantities: (i) the amount of time remaining during the first layover period before partial acclimatization would have been assumed, and (ii) the duration of the period of minimum FDP for the second flight based on Table A2, as if it were the only flight.
 - c) The values in (i) and (ii) should be added together when the second flight is in the same direction as the first, and subtracted if the flights are in opposite directions. This will determine the duration of the period of minimum FDP, and it would be followed, as in Table A2, by a 24-hour period during which crews would be assumed to be partially acclimatized to local time.
- A4.4 To illustrate the method of calculation, consider a sequence of flights between London and Auckland via Hong Kong, where London is on UTC time, Hong Kong is UTC+8 and Auckland UTC+13, and the layover times in Hong Kong, Auckland and Hong

Kong are three, two and three days respectively.

a) First layover in Hong Kong. This follows an eastward flight across eight time zones. After a layover of three days (72 hours) there would, according to Table A2, be a further 36 hours (108 less 72) before partial acclimatization would be assumed. The crews are therefore still unacclimatized and the residual period of 36 hours is carried forward to the next layover.

b) Layover in Auckland. This follows a five-hour transition in the same direction as the previous flight. From Table A2, a five-hour eastward transition has a 48-hour period with the minimum FDP. This is added to the value carried over (36 hours) to give a total of 84 hours. This is the period after landing in Auckland when the minimum FDP would be applied to the following flight. It would be followed by a period of 24 hours of partial acclimatization. However the duration of the layover in this example is two days, or 48 hours. The crews are therefore still unacclimatized, and the residual period of 36 hours (84 less 48) is carried forward to the next layover.

c) Second layover in Hong Kong. This follows a five-hour transition in the opposite direction to the previous flight. A five-hour westward transition has a 24-hour period where the minimum FDP applies. The difference between 24 and the carried-forward value of 36 hours is 12 hours, which is the length of time when the minimum FDP would be applied to the second layover in Hong Kong. For a layover between 12 and 36 hours the partial acclimatization rule would apply. However, the return flight occurs after three days, or 72 hours. At that stage the crews would be assumed to be fully acclimatized to Hong Kong time. Therefore the normal fully-acclimatized table would be applicable to the final flight.

A4.5 This discussion has highlighted the difficulty of incorporating scientific knowledge of the process of acclimatization into the regulations. However, as long as there is a requirement to operate disruptive schedules involving multiple layovers, it will be necessary to ensure that adequate protection is in place. An alternative to complex regulations, as in many other areas covered in this report, would be an approach based on FRM. The fatigue issues arising in schedules such as the one in the above example, could then be addressed by the equivalent of the city-pair methodology for ULR operations.