



NOTICE OF PROPOSED AMENDMENT (NPA) No 2010-14A

**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 on Flight and Duty Time Limitations and rest requirements
for commercial air transport (CAT) with aeroplanes'***

A. Explanatory Note and Appendices

NOTE: This NPA contains the draft Opinion on the Implementing Rules on Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes to be included as a Section VIII to Subpart OPS of Part-OR. It also contains a draft Decision with related acceptable means of compliance (AMC) and guidance material (GM). The NPA is split into four separate documents (2010-14A, 2010-14B, 2010-14c and 2010-14D) as indicated in the Table of Reference below. The documents are published in the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>.

TABLE OF REFERENCE FOR NPA 2010-14:

A.	EXPLANATORY NOTE:	SEE NPA 2010-14A
	I. GENERAL	SEE NPA 2010-14A
	II. CONSULTATION	SEE NPA 2010-14A
	III. COMMENT RESPONSE DOCUMENT	SEE NPA 2010-14A
	IV. CONTENT OF THE DRAFT OPINION AND DECISION	SEE NPA 2010-14A
	V. REGULATORY IMPACT ASSESSMENT	SEE NPA 2010-14A
	VI. EXPLANATORY MEMORANDUM ON PART-OR SUBPART OPS	SEE NPA 2010-14A
B.	REGULATORY IMPACT ASSESSMENT:	SEE NPA 2010-14B
C.	DRAFT OPINION AND DECISION:	
	I. DRAFT OPINION PART-OR (SUBPART OPS)	SEE NPA 2010-14c
	II. DRAFT DECISION AMC AND GM TO PART-OR (SUBPART OPS)	SEE NPA 2010-14c
D.	CROSS-REFERENCE TABLE:	SEE NPA 2010-14D

TABLE OF CONTENTS FOR NPA 2010-14A:

I. GENERAL	3
II. CONSULTATION	3
III. COMMENT RESPONSE DOCUMENT	4
IV. CONTENT OF THE DRAFT OPINION AND DECISION	4
V. REGULATORY IMPACT ASSESSMENT	15
VI. EXPLANATORY MEMORANDUM ON PART-OR SUBPART OPS	17

A. EXPLANATORY NOTE**I. General**

1. The purpose of this Notice of Proposed Amendment (NPA) 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 Acceptable Means of Compliance (AMC) and Guidance Material (GM). The scope of this rulemaking activity is outlined in the Terms of Reference (ToR) OPS.055 and is described in more detail below.
2. The European Aviation Safety Agency (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 Regulation¹ 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)].
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'².
4. This rulemaking activity is included in the Agency's 2010–2013 Rulemaking Programme. It implements the rulemaking task OPS.055.
5. The text of this NPA has been developed by the Agency, based on the input of the OPS.055 rulemaking groups. 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.

II. Consultation

6. To achieve optimal consultation, the Agency is publishing the draft opinion and draft decision of the Executive Director on its internet site. Comments should be provided

¹ 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).

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.

within 3 months in accordance with Article 6(5) of the Rulemaking Procedure. Comments on this proposal should be submitted by one of the following methods:

CRT: Send your comments using the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>

E-mail: **Only** in case the use of CRT is prevented by technical problems these should be reported to the [CRT webmaster](mailto:CRT_webmaster@easa.europa.eu) and comments sent by email to NPA@easa.europa.eu.

Correspondence: If you do not have access to internet or e-mail you can send your comments by mail to:

Process Support
Rulemaking Directorate
EASA
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be received by the Agency before **20 March 2011**. If received after this deadline they might not be taken into account.

III. Comment Response Document

- All comments received in time will be responded to using a comment response summary table (CRST), which includes in a single document a summary of comments received, the Agency responses and the amended text, where relevant. This table will be incorporated in a comment response document (CRD) and will be available on the Agency's website and in the Comment-Response Tool (CRT).

IV. Content of the draft Opinion and Decision

Scope

- This NPA includes a proposal for Implementing Rules (IR), 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.

Background

- The FTL requirements laid down in Subpart Q of EU-OPS, and applicable to commercial air transport with aeroplanes, are the result of long-lasting negotiations based on operational experience. Therefore, the European Parliament and the Council when adopting Regulation (EC) No 1899/2006 specifically requested EASA to conduct a scientific and medical evaluation of Subpart Q [ref. Regulation (EC) No 3922/91 new Article 8(a)] and 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.'

- To complete this task, the Agency established an FTL Advisory Group representing the affected stakeholders, to provide recommendations on how the said evaluation should be completed. Taking into account that a number of key elements of Subpart Q were widely accepted and some elements needed more attention than others, the FTL Advisory Group

identified 18 elements to be addressed, including the points within Subpart Q still subject to national provisions.

11. The scientific FTL experts who completed the evaluation reached a consensus on the 18 key elements, which were published in a report compiled by Moebus Aviation. The related report included various conclusions that could broadly be described as 'recommendations, precautions, advice, guidance, questions and needs for further scrutiny or dedicated research'. This report triggered discussions from different interest groups with contradicting views about its conclusions.
12. This report was forwarded to the Commission and published by EASA but, due to time constraints and the need for a full assessment including any relevant aspects in addition to those relating to flight safety, the elements resulting from the above-mentioned report could not be included into the proposals laid down in the NPA 2009-02 on operations, which was published by the Agency on 30 January 2009.
13. Considering the follow-up of the Moebus report, the Commission tasked the Agency to complete the necessary rulemaking activity taking into account recent scientific evidence and to consider it as a priority task.
14. The Terms of Reference (ToR) of Rulemaking Task OPS.055 were published on 20 November 2009 and required the Agency in particular:
 - To fulfil the task as required by the legislator taking into consideration all relevant recent publicly available studies/evaluations and operational experience:
 - by reviewing the flight and duty time limitations and rest requirements specified in Subpart Q;
 - by addressing those areas/points in EU-OPS Subpart Q currently subject to national provisions in accordance with Article 8(4) of Council Regulation (EEC) No 3922/91 (e.g. extended FDPs with augmented flight crew, split duty, time zone crossing, reduced rest and standby);
 - by submitting regulatory proposals (IR, CS, AMC, GM) based on the preferred option retained after completion of a regulatory impact assessment; and
 - by reviewing and clarifying accordingly the proposed Authority (NPA 2009-02d) and Organisation (NPA 2009-02c) requirements regarding the development and modification of individual schemes and the process for their approval, and the use and role of a Fatigue Risk Management System (FRMS) in relation to an operator's safety management system (SMS) and to the use of individual schemes.
 - To carefully evaluate the impact of the regulatory solutions envisaged and to provide a comprehensive Regulatory Impact Assessment encompassing flight safety as well as other relevant aspects, such as economic and social.
 - To take account of all relevant recent and publicly available scientific and/or medical studies/evaluations and operational experience, as well as the conclusions drawn from the discussions on Subpart Q by the Air Safety Committee, relevant comments to NPA 2009-02, experience gained in requests for derogations to Subpart Q, any amended ICAO SARPS, and international developments. In particular, the outcome of the ICAO Fatigue Risk Management System Task Force was to be considered.
15. As required by the ToR, the Agency set up a Rulemaking Group to support it in drafting the NPA. The Rulemaking Group was composed of a representative membership, including National Aviation Authorities (NAA), Airlines and Flight and Cabin Crew representatives. It also included an observer from the European Commission.
16. The first Rulemaking group meeting took place on 4 December 2009. In total ten plenary meetings were held until 30 November 2010. In May 2010 a dedicated 'RIA Subgroup' was set up with the view to defining the elements to be covered by the Regulatory

Impact Assessment (RIA). Between May and end of August 2010, four Subgroup meetings were held in addition to the ten plenary meetings mentioned above.

17. FTL provisions for all operations (CAT with aeroplanes, but also CAT with other-than-aeroplanes and non-CAT operations) were originally included in NPA 2009-02 and were as such commented on by stakeholders. Therefore this NPA supersedes the proposals for CAT with aeroplanes from NPA 2009-02. In order to ensure the consistency of the future FTL regulations, the comments to the draft FTL provisions from NPA 2009-02 and this NPA will be reviewed concurrently. This will result in a single Comment Response Document (CRD) and a single Opinion for FTL provisions. The CRD is scheduled to be published in the second quarter of 2011 and the Opinion will be delivered during the fourth quarter of 2011.

Safety data

18. Accidents and serious incidents are important high-level safety indicators ('1st tier indicators', as described in the RIA). As a first step it is therefore important to look into this data as it can also give an indication of the potential benefits of rule changes. A rule change could improve the fatigue risk mitigation and thereby reduce the number of accidents and serious incidents in the future by minimising contributing factors such as degraded performance and human errors.
19. When collecting data it is crucial to collect only such accidents and incidents on which the proposed rule could possibly have had an impact. Therefore, the Agency's Safety Analysis Department extracted from the European Central Repository records with the following criteria:
 - EASA-country registered fixed-wing aircraft;
 - Commercial Air Transport;
 - Period 2000–2010;
 - Narrative containing mention of 'crew fatigue'.
20. The period of 10 years was chosen in order to capture accidents and incidents under recent national FTL regulations, upon which EU-OPS is based to a certain extent, therefore in a context comparable to the one under current EU-OPS Subpart Q. Subpart Q itself has only been in force since 2008.
21. When assessing this data, it is to be borne in mind that focussing on the narrative specifically mentioning 'crew fatigue' risks missing fatigue-related incidents. Another possibility would have been to use the term 'human factor' as behind a human factor fatigue might be a contributing element, but then the risk would have been to overestimate the number of fatigue-related incidents. Also, many operators operate according to their collective labour agreements with air crew, containing further mitigating measures beyond the legal requirements of Subpart Q (or national regulations), which could explain the relatively low number of identified events (see below). Finally, fatigue is an issue that is traditionally under-reported by aircrew, as (self) assessing fatigue is generally a difficult exercise.
22. By applying this rather conservative approach, the Agency found two accidents and eight serious incidents involving three fatalities. However, in both accidents the crew operated outside the legal limits. In one case the FDP was exceeded by almost three hours and in the other case the crew did not respect the minimum rest period. These accidents therefore indicate that oversight is a key issue when looking at crew fatigue rather than the rules themselves.
23. The Accident Investigation report on one serious incident indicates that an arrangement of economy seats may be an inadequate in-flight rest facility. On the whole this data contains a number of note-worthy facts related to fatigue, but
 - the data is statistically insufficient to directly deduct potential benefits of rule changes;

- the data is statistically insufficient to detect current and future safety risks, in particular as more fatigue risks may be masked under human factor related incidents or as they are not reflected at all in this data.

As a result, the Agency decided to follow a pro-active and predictive approach and base the development of EASA FTL rules on a process of hazard identification and safety risk management as described below in 'Chapter V — Regulatory Impact Assessment'.

Structure

24. The Subpart Air Operations of Part Authority Requirements (Part-AR) contains the requirements for national competent authorities, specific to air operations (in addition to Subpart AR.GEN). The Subpart AR.OPS contains four sections dealing with general requirements, certification of commercial air operators, specific operations approvals and the approval of flight time specification schemes.
25. The Subpart Air Operations of Part-Organisation Requirements (Part-OR) is applicable to non-commercial operators with complex motor-powered aircraft and all commercial operators and is divided into 9 sections:

Section I	Operator requirements (OR.OPS.GEN.001)
Section II	Manuals, logs and records (OR.OPS.MLR.001)
Section III	Air operator declaration (OR.OPS.DEC.001)
Section IV	Air operator certification (OR.OPS.AOC.001)
Section V	Flight crew (OR.OPS.FC.001)
Section VI	Cabin crew (OR.OPS.CC.001)
Section VII	Technical crew (OR.OPS.TC.001)
Section VIII	Flight and Duty Time Limitations and Rest Requirements (OR.OPS.FTL.001)
Section IX	Security (OR.OPS.SEC.001)

The following graph provides an overview of EASA's overall rulemaking structure and the rulemaking structure for organisation requirements, which includes the proposed FTL requirements.

Table 1: Overview of the EASA Rule structure

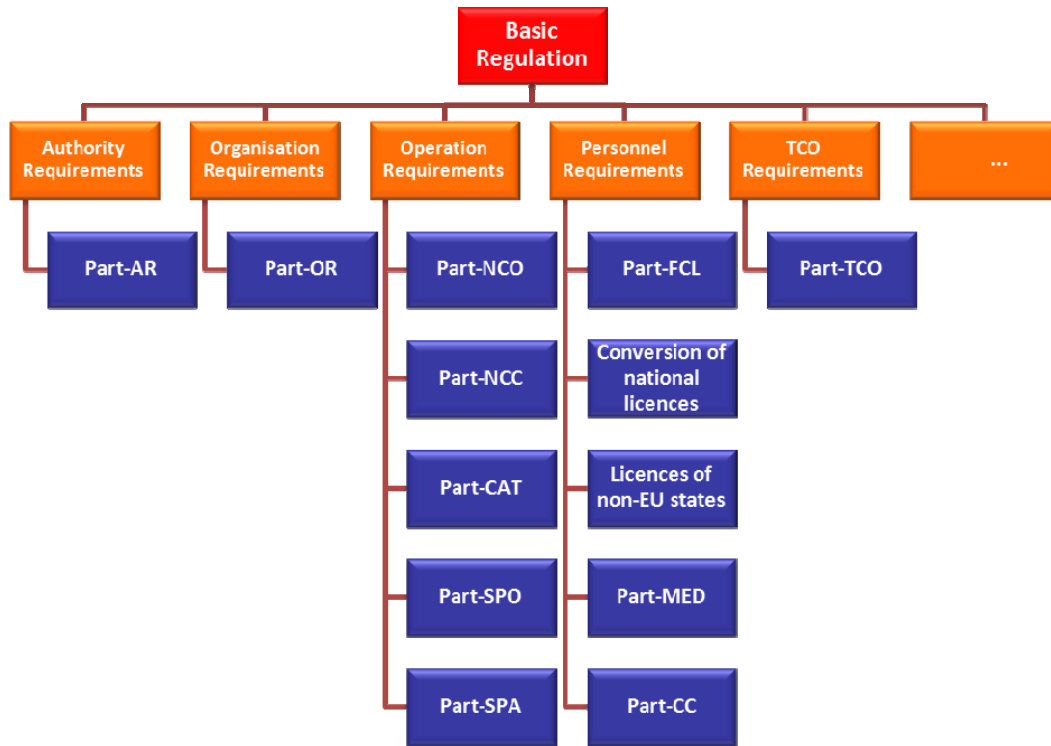
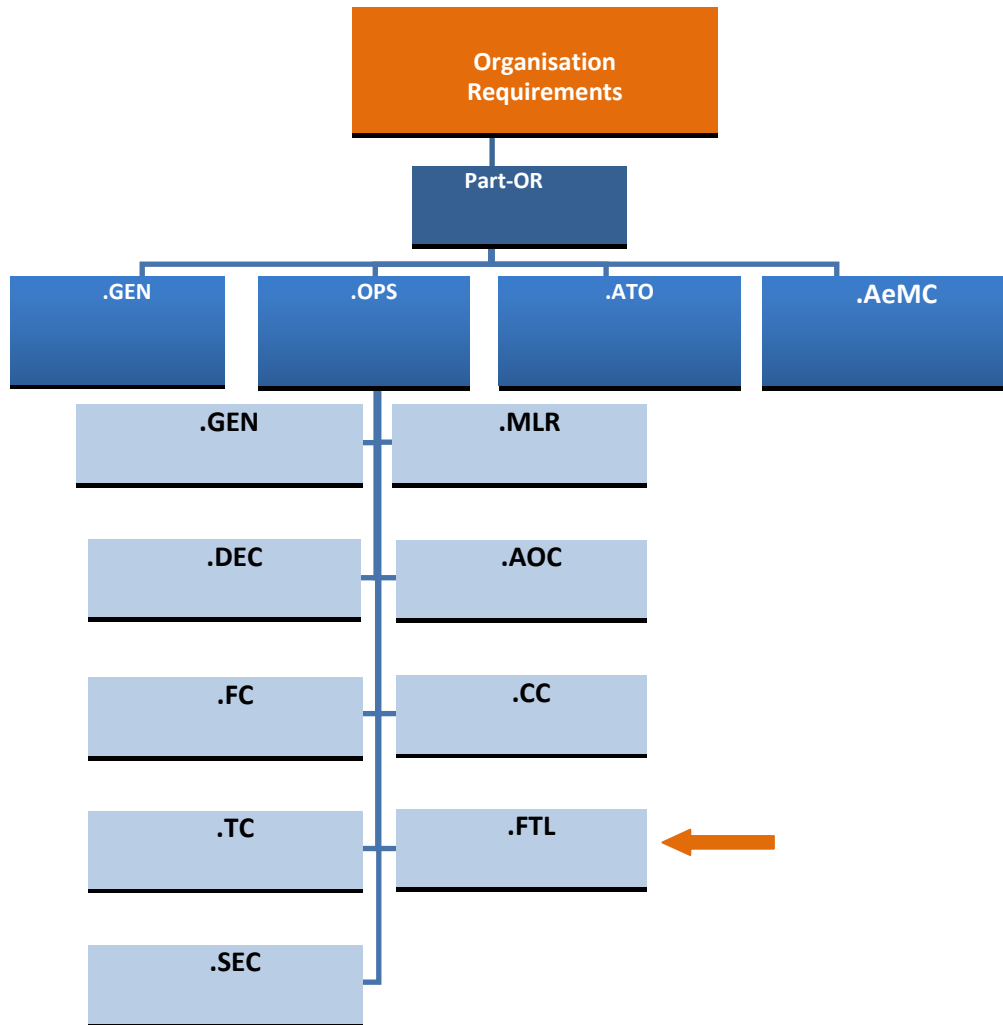


Table 2: Overview of Part OR.OPS Rule structure

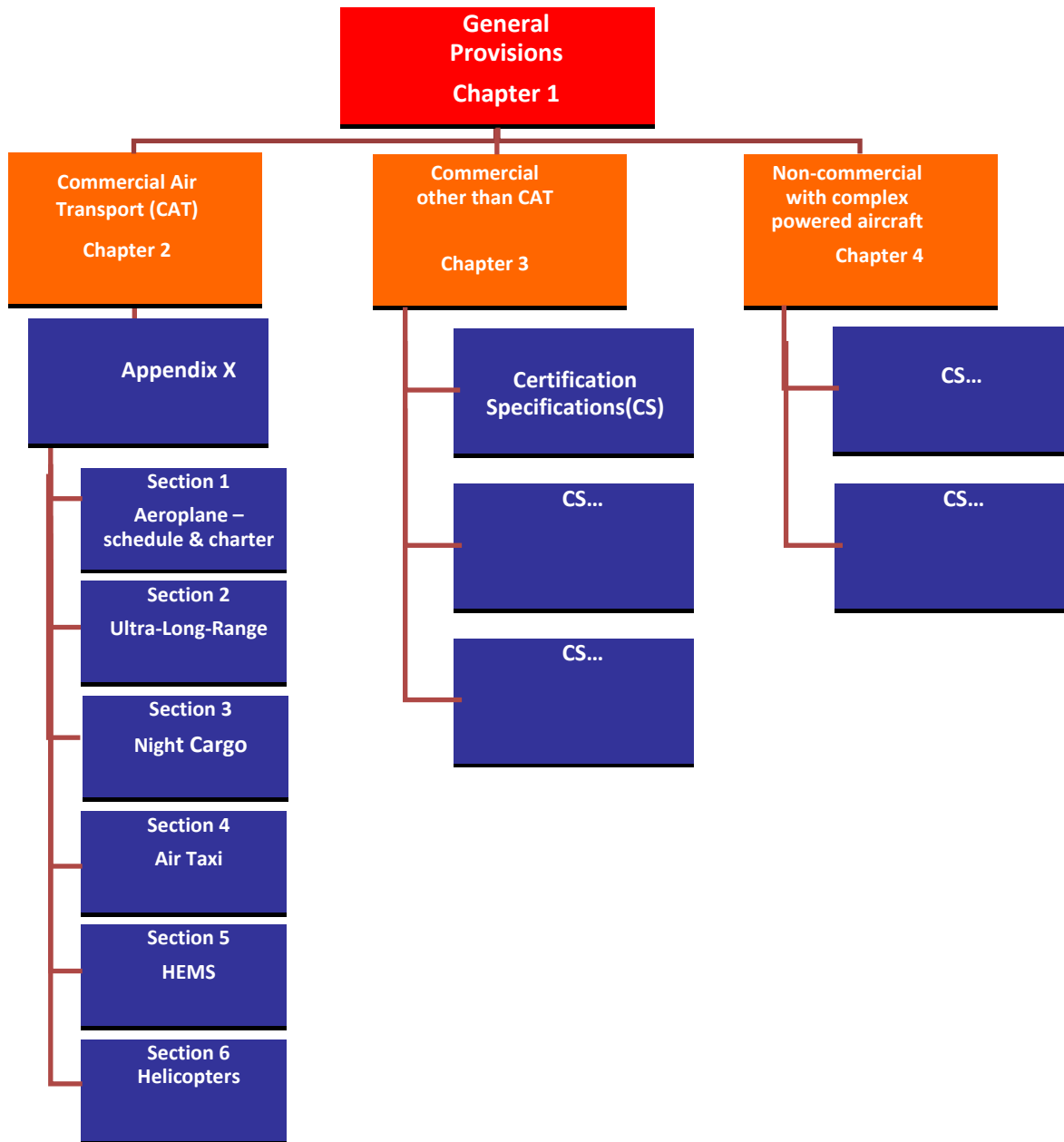


26. Flight and Duty Time Limitations and Rest Requirements are included in Section VIII of Subpart OPS of Part.OR. Section VIII is divided into four chapters, and includes several appendices:

Chapter 1 includes general provisions applicable to non-commercial operators with complex motor-powered aircraft and all commercial operators. It includes in particular a definition section, addresses Operators' responsibility and includes provisions on Fatigue Risk Management.

Chapter 2 includes general provisions applicable to commercial air transport operators with all aircraft types. It addresses in particular requirements on home base, flight duty period, flight times and duty periods, positioning duty, split duty, standby duty, rest periods, nutrition and records.

Chapters 3 and 4 are reserved for the moment. They will include general provisions applicable respectively to Commercial Operators other than CAT and Non-Commercial Operators with Complex Motor-Powered Aircraft. The content of these chapters has already been consulted under NPA 2009-02, although not under the structure currently proposed by this NPA 2010-14A. As noted in paragraph 17, the CRD on FTL requirements will address both comments received under this NPA 2010-14A for Commercial Air Transport and the comments received under NPA 2009-02.

Table 3: Overview of sections in this NPA

27. Appendix X to OR.OPS includes in its section 1 specific Flight and Duty Time Limitations and Rest Requirements for Commercial Air Transport by Aeroplane — Scheduled and Charter Operations. It contains the detail of the requirements addressed in Chapter 2.
28. Additional Sections (2 to 7) are planned, addressing detailed requirements for Ultra Long Range Operations, Sole Night Operations, Air Taxi Operations, Emergency Medical Service (EMS) Operations, Single Pilot Operations and Helicopter Operations. This NPA does not include proposals for these operations. They will be addressed by a future Rulemaking Task (OPS.071).
29. The structure of AMC and GM follows the structure of the Implementing Rules. For each AMC or GM subheadings have been assigned to clarify the content of the applicable material.

'Hard Law' vs 'Soft Law'

30. The question whether FTL requirements for Commercial Air Transport by Aeroplane should be addressed through 'Hard Law' (Implementing Rules) or 'Soft Law' (Certification Specifications) was discussed by the Rulemaking Group.
31. In essence, the difference between these two approaches is the flexibility provided and the fact that derogations from Implementing Rules have to be processed under Article 14(6) of the Basic Regulation (BR) (approval by the European Commission after consultation of the EASA Committee and scrutiny by the European Parliament and the Council), while deviations from a Certification Specification have to be processed under Article 22(2) of the Basic Regulation (approval of individual schemes by the Member State and validation by the Agency).
32. Article 22(2) of the Basic Regulation offers the Agency the possibility to use Certification Specification (CS) to address FTL requirements in the following terms: *'with regard to flight time limitation, the Agency shall issue applicable flight time limitation CS to ensure compliance with the related Implementing Rules taking into account the latest scientific and technical evidence. Member States may approve individual flight time specification schemes, which deviate from those issued by the Agency, but in this case they shall inform the Agency, the Commission and other Member States. The Agency shall within one month assess the individual scheme. If a Member State disagrees with the Agency's conclusions, it shall refer the issue to the Commission. The content of individual schemes, which are acceptable to the Agency or on which the Commission has taken a positive decision, shall be published.'*
33. Article 22 of the Basic Regulation also specifies that initially the implementing rules shall include all substantive provisions of Subpart Q of Annex III to Council Regulation (EEC) No 3922/91, taking into account the latest scientific and technical evidence.
34. On the basis of this latter provision, the majority of the members of the Rulemaking Group, including the Flight and Cabin Crew Representatives and the Airline Associations, expressed the opinion that FTL requirements for Commercial Air Transport by Aeroplane should be addressed only through Hard Law. Concerns were also expressed that full standardisation and level playing field could not be achieved through Certification Specifications.
35. The Agency is not of this opinion, because it considers that the provisions of Article 22 (individual schemes) provide at least the same level of control than Article 146 (derogations). However it decided to follow the opinion of the Rulemaking Group in order to obtain stakeholders' adherence.
36. Finally it should be noted that, considering the outcome of the consultation of NPA 2009-02, the Agency may maintain the use of Certification Specifications for Commercial Operations other than Commercial Air Transport and Non-Commercial Operations of Complex Motor-Powered Aircraft.

Differences with ICAO

37. The need to regulate flight time and rest periods to control and mitigate the effects of fatigue is recognised internationally. ICAO published these rules in Parts I, II and III of Annex 6. According to this document, crew members' fatigue issues are treated equally with other important issues like sickness or lack of oxygen during flight. The proposed Implementing Rules related to FTL requirements are in accordance with the ICAO provisions. ICAO Annex 6 also requires the flight time limitations to be based on scientific evidence, where available. While the Agency's Regulatory Impact Assessment aimed at collecting and assessing such available evidence, the rulemaking group did not gather direct input from scientists to validate the RIA's conclusions and their translation into the NPA. However, such input is planned for the period between January and June 2011 during the NPA Comment Review period.

Impact of new EASA rules on different national FTL schemes and provisions contained in Article 8 of EU OPS

38. Rules on flight and duty time limitations and rest requirements are laid down in Subpart Q of Annex III to the EU OPS Regulation³. The regulation lays down harmonised rules by setting a minimum safety level. However some elements of subsidiarity⁴ remain in Subpart Q. In particular, there are several cases where different rules apply in different Member States for the following reasons:
- EU OPS ensures a set of legally binding minimum requirements, but individual EU countries can apply stricter FTL rules at national level. This is allowed by recital 11 of Regulation (EC) No 1899/2006 in the following terms: *'Member States should be able to continue to apply national provisions on flight and duty time limitations and rest requirements for crew members, provided that the limits established by such national provisions are below the maximum limits and above the minimum limits laid down in Subpart Q of Annex III.'*
 - Recital 7 of Regulation (EC) No 1899/2006 also contains a so-called 'non regression' clause specifically applicable to Subpart Q, which allows Member States to maintain collective labour agreements or national legislation more favourable than those laid down in Subpart Q.
 - Subpart Q today does not cover some elements of flight time limitations, such as split duty, augmented crew and standby. These areas 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.
39. Under the Basic Regulation, the above elements of subsidiarity should not be allowed anymore, as the Basic Regulation mandates the development of fully harmonised aviation safety regulations. The impact of EASA's rulemaking task to prepare a new 'proposal for the modification of the applicable technical provisions of Subpart Q of Annex III' as foreseen in Article 8a of EU OPS is therefore twofold.
- Firstly, under the new regulatory framework the possibility to apply stricter FTL rules at national level is removed.
 - Secondly, the new rules will fill the gaps that were left by default to the national legislator and will therefore harmonise FTL rules across Europe.

Comparison with EU-OPS Subpart Q

40. In order to facilitate the assessment of changes implied by the proposals attached in comparison with the existing regulatory framework, the Agency has prepared cross-reference tables to help the comparison between the proposed requirements and EU-OPS Subpart Q, which can be found in Section D to this NPA (see NPA 2010-14D).

Flight Time and Pilot Rest Requirements in the United States

41. Regulations limiting flight time and pilot rest requirements have been in place in the United States since the 1940s. Compared to the European legal requirements contained in EU-OPS Subpart Q, the current US rules are less specific and leave more room for interpretation. As an example, they do not address the amount of time a pilot can be on duty. The US regulation is based on an 8 hour flight time duty and currently does not take into account circadian rhythms and operations with multiple take-offs and landings. It also distinguishes between domestic and international flights.

³ Regulation (EEC) No 3922/91 (OJ L 373, 31.12.1991, p. 4), as last amended by Regulation (EC) No 859/2008 (OJ L 254, 20.9.2008, p. 1).

⁴ *'The principle of subsidiarity is defined in Article 5 of the Treaty establishing the European Community. It is intended to ensure that decisions are taken as closely as possible to the citizen and that constant checks are made as to whether action at Community level is justified in the light of the possibilities available at national, regional or local level. Specifically, it is the principle whereby the Union does not take action (except in the areas which fall within its exclusive competence) unless it is more effective than action taken at national, regional or local level. It is closely bound up with the principles of proportionality and necessity, which require that any action by the Union should not go beyond what is necessary to achieve the objectives of the Treaty.'* (source: Europa Glossary).

42. For domestic flights the regulation generally limits pilots to 8 hours of flight time during a 24-hour period. This limit may be extended provided the pilot receives additional rest at the end of the flight. For domestic operations a minimum rest requirement of 8 continuous hours of rest during the 24-hour period is also required.
43. For international flights that require more than 12 hours of flight time, air carriers must establish rest periods and provide adequate sleeping facilities outside of the cockpit for in-flight rest.
44. On 14 September 2010 the FAA issued a new legislative proposal in the form of a Notice of Proposed Rulemaking (NPRM) on Flight time limitations and rest requirements for commercial air transport. An update of the existing flight time limitation and rest requirements has been triggered by recommendations of the US National Transportation Safety Board (NTSB) following investigations into a number of accidents and incidents, where the NSTB identified pilot fatigue as one of the contributing factors.
45. The US NRPM has been inspired by the regulations currently in place in Europe (in particular CAP 371, and to a certain extent EU-OPS Subpart Q), as well as scientific research. It proposes, among others:
- A single rule for domestic, international and unscheduled flights.
 - Increased rest requirements.
 - Weekly and monthly (28 days) cumulative fatigue limits as well as weekly and yearly limits on the amount of time a pilot may be assigned any type of duty.
 - 30 consecutive hours of off-duty time every week.
 - A number of requirements on maximum flight duty periods based on time of day taking into account the circadian rhythm, number of scheduled segments, time zones and in-flight rest.
 - Standby duty requirements.
 - FDP extension and a minimum rest reduction at commander's discretion.
 - A possibility for operators to exceed any of the provisions under Fatigue Risk Management (FRM).
46. When reviewing this NPA, the reader will be tempted to make comparisons between the EASA NPA and the FAA NPRM. However, the individual elements of this draft NPA and the FAA NPRM proposal should not be compared in isolation. For instance, with respect to maximum allowed flight duty periods and rest requirement:
- The EASA NPA is more protective at reporting times between 14:00 to 17:00.
 - The NPRM is more protective when the WOCL is encroached (09:00 hrs max FDP vs 11:00 hrs).
 - The EASA NPA prescribes rest in function of the preceding duty period, the NPRM only defines a standard sleep opportunity of 9 hours. The NPA is also more protective in terms of weekly rest (36 hours including 2 local nights, vs 30 hours).
 - NPRM does not reduce FDP up to 4 sectors.

On the whole the overall level of protection might be comparable as both schemes have a similar approach, but lay different emphasis on FDP limits and rest requirements.

Transitional measures

47. Transitional measures for the entry into force of the new requirements will need to be included in the Cover Regulation which will accompany the implementing rules, taking into account the time needed to prepare their implementation. However, such provisions can only be elaborated when more is known about the exact content of the final rule and its impact; as a consequence this NPA does not include detailed proposals on how the transition from EU-OPS Subpart Q and national requirements under Article 8 of EU OPS to the Implementing Rules will take place. This will be further elaborated in the CRD and will

be included in the Agency's final Opinion. To be in a position to prepare such measures the Agency would like to know the views of stakeholders in this respect.

V. Regulatory Impact Assessment

48. According to the formal Rulemaking Procedure of the Agency⁵, a full regulatory impact assessment (RIA) had to be introduced as a part of any proposed new rule.
49. The aim of the RIA is to determine the best option to achieve the objective of a rulemaking activity while minimising potential negative impacts. It consists of a series of five logical steps that structure the analysis: issue identification, objective definition, option development, impact analysis and option comparison. By providing transparent and evidence-based analysis of the advantages and disadvantages of the rule options against the defined objectives, decision-makers and stakeholders have a solid reference framework for discussion and informed evidence-based decisions. It should be noted however that not all detailed provisions have been assessed by the RIA; in this case, this is highlighted in this explanatory note.
50. The methodology for comparing the options in Agency RIAs is not prescribed. In the past the Agency applied different methodologies in order to determine the preferred option, including Cost-Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA). When applying CBA a crucial element is to identify accidents and incidents that could be avoided by introducing the new rule in order to estimate the expected benefits. However, as regards fatigue as a causal or contributing factor, the Agency could not draw on statistically representative data on accidents⁶ and serious incidents for European operators where fatigue was specifically cited in the narrative. Where fatigue was identified as a contributing factor it would also be necessary to establish a certain percentage of contribution. No information was available on which this percentage could be based.
51. However, the lack of statistically representative data on reported fatigue-related accidents/serious incidents for European operators does not necessarily mean that all mitigation measures are fully effective. Instead of the reactive approach underlying the CBA, it was decided within the OPS.055 rulemaking group to apply a more pro-active methodology based on Safety Risk Management and MCA that would allow identifying benefits based on hazards and their mitigation. As a first step, an inventory of fatigue hazards (e.g. high cumulative workload) was developed. Based on this, all mitigation measures addressing the hazards (e.g. rolling limits on duty and flight duty periods) known to the group of FTL experts were listed. The options to be assessed in the RIA were then based on the specific limits the mitigation measures could prescribe (e.g. no more than 60 duty hours in 7 consecutive days). For this reason, the RIA looks at different options at a very detailed level and tries to identify improvements at this level rather than comparing the current scheme to a totally different one.
52. The reference point (Option 0) of the assessment was EU-OPS Subpart Q, which is considered a comprehensive FTL scheme which already provides a certain standard of fatigue-risk mitigation. The task of this rulemaking effort was thus not to entirely replace this scheme, but to identify possible weaknesses in the system and to rectify them.
53. The safety assessment of the derived options was based on scientific evidence put together by the rulemaking group as well as on a limited exercise of ad hoc scenario-based modelling of fatigue risks related to some of the proposed rules, using the SAFE model. The SAFE model is currently considered to be the only validated model to assess most fatigue risks in aviation. Where available, information from Air Accident Investigation Boards (AAIB) was considered. All other impacts were assessed using a mix of qualitative and quantitative methods.

⁵ See footnote 2 above.

⁶ As mentioned in paragraph 21, there were two accidents identified with fatigue as a contributing factor, but in those cases the crew operated outside the allowable FDP limits or did not respect the minimum rest requirements.

54. The individual options were then compared using the MCA methodology. Essentially, the MCA applies cost benefit thinking to cases where there is a need to compare impacts that are a mixture of qualitative, quantitative and monetary data, and where there are varying degrees of certainty. Positive and negative impacts of the proposed rule on safety, environmental, social, economic and regulatory issues are thus compared by a transparent scoring system.
55. Based on the primary objective of the Agency to ensure 'a high uniform level of safety' the identified impacts on safety received a higher weight than other impacts.
56. The results of the MCA should not be seen as a mathematical result, but rather as an effort to make transparent the considerations of the experts and the final assessment of the Agency.
57. In order to ensure that the scoring is used consistently and the results are robust a sensitivity analysis was conducted to identify what aspect drives the final result.
58. When looking at the positive (safety benefits) and negative (economic, social) impacts of different FTL options it is crucial to define the reference against which to measure these effects. For this RIA the reference is the FTL requirements in EU-OPS Subpart Q. This means that some of the potential safety benefits will be overestimated because in reality some Collective Labour Agreements (CLA) already provide — sometimes significantly — a higher level of protection than Subpart Q. The same is true for negative effects on the economic or social side which may not be as high as estimated due for example to the additional costs already implied in a CLA. The task of the Agency is to ensure that any rule provides a uniform high level of safety irrespective of CLAs as any operator may chose to operate purely to the applicable FTL scheme. This RIA therefore does not explicitly take into account CLAs and assumes that the potential over-estimates on safety benefits are neutralised by the potential over-estimation on the cost-side. On the other hand, it is acknowledged that the wide-spread existence of CLAs will also have a 'cushioning' effect on the potential cost implications a rule change might have on airlines' operations.
59. While conducting the Regulatory Impact Assessment and the review of publicly available scientific research, the Agency identified a number of subjects for which further research might be needed:
 - o Health effects of long duty periods followed by long rest periods;
 - o The cumulative effect of regular consecutive duties of more than 10 hours by day and 7 hours by night;
 - o The cumulative effect of duty of more than 100 hours per 14 days;
 - o The possible impact of the high level of sectors (>6) on crew alertness;
 - o The impact of disruptive schedules on cumulative limits;
 - o The use of economy seats as in-flight rest facility;
 - o The combination of Split Duty with augmented crew, time zone crossing;
 - o The combination of non-acclimatisation with split duty;
 - o The combination of Split Duty with FDP extension by in-flight relief rest;
 - o The impact of standby other than at the airport on allowable FDP and calculated DP;
 - o The appropriate mitigating measures for early-to-late and late-to-early transitions;
 - o The effectiveness of Subpart Q provisions for (partially) non-acclimatised crew;
 - o The appropriate mitigating measures for Eastward-Westward and Westward-Eastward time zone transitions.

The need to conduct further research on these subjects will be further assessed by the Agency on the basis of the comments received from this NPA.

60. The Rulemaking Group also identified subjects for the development of additional Guidance Material (GM), although some group members felt some of those subjects should be covered by legally binding rules. The development of GM not being a priority as opposed to the development of implementing rules, these subjects will be addressed by a future Rulemaking Task. The Group identified the following areas:
- Guidance on the protection of the 8 hours sleep opportunity in case of long duty.
 - Avoiding the combination of Simulator Training/Cabin Crew Safety Training in the same Flight Duty Period.
 - Fatigue management countermeasures for long-range flying.
 - The use of models and scales to measure fatigue, e.g. Samn-Perelli.
 - Operators' policy in term of short recuperative breaks (e.g. 10mn/3hrs for Cabin Crew).
 - In-flight rest: avoid returning to the controls within 30 minutes of waking, after bunk rest.
 - Highlighting operating or relief crew on the roster for augmented crew operations (Industry best practice).
 - Exceeding max FDP: adapting schedules after season while adapting crewing arrangements (i.e. augment crew, change crew at stopover) after shorter period.
 - The best start time to optimise crew alertness on flights with augmented crew, based on CAP 371 13.3.
 - NAA oversight of commander's discretion.
 - Rest break optimisation in function of circadian rhythms.
 - Optimisation of rest period scheduling in combination with significant Time Zone Crossing (e.g. guidance material in CAP 371 on periods between 18 and 30 hours to be avoided).

The need for guidance material is further discussed in the RIA.

VI. Explanatory memorandum on Part-OR Subpart OPS

61. The purpose of this memorandum is to provide more detailed explanations on the proposed Implementing Rules for Organisations on Flight and Duty Time Limitations and Rest Requirements than the ones offered in the general part of the Explanatory Note to this NPA.
62. While stakeholders are invited to comment on all aspects of this NPA, including the explanatory note and the RIA, the Agency has identified several subjects where the views of stakeholders are more particularly needed. These issues are identified as 'Questions' to stakeholders in the text below.
63. The Basic Regulation requires all operators to ensure that the performance of crew members will not deteriorate to the extent that flight safety is endangered because of the effects of fatigue. Operators are required to provide rest periods for crew members in order to overcome the effects of previous duties. For commercial operations and non-commercial operations with complex motor-powered aircraft limitations to flight time, flight duty periods and rest periods shall be specified in the operations manual. Crew member's fatigue management should be implemented through a rostering system. Such a system shall take into account the number of sectors flown, time zone crossing, sleep deprivation, disruption of circadian cycles, night hours, positioning, cumulative duty time for given periods of time, sharing of allocated tasks between crew members and possible crew augmentation.
64. The Implementing Rules which should supplement the above described provisions, taking into account EU-OPS — as specifically required by the Basic Regulation — and available

scientific evidence, are included in Part CAT Subpart GEN and in a dedicated section of OR.OPS.

65. The FTL requirements in general are the same for flight, cabin crew and technical crew with very few marginal differences.

Section VIII — Flight and Duty Time Limitations and Rest Requirements (OR.OPS.001.FTL)

66. The general chapter specifies the scope of rule and defines the terms used in the document. Provisions of this chapter should be applicable to all types of operators (commercial or not).

Chapter 1 — General

Scope (OR.OPS.FTL.100) and Applicability (FTL.1.200)

67. Due to the rule structure, the scope of OR.OPS.FTL Chapter 1 covers all operations and Chapter 2 covers all commercial air transport operations. Therefore these chapters will need to be reviewed when Flight Time Limitations regulations will be developed for these types of operations. This will be the purpose of the Rulemaking Task OPS.071, as defined by the EASA Rulemaking Programme.
68. FTL.1.200 applies to commercial air transport operations by aeroplanes, other than Air Taxi, EMS and single pilot operations, in conjunction with the scope defined in OR.OPS.FTL.100. After carefully reviewing possible requirements to manage fatigue for Air Taxi Operators, the Rulemaking Group concluded that the current provisions of Subpart Q were not adapted to this kind of operations. The Group consequently proposed that Air Taxi Operations needed to be addressed separately. This will be taken care of by Rulemaking Task OPS.071. The same applies to EMS and single pilot operations.

Definitions (OR.OPS.FTL.105)

69. Definitions to be used for the purposes of Subpart Q are described in paragraph *OPS 1.1095*. This paragraph is transposed into OR.OPS.FTL.105. There are some new definitions introduced and some differences with definitions laid down in ICAO Annex 6 Part I. The majority of definitions proposed in Paragraph *OPS 1.1095* are still subject to discussions of the ICAO Operations Panel Working Group as, for example, a definition of 'Standby'. Therefore, some definitions already proposed in Subpart Q may be harmonised with ICAO definitions after their review by the ICAO Air Navigation Commission.
70. A few definitions were added to those included in Subpart Q, or amended, as explained below:

'Acclimatised': the initial definition of WOCL included also an implicit definition of acclimatisation. The initial definition of WOCL is now split in two; a new definition of 'Acclimatised' being introduced. As compared to Subpart Q, the criteria for acclimatisation have been amended in relation to the Time Zone Crossing requirements of FTL.1.235(2) and will be discussed under paragraph 94.

'Accommodation' and 'Suitable Accommodation' were introduced in order to clarify and make consistent the requirements on Split Duty, Standby Duty and Minimum Rest Periods.

'Air Taxi Operations': as explained above such operations are excluded from the scope of Appendix 1 to OR.OPS.FTL.200; therefore this new definition is needed.

'Flight time': this term replaces the former 'Block Time' of Subpart Q and corresponds to the term used in ICAO Annex 6.

'Early start' (FDP starting in the 05:00–05:59 hr period) and, 'Late finish' (FDP finishing in the 01:00–01:59 hr period): these definitions were introduced in support of the new requirements of FTL.1.235 1-(d) on Disruptive Schedules and are discussed under paragraph 133.

'A single day free of duty': this definition is placed in the context of Council Directive

2000/79/EC of 27 November 2000 requiring 7 days free of duty per calendar month.

'Night duty': this definition was introduced in support of the new requirements of FTL.1.210 1-(d) on Night Duties.

'Rest facility', 'Class 1 rest facility', 'Class 2 rest facility', 'Class 3 rest facility': these definitions were introduced in support of the new requirements of FTL.1.210 2 on Extension of flight duty period due to in-flight rest (augmented crew).

'Split duty': this definition was introduced in support of the new requirements of FTL.1.225 on Split Duty.

'Ultra long range operations (ULR)'; this definition was introduced because the term is mentioned as a possible subject for specific FTL requirements in the form of a future Appendix 2 to OR.OPS.FTL.200.

'Window of Circadian Low (WOCL)'; the elements related to acclimatisation have been transferred to a new definition 'Acclimatised'.

Operator responsibilities (OR.OPS.FTL.110)

71. The Operator's responsibility requirements from *OPS 1.1090* are transposed into OR.OPS.FTL.110. A change to EU-OPS Subpart Q is introduced in OR.OPS.FTL.110 to specify reporting times proportionate to the ground duties to be executed.
72. OR.OPS FTL.110(a) requires the operator to publish rosters 'sufficiently in advance'. This Subpart Q provision is complemented by an AMC recommending publishing rosters at least 14 days in advance.
73. OR.OPS FTL.110(i) also includes a requirement to change a schedule or crewing arrangements where the actual operation exceeds the maximum flight duty period on a significant proportion of flights in that schedule during a scheduled seasonal period, and has to be read in conjunction with AMC1-OR.OPS.FTL.110(i). This corresponds to the requirements set out in *OPS 1.1105*.

Crew Member Responsibility

74. The Crew Member responsibility requirements from *OPS 1.1090* have been transposed into the future Implementing Rules for air operations of Community operators 'Part CAT'. Those draft implementing rules have originally been published as NPA 2009-02b on 30 January 2010 and, after comment review as a Comment Response Document (CRD) on 25 November 2010. In this CRD, paragraph *CAT.GEN.AH.100 Crew responsibilities* addresses crew member's responsibilities. 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 ERs. 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. The GM FTL.APP.1.110 explains what actions the commander can take to control rest during flight and how crew members can assess personal fatigue and make optimal use of rest possibilities.

Responsibility of the Competent Authority

75. *OPS 1.1090* 5 provisions on the grant of variations by civil aviation authorities have not been transposed in this NPA. In fact, those provisions are linked to the grant of exemptions and derogations in accordance with Article 8 of EU-OPS, which are covered respectively by Article 14(4) and 14(6) of the BR. The scope of these articles covers all Implementing Rules of the Basic Regulation and, therefore, does not need not to be specifically transposed for exemptions or derogations on flight time limitations.

Fatigue Risk Management (FRM) (OR.OPS.FTL.115)

76. Part Organisation Requirements (OR), as published in NPA 2009-21, includes the requirement for an Integrated Management System (see OR.GEN.200). This Integrated Management System will encompass a Safety Management and a Compliance Monitoring element. The terms 'Safety Management System' and 'Compliance Monitoring System'

are not used because they would contradict the very idea of an Integrated Management System. For the same reason, this NPA does not use the term 'FRMS' (Fatigue Risk Management System) but 'FRM' (Fatigue Risk Management), as the Agency considers it should be integrated in the Organisation's Management System as a constitutive element of Safety Management.

77. FRM provisions are generally used in support of non-prescriptive requirements (Soft Law). This is the approach supported by ICAO, which promotes the use of FRM(S) in this very case. Also the FAA, in its NPRM on Flight Time Limitations, mandates the use of FRM(S) only in the case of deviations from prescriptive requirements.
78. As discussed above, the FTL requirements for Commercial Air Transport by Aeroplane are addressed exclusively through 'Hard Law'. Therefore FRM should not be a general requirement for CAT operators. The only exceptional cases where FRM is proposed to be required is when an operator wishes to operate under reduced rest provisions [see FTL.1.235 3-(b)], FDP extensions in the 18:00–21:59 window [see FTL.1.210 &-(b)] and for certain night operations [FTL.1.210 1-(d)].
79. General requirements concerning the establishment of FRM are laid down in paragraph OR.OPS.FTL.115.
80. Paragraph OR.OPS.FTL.115 specifies that FRM provisions shall be applicable to the type, size and complexity of the operations and shall correspond to the operator's flight time specifications scheme. This paragraph specifies key elements of FRM while more detailed explanation is moved to AMC material explaining the application of FRM principles (AMC1-OR.OPS.FTL.115). Both the Implementing Rule and the AMC are based upon appendix 8 requirements of the ICAO SARPs.

Chapter 2 — Commercial Air Transport Operators and Appendix 1 to OR.OPS.FTL.200 Commercial Air Transport by Aeroplane — Scheduled and Charter Operations other than Single Pilot Operations

81. Chapter 2 of Section VIII includes general requirements, in terms of principles, on Flight and Duty Time Limitations and rest requirements for commercial air transport operators, while Appendix 1 to OR.OPS.FTL includes the detailed requirements, in terms of figures, for commercial air transport by aeroplane — scheduled and charter operations other than single pilot operations. These requirements are based on Subpart Q requirements and contain all substantive provisions of Subpart Q required by Article 22(2)(a) of the Basic Regulation.

Flight time specification schemes (OR.OPS.FTL.200)

82. The requirement to establish, implement and maintain flight time specification schemes is laid down in paragraph OR.OPS.FTL.200. To meet this requirement, commercial air transport operators shall comply with Chapter 1 and 2 of Section VIII, as well as with the relevant Appendix including the appropriate detailed requirements. As explained above, the possibility of using Certification Specifications (CS) has not been included in the proposed FTL rules for CAT. However this possibility, as presented in NPA 2009-02, should be used for Commercial Operators other than CAT and Non-Commercial Operators of Complex Motor-Powered Aircraft. Consequently, for Commercial Air Transport Operators, flight time specification schemes deviating from the provisions of Appendix 1 to OR.OPS.FTL.200 will have to be processed under Article 14(6), not Article 22(2), of the Basic Regulation.

Home Base (OR.OPS.FTL.205 and FTL.1.205)

83. In EU-OPS, Home Base is defined in *OPS 1.1095* Definitions. This definition failed to clarify whether the Home Base should be a single airport or could be an airport system. Consequently, various national interpretations are currently in force in the EU, leading to an uneven playing field. FTL.1.205(a) clarifies that the Home Base may be a multiple airport location when the distance between any of these airports does not exceed a driving distance of 50km and the related travelling time does not exceed 60 minutes under normal conditions.

84. FTL.1.205(b) further 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 point of landing back to the initial location of the start of the duty shall count as positioning.

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.

Flight Duty Period (FDP) (OR.OPS.FTL.210 and FTL.1.210)

85. Paragraph OR.OPS.FTL.200 elaborates further requirements for flight time specification schemes in respect of flight duty period for crew members requiring operators to take into account such elements as number of sectors flown, encroachment of the Window of Circadian Low (WOCL), extension of FDP due to commander decision and minimum in-flight break including augmentation of basic flight crew.

1 — Maximum daily Flight Duty Period (FDP)

86. In FTL.1.210 instead of the transposition of the Subpart Q text concerning maximum basic daily flight duty period and its changes in respect of encroachment on the Window of Circadian Low (WOCL) and extensions of FDP, two tables for maximum daily FDP calculations are proposed. Both tables are based on maximum daily FDP of 13 hours which corresponds to the EU-OPS Subpart Q requirement (*OPS 1.1105*). The table in paragraph 1-(a) is a requirement to calculate maximum daily FDP when extensions are not used and the table in paragraph (b) is applicable for the calculations of maximum daily FDP with extensions. Both paragraphs enable anyone to calculate maximum daily FDP with regard to the time of the day or night when FDP starts. The Agency believes that the introduction of these tables will enable the clear understanding of the maximum limits and will simplify the rostering process. GM FTL.1.210 further clarifies the calculation method for the WOCL encroachment, the regulatory reference being the tables in the implementing rules.
87. Concerning the WOCL encroachment, some Group members noted that the Subpart Q FDP calculations are based upon reporting time, not wake-up time. Consequently, a crew member may report at 6:00 and benefit from the full FDP, while actually waking up in the WOCL. A comparison between Subpart Q and CAP 371 shows indeed that Subpart Q is in general less protective in the morning, but more protective in the evening than CAP 371. However, as explained in the RIA, a scientific study on CAP 371 shows that it overestimates the impact of early starts on crew alertness.
88. While the tables reflect the values of Subpart Q, the Agency proposes that extensions on FDP starting in the period 18:00 to 21:59 shall only be permitted under OR.OPS.145.FTL Fatigue Risk Management provisions. This is based on the fact that such extensions, when granted at the most fatiguing reporting time of the day, should be carefully monitored.

Question 2: 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.

89. Conversely, the *OPS 1.1105 2.7* FDP limitation to 11:45 when the extension starts in the period between 22:00 and 4:59 was removed. Its safety justification was not only unclear to the Rulemaking Group; the Agency considers that the mitigating measure discussed under paragraph 88 is more focused on the more critical FDP starting time.
90. FTL.1.210 1-(b) reflects Subpart Q requirement:
- to limit the maximum number of times that extensions are used to 2 in any 7 consecutive days;
 - to increase the minimum pre-flight and post-flight rest periods by 2 hours, or post-flight rest by 4 hours;
- and clarifies that the use of the 1-hour extension shall be planned in advance.
91. In FTL.1.210 1-(c) a difference in FDP of flight and cabin crew due to different reporting time shall not exceed 60 minutes which corresponds to *EU-OPS 1.1105 1.4*.
92. FTL.1.210 1-(d) includes additional provisions to Subpart Q for night operations. It prescribes extended rest periods if three or more flight duty periods encroach on all or any portion of the window circadian low between two recovery rest periods defined in FTL.1.235(c). A limit of 4 sectors per duty for consecutive night duties is established, unless operated under Fatigue Risk Management provisions.
93. It should be noted that the Agency envisages the development of an alternative appendix for sole night operations. This would be addressed under a future Rulemaking task (Task OPS.071). Provision is made in Appendix 3 to OR.OPS.FTL.200.
94. Concerning Subpart Q (and as opposed to CAP 371), no specific table is used for non-acclimatised crew. The principle laid down in Subpart Q has been kept, i.e. for the maximum FDP calculation local time is used when the crew is acclimatised and home base time is used when the crew is not acclimatised. However, the following changes are proposed:
- As said in paragraph 70 above, the definition of acclimatised crew, which was implicitly included in the WOCL definition, has been moved to a specific definition ('Acclimatised').
 - The definition of acclimatised has been changed: instead of the Subpart Q criterion that a crew is acclimatised after 48 hours in a single time zone performing duty or not, two alternative criteria are used:
 - either at least 36 consecutive hours free of duty in an area of 3 hours time difference, or
 - at least 72 hours in an area of three hours time difference conducting duties.

Those two criteria are deemed by the Agency to take better account of the crew capacity to acclimatise quickly when being free of duty than being conducting duty and are seen as an improvement to the preceding Subpart Q criterion. However it should be noted that there is no scientific assessment available on this provision.

Question 3: 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.*

2 — Extension of Flight Duty Period due to in-flight rest

95. This provision, known also as 'augmented crew' is based to a large extent on the TNO study, discussed in the RIA, and on operational experience. Three classes of rest facilities are defined in *OR.OPS.FTL.105 Definitions* on the basis of the TNO study. This can be roughly summarised as Class 1 being a bunk, Class 2 a first class seat, and Class 3 being a business class seat, with additional conditions on their environment in terms of light,

noise and disturbance. Based on the TNO figures (75% of in-flight rest duration in a Class 1 rest facility, 56% of in-flight rest duration in a Class 2 rest facility, and 25% of in-flight rest duration in a Class 3 rest facility, should be credited towards the FDP extension), the Agency proposes in subparagraph (a)(1) to increase the FDP up to 15 hours with Class 3 rest facilities; up to 16 hours with Class 2 rest facilities and up to 17 hours with Class 1 rest facilities with one additional flight crew member. Subparagraph (a)(2) further increases these values by 1 hour for flights with two additional flight crew members. This proposal is not a direct transcript of the TNO study figures, but their transposition into practical terms, the objective being to keep the rule simple to understand, easy to implement, and enforceable. It is also, as the RIA shows, a proposal with a minimal economic impact on the Operators. This NPA does not permit extensions beyond 18 hours. This would be addressed by a specific appendix to OR.OPS.FTL.200 when the need arises.

Question 4: 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.

96. The above limits are irrespective of the WOCL. This approach has been chosen on the basis that while an FDP encroaching the WOCL would benefit from a greater extension, to reach the above limits, than a flight not encroaching the WOCL, this should be compensated by the fact that the sleep is also more recuperative during the WOCL. This approach is simple and seems to be validated by the operational experience of some operators, a number of MS having used it for a number of years and more recently, under EU-OPS Article 8 provisions.

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

97. In subparagraph (b), the use of 'augmented crew' is limited to three sectors in order to limit as far as possible the fragmentation of sleep. For the same reason, the minimum consecutive in-flight rest is set at 90 minutes in subparagraph (c), and at 2 hours for those crew members at the controls during landing. Finally, an FDP reduction of 30 minutes is required for FDP with 3 sectors.

Question 6: 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.

98. Paragraph (c) defines the minimum consecutive in-flight rest period. The minimum in-flight rest period is further clarified in subparagraph (d) for flight crew. For the purpose of allowing in-flight rest to the flight crew, the time during cruise is divided, equally or not, in 3 if one additional crew member is used, and by 2 if two additional crew members are used. Therefore, no need for an additional table of minimum rest was identified. The requirement is limited to ensuring that the cruise phase of the flight above FL 200 be used to maximise the in-flight rest period of those crew members at control during landing.

99. As seen above, the duration of in-flight rest for flight crew does not need to be specified; the same could not be done for cabin crew. A table has been included in subparagraph (e) which sets this minimum duration for Cabin Crew, as a function of the FDP extension and the type of rest facility. The table specifies different in-flight rest time requirements depending of the type of in-flight rest facility used. The table follows the general principles established by scientific studies in terms of differentiation per type of rest facilities. However, the values themselves take account of current practices and operational experience from operators, which were not supported by all participants of the Rulemaking Group.

Question 7: 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.

100. Subparagraphs (f) to (h) include additional provisions, among others on cumulative limits calculation and minimum rest at destination.

3 — Unforeseen circumstances in actual flight operations — Commander

101. Paragraph OR.OPS.FTL.210 requires operators to establish procedures concerning commander decisions in special circumstances and to report when the flight duty period (FDP) was increased at their discretion. Subparagraph (d) includes a requirement for a non-punitive process for the use of the Commander's discretion.
102. In FTL.1.210 3 (Unforeseen circumstances in actual flight operations — discretion by the pilot-in-command) (a)(1) it is required that the maximum basic daily FDP which results after applying FTL.1.210 1(a) and (b) (extensions of basic FDP) or FTL.1.225 (split duty) 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. This corresponds to the requirement set out in *OPS 1.1120*; however, the wording in FTL.1.210 3 removes the Subpart Q ambiguity as to which FDP the extension shall apply; the extension shall apply to the calculated maximum daily FDP (Basic Maximum FDP reduced by the number of sectors and the WOCL encroachment), not to the Basic Maximum FDP itself.

Question 8: 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.

103. Subparagraph (b) includes the original *OPS 1.1120* provisions to allow the Commander to decrease the FDP or increase the rest in case of severe fatigue.

4 — Unforeseen circumstances in actual flight operations — Short-term re-planning

104. While OR.OPS.FTL.110 requires the operator to publish duty rosters sufficiently in advance where applicable to the type of operation, this paragraph provides specific instructions to the operator when short-term re-planning is necessary in case of operational need.
105. Subparagraph (a) addresses the case when the crew schedule is changed before leaving the place of rest, and its consequence on the FDP.
106. Subparagraph (b) specifies the conditions under which the operator may use split duty and reduced rest on short-term re-planning. In these cases, reporting to the Competent Authority is required by subparagraph (c).
107. It should be noted that the elements above were introduced at a very late stage in the development of this NPA and have not been assessed by the RIA in terms of safety and economic implications. The proposed provisions simply reflect current operational practices.

Question 9: 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.

Flight times and duty periods (OR.OPS.FTL.215 and FTL.1.215)

108. Flight times and duty periods, where applicable to the type of operation, are specified in OR.OPS.FTL.215. Total duty periods in any 28 and 7 days and total flight time in any 12 consecutive calendar months and any 28 consecutive days are without indication of time in hours. These figures were moved to Appendix 1 to OR.OPS.FTL.215. This was done for the purpose of developing FTL requirements for different types of flight operations in the future.
109. In FTL.1.215 (Flight times and duty periods), figures are defined as follows:
- (a) The total duty periods to which a crew member is assigned shall not exceed:
 - (1) 60 duty hours in any 7 consecutive days;
 - (2) 190 duty hours in any 28 consecutive days.
 - (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 flight hours in any 28 consecutive days;
 - (2) 900 flight hours in any calendar year;
 - (3) 1 000 flight hours in any 12 consecutive calendar months.
110. In FTL.1.215 (a)(2), the operator is required to spread duty periods within any 28 consecutive days as evenly as practicable. The Rulemaking Group discussed whether an additional limit of 14 days (as recommended by the Moebus report) would be useful in order to fulfil this safety objective. The RIA shows that while the safety benefit of this measure could not be established with certainty, its impact on airlines could 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, where the 14 days limit would artificially constrain sequences of '5 on-4 off-5 on'. It was also noted that the FAA NPRM did not include this additional 14 day limit. Instead of including such an additional limit, a new subparagraph (c) requires the operator to demonstrate the implementation of this provision ('spread as evenly as possible').
111. As compared to Subpart Q, an additional limit in 'any 12 consecutive calendar months' has been added to the limit in 'any calendar year' for the limitation of total flight time. 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 12 consecutive months, and by its consequence on cumulative fatigue. However, it noted that setting this 900-hour limit per any 12 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 RIA identifies the possible cost associated with such a proposal. The double limit: 900 flight hours in any calendar year and 1 000 flight hours in any 12 consecutive calendar months could solve the above concern on cumulative fatigue while addressing the irregular activities inherent to charter operators. Finally 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 (note: the FAA NPRM proposes 1 000 hrs in 365 consecutive days).

Positioning duty (OR.OPS.FTL.220)

112. 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.

Split duty (OR.OPS.FTL.225 and FTL.1.225)

113. Under EU-OPS, split duty provisions are addressed by national regulations in accordance with Article 8 provisions (see OPS 1.1105 6).
114. The Rulemaking Group discussed different possible approaches for Split Duty and based on these discussions, and after careful impact analysis, the Agency decided to propose provisions inspired to a large extent by CAA-UK provisions of CAP 371.
115. General principles are set out in OR.OPS.FTL.225. They are: (1) the FDP shall count continuously from initial reporting time, and (2) no split duty shall follow a reduced rest period.
116. FTL.1.225 includes specific requirements on split duty, namely concerning the minimum duration of the break on the ground (3 hours), the increase of the FDP by 50% of the break and the use of suitable accommodations for breaks of 6 hours or more. Accommodations and suitable accommodations are defined in the Definition Section (OR.OPS.FTL.105). This paragraph also includes additional limitations concerning the combination of split duty and reduced rest.

Question 10: 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.

Standby duty (OR.OPS.FTL.230 and FTL.1.230)

117. Operators need to be able to use standby to cater for unpredictable events, e.g. replacement of a sick crew member, delays due to severe weather conditions, crew member unavailability, etc. The unpredictability of standby duty is therefore a given fact and this proposal is trying to strike the right balance between maintaining the Operator's flexibility to uphold the service while introducing an element of predictability into the scheduling of standby and addressing the risk of increased levels of fatigue. This proposal acknowledges the fact that one of the most fatiguing elements of standby duty is the lack of predictability and standby does not allow the crew member to plan his/her rest. Unlike a crew member on a scheduled duty, a crew member on standby cannot schedule naps or otherwise control his/her sleep opportunities to assure that the standby crew member is adequately rested before reporting to work.
118. Overall, there was no agreement amongst the members of the Rulemaking Group on standby and the Agency was confronted with a wide variety of national practices and legislation. The variety existing in national rules can be summarised as follows:
- (a) 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. 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.
 - (b) Regarding standby at home or in a suitable accommodation Member States' approaches differ even more. The limit in most Member States for the maximum allowable hours for this type of standby is between 12–14 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.
119. 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.

120. Requirements for the assignment of crew members to standby duty are in paragraph OR.OPS.FTL.230(a) and (b) and reflect corresponding requirements of Subpart Q.
121. Elements of FTL standby duty to be included into the operator's flight time specification scheme are explained in paragraph OR.OPS.FTL.230(c).

1 — Airport Standby

122. For Airport Standby a crew member may receive notice to report as little as 1 hour or less before departure and therefore has to stay in a constant state of readiness. Being at the airport, immediately ready to start an FDP is considered fatiguing; this proposal therefore considers that time spent on airport standby before being called out for an FDP has an impact on the maximum FDP. This mirrors *OPS 1.1125* 1.2 provisions.
123. *OPS 1.1125* left the definition of the relationship between airport standby duty duration and the assigned FDP at the discretion of the Competent Authority. FTL.1.230 establishes two cases, depending on whether an accommodation (as defined in OR.OPS.FTL.105) is provided to the crew or not: standby time counts as FDP where no accommodation is provided, but a 6-hour buffer is granted where an accommodation is provided. 'Accommodation' is defined in OR.OPS.FTL.105. It should be noted that this 6-hour buffer is based upon operational experience, not science.
124. No limits on Airport Standby are specified, as the provisions of subparagraph (c) are self-limiting.
125. *OPS 1.1125* 1.4 provisions on minimum rest following Standby Duty were left at the Competent Authority's discretion. As in this NPA Standby Duty is considered as duty, there is no need to include a specific rest requirement: FTL.1.235 rest requirements at home base apply.

2 — Other Standby

126. Under EU-OPS, Standby other than at the airport is addressed by national regulations in accordance with Article 8 provisions (see *OPS 1.1125* 2). Those national regulations differ significantly from each other, and it was not possible to reach a consensus on the subject within the Group. Therefore the proposal below has to be seen as an Agency proposal intended to raise focussed comments from the stakeholders.
127. Standby other than at the airport shall be provided in a suitable accommodation [paragraph 2 (a)]. A Suitable Accommodation is defined in OR.OPS.FTL.105.
128. Standby is limited to 12 hours [paragraph 2(b)] and shall count as 25% of duty time for the purpose of cumulative duty hours' calculation [subparagraph (d)].
129. Subparagraph (d) requires further reduction of the FDP depending on the crew ability to rest between the call-out and the reporting time.

Question 11: 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.

Question 12: 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.

Rest periods (OR.OPS.FTL.235 and FTL.1.235)

130. In OR.OPS.FTL.235 *Rest periods* the requirement for commercial operators to provide crew members with recurrent extended recovery rest periods to compensate for cumulative fatigue was introduced.

1 — Basic Minimum Rest

131. In FTL.1.235, minimum rest periods at home base 1-(a) and away from home base 1-(b) mirror the corresponding EU-OPS provisions (*OPS 1.1110 1.1 and 1.2* respectively).

132. An additional provision to *OPS 1.1110 1* includes in 1-(b) the possibility to apply to home base the rest requirements for away from base, when a suitable accommodation is provided to the crew. This reflects the current operational practice under EU-OPS and CAP 371, known as 'back to back operations'.

Recurrent extended recovery rest periods (also known as 'weekly rest') in FTL.1.235 1-(c), (36-hour period including 2 local nights separated by no more than 168 hours) also mirror *OPS 1.1110 3* provisions, with the following exception: the Subpart Q provision which allows reporting at 04:00 after 'weekly rest' if the 'weekly rest' is at least 40 hours, has been deleted. No scientific evidence was found to support the fact that 4 additional hours of rest would compensate the lack of rest due to the suppression of the second local night.

133. Subparagraph (d) includes an additional provision providing additional minimum rest in case of certain disruptive schedules, namely transitions from a late/night arrival to an early start.

Question 13: 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.*

2 — Time zone differences

134. Under *OPS 1.1110 1.3*, minimum rest after time zone crossing was left at Member States' discretion under Article 8 provisions. FTL.1.235(a) specifies (1) the minimum rest period at home base (36 hours including 2 local nights), and (2) out of base (the greater of the preceding duty period and 14 hours), when one sector of the FDP encompasses 4 time zones or more. An additional provision to *OPS 1.1110 1.3* includes in 2-(a)(2) the possibility to apply to home base the rest requirements for away from base, when a suitable accommodation is provided to the crew. This reflects the current operational practice under EU-OPS and CAP 371, known as 'back to back operations'.

135. As regards acclimatisation of crew, this NPA follows the logic of Subpart Q: acclimatisation is defined through the application of home base time or local time to the WOCL reduction in FTL.1.210 1.

136. Subparagraph (a)(3) includes an additional requirement for additional rest in case of certain disruptive schedules, namely Eastward-Westward or Westward-Eastward transitions. This term is defined in OR.OPS.FTL.105.

137. In addition to the limits of subparagraph (a), subparagraph (b) requires the Operator to monitor the combinations of rotations in terms of their effect on crew fatigue. The related AMC material clarifies that this should be conducted under the Operator's Safety Management provisions.

3 — Reduced Rest

138. Under *OPS 1.1110 1.4*, Reduced Rest provisions are left to national regulations under Article 8 provisions.
139. This NPA proposes Reduced Rest provisions that are based upon the current corresponding French regulations, which are very different from the practice in other Member States and rather different from the FAA NPRM proposal. The reason for this choice is that these are the only national provisions in Reduced Rest which have been subject to publicly available scientific study. This study, known as the STARE study, reviews the approach of the French regulation on Reduced Rest, recommends the use of FRMS as part of the Reduced Rest provisions and identifies certain areas which the FRMS should monitor closely. The STARE study has been published on 22nd November 2010, and in the French language, i.e. one week before the last meeting of the Rulemaking Group. Only an executive summary had been provided to the Rulemaking Group on 2nd November 2010. For this reason, it has not been possible for them to review and issue an opinion on the conclusions of the study, nor for a peer review by other scientists to take place. Some group members repeatedly opposed the STARE study to be taken as a basis for this rulemaking task, having come too late for an assessment to be carried out, and suggested instead that the French airlines ask for a derogation to cover their specific model, rather than generalising this model across Europe. Finally, the Rulemaking Group noticed that the three airlines on which the study was conducted implemented CLA's, which were on certain aspects more restrictive than the French rules that were subjected to the study. However, those differences being minor, the Agency considers the results of the study could apply to the French rules, on which this proposal is based. For reference, the executive summary of the STARE study is annexed to the RIA.
140. FTL.1.235(3) include the following provisions:
- Subparagraph (a) limits reduced rest to a minimum of 7h30 and shall be further extended if the travelling time to and from the suitable accommodation exceeds two times 15 minutes.
- Subparagraph (b) requires the use of Fatigue Risk Management when using Reduced Rest provisions.
- Subparagraphs (c) and (d) include provision on the extension of subsequent rest periods and the diminution of subsequent FDP.
- Subparagraph (e) limits the number of Reduced Rests between two 'weekly rest' periods to two, while subparagraph (f) limits the number of sectors for the FDP preceding or following the reduced rest.
- Subparagraphs (g) and (h) limit de facto the use of reduced rest to Regional Operations, as this is scope validated by the STARE study.
- Finally, subparagraph (i) forbids the use of reduced rest in combination with FTL.1.200 &-(b) 1 hour extension.

Question 14: 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.

Nutrition OR.OPS.FTL.240 and FTL.1.240

141. OR.OPS.FTL.240 mirrors the corresponding requirements of *OPS 1.1130*.
142. A new requirement to describe in the Operations Manual how crew member's nutrition during FDP is ensured is introduced in FTL.1.240 and further expanded in AMC to FTL.1.240.

Records of flight and duty times and rest periods OR.OPS.245.FTL

143. 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 and how long they shall be kept by the operator. These requirements correspond to those of *OPS 1.1135*.
144. 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.

Fatigue management training FTL.1.250 and AMC1-FTL.1.250

145. The Rulemaking Group agreed on the importance to train crew members and concerned scheduling and management personnel on possible causes and effects of fatigue, and fatigue countermeasures. FTL.1.250 introduces the requirement; a training syllabus is included in the AMC.

NOTICE OF PROPOSED AMENDMENT (NPA) No 2010-14B

**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 on Flight and Duty Time Limitations and rest requirements
for commercial air transport (CAT) with aeroplanes'*

B. Regulatory Impact Assessment

NOTE: This NPA contains the draft Opinion on the Implementing Rules on Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes to be included as a Section VIII to Subpart OPS of Part-OR. It also contains a draft Decision with related acceptable means of compliance (AMC) and guidance material (GM). The NPA is split into four separate documents (2010-14A, 2010-14B, 2010-14c and 2010-14D) as indicated in the Table of Reference below. The documents are published in the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>.

TABLE OF REFERENCE FOR NPA 2010-14:

A.	EXPLANATORY NOTE:	SEE NPA 2010-14A
	I. GENERAL	SEE NPA 2010-14A
	II. CONSULTATION	SEE NPA 2010-14A
	III. COMMENT-RESPONSE DOCUMENT	SEE NPA 2010-14A
	IV. CONTENT OF THE DRAFT OPINION AND DECISION	SEE NPA 2010-14A
	V. REGULATORY IMPACT ASSESSMENT	SEE NPA 2010-14A
	VI. EXPLANATORY MEMORANDUM ON PART-OR SUBPART OPS	SEE NPA 2010-14A
B.	REGULATORY IMPACT ASSESSMENT:	SEE NPA 2010-14B
C.	DRAFT OPINION AND DECISION:	
	I. DRAFT OPINION PART-OR (SUBPART OPS)	SEE NPA 2010-14c
	II. DRAFT DECISION AMC AND GM TO PART-OR (SUBPART OPS)	SEE NPA 2010-14c
D.	CROSS-REFERENCE TABLE:	SEE NPA 2010-14D



European Aviation Safety Agency
Rulemaking Directorate
Flight Standards Department

Regulatory Impact Assessment

Flight Time Limitations
OPS.055

Table of Contents

1	PROCESS AND CONSULTATION	38
2	ISSUE ANALYSIS AND RISK ASSESSMENT	38
	2.1 SAFETY ANALYSIS ACCIDENTS AND SERIOUS INCIDENTS	38
	2.2 FATIGUE HAZARD IDENTIFICATION	39
	2.2.1 Methodology	39
	2.2.2 Hazard/Mitigation table	41
2	OBJECTIVES	45
3	METHODOLOGY FOR ASSESSMENT OF IMPACTS	45
	3.1 ASSESSING THE SAFETY IMPACTS	45
	3.1.1 REVIEW OF SCIENTIFIC EVIDENCE	45
	3.1.2 ASSESSMENT OF ALERTNESS: SAFE MODEL	46
	3.1.3 SAFETY IMPACT SUMMARY	47
	3.2 ASSESSING ECONOMIC IMPACTS	47
	3.3 ASSESSING OTHER IMPACTS	51
	3.4 COMPARING AND RANKING THE OPTIONS: MULTI-CRITERIA ANALYSIS	52
4	IDENTIFICATION AND ANALYSIS OF OPTIONS	54
	4.1 DUTY HOURS	54
	4.1.1 OPTIONS IDENTIFIED	54
	4.1.2 Safety impact	54
	4.1.3 Other impacts	55
	4.1.4 Conclusion	56
	4.2 CUMULATIVE FATIGUE	57
	4.2.1 OPTIONS IDENTIFIED	57
	4.2.2 Safety impact	58
	4.2.3 Other impacts	59
	4.2.4 Conclusion	61
	4.3 MAXIMUM ALLOWABLE FLIGHT DUTY PERIOD	63
	4.3.1 OPTIONS IDENTIFIED	63
	4.3.2 Safety impact	64
	4.3.3 Other impacts	68
	4.3.4 Conclusion	71
	4.4 CONSECUTIVE NIGHT, EARLY OR LATE DUTIES	72

4.4.1	OPTIONS IDENTIFIED	72
4.4.2	Safety impact	73
4.4.3	Other impacts.....	76
4.4.4	Conclusion	77
4.5	PLANNED DUTY EXTENSIONS	79
4.5.1	OPTIONS IDENTIFIED	79
4.5.2	Safety impact	79
4.5.3	Other impacts.....	81
4.5.4	Conclusion	83
4.6	DUTY EXTENSION BY IN-FLIGHT REST	84
4.6.1	OPTIONS IDENTIFIED	84
4.6.2	Safety impact	86
4.6.3	Other impacts.....	89
4.6.4	Conclusion	93
4.7	POSITIONING AND EXCESSIVE TRAVELLING TIME	94
4.7.1	OPTIONS IDENTIFIED	94
4.7.2	Safety impact	95
4.7.3	Other impacts.....	95
4.7.4	Conclusion	96
4.8	EXTENSION BY ON-GROUND BREAK (SPLIT DUTY)	97
4.8.1	OPTIONS IDENTIFIED	97
4.8.2	Safety impact	98
4.8.3	Other impacts.....	99
4.8.4	Conclusion	101
4.9	COMMANDER'S DISCRETION	102
4.9.1	OPTIONS IDENTIFIED	102
4.9.2	Safety impact	103
4.9.3	Other impacts.....	105
4.9.4	Conclusion	105
4.10	AIRPORT STANDBY	107
4.10.1	OPTIONS IDENTIFIED	107
4.10.2	Safety impact	107
4.10.3	Other impacts.....	108
4.10.4	Conclusion	110
4.11	STANDBY OTHER THAN AIRPORT	110
4.11.1	OPTIONS IDENTIFIED	110
4.11.2	Safety impact	112

4.11.3	Other impacts.....	113
4.11.4	Conclusion	115
4.12	BASIC REST	116
4.12.1	OPTIONS IDENTIFIED	116
4.12.2	Safety impact	116
4.12.3	Other impacts.....	117
4.12.4	Conclusion	118
4.13	REDUCED REST	119
4.13.1	OPTIONS IDENTIFIED	119
4.13.2	Safety impact	120
4.13.3	Other impacts.....	121
4.13.4	Conclusion	121
4.14	EXTENDED AND RECOVERY REST	123
4.14.1	OPTIONS IDENTIFIED	123
4.14.2	Safety impact	124
4.14.3	Other impacts.....	126
4.14.4	Conclusion	126
4.15	TIME ZONE CROSSING	128
4.15.1	OPTIONS IDENTIFIED	128
4.15.2	Safety impact	128
4.15.3	Other impacts.....	129
4.15.4	Conclusion	130
4.16	OTHER ELEMENTS	131
4.16.1	OPTIONS IDENTIFIED	131
4.16.2	Safety impact	132
4.16.3	Other impacts.....	132
4.16.4	Conclusion	133
5	SUMMARY AND RECOMMENDATIONS	134
5.1	IMPACT SUMMARY OF THE RECOMMENDED OPTIONS	134
5.2	FURTHER RESEARCH NEEDS IDENTIFIED	136
6	ANNEXES	137
6.1	RIA OPTION ANALYSIS USING THE SAFE MODEL	137
6.1.1	APPLICATION OF SAFE IN OPS.055: OPTIONS AND SCENARIOS	137
6.1.2	CUMULATIVE DUTY — 14-DAY ROLLING LIMIT ON DUTY PERIOD — 4.2(B)	137
6.1.3	BASIC MAXIMUM FDP — WOCL REDUCTION — 4.3(H)	139

6.1.4 BASIC MAXIMUM FDP — ALLOWABLE FDP REDUCED IN FUNCTION OF THE NUMBER OF SECTORS FLOWN — 4.3 (L)	142
6.1.5 OPERATOR PLANNED DUTY EXTENSIONS — 4.5(B)	145
6.1.6 REDUCED REST — LIMITS ON REDUCED REST — 4.13	146
6.1.7 DUTY EXTENSION BY IN-FLIGHT REST (4.6)	148
6.1.8 WORST CASE SCENARIOS	149
6.1.9 MEDIUM HAUL/SHORT HAUL	149
6.1.10 MEDIUM HAUL/LONG HAUL	150
6.1.11 WORST CASE SCENARIO 'WEEKLY REST'	152
6.1.12 REDUCED REST SCENARIOS	154
6.2 BIBLIOGRAPHY	158
6.3 DETAILED TABLES	177
6.4 NOTES ON CREW ESTIMATES	179
6.5 STARE STUDY — EXECUTIVE SUMMARY	180

1 Process and consultation

The aim of this Regulatory Impact Assessment is to determine the best option to achieve the objective of a rulemaking activity while minimising potential negative impacts. It consists of a series of five logical steps that structure the analysis: issue identification, objective definition, option development, impact analysis and option comparison. By providing transparent and evidence-based analysis of the advantages and disadvantages of the rule options against the defined objectives, decision-makers and stakeholders have a solid reference framework for discussion and informed evidence-based decisions.

This Regulatory Impact Assessment was developed in the framework of the EASA rulemaking task OPS.055. As required by the OPS.055 Terms of Reference, the Agency set up a Rulemaking Group to support it drafting the NPA. The Rulemaking Group was composed of a representative membership of National Aviation Authorities (NAA), Airline representatives and Flight and Cabin Crew Representatives. It also included an observer from the European Commission.

The rulemaking group developed the below hazard and mitigation table (2.2.2) as well as the options identified in Chapter 5. The group also contributed to the assessment of impacts and commented on early drafts of this publication. Certain group members noted dissenting views notably on the following issues:

- The weighting of safety with 3 and economic impacts with 1. Charter and regional operators' representatives stated that economic impacts should be weighted with 2. The Agency kept the weighting as it reflects the main objective of the Agency as laid down in Regulation (EC) No 216/2008.
- The scenario assessment with SAFE. Union representatives noted that this assessment should be conducted by the experts that developed the system and therefore challenges for example the positive safety assessment of the 1-hour planned extension and early starts with full FDP. The Agency believes the use of SAFE was adequate as it helped to look at certain mitigation measures independently. This approach was discussed in the group and complemented by 'worst case scenarios' in order to capture interdependencies and high cumulative workload over a monthly period (see Annex 7.1.8).
- The use of safety notations and scoring. The mechanism of the Multi-criteria analysis (MCA) was questioned by some group members. The Agency acknowledges the fact that there are a number of ways to perform a MCA. However, the main aim is to allow comparison of non-monetised impacts. Furthermore the approach serves to make the proposals and reasoning of the rulemaking group and the Agency transparent. The Agency believes that this was achieved.

2 Issue analysis and risk assessment

2.1 Safety analysis accidents and serious incidents

Accidents and serious incidents are important high-level safety indicators ('1st tier indicators')⁷. As a first step it is therefore important to look into this data as it can also give an indication of the potential benefits of rule changes. A rule change could improve the fatigue risk mitigation and thereby reduce the number of accidents and serious incidents in the future by minimising contributing factors such as degraded performance and human errors.

When collecting data it is crucial to collect only such accidents and incidents on which the proposed rule could possibly have had an impact. Therefore, the Agency's Safety Analysis Department extracted from the European Central Repository records the following criteria:

- EASA-country registered fixed-wing aircraft;

⁷ For definition and discussion of the 3 tiers of safety performance indicators, see working paper HLSC 2010-WP/19 submitted by Spain on behalf of the European Union and its Member States to the ICAO High Level Safety Conference 2010.

- Commercial Air Transport;
- Period 2000–2010;
- Narrative containing mention of 'crew fatigue'.

The period of 10 years was chosen in order to capture accidents and incidents under recent national FTL regulations, upon which EU-OPS is based to a certain extent, therefore in a context comparable to the one under the current EU-OPS Subpart Q. Subpart Q itself has only been in force since 2008.

When assessing this data, it is to be borne in mind that focussing on the narrative specifically mentioning 'crew fatigue' we risk missing 'fatigue-related' incidents. Another possibility would have been to use the term 'human factor' as behind a human factor fatigue might be a contributing element, but then the risk would have been to overestimate the number of fatigue-related incidents. Also, many operators operate according to their collective labour agreements with air crew, containing further mitigating measures beyond the legal requirements of Subpart Q (or national regulations), which could explain the relatively low number of identified events (see below). Finally, fatigue is an issue that is traditionally under-reported by aircrew, as (self) assessing fatigue is generally a difficult exercise.

By applying this rather conservative approach, the Agency found two accidents and eight serious incidents involving three fatalities. However, in both accidents the crew operated outside the legal limits. In one case the FDP was exceeded by almost 3 hours and in the other case the crew did not respect the minimum rest period. These accidents therefore indicate that oversight is a key issue when looking at crew fatigue rather than the rules themselves.

The Accident Investigation report on one serious incident indicates that an arrangement of economy seats may be an inadequate in-flight rest facility. On the whole, this data contains a number of facts worth noting related to fatigue, but

- the data is statistically insufficient to directly deduct potential benefits of rule changes;
- the data is statistically insufficient to detect current and future safety risks, in particular as more fatigue risks may be masked under human factor-related incidents or as they are not reflected at all in this data.

As a result, the Agency decided to follow a pro-active and predictive approach and base the development of EASA FTL rules on a process of hazard identification and safety risk management as described in Section 2.2 below.

2.2 Fatigue hazard identification

2.2.1 Methodology

The purpose of the rulemaking task was to review the flight and duty time limitations and rest requirements specified in Subpart Q, taking account of all relevant recent and publicly available scientific and/or medical studies/evaluations and operational experience.

In order to ensure a comprehensive review and that no possible loophole in Subpart Q is left unassessed, the rulemaking group agreed with the following methodology:

1. Identify all possible hazards related to the fatigue of crew members.
2. Identify generic mitigating measures associated to these hazards.
3. Identify if and how these mitigating measures are covered by a specific Subpart Q requirement.
4. Identify other possible specific mitigating measures to those from Subpart Q, insofar as they are supported by scientific evidence taking into account operational experience.
5. The subpart Q requirements and the specific mitigating measures identified under point 4 would then form the basis of the RIA options (see chapter 5).

In order to identify all possible hazards and related mitigating measures, the major factors affecting fatigue, according to scientific literature, have been considered:

Time of day. Fatigue is, in part, a function of circadian rhythms. Human waking and sleep cycles follow a 24-hour cyclical wave pattern known as the internal body clock (circadian rhythm). The circadian rhythm is closely correlated to core body temperatures. All other factors being equal, fatigue is most likely and, when present, the most severe during the WOCL, when body temperatures are at their lowest during a 4-hour period between 12:00 AM and 6:00 AM. Studies have found that subjects remaining awake through the WOCL and during the daytime hours experience improvements in performance, once past the WOCL, relative to their performance during the WOCL.

Amount of recent sleep. If a person has had significantly less than 8 hours of sleep in the past 24 hours, he or she is more likely to be fatigued.

Time awake. A person who has been continuously awake for more than 17 hours since his or her last major sleep period is more likely to be fatigued.

Cumulative sleep debt. Sleep debt refers to the impact of receiving less than a full night's sleep for multiple days. For the average person, cumulative sleep debt is the difference between the sleep a person has received over the past several days and the sleep they would have received if they obtained 8 hours of sleep per night. For example, a person who has received 10 hours of sleep over the past 2 nights has a cumulative sleep debt of 6 hours. A person with a cumulative sleep debt of more than 8 hours since his or her last full night of sleep is more likely to be fatigued.

Time on task. The longer a person has continuously been doing a job without a break, the more likely he or she is to be fatigued.

Individual variation. Different individuals will respond to fatigue factors differently. Different individuals may become fatigued at different times, and to different degrees of severity, under the same circumstances.

The table in paragraph 2.2.2 below shows the hazards and related mitigated measures identified under steps 1 to 4 above.

2.2.2 Hazard/Mitigation table

Hazard Ref.	Applicability	Fatigue description hazard	Possible mitigation measures
1. Duty Hours			
2.1	All operations	Combination of flight duties with ground duties (e.g. administrative, managerial, simulator, etc.)	<ul style="list-style-type: none"> a) Reduced duty/flight duty periods b) Limitations on combining flight and ground duties
2. Cumulative Duty			
2.1.	All operations	High cumulative workload	<ul style="list-style-type: none"> a) Limit on successive long duty periods together b) Rolling limits on duty and flying hours c) Cumulative fatigue management through a required minimum number of days off (to be defined), including longer rest periods d) Spread out duty as evenly as possible e) Rest period increased periodically
3. Basic Maximum Flight Duty Period			
3.1.	All operations	Length of Flight Duty Period	<ul style="list-style-type: none"> a) Clear maximum FDP limit (table) b) Extra rest requirements c) Inclusion of positioning at the behest of the operator immediately before flight duty in FDP d) Break (relief from duties) during duty e) Meal opportunity f) Break on the ground g) Inclusion of post-flight duty in FDP, taking into account number of seats and configuration
3.2	Operations encompassing duties between 02:00 and 05:59	Sleep deprivation/deficit due to waking-up/staying awake/finishing duty in the WOCL	<ul style="list-style-type: none"> h) Reduce the allowable maximum FDP for duties where the crew member reports after wakes in/actually reports in/finishes in or FDP encompasses the WOCL i) Additional rest j) Maximum number of these duties in a work block or number of days k) Planning of these duties to enable flow of work and optimum sleep opportunity
3.3	All operations (more on short-haul)	Number of Sectors/Workload	<ul style="list-style-type: none"> l) Allowable FDP decreased by the number of sectors worked
4. Night, early and late duties			
4.1	Night operations	Consecutive Night Duties	<ul style="list-style-type: none"> a) Definitions applicable to this section b) Reduce allowable FDP/DP, maximum numbers of such duties allowed in a work block or number of days, sole night freight operation with set rest requirements and pattern construction c) Limit the number of sectors d) Limit the number of consecutive night duties e) Additional rest after a series of night duties
4.2.	All operations	Consecutive series of early starts and/or late arrivals	<ul style="list-style-type: none"> f) Limit the number of consecutive Earlies (define) and/or Late finishes (define) and provide an extended rest period between such series of duties

Hazard Ref.	Applicability	Fatigue description hazard	Possible mitigation measures
			<ul style="list-style-type: none"> g) Limitations on FDP for regular services with early starts and/or late arrivals h) Consecutive early start duties should never start earlier than the day before i) Limit the number of consecutive early starts j) Additional rest after a series of early starts
5. Duty Extensions			
5.1	All operations	Company extension of planned duty/flight duty periods	<ul style="list-style-type: none"> a) Maximum limit on extension b) Restriction on the number of times a week/month that extensions are allowed c) Extra rest requirements surrounding the extended duty d) Notification of the 1-hour extension
6. Duty extensions due to in-flight rest			
6.1	All relevant operations	Flight sectors beyond maximum FDP	<ul style="list-style-type: none"> a) Consistent in-flight relief planning b) Augmented flight/cabin crew when applicable (to be defined) c) Minimum rest period onboard requirement d) Extension of FDP dependent on type of onboard rest, facilities and number of additional crew carried e) Use of depart window to optimise crew alertness during critical phases of flight f) Requirement of prior notification of crew position for optimal rest planning (operating or relief crew) g) Limit the number of sectors h) Augmented Cabin Crew i) Minimum rest at destination j) Minimum rest at home base following extended FDP
7. Positioning & Travelling			
7.1	All operations	Positioning duties — before an FDP, immediately after an FDP	<ul style="list-style-type: none"> a) Positioning duties to count as FDP when immediately prior to an FDP b) Post-FDP positioning should be limited to prevent an excessive Duty day c) The FDP and all post-FDP positioning to be taken into account for subsequent Rest period
7.2	All operations	Excessive travelling time	<ul style="list-style-type: none"> d) Require a set home base (define) with a maximum travelling time beyond which crew are recommended to have alternative accommodation closer to base. e) Limit travelling time out of base
8. Extension by on-ground break			
8.1	All operations (predominantly short-haul)	Split Duty beyond maximum FDP	<ul style="list-style-type: none"> a) Establish minimum consecutive number of hours for the break b) Establish maximum FDP based on the length of the break and the time of the day c) Suitable accommodation for the break d) Take account of split duty for subsequent rest calculation e) Limitation on number of sectors after the split f) Limit the number of consecutive Split Duties g) Take account of (non) acclimatisation

Hazard Ref.	Applicability	Fatigue description	hazard	Possible mitigation measures
9. Pilot-in-command discretion				
9.1	All operations	Disruption — on the day		<ul style="list-style-type: none"> a) Adapt schedules or crewing arrangements when actual operation exceeds planning over a defined period of time b) Process for Commander to extend an FDP based on the circumstances on the day and of his/her crew. c) Process for Commander to reduce a rest period based on the circumstances on the day and of his/her crew. d) Process for the Commander to reduce FDP and/or increase rest in case of fatigue risk e) Report to NAA above a certain threshold f) Focused oversight by NAA g) Establish limits on the number of Commander's discretion
10. Airport Standby				
10.1	All operations	Standby — Airport		<ul style="list-style-type: none"> a) Take account of airport standby time in duty/flight duty period and rest calculation b) Quality and type of airport standby facilities c) Limit on Standby duration d) Minimum rest after standby with no FDP
11. Standby other than airport				
11.1	All operations	Standby — elsewhere		<ul style="list-style-type: none"> a) Take account of standby time in duty/flight duty period and rest calculation b) Standby callout requirements [immediate readiness/long call/contactable (?)/available (?)] used to develop different levels of requirement based on worst case fatigue level c) Quality and type of standby facilities d) Limit on Standby duration e) Calculations of cumulative duty hours dependent on type of standby and whether crew are called out or not
12. Basic Rest				
12.1	All operations	Disruption — before the day		<ul style="list-style-type: none"> a) Prepare and publish rosters giving crews time to adapt and recover from cumulative fatigue b) Focused oversight by NAA
12.1	All operations	Lack of rest opportunity and rest at sub-optimal periods		<ul style="list-style-type: none"> c) Set a minimum rest period and recuperative sleep opportunity between duties d) Minimum number of sleep hours over a specific preceding period of time
13. Basic Rest — reduced rest				
13.1	Predominantly regional operations	Lack of rest opportunity		<ul style="list-style-type: none"> a) Minimum duration of reduced rest b) Augmentation of rest period following reduced rest c) Reduced max FDP d) Limit the number of reduced rest occasions e) Limit the length and number of sectors under reduced rest f) Limit the effect of time zone de-synchronisation under reduced rest g) Limit the possibility of interaction of split duty and reduced rest h) Publish roster sufficiently in advance

Hazard Ref.	Applicability	Fatigue description	hazard	Possible mitigation measures
				i) Establish conditions for applicability of reduced rest
14. Extended & Recovery Rest				
14.1	All operations	Circadian Disruption — mixing duty transitions between early/late/night duties		a) Regulations around duty construction with restrictions on the number of early/late/night transitions in a work block, reduced max FDP b) Extended rest periods c) Consistent scheduling, limiting mix of day/night duties
14.2	Predominantly long-haul operations	Time de-synchronisation	zone	d) Duty restrictions for a set period of time or based on rest period based on the number of time zones e) Limit max FDP according to daytime & acclimatisation f) Minimum time set before a crew could be considered time zone adjusted or acclimatised (to be defined)
15. Time zone crossing				
15.1	Predominantly long-haul operations	Time de-synchronisation	zone	a) Minimum rest/days off requirements at home base following time zone crossing b) Additional minimum rest at destination away from home base c) Avoid or limit the number of alternating east-west rotations per month d) Additional rest between rotations home base-west-home base & home base-east-home base
16. Other elements				
16.1	All operations (predominantly short-haul)	Lack of meal and drink opportunity		a) Include meal and drink opportunity (ground/flight) in planning
16.2	All operations	Lack of fatigue risk awareness		b) Provide fatigue management training
16.3	All operations	Improper implementation of fatigue as a safety issue in the operator's safety management system		c) Implementation of effective SMS/FRMS d) Reporting on fatigue-related issues

3 Objectives

The objective of this rulemaking activity is to update the Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes taking into account all relevant recent publicly available research studies/evaluations and operational experience.

In particular this should be achieved by:

- reviewing the flight and duty time limitations and rest requirements specified in Subpart Q;
- addressing those areas/points in EU-OPS Subpart Q currently subject to national provisions in accordance with Article 8(4) of Council Regulation (EEC) No 3922/91 (e.g. extended FDPs with augmented flight crew, split duty, time zone crossing, reduced rest and standby); and
- submitting regulatory proposals (IRs, CSs, AMCs, GMs) based on the preferred option retained after completion of a regulatory impact assessment. These proposals shall also include a review and clarification of the proposed Authority (NPA 2009-02d) and Organisation (NPA 2009-02c) requirements regarding:
 - the development and modification of individual schemes and the process for their approval, and
 - the use and role of Fatigue Risk Management System (FRMS) in relation to the operator's safety management system (SMS) and the use of individual schemes.

4 Methodology for assessment of impacts

The assessment of impacts in the RIA is not based on the whole package of proposals, but on the 16 blocks of mitigation measures identified in 2.2.2 above. This approach acknowledges that specific hazards that were identified have specific mitigation measures that need to be assessed independently and not as part of a big revision package.

The below description of the assessment methodology is therefore applicable to each of the 16 blocks of options.

4.1 Assessing the safety impacts

As discussed in section 2.1, the assessment of safety impacts for this RIA could not be based on statistical data from accidents and incidents as there was no statistically significant number of accidents and incidents for EASA-country operators. Furthermore, the Terms of Reference of the rulemaking group were very clear that the assessment should be based on relevant recent and publicly available scientific and/or medical studies/evaluations and operational experience, as well as on the conclusions drawn from the discussions on Subpart Q by the Air Safety Committee.

The OPS.055 rulemaking group therefore agreed to assess the safety impacts based on three main elements: the review of scientific evidence, operational experience and the use of a computer-based model to predict alertness for specific crew flight plans.

4.1.1 Review of scientific evidence

For the review of scientific evidence the members of the OPS.055 rulemaking group provided the Agency with a comprehensive set of scientific studies, reports and evaluations, which includes more than 200 items (see Bibliography). In a very thorough process the rulemaking group discussed each option to identify which scientific study included some evidence to support or discard a particular option. In this way the studies mentioned in the chapters on safety impact below were identified. The Agency then reviewed the evidence in these studies and discussed with the group to what extent they are applicable to the options. One basic issue encountered in this process was that no study exists that assesses the effectiveness of Subpart Q as a whole and under all types of operations. Nevertheless, there is a broad body of science on certain requirements that exist in Subpart Q, including one study that looks at low-cost operation under Q. Where no sufficient scientific evidence was available, these issues were identified and listed at the end of each safety impact chapter.

4.1.2 Assessment of alertness: SAFE Model

The rulemaking group OPS.055 developed a set of alternative options to address fatigue hazards. In order to assess the alertness impact of certain options and worst case scenarios a computer-based alertness model ('SAFE') provided by the UK CAA was used. Key options were assessed in one or more operational scenarios. This section provides a description of the model. The scenarios as well as the results obtained are described in detail in Annex 7.1. The results are used in the assessment of the safety impacts in several sections of Chapter 5.

When using and interpreting the results, it is important to understand that computer modelling of fatigue is a computation based on a given alertness model and a given roster to provide an initial assessment of alertness levels. The results can thus only provide indications for the development of sound regulations and must be used carefully in conjunction with other elements, such as scientific studies and operational experience. They cannot be the sole basis for assessing the effectiveness of fatigue mitigation measures.

SAFE (System for Aircrew Fatigue Evaluation)

It is well established that fatigue, sleep loss and circadian disturbance can degrade performance and safety.⁸ SAFE is a computer program that has been designed by QinetiQ for the UK CAA to provide an initial assessment of the likely impact of pilot work hours on level of fatigue and alertness of crews throughout any given rosters.⁹ It can be used to indicate periods within an individual duty, or combination of duties, where high levels of fatigue, and corresponding low levels of alertness, may be experienced.

In its initial form, SAFE was based on a series of laboratory experiments, and it was adapted to the aviation environment as a result of an extensive validation. The two main features found to influence performance in these experiments were:

- The time of day, or circadian rhythm;
- The time that had elapsed since the end of the previous sleep period.

Since then, the Alertness Model has been further adapted for the civil aviation environment and numerous studies have been completed which have helped to identify factors relevant to air operations that influence the levels of alertness.¹⁰ The output from the SAFE model can be expressed in a number of different globally acknowledged scales, the method chosen for this evaluation was the Samn-Perelli 7 point alertness scale. Other methods by which the output could have been assessed include the Karolinska sleepiness scale, comparative blood alcohol concentration, missed performance measures (reaction time and missed responses).

The various validation studies that have been carried out involving more than 1 800 aircrew members improved the model considerably, and it can now provide a realistic assessment of fatigue levels associated with a large number of different types of operation. The model has been improved with results incorporated from the following areas:

- The effect of early starts;
- Trends related to time of day and time on task;
- The recuperative value of bunk sleep;
- Sleep in a seat vs sleep in a bunk;
- The effect of multiple sectors;
- The effectiveness of daytime compared with overnight sleep;
- The effect of cumulative fatigue;
- The effects of time zone crossings.

⁸ See for example: Spencer MB and Robertson KA. CAA Paper 2005/04. Aircrew Fatigue: A Review of Research Undertaken on Behalf of the UK Civil Aviation Authority.

⁹ Belyavin AJ and Spencer MB. Modeling performance and alertness: The QinetiQ approach. Aviation Space and Environmental Medicine 75 (3, Suppl); A93-103, 2004.

¹⁰ Spencer MB and Robertson KA. The application of an alertness model to ultra-long-range civil air operations. Somnologie 11: 159-166, 2007.

As it would be expected there are still some areas where the model could be improved through further validation, for example:

- Short-haul schedules with an adverse juxtaposition of early starts and late finishes;
- The issue of cumulative fatigue as the result of a succession of long time zone changes;
- Individual differences;
- The quality of hotel accommodation;
- The distance of the hotel from the airport;
- Commuting time;
- The effect of standby;
- Helicopter Operations.

Further development is needed in the areas of cumulative fatigue and standby. The results on these aspects need to be treated with particular care.

4.1.3 Safety impact summary

In order to bring all the arguments delivered by scientific evidence, operational experience and the modelling exercise at the end of each safety impact section, there is a safety impact summary which points out the main arguments and defines the MCA score given for each option. See Section 4.4 for the details on the MCA methodology.

4.2 Assessing economic impacts

FTL schemes introduce limitations to the way crews can be scheduled by airlines in order to mitigate fatigue hazards. The mitigating measures include duty and flight time limits, minimum rest rules and other constraints. The most immediate economic effects induced by these measures are on crew productivity and thus on unit costs usually expressed in € cent per ASK. This RIA will initially focus on the potential effects on crew productivity and costs. Knock-on effects on capital use and competitiveness are currently not considered.

The way in which different FTL schemes impact on airlines depends to a large extent on the flight routes and rosters they operate, which in turn depend on the business model. Therefore a meaningful analysis of economic impacts has to differentiate business models.

As it was not feasible for this RIA to use the real schedules and rosters of all European airlines or even to have a representative selection of them, the approach taken here is to look at certain business models and analyse the impacts on a 'model airline' basis. Where there is a need to put these results in perspective of the whole industry extrapolation was made based on the basic figures on operators, fleet and crew (See Table 1, p. 50).

Due to the thorough as well as time consuming process of option development, the economic analysis concentrated on the options which were expected to induce the highest costs. Other options are considered with a more qualitative approach. The economic assessment has always to be seen in relation to other options.

The analysis is therefore comparative. Options are compared with each other to find out which is the economically most damaging and which is the economically most favourable. Where available, current Subpart Q provisions are considered as the reference ('base line'). The absolute values of productivity gains/losses and the associated cost are therefore only relevant in comparison with the other options. The exact value of costs for a particular option, for example, is therefore less relevant than the relative cost created by the option compared to another.

For the purpose of this study the following basic model of operating performance is applied¹¹:

TRAFFIC × YIELD – OUTPUT × UNIT COST = OPERATING PERFORMANCE (profit/loss)

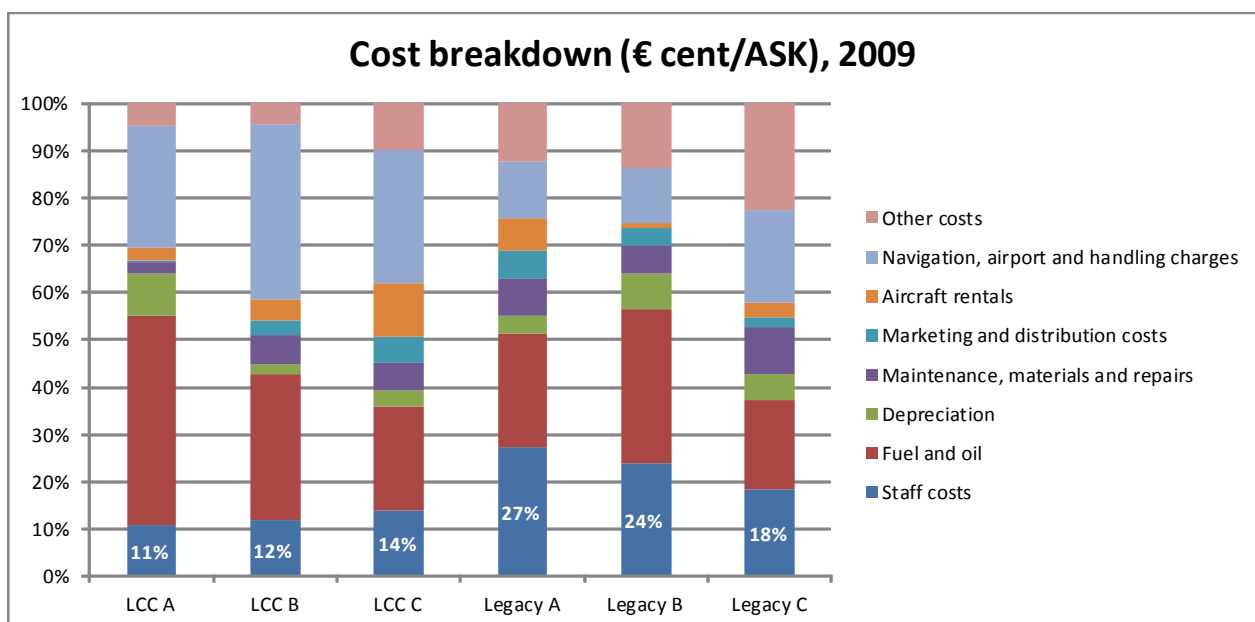
¹¹ Holloway, S. (2003): Straight and level: Practical airline economics.

As the impact of FTL schemes is on crew productivity it essentially affects the unit costs in the above equation. *Ceteris paribus*, an increase in unit costs would thus reduce operating performance. Due to the nature of FTL schemes, the largest part of the cost increase would be recurrent every financial period. This RIA therefore looks largely at annual costs. The degree to which an increase in crew unit costs would result in increased overall unit costs depends on its share in the total operating unit costs.

Costs will change over time and one can expect efficiency gains that would tend to reduce the annual cost of any option. However, it is assumed that the changes over time would not have an impact on the relative efficiency of one option over another.

Staff costs range between 0.4 and 0.9 € cent per ASK for LCCs and between 1.6 and 2.2 € cent per ASK for legacy carriers¹². These represent around 12% of the total operating costs for LCCs and around 20% of the total operating costs for legacy carriers. Charters and Regionals tend to be closer to LCCs in their cost structure.

Figure 1: Cost breakdown of major European airlines¹³



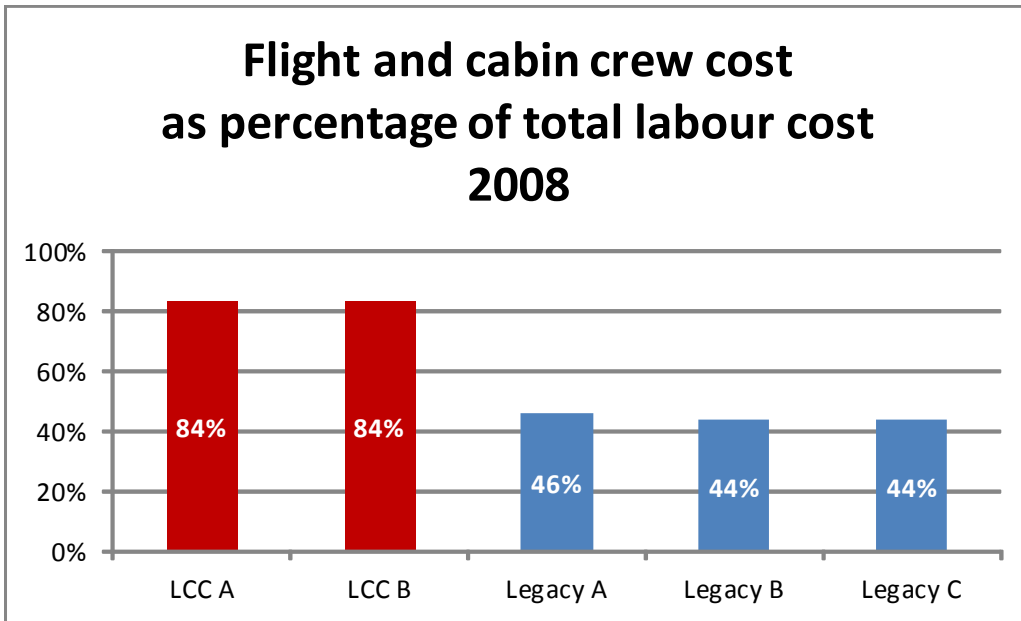
The following figure

Figure 2 shows the share of crew cost in total labour costs for selected European operators in 2008. For LCCs this share is in the order 80% of total staff costs, while the share is significantly lower for network carriers (45%).

¹² Source: Operator annual reports 2009.

¹³ Source: Operator Annual reports.

Figure 2: Flight and cabin crew cost as percentage of total labour cost, 2008¹⁴



In order to estimate the magnitude of the impacts generated by the new Flight Time Limitations it is crucial to know the overall number of operators and crew affected. No integrated data base currently exists for this kind of information as the European competency in the field of aviation safety for operations has only recently been created. Table 1 gives an overview of the sources used by the Agency and the resulting estimate. The estimated figures are derived by extrapolating the available data from ICAO with the traffic figures from Eurocontrol and then adjusting it to the overall number of flight and cabin crew reported by the European Commission’s Study ‘Effects of EU Liberalisation on Air Transport Employment and Working Conditions’¹⁵. This study is based on questionnaires and interviews with the National Aviation Authorities and is thus considered as the best source currently available on crew figures in Europe. For full details on how the total figures from the study were broken down to business models, please see Annex 7.4.

¹⁴ Source: ICAO.

¹⁵ European Commission (2009): Effects of EU Liberalisation on Air Transport Employment and Working Conditions, p. 35 and 41. The figure given is from 2007, which is considered the upper limit for 2008 due to the effects of the financial crisis.

Table 1: Sources and estimate of number of crew in EASA countries, 2008¹⁶

Business model	Ascend 1 July 2008		Eurocontrol 2008		Estimate for 31 EASA countries		
	Number of operators	Number of aircraft	Total number of flights in EASA countries	Share of total EASA-country flight	Pilots and co-pilots	Cabin crew	Total
Legacy	42	2,107	4,939,760	59.9%	24,608	76,587	101,195
Low-cost	38	962	1,911,951	23.2%	8,817	16,005	24,822
Business	733	2,118	669,423	8.1%	6,161	9,454	15,615
Charter	73	530	448,710	5.4%	4,145	9,663	13,808
All-cargo	63	445	282,403	3.4%	1,720	-	1,720
Regional	84	1016			5,358	4,149	9,507
Total	1,033	7,177	8,252,247	100.0%	50,810	115,858	166,668

Overall the estimates are considered sufficiently accurate for the purpose of this RIA.¹⁷

As regards crew costs, there is a number of sources available to get an understanding of the related costs. Table 2 gives an overview of the ranges established in a study by Westminster University for Eurocontrol.

Table 2: Annual crew costs in Europe, 2008 (Westminster Study)

Personnel category	From	To
Captain	81,900	266,500
First Officer	45,500	195,000
Senior Flight Attendant	39,000	58,500
Flight Attendant	26,000	39,000
Source: University of Westminster, London http://www.eurocontrol.int/eec/gallery/content/public/documents/projects/CARE/CARE_INO_III/DCI_TDD5-0_Aircraft_crewing-marginal_delay_costs.pdf		
Notes: Costs are gross per annum including allowances and 30% on-costs, excluding overtime. All data in euros. Key exchange rates used: EUR/USD 1.5, EUR/GBP 0.8		

Unfortunately, this study does not differentiate according to business model, which is necessary for the further analysis in this RIA. The Agency therefore also looked into data from ICAO, which is available for selected countries and operators. Table 3 and Table 4 give an overview of the data derived from ICAO by business model. The averages in the below table are weighted by traffic (number of flights).

¹⁶ For details on how the data was derived see Annex 7.4. For charter operators the flight data given here is based on the flight plans filed. It is acknowledged that a large part of operators servicing the leisure industry file 'scheduled' flight plans. On the other hand, a number of airlines considered as 'charter' now operate like Low Cost Carriers. As far as FTL schemes are concerned, it was important to look at charter airlines as they often have more complex and dynamic schedules than LCCs.

¹⁷ For the RIA an order of magnitude is required, not an exact figure. A sensitivity analysis is performed in order to ensure that data uncertainties do not determine the final outcome of the assessment.

Table 3: Flight crew: Annual costs for selected airlines by business model in Europe, 2008 (ICAO)

Business Model	No. of airlines	Airline average expenditure		
		Minimum	Maximum	Average
Legacy	13	€22,835	€247,943	€164,544
Low-cost	7	€54,213	€130,462	€78,947
Business	4	€59,305	€115,205	€111,585
Charter	11	€36,178	€127,832	€99,484
All-cargo	4	€50,305	€82,622	€61,396
Regional	8	€41,587	€118,910	€64,054
Total	47	€22,835	€247,943	€132,768

Table 4: Cabin crew: Annual costs for selected airlines by business model in Europe 2008, (ICAO)

Business Model	No. of airlines	Airline average expenditure		
		Minimum	Maximum	Average
Legacy	13	€14,738	€63,850	€44,892
Low-cost	7	€14,095	€37,815	€21,653
Business	4	€42,629	€72,093	€57,952
Charter	11	€10,795	€45,500	€20,341
All-cargo	4	-	-	-
Regional	8	€19,517	€38,761	€22,886
Total	47	€10,795	€72,093	€38,372

Finally, the Agency received a set of current data from charter operators for salary costs from 11 European operators.

Table 5: Crew costs for European charter operators, 2010

Operator	Flight crew	Cabin Crew
1	150,000.00	32,500.00
2	187,500.00	32,500.00
3	150,000.00	32,500.00
4	123,000.00	-
5	63,700.00	32,500.00
6	134,900.00	58,700.00
7	110,200.00	37,400.00
8	116,800.00	51,900.00
9	194,500.00	54,100.00
10	170,000.00	55,000.00
11	174,000.00	55,000.00
Total	143,145.45	40,190.91

The above information does not give associated traffic or personnel numbers, so it is not possible to derive the weighted averages. However, the information seems to indicate that the crew costs are underestimated in the ICAO figures. Thus, for further assessments of charter operations and as a careful assumption the maximum value of the flight crew figures from ICAO is used (EUR 127,832 in Table 3) instead of the average figure. For cabin crew the charter operators' average figure in Table 5 (EUR 40,190) is retained.

4.3 Assessing other impacts

Potential negative **social impacts** were identified wherever possible with the help of the rulemaking group. This could include negative effects on employment conditions, potentially

including negative effects on health that should be considered. In order to make these impacts comparable with other impacts, they were scored in line with the multi-criteria analysis (MCA) methodology outlined in the following section.

Issues related to **regulatory harmonisation and coordination** were also identified. An important document in this context was the recently published FAA NPRM (Notice of Proposed Rulemaking) of 14 September 2010 on 'Flightcrew member duty and rest requirements'. Again the MCA was used to compare the effects. However, it is important to stress that the NPRM is a proposal and the final legal text is not yet known.

4.4 Comparing and ranking the options: Multi-criteria analysis

The term multi-criteria analysis covers a wide range of techniques that share the aim of combining a range of positive and negative impacts into a single framework to allow easier comparison of scenarios. Essentially, it applies cost/benefit thinking to cases where there is a need to present impacts that are a mixture of qualitative, quantitative and monetary data, and where there are varying degrees of certainty.

Key steps of a MCA generally include:

1. establishing criteria to be used to compare the options (these criteria must be measurable, at least in qualitative terms);
2. assigning weights to each criterion to reflect its relative importance in the decision;
3. scoring how well each option meets the criteria; the scoring needs to be relative to the baseline scenario;
4. ranking the options by combining their respective weights and scores;
5. performing sensitivity analysis on the scoring so as to test the robustness of the ranking (at the end of each section).

The objective for this rulemaking activity has been outlined in the previous Chapter 3 (Step 1). The options will be described and analysed in the following chapter. The criteria used to compare the options were derived from the Basic Regulation (EC) No 216/2008 and the guidelines for Regulatory Impact Assessment developed by the European Commission.¹⁸ The principal objective of the Agency is to 'establish and maintain a high uniform level of safety' [Article 2(1)]. As additional objectives, the Basic regulation mentions environmental, economic and harmonisation issues, which are reflected in Table 6 below.

As regards social impacts, this RIA focuses on avoiding negative effects for crew employment conditions. The Commission guidelines for Impact Assessment cover 'Safety' under 'Social issues'. However, the Agency uses 'Safety' as a distinct criterion due to the mandate in Article 2 of the Basic Regulation. Effects on employment conditions are considered the most immediate effects. Possible further social effects, for example negative health impacts, are considered where appropriate.

The table also shows the weights that were assigned to the individual groups of criteria. Based on the above considerations and on the mandate of the Agency, Safety received the highest weight of 3.

¹⁸ http://ec.europa.eu/governance/impact/commission_guidelines/commission_guidelines_en.htm.

Table 6: Assessment criteria for Multi-Criteria Analysis (MCA)

Assessment areas		Assessment criteria
	Weights	Description
Safety	3	Establish and maintain a high uniform level of safety
Environment	2	Avoid negative effects on the environment (noise and emissions)
Social	1	Avoid negative effects for current crew employment conditions
Economic	1	Avoid excessive costs to the sector while ensuring safety Avoid competitive disadvantages for European industry
Proportionality	1	Ensure proportionate rules for Small and Medium sized Enterprises (SMEs)/General aviation/Business Aviation Avoid an uneven regional distribution of impacts
Regulatory harmonisation	1	Avoid excessive implementation problems Ensure compliance with ICAO standards where required and appropriate from a European perspective Achieve the maximum appropriate degree of harmonisation with the Third Country equivalent rules for commercial aviation

Environmental impacts are attributed with a weight of 2 as the Agency has certain specific responsibilities in this area related to noise and emissions. For this Impact Assessment, however, no environmental effects are expected.

Each option developed below will be assessed based on the above criteria. Scores are used to show the degree to which each of the options achieves the assessment criteria. The scoring is performed on a scale between –5 and +5. Table 7 gives an overview of the scores and their interpretation.

Table 7: Scores for the Multi-criteria analysis

Score	Descriptions	Example for scoring options
+5	Highly positive impact	Highly positive safety, social or environmental protection impact. Savings of more than 5% of annual turnover for any single firm; Total annual savings of more than 100 million euros
+3	Medium positive impact	Medium positive social, safety or environmental protection impact. Savings of 1% - 5% of annual turnover for any single firm; Total annual savings of 10-100 million euros
+1	Low positive impact	Low positive safety, social or environmental protection impact. Savings of less than 1% of annual turnover for any single firm; Total annual savings of less than 10 million euros
0	No impact	
-1	Low negative impact	Low negative safety, social or environmental protection impact. Costs of less than 1% of annual turnover for any single firm; Total annual costs of less than 10 million euros
-3	Medium negative impact	Medium negative safety, social or environmental protection impact. Costs of 1% - 5% of annual turnover for any single firm; Total annual costs of 10-100 million euros
-5	Highly negative impact	Highly negative safety, social or environmental protection impact. Costs of more than 5% of annual turnover for any single firm; Total annual costs of more than 100 million euros

5 Identification and analysis of options

In order to achieve the objectives outlined in Section 3, a range of options was developed and agreed by the rulemaking group OPS.055.¹⁹ These options are presented below based on the major fatigue hazards presented in section 2.2.2. For each major fatigue hazard the options are presented below by mitigation measure. Where available, the provision in Subpart Q is the reference option 0.

In line with the methodology presented in Section 0, each of the 16 blocks of hazards below is evaluated in terms of safety impact. Where there was a consensus approach, it is indicated by a merged field across all options. Furthermore the social, economic and environmental impacts are discussed. Where applicable, regulatory harmonisation and coordination issues are considered.

5.1 Duty hours

5.1.1 Options identified²⁰

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Limit the maximum allowable duty period	No limit but addressed through rest requirements	No limit but addressed through rest requirements and guidance to protect the 8-hour sleep opportunity	More than 18 hours duty period are only allowed at crew's discretion	Limit to duty to 14 hours
b) Limitations on combining flight and ground duties		Consensus approach: Include ground duty as 100% FDP in subsequent FDP Guidance: No SIM/Cabin Crew Safety Training in same duty before Flight Duty		

5.1.2 Safety impact

a) *Limit the maximum allowable duty period*²¹

The NASA Study²² recommends limiting the duty period to 14 hours. However, this study has to be seen in the context of the current FAA FTL rules where duty time is limited to 16 hours but rest requirements are only 8 hours, whatever the length of the duty.

In terms of fatigue risk, there are two possible approaches to mitigate the impact of long duty periods: either limiting the duty itself, which is the current FAA approach on which the NASA study is based, or introduce an appropriate rest requirement related to the length of the duty period in order to protect the subsequent flight duty period. EU-OPS Subpart Q (Option 0)

¹⁹ This does not imply that all group members agreed to the content of each option, but they agreed that the options specified are in principle possible and one of the options represented their expert position.

²⁰ Editorial note: The preferred option is marked with grey shading. Where the preferred option is identical to other options, the respective cells are merged to show consensus items.

²¹ The definitions of Flight Duty Period and Duty Periods used in this discussion are those from EU-OPS Subpart Q:

Duty period: 'A period which starts when a crew member is required by an operator to commence a duty and ends when the crew member is free of all duties.'

Flight Duty Period: 'A Flight Duty Period (FDP) is any time during which a person operates in an aircraft as a member of its crew. The FDP starts when the crew member is required by an operator to report for a flight or a series of flights; it finishes at the end of the last flight on which he/she is an operating crew member.'

²² *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996).

follows the latter approach by introducing rests requirements proportionate to the duty period above a minimum of 10 hours.²³

Research on sleep generally recommends 8 hours of sleep every 24 hrs. If a 24-hour duty day is permitted (Options 0 and 1), then the safety impact on that day is null, as it is already protected by FDP limits and the fact that duty prior to reporting is counted as FDP.

There is also no safety impact on the second day because it is a day off duty. The question that remains open is the impact on the third day, and in particular whether the 24-hour rest on the second day is sufficient to compensate the 24 hours without sleep opportunity on day one.

To support this, Belenky (Vol. 12, p. 10, 2003) observes that 'following chronic, mild to moderate sleep restriction (5 or 7 h Time In Bed), 3 days of recovery sleep (8-h TIB) did not restore performance to baseline levels'.

Apart from option 0, all options try to address this issue, albeit in a different manner:

Option 1 introduces guidance on the protection of the 8-hour sleep opportunity in case of long DP.

Option 2 introduces an 18-hour limit for the max FDP, based on current Spanish regulations.

Option 3 introduces a 14-hour limit for the max FDP, based on the NASA Study (Dinges, 1996).

Considering the above, options 1–3 are considered to provide the same level of protection against fatigue risks.

b) Limitations on combining flight and ground duties

All options are identical.

Safety impact summary: The assessment has shown that options 1–3 do not result in significant safety differences due to long duty periods. Options 1, 2 and 3 introduce a guidance to limit the combination of flight duty and flight simulator training. These options are therefore expected to have a low positive safety impact (+1).

5.1.3 Other impacts

(a) Social

Research recommends that there should be an 8-hour sleep opportunity every 24 hours. Long duty periods as possible under option 0 and 1 may cause sleep disorders. However, operators have a strong incentive to minimise non-FDP duty periods as they limit the productivity of the crew (rest equivalent to the preceding duty) and have them reach the weekly duty period limit of 60 hours very quickly. More research is required to understand the effect of long duty periods followed by long rest periods. Option 0 is therefore scored with a low negative social impact due to the potential of sleep disorders during long continuous duty periods. Option 1 is considered neutral in this respect as it contains guidance to the operators to protect the 8-hour sleep opportunity.

(b) Economic

Due to the rest requirements and cumulative duty limits, Options 0 and 1 contain strong economic incentives for operators to use the possibility of long daily duty times only very restrictively. For example, should an operator schedule a long duty of 24 hours²⁴ including a full FDP, the subsequent rest period also has to be at least 24 hours, which has a negative effect on crew productivity.

²³ A similar approach is taken by the UK CAA Cap 371.

²⁴ This could be possible by scheduling a full FDP of, say, 14 hours and subsequent post-flight duty of another 10 hours, e.g. for positioning.

In cases when a 24-hour duty is scheduled without FDP, only the minimum rest is required. However, crew productivity is significantly reduced due to the duty day without a flight. Furthermore, the respective crew member will very quickly reach the weekly limit of 60 hours of duty. Therefore, operators have a strong economic incentive to avoid this practice.

Operators nevertheless are interested in keeping this possibility for cases when no other options are available. The possibility of allowing up to 24 hours of duty per day therefore gives operational flexibility (e.g. for positioning after a flight or before simulator training).

Option 2 and 3 restrict this operational flexibility to 18 and 14 hours respectively. Given that long duty periods are deemed to be exceptional, the economic cost of introducing a restriction would be measurable but low (Score -1). In terms of simulator/FDP combination, the economic impact is deemed negligible, as it already reflects industry best practices and the provisions are intended to be included as guidance material.

(c) Regulatory coordination and harmonisation

In the United States the proposed changes to the existing rules on flight time limitations are contained in the NPRM (Notice of Proposed Rulemaking) of 14 September 2010 on 'Flightcrew member duty and rest requirements'. This NPRM is currently being discussed and is subject to consultation, which means that the final rule could still change. Contrary to existing FAR 117 provisions, today's NPRM of the Federal Aviation Administration (FAA) does not impose a daily limit on duty, but is proposing to impose cumulative limitations on duty, flight duty periods, and flight time. Therefore Options 0 and 1 are more in line with the FAA proposal than Options 2 and 3 (Score -1).

5.1.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		1	1	1		3	3	3
Environment	2								
Social	1	-1				-1			
Economic	1			-1	-1			-1	-1
Proportionality	1								
Regulatory co-ordination and harmonization	1			-1	-1			-1	-1
Total						-1	3	1	1

Option 1 is the preferred option because:

- The major safety implications of long duty periods are mitigated by full, including pre-flight, duty in the FDP calculation and using the total duty time for rest calculations. All options have this key requirement.
- Guidance on the combination of simulator duty and flight duty (Option 1) is considered equivalent in terms of safety as compared to a fixed requirement as it constitutes industry best practice.
- Option 1 ensures safety while allowing for operational flexibility and increased harmonisation with the FAA.

Sensitivity analysis: The preferred option is chosen as it allows more operational flexibility at the same level of safety. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate.

Further research is recommended on:

Health effects of long duty periods followed by long rest periods.

5.2 Cumulative fatigue

5.2.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Limit on successive long duty periods together		Further research on: <ul style="list-style-type: none"> duty of more than 10 hours by day and 7 hours by overnight, cumulative limits on disruptive schedules 		
b) Rolling limits on duty and flying hours	60 duty hours in 7 consecutive days 190 duty hours and 100 block hours in 28 consecutive days 900 block hours in a calendar year	60 duty hours in 7 consecutive days 190 duty hours and 100 block hours in 28 consecutive days 900 block hours in a calendar year AND 1 000 block hours per 12 consecutive calendar months	55 hours (scheduled), 60 hours (actual) in 7 consecutive days; 190 hours and 100 block hours in 28 consecutive days 900 block hours per 12 <i>consecutive</i> calendar months 95 hours in 14 consecutive days;	60 duty hours in 7 consecutive days; 190 duty hours and 100 block hours in 28 consecutive days 900 block hours per 12 <i>consecutive</i> calendar months 100 duty hours in 14 consecutive days;
c) Cumulative fatigue management through a required minimum number of days off per month	No Day-Off requirement, but Working Time Directive applies (7 days off)	No Day-Off requirement, but Working Time Directive applies (7 days off)	Additional days off requirements that meet the Q definition (1.1095 1.10) of a single day free of duty (to include 2 local nights). Minimum of 7 days off in any 4 weeks/minimum of 2 days off in 14 consecutive days/minimum of 24 days off in 12 weeks.	WTD days off requirement included (7 in a month) and expanded to require them to meet the single day off definition in Q (each must have 2 local nights).
d) Spread out duty as evenly as possible	Guidance	Demonstration by the Operator and Include Nicholson curve assessment when appropriate		
e) Rest period increased periodically	36 hours including 2 local nights after 168 hours As an exception, the second local night may start from 20:00 hours if the weekly rest period has a duration of at least 40 hours. Reporting time in this case can be 04:00	36 hours including 2 local nights after 168 hours No exception on the second local night	36 hours including 2 local nights within 7 consecutive days or 60 hours including 3 local nights within 10 consecutive calendar days No exception on the second local night	

5.2.2 Safety impact

a) *Limit on successive long duty periods together*

All options are identical.

b) *Rolling limits on duty and flying hours*

There is a lack of research regarding maximum cumulative limits. This is also acknowledged by the FAA (Battelle Memorial Institute - JIL Information Systems, 1998) 'No data were found that provide guidance for maximum duty times over longer time periods, such as one month or one year'. Current Subpart Q limits (Option 0) can therefore not be challenged from a scientific point of view. The question whether they are safe or not can thus only be evaluated on the basis of operational experience.

The **190-hour duty limit in 28 days** is deemed 'reasonable' by the Moebus Aviation report (2008, p. 14). All options include this provision and there was a general support for this requirement in the rulemaking group.

The same report recommends introducing an additional limit of **100 duty hours in 14 days** (Option 2 and 3), in order to avoid the possible accumulation of those 180 hours in 21 days (3 x 60 hours week), this being qualified as 'unreasonable' by the report. However, no scientific evidence was found to support this statement. There is therefore no evidence to validate the possible safety gain of Option 2 and 3 in this respect. The SAFE model simulation used to further explore this issue (see detailed analysis in Annex 7.1.2) tends to confirm this view. Furthermore, Options 0 and 1 already include a related mitigating measure saying that operators should ensure that duty is 'spread as evenly as possible'.

Concerning the cumulative limit of 900 **block hours per calendar year** (Option 0 and 1), the Moebus Aviation report (2008, p.14) points out that it may lead in practice to 1 800 block hours in 18 consecutive months. Option 2 and 3 therefore follow the Moebus Aviation recommendation to limit the 900 block hours per 12 *consecutive* months. However, on this subject also, scientific evidence is missing in order to decide whether 1 800 block hours in 18 consecutive months is 'unreasonable' or not. Option 1 proposes to add an additional limit of 1 000 block hours per 12 consecutive months. On this basis, Options 1, 2 and 3 are deemed to provide equivalent safety improvements.

c) *Cumulative fatigue management through a required minimum number of days off per month*

The question of the required minimum of days off lacks scientific substantiation. The Moebus Aviation report (2008, p. 27) states: 'In the absence of direct scientific evidence, it is not possible to provide clear guidance on the relationship between cumulative fatigue and the frequency of days off.' It however recommends, 'as a precaution', 4 weekly rest periods in every 28 consecutive days.

Subpart Q (Option 0) and Option 1 do not include such a limit but it should be noted that the Working Time Directive requires a minimum of 7 days off per month. Option 2 and 3 require additional days off to include two local nights. In view of the missing scientific evidence all four options are considered to have the same safety impact.

d) *Spread out duty as evenly as possible*

All options are identical.

e) *Rest period increased periodically*

36 hours of weekly rest including two local nights is a widespread provision in FTL rules. This is also supported by scientific evidence: 'Scientific studies show that two nights of recovery sleep are typically needed to resume baseline levels of sleep structure and waking performance and alertness' (Rosekind, 1997, p. 6). Dinges (*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'*, 1996) specifies that 'the standard off-duty period for recovery should be a minimum of 36 continuous hours, to include two consecutive nights of recovery sleep, within a 7-day period'.

Where opinion diverges is on the effectiveness of this provision depending on how protective the second night should be. Essentially, as regards Subpart Q provisions (Option 0), the question is whether the fact that the crew may report at 06:00 after the weekly rest is protective enough. While some scientific studies clearly show the effect of early start on transient fatigue, we are not aware of any scientific study addressing its effect on the effectiveness of the weekly rest.²⁵ Moebus Aviation (2008, p. 26) also recommends deleting the exemption in current Subpart Q which allows a 04:00 reporting time after weekly rest if the weekly rest is at least 40 hours.

Options 1, 2 and 3 propose the deletion of the Subpart Q exemption on the basis of the Rulemaking Group's consensus that this exemption seriously impairs the weekly rest provision. Options 2 and 3 introduce a slightly more flexible approach based on CAA Cz operational experience. All three options are considered to provide a safety improvement on current Subpart Q provisions.

Safety impact summary: The assessment has shown that options 1, 2 and 3 introduce safety improvements by introducing rolling limits on annual block hours and better protecting the weekly rest period for recovery sleep by deleting the exemption on the second local night. These options are therefore expected to have a low positive safety impact (+1).

5.2.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

The most significant economic effect of the provisions addressing high cumulative workload is expected from the proposed additional **limit on cumulative duty within 14 days** included in options 2 and 3. The impact is driven by the degree to which airlines actually schedule beyond the proposed limits of 95 and 100 hours per 14 days.

According to operators, legacy carriers tend to operate within the range of 60 to 110 cumulative duty hours per 14 days. A number of legacy carriers have CLAs, which prescribe 55 hours per week and thus cannot exceed 110 hours per 14 days. Nevertheless there are legacy carriers which exceed 110 hours on medium haul operations.

Low cost carriers tend to operate relatively stable rosters (e.g. 5 days on, 4 days off) which allow for an even distribution of duty time across a given period. Therefore they can be expected not to be significantly affected by the proposed 14-day limitations.

Regional airlines generally have longer daily duty periods due to split duties or due to the effects of operating from multiple bases. Therefore airlines estimate their operations to range between 70 and 110 hours per 14-day period.

Charter operators tend to make most use of the possibilities during their peaks times. They are assumed to operate a range up to the maximum of 120 hours per 14 days.

The above overview shows that charter operators would be most severely affected due to their holiday period peaks. CAP 371 experience²⁶ indicates, however, that the additional costs would not be prohibitive.

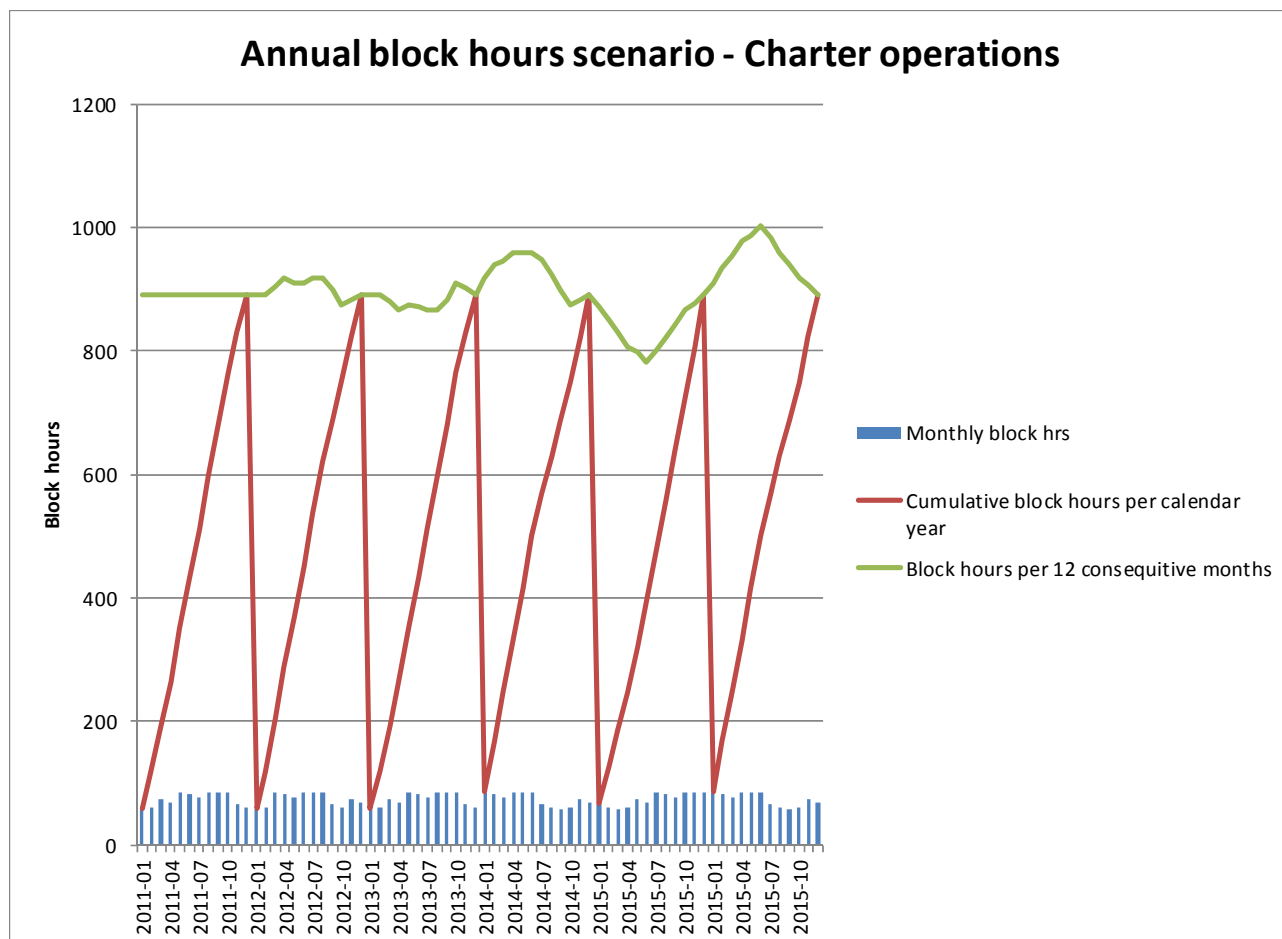
Another new element introduced in the proposal is a limit of **1 000 block hours per 12 consecutive months**. This limit is intended to avoid cumulative fatigue created by a pilot serving two peak times within 12 consecutive months thereby significantly exceeding the 900 block hours limit. Due to their services provided to the leisure industry, charter operators would be most affected by such an additional limit. Especially in Member States where holiday seasons can shift from one year to another, charter operators have to address this peak demand and follow the shifting season.

²⁵ It should be noted that Moebus Aviation (Moebus Aviation, 2008, p. 27) recommends changing the definition of local nights (10 hours between 22:00 and 10:00) in order to avoid reporting before 08:00 after a weekly rest. However, as this proposal lacks scientific substantiation, all four options reflect the current Subpart Q requirements.

²⁶ Option 2 is based on CAP 371 provisions.

In order to see the possible effect, a simulation was performed based on average monthly block hours provided by charter operators. These block hours show a peak in the months of May and then again August to October with monthly block times in excess of 80 hours. To simulate a worst case scenario, these peak block hours were then put at the end and at the beginning of a year in order to simulate the block hours that could be achieved within 12 consecutive months in an extreme case with shifting peak times. The results in Figure 3 show that block times per 12 consecutive months may — under these extreme assumptions — reach 1 000 hours.

Figure 3: Annual block hours scenario for charter operations



The smaller a company with fewer pilots, the more the effects of such a limit would be felt. As far as the whole industry is concerned the effects of this annual rolling limit are likely to be minimal.

Overall a low negative economic effect (-1) is estimated for options 2 and 3 due to the more restrictive 14-day rolling limit and the more restrictive limit of 900 block hours per 12 *consecutive* months.

(c) Regulatory coordination and harmonisation

- On cumulative duty, the FAA NPRM proposal would limit duty time to 65 hours in any consecutive 168-hour period (7 days) and 200 hours in any consecutive 672-hour period (28 days). The weekly limit could be extended by up to 10 hours to 75 hours during a rolling 168-hour period and the 28-day limit could be extended to 215 hours if the duty period includes deadhead segments in a rest seat outside the flight deck meeting or exceeding the provisions of class 2 rest facility. In this respect, all four options proposed are more protective than the FAA proposal.

- On periodic rest, the FAA NPRM also proposes a duration of 36 hours, but does not require to include 2 local nights. In this respect, all four options proposed are more protective than the FAA proposal.
- On cumulative duty, the FAA NPRM does not include a 14-day limit. Therefore Options 0 and 1 are more harmonised with the FAA proposal than Options 2 and 3.

5.2.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		1	1	1		3	3	3
Environment	2								
Social	1								
Economic	1			-1	-1			-1	-1
Proportionality	1								
Regulatory coordination and harmonisation	1			-1	-1			-1	-1
Total							3	1	1

Option 1 is the preferred option because:

- Options 1 to 3 are all considered equal in terms of safety.
- Option 1 achieves this level of safety at the least costs to the operators and increased harmonisation with the FAA.

Sensitivity analysis: The preferred option chosen is more cost-effective in providing the same level of safety. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but only to relative costs between options 1, 2 and 3.

Further research is recommended on:

- The cumulative effect of duties of more than 10 hours by day and 7 hours by overnight, more than 100 hours per 14 days.
- The impact of disruptive schedules on cumulative limits.

5.3 Maximum allowable flight duty period

5.3.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Clear maximum FDP limit	13 hours			
b) Extra rest requirements	If the duty period is above 10 or 12 hours			
c) Inclusion of positioning immediately before flight duty in FDP	Yes 100%			
d) Breaks	No	Guidance: Short breaks 10mn/3hrs for cabin crew		
e) Meal opportunity	Yes (when FDP exceeds 6 hrs)	Yes (when FDP exceeds 6 hrs) Guidance: 30 mn meal break in 6 hrs period (CC) Guidance should include CC responsibility for drinking and eating	30 mn meal break in 6 hrs period (CC)	
f) Break on the ground	No			Yes for short sectors and turn-around time
g) Inclusion of post-flight duty in FDP, taking into account the number of seats and configuration	No counts as duty	No: counts as duty, but prescribe minimum <u>duty</u> period after flight in OPS manual based on actual Operator's average		
h) Reduction of FDP when the Window of Circadian Low (WOCL) is encroached	50% in the evening, 100% in the morning of the WOCL encroachment down to 11 hours		50% in the evening, 100% in the morning of the WOCL encroachment down to 11 hours + no extension in the 5-8 window	3 hours FDP reduction in the WOCL. 1 hour FDP reduction for reporting between 6 and 8 AM
i) Additional rest if the WOCL was encroached	No	If two or more flight duty periods within a 7-day period encroach on all or any portion of the window circadian low, then the standard off-duty period (36 continuous hours within 168 hours) be extended to 48 hours of recovery	Increase required sleep opportunity during the day by 2.5 hours	Increase required sleep opportunity during the day by 2.5 hours
j) Limit the number of WOCL duties in a work block or number of days	None			3 consecutive and 4 max in 7 consecutive days or 5 under max FDP reduction

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
k) Planning of WOCL duties to enable flow of work and optimum sleep opportunity	Yes			
l) Allowable FDP decreased by the number of sectors worked	30-minute reduction from the third sector, with a limit to 2 hours	30-min reduction from the third sector, with a limit to 2 hours. Further research needed for FDP with more than 6 Sectors	30-mn reduction from the second sector, with a limit to 2 hours. Further research needed for FDP with more than 6 Sectors	45-mn reduction from the second sector, to a max of 8 sectors

5.3.2 Safety impact

a) Clear maximum FDP limit

b) Extra rest requirements

c) Inclusion of positioning immediately before flight duty in FDP

On mitigation measures a, b and c there was a broad consensus among experts and stakeholders that the basic maximum FDP limit should be 13 hours (a). Equally, on the other mitigating measures b and c there was a broad agreement. Therefore, no options different from Option 0 (Subpart Q) were developed for the mitigation measures a, b and c.

d) Breaks

Subpart Q does not include a provision for break during duty. Based on scientific studies, Moebus Aviation recommends that cabin crew have a 10-minute break every 3 hours. This is reflected by Options 1 and 2 as guidance and in option 3 as a requirement. Options 1–3 are therefore considered to bring a marginal safety improvement.

e) Meal opportunity

The need for a drink and meal opportunity is supported by a number of scientific studies, among others: *The impact of rest breaks upon accident risks, fatigue and performance: a review*, Work & Stress, Vol. 17, 2, pp. 123-137 (Tucker, 2003) and *Rest breaks and accident risk* The Lancet, Vol. 361, p. 680, 22 (Tucker, 2003). This is addressed by Subpart Q (option 1) by requiring such an opportunity. However, Moebus Aviation (2008) recommends being more specific on the duration of the meal break. This is reflected in Options 1 and 2 as guidance and in Option 3 as a requirement. Options 1–3 are therefore expected to provide a marginal safety improvement.

f) Break on the ground

One study (*The impact of rest breaks upon accident risks, fatigue and performance: a review*, Work & Stress, Vol. 17, 2, pp. 123-137 (Tucker, 2003) recommends breaks on the ground for short sectors and turn-around time as reflected by Option 3. This is expected to have a marginal positive safety impact. All other options do not foresee the break on the ground largely for operational reasons. See discussion of the economic impact below.

g) Inclusion of post-flight duty in FDP, taking into account the number of seats and configuration

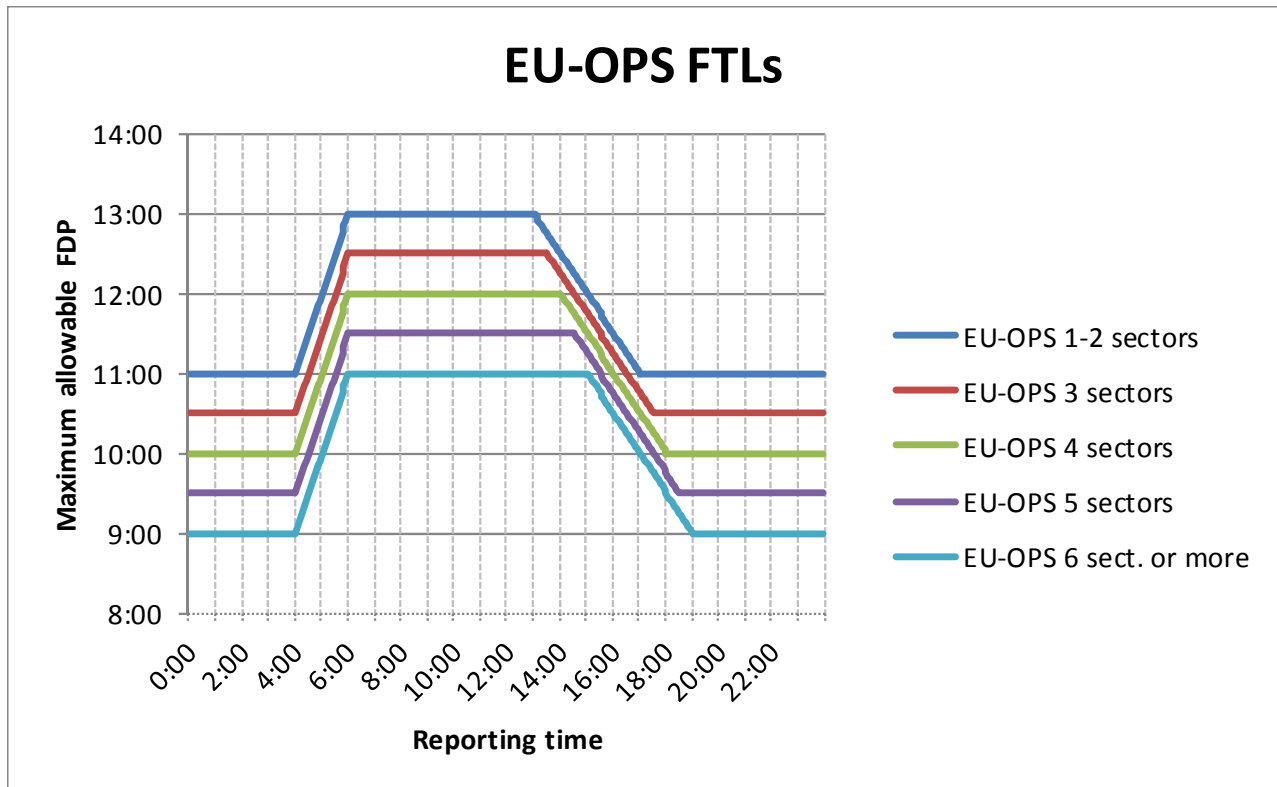
There is no scientific evidence to support the inclusion of post-flight duties as FDP. Yet it is recognised that post-flight duties are fatiguing, therefore it appears an adequate mitigation to increase rest proportionally as is currently the case in Subpart Q. Therefore, all options recommend keeping the current Subpart Q requirement. Options 1 to 3 require however the Operator to specify the duration of post-flight DP in the OPS Manual. This would represent a marginal safety improvement.

h) Reduction of FDP when the Window of Circadian Low (WOCL) is encroached

All Scientific studies and operational experience confirm that the length on FDP should be reduced depending on the reporting time. Reduction should be applied for flight duty periods where the crew member cannot sleep during the entire WOCL.²⁷

Subpart Q (Options 0 and 1) includes provisions addressing the FDP reduction depending on the WOCL encroachment. **Figure 4** below illustrates the current European practice for different reporting times and number of sectors, which is reflected in options 0 and 1. When looking at 1 and 2 sectors, one can see that the maximum FDP of 13 hours is allowed between 06:00 and 13:00. Before and after this period the FDP is gradually reduced down to 11:00 hours.

Figure 4: Maximum allowable FDP in function of the reporting time (EU-OPS, Options 0 and 1)



Two aspects of these provisions have been assessed by scientific research: impact of early start and the impact of 11:00 hours duty period overnight.

The impact of early start: the max FDP when reporting as early as 06:00 is 13 hours. This implies that the waking up period was indeed inside the WOCL. The following assessments can be found in research on this issue:

- *Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airlines Operations* (Co, E., 1999) identifies early morning starts as being a major fatigue factor.
- *The paper for the European Transport Safety Council (ETSC) 'meeting to discuss the role of EU FTL legislation'* (Akerstedt, 2003): 'ECASS has no objection to an FDP of 12 hours during the day, but does not support FDPs as long as 14 hours for early starts.'
- *A diary study of aircrew fatigue in short haul multi sector operations* (Spencer, 2000): 'when the reporting time is before 07:00, the increase of fatigue is similar to the effect of an extra 3 hours duty'.

²⁷ I.e. the crew member reports after/wakes in/reports in/finishes in the WOCL or the FDP encompasses the WOCL.

- The UK Civil Aviation Authority (2005) also evaluates the impact of early start on short haul routes: 'When a duty period started before 09:00, the duration of the preceding sleep period was reduced, as the crews did not advance their bedtime sufficiently to compensate for the early start. The loss of sleep amounted to approximately 30 minutes for every hour that the duty period advanced between 09:00 and 05:00.'

On the other hand:

- CAP 371 is more protective than Subpart Q on this issue, but a scientific study points out that its related provisions should be relaxed; *Alertness during short haul operations, including the impact of early starts* (Spencer, 2002): 'the fatiguing effects of early starts is less strong than previously estimated'.
- Simulation of alertness levels for early starts using the SAFE model indicate that whatever the FDP reduction, alertness for early starts remains at a generally high level and certainly below critical values (see RIA option analysis using the SAFE Model, Annex 7.1).

To reflect the different possibilities to address early starts, options 0 and 1 are based on Subpart Q. Option 2 is based on Subpart Q but forbids the 1-hour FDP extension in the 5:00 to 8:00 window. Option 3 is based on CAP 371, which is more protective in the morning.

Considering the above, there is no conclusive evidence that more restrictive options would bring a significant safety benefit.

The maximum FDP overnight is 11 hours

A number of scientific studies are in agreement on the fact that these limits may be too high:

- The *Paper for the European Transport Safety Council (ETSC) 'meeting to discuss the role of EU FTL legislation'* (Akerstedt, 2003): 'ECASS [...] cannot support duty periods as long as 12 hours when the WOCL is encroached.'
- *The Haj operation: alertness of aircrew on return flights between Indonesia and Saudi Arabia* (Spencer, 1999): 'These results support the recommendation that unaugmented flight duty periods should not exceed 10 hours overnight'.
- The *Air New Zealand Study* (QinetiQ) proposes reduced FDP limits (WOCL effect).
- Also, one study based on CAP 371 provisions recommends that [*Fatigue in Two Pilot Operations: Implications for Flight and Duty Time Limitations* (Powell, 2008)] 'limits for day time duties should be relaxed and night time duties tightened'.

On the other hand:

- No evidence was found in accident and incident data that 11 hours at night was a safety risk.
- The SAFE model simulation was used to further explore the effectiveness of Subpart Q 2-hour WOCL reduction. The detailed analysis in RIA Option Analysis using the SAFE Model, Annex 7.1.3 tends to confirm its effectiveness.

Options 0, 1 and 2 are based on Subpart Q. Option 3 is based on CAP 371, which includes 3-hour FDP reduction in the WOCL (as opposed to 2 hours for Subpart Q).

Overall, the Agency concluded that option 3 would not bring a significant positive safety impact as compared to Options 0, 1 and 2.

i) Additional rest if the WOCL was encroached

The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) notes that 'flight duty periods that occur during the window of circadian low have a higher potential of fatigue and increased requirements for recovery' and recommends that "if two or more flight duty periods within a 7-day period encroach on all or any portion of

the window circadian low, then the standard off-duty period (36 continuous hours within 7 days) be extended to 48 hours of recovery'.

Sleep Patterns of aircrew on Charter/air haulage routes (Spencer, 1997) observed on a series of long haul flights that 'the mean duration of sleep starting between 21:00 and 01:00 was greater than 7 hours. As the start of sleep was progressively delayed, its duration reduced to a value of 2.46 hours between 17:00 and 18:00', and concludes: 'The time of the day at which sleep is taken is by far the most influence on the duration and quality of sleep. The best and the longest sleep period start in the late evening. There is a progressive deterioration from midnight until the early evening, except for a small secondary peak at midday'. Sleep opportunity during the day should therefore be increased to be effective.

Options 2 and 3 require additional sleep opportunity, thereby reflecting the recommendations from *Sleep Patterns of aircrew on Charter/air haulage routes* (Spencer, 1997). Option 1 requires additional weekly rest.

Considering that scientific studies generally consider that early starts provoke a sleep deficit, Options 2 and 3 would provide no safety impact while Option 1 is considered to be a significant safety improvement due to the additional rest compensating for the WOCL encroachment.

j) Limit the number of WOCL duties in a work block or number of days

CAP 731 includes a provision limiting the number of consecutive duties under max FDP reduction as in option 3. However, the *Support for CAP 371 from research findings* (UK CAA) mentions that 'the preliminary results from a study on night cargo operations suggests that there is little increase in fatigue over 4 consecutive nights'.

Considering the above, there is little evidence that the provision under option 3 would have a significant safety impact. Furthermore, the additional weekly rest proposed under Option 1(i) above is considered to be a better approach as it mitigates the cumulative fatigue element identified by the scientific studies.

k) Planning of WOCL duties to enable flow of work and optimum sleep opportunity

This Subpart Q provision is not questioned and reflects best operational practices. It is therefore included in all options.

l) Allowable FDP decreased by the number of sectors worked

The need to decrease the FDP by the number of sectors is confirmed by many scientific studies. **Figure 4** above shows the effect of the current Subpart Q requirements on maximum allowable FDP (option 0 and 1), which is based on a 30-minute reduction after the second sector.

The main questions related to Subpart Q provisions are:

Should the reduction start from the 2nd sector?

The scientific literature reviewed does not give a uniform answer to this question.

- *Fatigue in Two Pilot Operations: Implications for Flight and Duty Time Limitations* (Powell, 2008) states that fatigue increases from the second sector.
- *Pilot fatigue in short haul operations: effect of number of sectors, duty length, and time of day* (Powell, 2007): 'Duty length and the number of sectors increased fatigue in a linear fashion. Time of the day had a weaker influence...'

On the other hand:

- *A diary study of aircrew fatigue in short haul multi sector operations* (Spencer, 2000): 'there was no difference with respect to fatigue between one and two sectors'.

Should the reduction be 30 minutes or more?

Most of the studies recommend a reduction of more than 30 minutes per sector:

- *Alertness during short haul operations, including the impact of early starts* (Spencer, 2002): 'The 45 minutes per sector provided by CAP 371 should not be reduced'.

- *Support for CAP 371 from research findings (UK CAA): 'the reduction of 45 minutes per sector is in close agreement with the scientific evidence'.*

On the other hand:

- *Air New Zealand Study (QinetiQ): 'Averaged over all times of day, this is equivalent to an additional 37.3 minutes of duty. To reflect this, the maximum FDP should be reduced by between 30 and 45 minutes for each sector after the first'.*
- However, Moebus Aviation (2008) recommends to keep the Subpart Q 30-minute reduction, but for the second sector.
- Alertness level simulations provided by the SAFE model (see RIA option analysis using the SAFE Model, Annex 7.1.4) appear to indicate that the difference between 1 and 2 sectors in terms of alertness is not significant, whatever the time of the day. The reduction after the first sector does lead to better alertness levels for 3 and more sectors, albeit only to a limited extent and not from critical levels.

The Agency concludes that there is not sufficient evidence to show that the sector reduction should start after the first sector or that each reduction should be 45 minutes. Considering the above, all options are considered to provide the same level of safety.

It has been noted that with Options 1, 2 and 3 there is no further reduction after respectively 6, 5 and 8 sectors. Additional research should therefore be conducted in order to better understand the possible impact of a high level of sectors (>6) on crew alertness.

Safety impact summary: The review of scientific evidence above has shown that available research results are not always sufficiently robust to be directly applied to the above mitigating measures. A limited number of differences in terms of safety impact between the options have been identified. Option 1 provides a number of safety improvements including:

- Extension of the weekly rest to 48 hours when two or more duty periods encroach all or any portion of the WOCL.
- Requirement for the Operator to specify the duration of post-flight DP in the OPS Manual.
- Guidance on breaks and meal opportunities.

Overall, option 1 is expected to have a medium positive safety impact (score +3) and options 2 and 3 a low positive safety impact (+1).

5.3.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

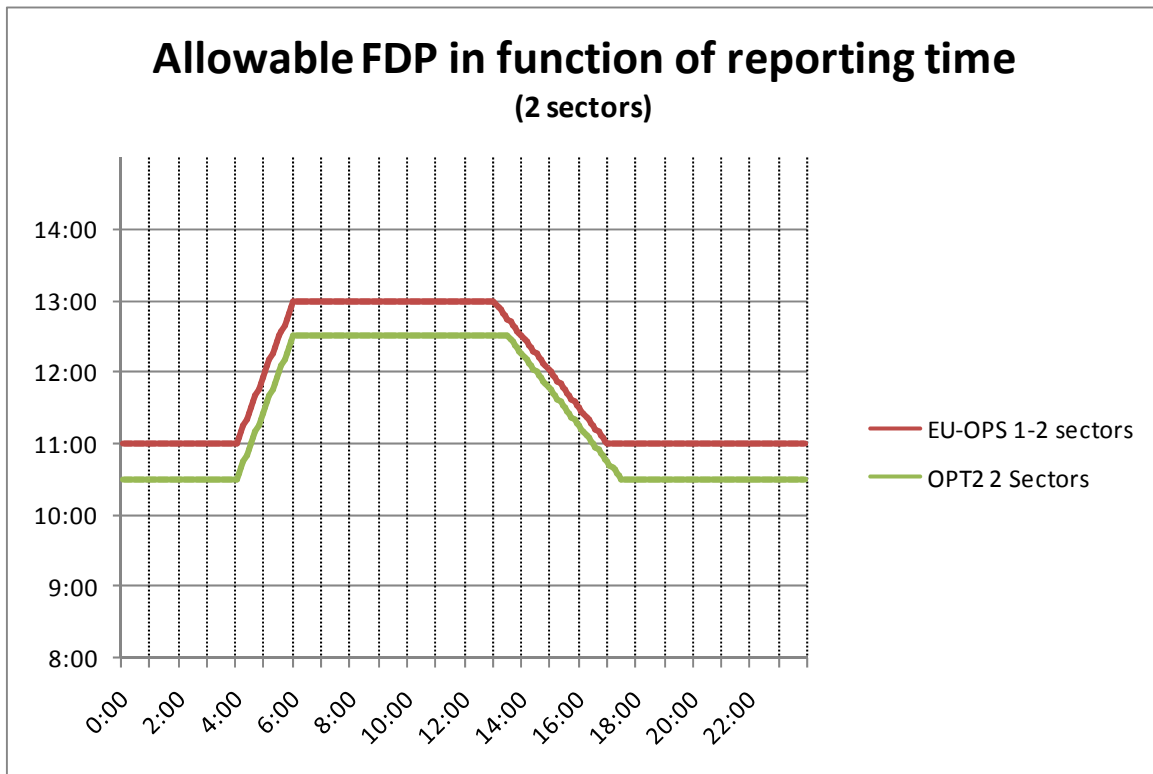
(b) Economic

In mitigation measure l) above the number of sectors and related workload was identified as a key fatigue hazard. As an appropriate means of mitigation, the allowable FDP should be decreased per sector. This is considered the economically most significant mitigation measure from this block of options and will therefore be assessed in more detail.

Current Subpart Q addresses this issue by reducing the allowable maximum FDP by 30 minutes per sector from the third sector on (Options 0 and 1). The alternative options propose to reduce by 30 (45) minutes from the 2nd sector on (Options 2 and 3).

Figure 5 illustrates the difference between the options. Essentially, in option 2 the maximum allowable FDP is reduced by 30 minutes for all flight duties with 2 sectors or more as compared to option 1, which reduces maximum allowable FDP as of the 3rd sector.

Figure 5: Allowable FDP options for 2 sectors — Options 1 and 2



The economic effects of such an additional restriction depend on the schedules and rosters of the individual airlines and the degree to which they operate close to those limits.

Low cost airlines usually operate two, four or eight sectors per day and aircraft with a morning and an afternoon crew out of a single base. Reporting times for the morning crew can be from 05:00 and end of duty for the afternoon crew is rarely later than 23:00. Thus, the aircraft would operate 18 hours per day with two crews, so 9 hours FDP per crew. In general, LCCs would therefore not be much affected by a decrease of allowable FDP by 30 minutes after the first sector. All options allow for sufficient margin and flexibility to operate. The maximum FDP requirement is rarely limiting their operations.

The picture for charter operators is quite different. They operate in a much more dynamic environment with complex rosters. Charter routes involve more frequently medium haul flights and triangular routes, which require longer FDPs. Charter operators therefore estimate that the above option would require 5% to 9% more flight crew and 6% to 10% more cabin crew.²⁸ In other words it would reduce crew productivity by those margins. For all charter airlines this could mean an annual cost increase of 50 to 87 million Euros initially (see Table 8). This can be categorised as a medium negative economic impact.²⁹ It is expected that after the first years of implementation of the rule these costs would be significantly reduced.

²⁸ This is the result of a survey conducted by charter operators and included responses from airlines that operate under a CLA. Companies operating purely to Subpart Q could observe stronger negative effects.

²⁹ Cost effects of 10–100 million Euros are considered 'medium negative'. See Table 7, page 53.

Table 8: Annual cost estimate for charter operators 'Sector reduction after 1st sector' (Option 2)³⁰

Column1	Estimated No of Employees (A)	Annual Salary (B)	Total Cost Employees (A × B)	Additional Staff Requirements (C)	Change in Labour Cost (A × B × C)
Cabin Crew	9,663	€ 40,191	€ 388,358,699	+6%	€ 23,301,522
				+10%	€ 38,835,870
Flight Crew	4,145	€ 127,832	€ 529,895,344	+5%	€ 26,494,767
				+9%	€ 47,690,581
Total				Low	€ 49,796,289
				High	€ 86,526,451

In order to get an understanding of economic impacts the absolute costs are only one indicator. Another relevant indicator is the relative cost increase. If one assumes for charter operators about 12% of total costs to be personnel³¹, then this would translate in an overall cost increase in the order of 0.5% to 0.9% at company level.

Table 9: Annual relative cost estimate charter operators 'Sector reduction after 1st sector' (Option 2)³²

Personnel Category	Additional Staff Requirements (A)	Share of Personnel Costs in Total Costs (B)	Share of CC and FC Cost in Total Personnel Cost (C)	Change in Total Cost (A×B×C)
Flight Crew (FC)	+5%	+12%	+55%	+0.33%
	+9%			+0.59%
Cabin Crew (CC)	+6%		+29%	+0.21%
	+10%			+0.35%
Total	Low			+0.54%
	High			+0.94%

A cost effect of below 1% is considered a low economic impact. The absolute and relative indicators thus do not give a uniform picture for charter operators.

The effect on network carriers can be expected to be somewhere between LCC and charter airlines.

Overall, taking into account the estimated effects on charter operators and the expected additional effects on network carriers, options 2 and 3 are considered to have a medium negative economic impact (−3, see Table 7 for an explanation of the scores). Option 1 is considered to have a low negative economic impact (−1) due to the compliance costs created by the safety improvement regarding additional weekly rest after WOCL encroachment.

(c) Regulatory coordination and harmonisation

The FAA proposes a maximum FDP of 13 hours. Unlike the EASA approach, the FAA proposes to reduce the amount of FDP once a flight crew member has flown more than 4 sectors,

³⁰ Estimates for number of employees from Table 1, page 50. Annual salary estimates from Table 3, Table 4 and Table 5.

³¹ This assumption is based on the average for LCCs in Figure 1.

³² Source: Column A: Operator estimates; Column B: Figure 1 assuming LCC figures for charter airlines; Column C: Average value from published airline annual reports, see Figure 2.

whereas the EASA proposal reduces the FSP as of the 2nd sector flown. As is the case in the EASA proposal, the FAA proposal foresees reduction of the amount of FDP during the WOCL and for non-acclimatised flight crew members. The FAA proposal also provides some flexibility as it foresees that FDPs should not exceed the maximum levels in the FDP table more than 5% of the time, while each crew pairing would need to fall within the FDP table 80% of the time.

Overall, the combined effect of WOCL and sector reduction leads to partly higher and partly lower FDP in the FAA NPRM than in the four options proposed there. However, the FAA NPRM also proposes shorter rest periods than the options envisaged in the NPA (see paragraph 5.12). Overall, the impact of all four options on Harmonisation is deemed equivalent.

5.3.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		3	1	1		9	3	3
Environment	2								
Social	1								
Economic	1		-1	-3	-3		-1	-3	-3
Proportionality	1								
Regulatory coordination and harmonisation	1								
Total						0	8	0	0

Option 1 is the preferred option because:

- It requires additional weekly rest in order to mitigate against the effects of WOCL encroachments on cumulative fatigue. For this reason it has the relatively highest score for safety as compared to the other options.
- It achieves the improved level of safety with relatively limited costs to the industry.

Sensitivity analysis: The preferred option is expected to provide the highest level of safety. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate due to the high weight for safety in the assessment.

Further research is recommended on:

- the possible impact of a high level of sectors (>6) on crew alertness.

5.4 Consecutive night, early or late duties

The provisions for consecutive night, early or late duties are currently partly subject to EU-OPS Article 8 provisions, i.e. the definition of these requirements are left to the Member States' Competent Authorities. For this reason there is not always a reference option 0 in this block of options.

5.4.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Definitions applicable to this section	Not applicable	<ul style="list-style-type: none"> Late finish: 01-02 hrs Night duty: 02-05 hrs Early start: 05-06 hrs 		<ul style="list-style-type: none"> Late finish: 22-02 hrs Night duty: 02-06 hrs Early start: 06-08 hrs
b) Reduce allowable FDP/DP for consecutive night duties	Not addressed	For sole night operations: longer FDP under specific patterns (FRMS principles)		10 max FDP in the WOCL (Samn-Perelli level 5)
c) Limit the number of sectors for consecutive night duties	Not addressed	Limited to 4 sectors, unless under FRMS	4 sectors on day 1 to 3, 3 sectors on day 4, 2 thereafter	Limit maximum sectors to 1 if a single continuous block-to-block flight period is greater than 10 hours and encroaches the WOCL
d) Limit the number of consecutive night duties	Not addressed	None	None	None
e) Additional rest after consecutive night duties	Not addressed	If two or more flight duty periods within a 7-day period encroach on all or any portion of the window circadian low, then the standard off-duty period (36 continuous hours within 7 days) be extended to 48 hours of recovery	When three or more duties are between 01:00 and 06:59 in a 7-day period, the 36-hour rest is increased to 48 hours	4 local nights following 5 night duties
f) Limit the number of consecutive early starts (see definitions) and/or late finishes (see definitions) and provide an extended rest period between such series of duties	Article 8	None, but additional conditions on late to early transitions (see 19-b, Option 3)	3 consecutive and 4 max in 7 consecutive days or 5 under max FDP reduction	No
g) Limitations on FDP for regular services with early starts and/or late arrivals	Article 8	None but additional conditions on late to early transitions (see 19-b, Option 3)	Above 3 consecutive early start, FDP limited to 9 hours	3 without additional limit. 4 with 1 hour FDP reduction every day. 5 with 2 hours FDP reduction every day + reduce allowable FDP by 45 minutes per each sector flown after the first. See Nr 30 & 31

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
h) Consecutive early start duties should never start earlier than the day before	No			Yes
i) Additional rest after a series of early starts	Article 8	No		63 hours rest after 4 or 5

5.4.2 Safety impact

a) Definitions applicable to this section

In order to determine the provisions for early starts, night duties and late arrivals, these notions have to be clearly defined. However, there is little scientific research that could support specific definitions.

On late finishes, the *CAA Paper 2005/04 Aircrew fatigue: a review of research undertaken on behalf of the UK Civil Aviation Authority* (UK CAA, 2005) identifies that 'the mean duration of sleep starting between 21:00 and 01:00 was greater than seven hours. As the start of sleep was progressively delayed, its duration decreased to a value of 2.5 hours in the late afternoon.' This would support the definition of late arrival being after 01:00. Only Moebus Aviation (2008, p. 18) suggests that early start should be up to 07:00.

The elements above, plus the input based on airline operational experience, were used to define **Options 1, 2 and 3**. Further input during the NPA comment period may help us to refine these definitions. Option 3 is probably more protective than options 1 and 2 but would have higher operational impact.

b) Reduce allowable FDP/DP for consecutive night duties

The maximum allowable FDP when the WOCL is encroached has already been addressed under 5.3.2 h). The question here is whether some alleviation could be given for operators conducting *only* night operations. Moebus Aviation (2008, p. 36) points out that there is little scientific evidence that the FDP provisions should be relaxed for sole night operations. It therefore recommends applying standard provisions. Derogation beyond the established limits should only be allowed in conjunction with FRMS.

This is reflected by **Options 1 and 2**. **Option 3** is the most restrictive with maximum allowable FDP values lower than those from Subpart Q.

c) Limit the number of sectors for consecutive night duties

Subpart Q (Option 1) currently does not limit the number of sectors for consecutive night duties. However, alertness simulations conducted with the SAFE model clearly indicate that the alertness level for night operation is in the lower zone (around 5 on the Samn-Perelli scale) and is sensitive to the number of sectors flown (see section 7.1.4). Option 1 therefore limits the number of sectors for consecutive night duties to 4. Furthermore, option 1 is consistent with research results (see 6-d below) which show that with consecutive sole night operations the first night is the more penalising. On the next consecutive nights, the body clock becomes progressively adapted to the night pattern. Option 1 also envisages that flight crew may fly more than 4 sectors, but then only under Fatigue Risk Management.

On the basis of the French DGAC regulation, **Option 2** proposes a limitation of the number of sectors for sole night operations. The number of sectors decreases when the number of consecutive nights increases. However, no scientific research would support this approach.

Option 3 is even more restrictive, but alertness modelling with SAFE suggests that the additional safety benefit over options 1 and 2 would be limited.

d) *Limit number of consecutive night duties*

While *Sleep Patterns of aircrew on Charter/air haulage routes* (Spencer, 1997) recommends to limit the number of consecutive night duties, the Qinetiq study on DHL night operation (UK Civil Aviation Authority, 2004), quoted by *CAA Paper 2005/04 Aircrew fatigue: a review of research undertaken on behalf of the UK Civil Aviation Authority* (UK CAA, 2005) identifies 'no evidence of an increase of fatigue over four consecutive nights'.

Also, *Support for CAP 371 from research findings* (UK CAA) states that '... preliminary results from a study of freight operations suggest that there is little increase in fatigue over 4 consecutive nights. It may therefore be possible in future to relax the guidelines for this type of operation'.

For this reason, **neither option** proposes a limitation of consecutive night duties.

e) *Additional rest after consecutive night duties*

There is scientific evidence suggesting that additional rest after consecutive night duties is required in order to mitigate against cumulative sleep debt. For this reason *Sleep Patterns of aircrew on Charter/air haulage routes* (Spencer, 1997) recommends additional rest between consecutive night duties. The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) recommends that 'if two or more flight duty periods within a 7-day period encroach on all or any portion of the Windows circadian low, then the standard off-duty period (36 continuous hours within 7 days) be extended to 48 hours recovery'.

The *Railway Safety – impact of shiftwork and fatigue on safety* (Folkard, 2000) on Railway Safety notes that: 'successive night shifts result in a cumulative sleep debt which is best mitigated by at least two days rest (avoiding an early shift on the return to work)'. It further notes that 'a number of studies done in industry have reported increases in accident risk over at least four successive night shifts (...)'.³³ The *Railway Safety – impact of shiftwork and fatigue on safety* (Folkard, 2000) therefore recommends: 'Having worked two or three consecutive night shifts it is important that staff are able to have sufficient sleep to fully recover. This requires two full nights' sleep after the consecutive night shifts, without an early start after the second night. In order to ensure this is achieved (and commuting time does not leave too short a period for rest), it is considered optimum that 54 hours or more should elapse between the end of the consecutive night shifts and the next shift.'

Option 1 is derived from the NASA recommendation [*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996)] but is made consistent with Option 1 of item 5.3.2 i).

Option 2 follows the NASA recommendation [*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996)] on additional rest.

Option 3 follows DGAC-F current regulations where four local nights are to follow 5 night duties.

Option 1 is considered a significant safety improvement as it better protects the recovery sleep. This assessment is supported by the worst case analysis with SAFE in Annex 7.1 which indicates that with a high duty load night duties can become critical. Option 1 mitigates this by providing additional rest.

There is no scientific evidence that Option 3 would in reality be more protective than Options 1 and 2 as it only applies to 5 consecutive night duties.

f) *Limit the number of consecutive early starts (see definitions) and/or late finishes (see definitions) and provide an extended rest period between such series of duties*

Subpart Q currently leaves it to NAAs how to mitigate possible cumulative fatigue from consecutive early starts (EU-OPS Article 8 provision). There is some scientific evidence to

³³ 'Relative to the first night shift, the risk is increased by about 15% on the second night shift, by about 30% on the third night shift and by 50% on the fourth night shift.'

suggest that series of early starts need to be limited. For example the *CAA Paper 2005/04 Aircrew fatigue: a review of research undertaken on behalf of the UK Civil Aviation Authority* (UK CAA, 2005) identifies that 'during schedules involving consecutive early starts, the sleep deficit accumulated and levels of alertness on retiring to bed tended to deteriorate.' However, the *CAA Paper 2005/04 Aircrew fatigue: a review of research undertaken on behalf of the UK Civil Aviation Authority* (UK CAA, 2005) does not recommend any limit. The *Sleep Patterns of aircrew on Charter/air haulage routes* (Spencer, 1997) also recommends to 'limit the number of consecutive early starts' without any clear guidance on how this should be implemented.

The *Railway Safety – impact of shiftwork and fatigue on safety* (Folkard, 2000), on railway safety, notes and recommends that: 'Due to the cumulative sleep deficit of working early shifts, it is considered best if the number of consecutive early shifts is restricted to three or four to minimise the build up of fatigue.'

Option 1, like Option 3, does not include any limit, but addresses the issue in conjunction with Option 3 of 5.14.1-b. Under this section the issue of transitions between early starts and late arrival and late arrival and early starts is discussed and addressed. Based on operational experience of the Rulemaking Group members and SAFE simulations (see Annex 7.1) it is acknowledged that more than a series of early starts, the transition between early/late and late/early, have a significant impact on fatigue. Option 3 of 5.14.1-b addresses this by introducing one local night at home base between such duty transitions.

Option 2 based upon CAP 371 directly reflects the scientific studies above. It should be noted however that those scientific studies focus mainly on early starts, not late finishes, and identify in particular their impact on cumulative fatigue. However, Option 2 provides a mitigating measure mainly on transient fatigue by limiting FDP.

In conjunction with Option 3 of 5.14.1-b, Option 1 is deemed to have the same positive safety impact as Option 2 compared to **Option 3**. Therefore Option 2 is deemed to have a low positive safety impact compared to **Option 3**.

g) Limitations on FDP for regular services with early starts and/or late arrivals

In relation to Options 2 and Option 3 f) above, a further limitation of the FDP for regular services with early starts and/or late arrival may be considered as a reasonable mitigating measure.

This is reflected by **Option 2** (based on UK Rules) and **Option 3** (based on French rules).

Option 2 is more protective than Option 3.

Consistently, **Option 1** does not include any limit and has also to be considered in conjunction with Option 3 of 5.14.1-b. **Option 3** is not considered effective as it does not provide additional rest, which is the most effective mitigation measure against cumulative fatigue.

h) Consecutive early start duties should never start earlier than the day before

Moebus Aviation (2008) recommends that 'when scheduling early morning duties it is important to ensure that the start times are not advanced on consecutive days (i.e. if duty start times change from day to day they should start later rather than earlier) as this will impact on the time available for sleep and the recovery period.' The practicality of this possible mitigating measure is questionable, as this equation (FDP + Rest = 24 hours) would lead to the flight crew member who has completed the shortest FDP receiving the longest rest period: FDP = 10 hours → rest = 14 hours minimum to keep to timing but rest period = 18 hours if the FDP only comes to 6 hours.

Option 3 reflects the Moebus Aviation proposal, but there is no evidence that it would provide any safety gain as compared to **Options 1 and 2**.

i) Additional rest after a series of early starts

In relation to f) above, additional rest after a series of early starts may be considered as an effective mitigating measure. This is also supported by the *Sleep Patterns of aircrew on Charter/air haulage routes* (Spencer, 1997), which recommends recovery sleep after no more than 3 consecutive early starts, and the *Alertness during short haul operations, including the impact of early starts* (Spencer, 2002) which states that fatigue is more pronounced when several early starts are operated without an intervening rest day.

Option 3 reflects these recommendations. However, based on the SAFE assessment both options would have only a low to negligible positive impact on safety as compared to Options 1 and 2, which foresee no additional rest.

Safety impact summary: All options proposed (1–3) are expected to provide an equivalent medium positive safety impact (+3). The safety benefits of Option 1 result in conjunction with the mitigation measures against duty transitions between late/early/night which is considered the most effective mitigation measure. Additionally, the option provides additional rest after 2 or more night duties within a 7-day period. The safety benefit of Option 2 results from additional rest after night duties. Option 3, finally, is more protective as regards the definition of late finish, early start and night duty, but does not foresee mitigation for transitions.

5.4.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

Additional rest following night duties in Option 1 is expected to have a low negative impact. The more restrictive requirements on FDP in Option 2 — and as regards the definitions in Option 3 regarding early starts and night duties — are expected to have a medium negative impact on crew productivity. Some of the effects may be cushioned by taking the new restrictions into account when the rosters are designed. This is an initial assessment and the Agency welcomes any data and assessment from stakeholders on this issue.

(c) Regulatory coordination and harmonisation

The FAA proposes to permit consecutive night time flying, constrained only by 30-hour consecutive rest required for any 168-hour period, as long as there is an opportunity to rest in a suitable facility during the flight duty period. As proposed, this sleep opportunity would have to comport with the proposed split duty requirements for extending a flight duty period. Should no such opportunity be provided, a carrier could not assign a flight crew member to more than three consecutive night time FDPs. This approach differs from all four options proposed in this NPA. The impact on these four options on harmonisation is therefore deemed equivalent.

5.4.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:	3	3	3	:	9	9	9
Environment	2	:				:			
Social	1	:				:			
Economic	1	:	-1	-3	-3	:	-1	-3	-3
Proportionality	1	:				:			
Regulatory coordination and harmonisation	1	:				:			
Total							8	6	6

Option 1 is the preferred option because:

- It ensures the highest level of safety due to:
 - additional rest after 2 night duties,
 - mitigation against the effect of early-to-late and late-to-early transitions;
- Of the lower cost to the industry compared to Option 2 and 3.

Sensitivity analysis: The preferred option provides an equivalent level of safety compared to Options 2 and 3. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 1 being the most cost-effective.

5.5 Planned duty extensions

5.5.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Maximum limit on extension	1 hour + 3 conditions on WOCL/Sectors	1 hour + 3 conditions on WOCL/Sectors Replace the 11:45 limitation by no extensions in the 18-22 window except under FRMS	1 hour, FC, 30 min CC (+ 11 conditions) Replace the 11:45 limitation by no extensions in the 18-22 window except under FRMS	0 hours, or 1 hour (+ clarify computation ref. EASA Committee discussions) and no extension in the 5-8 and 18-22 windows)
b) Restriction on the number of times that week/month extensions are allowed	2 times per 7 days		3 times a month	No extension
c) Extra rest requirements surrounding the extended duty	Augmented rest 2 hours before plus 2 after, or 4 after		Day off before and after	No extension
d) Notification of the 1-hour extension	No	12 hours in advance, or prior to minimum rest		N/A

5.5.2 Safety impact

a) Maximum limit on extension

EU-OPS Subpart Q (Options 1 and 2) includes a provision for a planned 1-hour extension. The extension is limited depending on the number of sectors and the WOCL encroachment:

- extensions are not allowed for a basic FDP of 6 sectors or more;
- where an FDP encroaches on the WOCL by up to 2 hours extensions are limited to up to four sectors;
- where an FDP encroaches on the WOCL by more than 2 hours extensions are limited to up to two sectors.

A similar provision exists in CAP 371. Both regulations differ in that Subpart Q authorises the use of this extension twice a week, while CAP 371 authorises it 3 times a month as reflected in Option 2. The difference of approach is difficult to justify from a scientific point of view, as there is no evidence that more frequent FDP extension would have a cumulative impact. Therefore, beyond the frequency of such extension, the actual question is whether such extensions (which per se induce a higher risk of being fatigued) can be authorised, and if so, whether appropriate mitigating measures are in place.

The Moebus Aviation report (2008, p. 15) is quite clear: 'The provisions of EU-OPS for the maximum basic FDP of 13 hours (extending up to 14 hours) are not in keeping with the body of scientific evidence'. However, in this report no mention is made of the increased rest period required by Subpart Q in case of an extension (2 hours before + 2 after or 4 hours after the extended FDP). There is no scientific evidence telling us that this mitigating measure is appropriate or not.

The *Paper for the European Transport Safety Council (ETSC) 'meeting to discuss the role of EU FTL legislation'* (Akerstedt, 2003) '... has no objection to an FDP of 12 hours during the day, but does not support FDPs as long as 14 hours for early starts.'

The NASA Study (*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'*) (Dinges, 1996) recommends that 'an extended cumulative flight duty period should be limited to 12 hours within 24 hours' (in the context of a 10-hour max FDP

recommendation) 'to be accompanied by additional restrictions and compensatory off-duty period'. It also recommends that 'there be no extended flight duty period that encroached on any portion of circadian low'.

Options 0, 1 and 2 propose an 1-hour extension with different mitigation measures. Considering these measures there is no evidence that Option 3 (no extension) would have a significant positive safety impact.

The results from the SAFE model analysis (see paragraph 7.1.5) indicate that company extensions need to be carefully monitored as they do increase fatigue, albeit not by a large margin. A special focus should be on flights with reporting times between 18:00 and 22:00. For this reason, Option 1 and 2 require monitoring the use of extensions through the company's FRMS. This would have a low positive safety impact as compared to Option 0.

Option 3 would forbid planned extensions. As a subset of Option 3, the possibility to forbid only the combination of early start (5–8 window) or afternoon/late starts (14–22) with an extension was also evaluated. The simulations made with the SAFE model (see above) did not show any significant positive safety impact for the 05:00–08:00 window, as the alertness scores in the area remain at reasonably high level with the 1-hour extension, and a slight improvement in the 14:00–22:00 window.

Therefore Option 3 is deemed equivalent to Options 1 and 2 in terms of positive safety impact.

b) Restriction on the number of times that week/month extensions are allowed

The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) recommends that 'extended flight duty periods can be scheduled for a cumulative total of 4 hours within a 7-day period', which means for example two extensions of 2 hours per week. This would thus support the current Subpart Q approach. Options 0 and 1 include two duty extensions per week, Option 2 three times a month (CAP 371). Based on the *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) and the SAFE simulation these options are considered to provide an equivalent level of safety.

c) Extra rest requirements surrounding the extended duty

The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) recommends that 'the subsequent 10-hour required off-duty period should be extended by the same duration of the flight duty period extension'. Options 0, 1 and 2 include extra rest requirements (based on Subpart Q and CAP 371) which go beyond the above recommendation. They are therefore deemed equivalent in terms of safety.

d) Notification of the 1-hour extension

Although no scientific research has addressed this issue so far, prior notification of the 1-hour extension sufficiently in advance seems to be a good practice that could be included in related guidance material. This is reflected in Option 1 and 2 and could have a positive impact on safety.

Safety impact summary: Options 1 and 2 require FRMS monitoring for extensions between 18:00 and 22:00. For this reason they are judged to provide a low safety improvement (+1) over Option 0 and 3. Option 3 is the most restrictive and does not allow a company extension between 05:00 and 08:00. However, this did not result in a significant safety improvement according to the SAFE model. Option 3 therefore is estimated to provide only a low safety improvement (+1) over the current provisions.

5.5.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

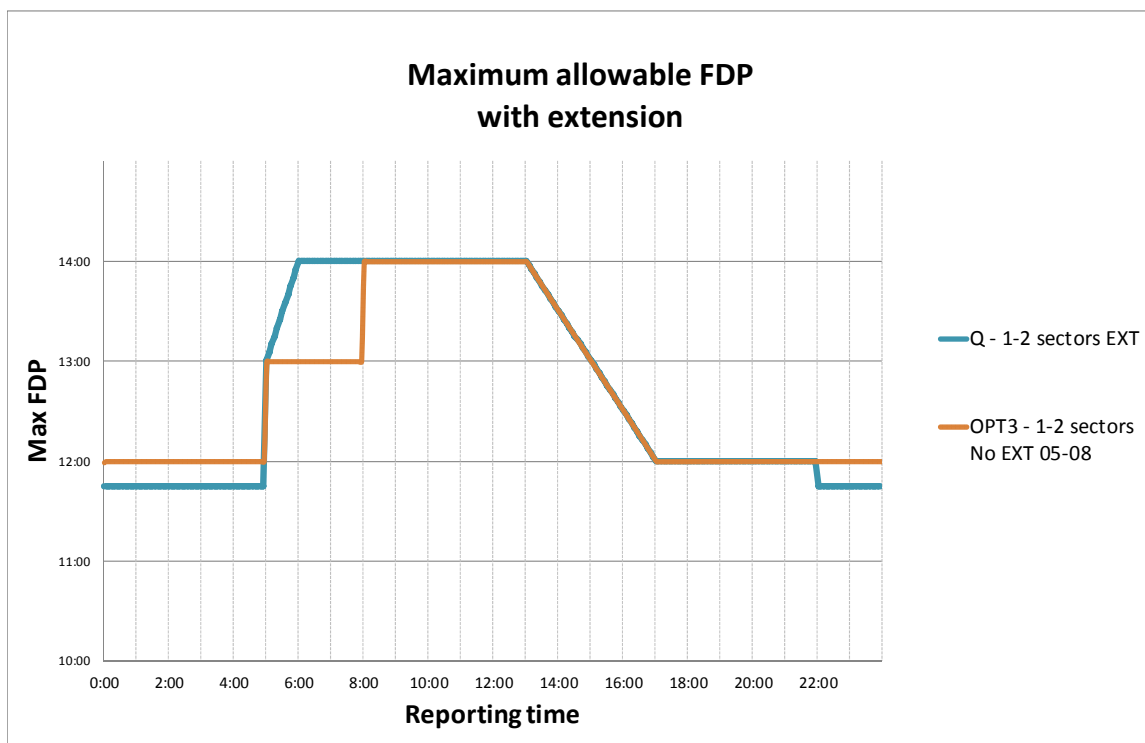
Planned company extensions give additional flexibility to the operator to schedule up to 14 hours of FDP twice per week with certain mitigation measures. The extent to which any changes to this provision would impact an airline depends on the degree to which it currently uses the flexibility (or will need to use it in the future). The need to use this kind of flexibility partly depends on the routes operated and the business model.

Option 1 is a refinement of current Subpart Q requirements and is thus expected to cause negligible additional costs. Option 2 is more restrictive and modelled after current CAP 371. For continental operators, which operate to Subpart Q, one can assume a low negative economic effect to adjust to these provisions.

Option 3 certainly would require the most significant adjustment as company extensions would no longer be allowed. As a subset of Option 3, the potential fatigue hazard created by company planned extension to the allowable FDP was discussed for one of the more critical times of the day, i.e. early reporting time between 05:00 and 08:00 or between 18:00 and 22:00.

Figure 6 gives an overview of how this would affect the maximum allowable FDP for 1–2 sector flights. The blue line represents the current Subpart Q provisions (Option 0 and 1). One can see that these options allow for FDP extensions 1 hour between 06:00 and 08:00 and some reduced extension between 05:00 and 06:00 due to the WOCL encroachment.

Figure 6: Options for maximum allowable FDP with extension



The economic effects of introducing such a new provision depend on the individual flight plans of airlines and more concretely on how many of their flights leave before 8:00 and require an FDP of more than 13 hours.

For a typical Low Cost Operator operating 2, 4 or 8 sectors with two crews between 05:00 and 23:00 the additional requirement in Options 2 and 3 would not pose a significant problem. The maximum FDP limits are unlikely to restrict their operations under the current conditions.

Charter operators would be affected the most. According to charter operators³⁴, 15% to 51% of charter flights depart before 08:00. More significantly, due to their networks and flight patterns their FDPs tend to be closer to the limits currently allowed. Charter operators therefore estimate that the proposal would require between 1% and 9% more flight crew and 2% to 10% more cabin crew in order to continue operating the same routes. For all charter airlines this could mean a cost increase of between 13 and 87 million Euro. Such a cost increase is categorised as a medium negative effect (see Table 7, p. 53). The Agency considers this an initial static effect without adjustment by the operator. This adjustment would be expected to decrease the costs of the years of implementation. The costs are therefore likely to be overestimated. However, it is clear that this option would be more costly than Option 1 and 2 described above.

Table 10: Annual cost estimate for charter operators
'No company extension 05:00–08:00' (Option 3)³⁵

	Estimated No of Employees (A)	Typical Annual Salary (B)	Total Cost Employees (A × B)	Additional staff requirement (D)	Change in Labour Cost
Cabin Crew	9,663	€ 40,191	€ 388,358,699	+2%	€ 7,767,174
				+10%	€ 38,835,870
Flight Crew	4,145	€ 127,832	€ 529,895,344	+1%	€ 5,298,953
				+9%	€ 47,690,581
Total				Low	€ 13,066,127
				High	€ 86,526,451

Another indicator is to estimate the percentage cost increase. If one assumes about 12% of the total costs to be personnel costs³⁶, this would translate in an overall cost increase in the order of 0.2% to 0.9% at company level for charter operators..

Table 11: Annual relative cost estimate for charter operators
'No company extension 05:00–08:00' (Option 3)³⁷

Personnel Category	Additional Staff Requirements (A)	Share of Personnel Costs in Total Costs (B)	Share of CC and FC Cost in Total Personnel Cost (C)	Change in Total Cost (A×B×C)
Flight Crew (FC)	+2%	+12%	+55%	+0.13%
	+10%			+0.66%
Cabin Crew (CC)	+1%		+29%	+0.03%
	+9%			+0.31%
Total	Low			+0.17%
	High			+0.97%

Overall, this a medium negative economic impact (–3). While the absolute value of the costs may be overestimated, the relative costs compared to Options 1 and 2 appear to be correctly reflected.

³⁴ Based on a sample of 7 airlines, 6 of which operate under a Collaborative Labour Agreement.

³⁵ Sources: Column A: Table 1; Column B: Table 3 to Table 5; Column D: Operator estimate.

³⁶ Based on the data for LCC in Figure 1: Cost breakdown of major European airlines.

³⁷ Sources: Column A: Operator estimates; Column B: Figure 1 assuming LCC values for charter airlines; Column C: Average value from published airline annual reports.

c) Regulatory coordination and harmonisation

The FAA proposes a maximum FDP of 13 hours without an extension, as in Option 3 above.

5.5.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		1	1	1		3	3	3
Environment	2								
Social	1								
Economic	1			-1	-3			-1	-3
Proportionality	1								
Regulatory coordination and harmonisation	1				1				1
Total						0	3	2	1

Options 1 is the preferred option, because:

- It achieves an equivalent level of safety at the lowest cost to the industry.

Sensitivity analysis: The preferred option provides an equivalent level of safety compared to Option 2 and 3. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 1 being the most cost-effective.

5.6 Duty extension by in-flight rest

5.6.1 Options identified

The provisions for FDP extension due to in-flight rest are currently subject to EU-OPS Article 8 provisions, i.e. the definition of the requirements are left to the Member States' Competent Authorities. For this reason there is no reference option 0 in this block of options.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Consistent in-flight relief planning	Article 8	Annotate crew position on the roster (relief/operating) Company procedures — Industry Best Practice		
b) Augmented flight/cabin crew when applicable	Article 8	Depends on basic max FDP and possible FDP extension and the rest facilities requirements. Augmented crew operations must commence their FDP as an augmented crew. No single crew member can start a positioning sector to then augment a crew.		Depends on basic max FDP and possible FDP extension and the rest facilities requirements
c) Minimum rest period onboard required	Article 8	Minimum 1 hour (Dutch law) or 1h30 rest taken continuously Guidance: crews should not return to the controls within 30 minutes of waking, after bunk rest	Minimum rest period of 1h30 for all crew members and 2 hours for those at the control at landing. Guidance: crews should not return to the controls within 30 minutes of waking, after bunk rest	Minimum rest period of 1h30 for all crew members Guidance: crews should not return to the controls within 30 minutes of waking, after bunk rest
d) Extension of FDP dependent on type of onboard rest facilities and number of additional crew carried <u>(See definitions of onboard rest facilities below)</u>	Article 8	Extension calculated by the type of rest facilities (no extension for an economy seat) Cockpit and cabin crew : <ul style="list-style-type: none"> • 15h with reclining seat class B • 16h with reclining seat class A • 18h with bunks available Irrespective of WOCL 50% of rest in a bunk, 33% in a seat accounts for the extension	Extension calculated by the type of rest facilities (no extension for an economy seat) Cockpit and cabin crew: With 3 flight crew members: <ul style="list-style-type: none"> • up to 15 hours with Class 3 rest facilities; • up to 16 hours with Class 2 rest facilities; • up to 17 hours with Class 1 rest facilities With 4 flight crew members: <ul style="list-style-type: none"> • up to 16 hours with Class 3 rest facilities; • up to 17 hours with Class 2 rest facilities; • up to 18 hours with Class 1 rest 	Extension calculated by the type of rest facilities (no extension for an economy seat) Cockpit and cabin crew : <ul style="list-style-type: none"> • 16h with seat rest seat(Class 2 & 3) • 18h with bunks rest (Class 1) Extension counts for: Class 1: FDP may be extended by 75% of the in-flight rest; Class 2: 56%; Class 3: 25% of the rest.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
			facilities Irrespective of WOCL	
e) Use of depart window to optimise crew alertness during critical phases of flight	Article 8	Guidance: <ul style="list-style-type: none"> • Best start time to be 08:00 to 12:59 hrs. • Flight Safety Foundation research on ULR operations. Should be used on sectors over 16 hours of Flight Time or FDP's 18 hours or more. 		
f) Requirement of prior notification of crew position for optimal rest planning (operating or relief crew)	Article 8	Guidance: the operator to set up a system to highlight operating or relief crew on the roster (Industry best practice)		
g) Limit the number of sectors		16-hour extension: max 4 sectors, 30-minute reduction for each sector from the third sector onwards 18-hour extension: max 2 sectors	max 3 sectors, 30-minute reduction for the third sector	None
h) Augmented Cabin Crew		No augmented cabin crew requirement;	No augmented cabin crew requirement	No augmented cabin crew requirement;
		EU-OPS minimum crew number.	EU-OPS minimum crew number.	EU-OPS minimum crew number.
			The minimum in-flight rest for Cabin Crew shall be based on the difference between the basic FDP from paragraph 1-(a) above and the extended FDP, in accordance with a specific table.	
i) Minimum rest at destination		Rest is to be 14 hours or the preceding duty period, whichever is the greater.		

Definition of onboard rest facilities:**Option 1:****Bunk**

A facility onboard an aircraft screened from the cockpit and passenger cabin, which can be darkened and in which horizontal rest can be enjoyed.

Seat class A

A seat not in the cockpit, screened from the passengers by at least a curtain, which is at least as wide as a business class seat and has more pitch than an economy class seat, with minimal 40° recline and has a fully integrated leg and footrest. Adjacent seat(s), not separated by an aisle, may only be occupied by another crew member.

Seat class B

An economy class passenger seat, not in the cockpit, screened from the passengers at least by a curtain. Adjacent seat(s), not separated by an aisle, may only be occupied by another crew member.

Option 2 and 3:

'**Class 1** rest facility' means a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature controlled, allows the crew member to control light, and provides isolation from noise and disturbance.

'**Class 2** rest facility' means a seat in an aircraft cabin that allows for a flat or near flat sleeping position, which is separated from passengers at least by a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or crew members.

'**Class 3** rest facility' means a seat in an aircraft cabin or flight deck that reclines at least 40 degrees, provides leg and foot support and is separated from passengers at least by a curtain to provide darkness and some sound mitigation. Adjacent seats shall not be occupied by passengers.

5.6.2 Safety impact

a) *Consistent in-flight relief planning*

Reflects industry best practices — included in all **three options**.

b) *Augmented flight/cabin crew when applicable*

The Haj operation: alertness of aircrew on return flights between Indonesia and Saudi Arabia (Spencer, 1999) states that '... results support the recommendation that unaugmented flight duty periods should not exceed 10 hours overnight'. This has to be seen in the context of CAP 371 requirements permitting a max FDP across the night of no more than 10 hours. *The alertness of aircrew on the London-Sidney route: comparison with predictions of a mathematical model* (Spencer, 1999) also suggests augmented crew above 10 hours of flight.

However, as in essence augmented crew are required for operations where more than the max FDP is needed, the need for 1 or 2 augmented crew members will depend on the basic max allowable FDP and the possible FDP extension, itself dependent on the crew rest facilities. Therefore all three options reflect this approach. Option 1 and 2 include an additional requirement based on industry's best practice, which may have a low positive safety impact.

c) *Minimum rest period onboard required*

There is no clear scientific evidence on the minimum rest period onboard for augmented crew. National practices vary. The Netherlands require 1 hour, France requires 1h30, reflected by Option 1, the United Kingdom requires 3 hours (Option 2). Option 3 is an intermediate option where 2 hours of continuous rest would be required for the crew at the controls during landing. Option 3 is derived from the FAA NPRM.

Options 2 and 3 should have a low positive safety impact as compared to Option 1 although this is not clearly confirmed by scientific studies. Moebus Aviation (2008) also recommends crews not to return to the controls within 30 minutes of waking, after bunk rest. This guidance has been included in all three options.

d) *Extension of FDP dependent on type of onboard rest facilities and number of additional crew carried*

The most complete study on FDP extension by in-flight rest is the TNO report [*Extension of flying duty period by inflight relief* (Simon, 2007)]. It recommends to 'allow an extension of the FDP based on the duration of the rest period available to the pilot [...] and on the environment which is available for rest'. It also concludes that 'the allowable extension should depend on whether the crew is acclimatised'. These conclusions are reflected by the Moebus Aviation report (2008).

The TNO report also recommends that 'if augmentation is only by one additional pilot, the maximum FDP should be 16 hours. Finally, the TNO report proposes to give no credit to rest in an economy seat, although 'no data are available concerning onboard sleep in a normal economy class seat'. However, 'based on laboratory data and ergonomic considerations, sleep in a [economy] seat is considered to be degraded to 0% of bunk/Class I seat' because:

- The seat does not recline more than 40 degrees and has no adequate foot and leg rest which diminishes the probability of recuperative sleep;
- Space around the seat is not sufficient to create adequate separation from passengers or guarantee any privacy;
- A majority of passengers are unable to sleep at all in an economy seat. Some succeed in obtaining some sleep, but they often feel a general malaise after sleeping in a cramped position.

The 'Class B' seat proposed in Option 1 for a 15-hour extended FDP is a Class 1 economy seat, isolated from the passengers by a curtain.

Other available studies show somehow different results: while TNO considers that 75% of the time spent in a bunk may be counted as actual sleep, *AC No: 120-100 Basics of Aviation Fatigue* [Federal Aviation Administration (FAA) AFS-200, 2010)] states that '... flight crews who had a 7 hour sleep opportunity obtained, on average, only 3 hours 25 minutes of bunk sleep'.

Support for CAP 371 from research findings (UK CAA) states: 'The reduction in the duty extension in CAP 371 for rest in a seat, rather than a bunk, is consistent with the research findings'.

Based on the above:

- All three options require the extension to be based on the type of rest facilities;
- Options 2 and 3 include no possibility for extension for economy class seats;
- Option 3 also considers the time spent in the rest facility.

The proposed extensions are based on Dutch rules (Option 1), industry practice (Option 2) and the UK CAA rules (Option 3). Option 1 includes the possibility for shorter FDP extension with a reclining Class B seat. There is no scientific data which could indicate different safety impact between Options 2 and 3. With this in mind, it seems reasonable to say that due to the exclusion of the economy seat, Options 2 and 3 are more protective than Option 1 as regards rest facilities.

Additional evidence on the safety impact of the quality of in-flight rest in an economy seat can be derived from Icelandic AAIB report M-03707/AIG-19 on a serious runway excursion incident at Kevlavik airport. The report concluded that 'it is very likely that the crew was fatigued and that the fatigue led to performance impairments'. The AAIB therefore recommended amending the OPS FTL scheme and taking into account the type of rest facility. Options 2 and 3 address this recommendation by not allowing economy seats for extension due to in-flight rest and limiting the maximum extension depending on the seat class. Option 1 on the other hand would allow economy seats as an in-flight rest facility for all European operators and is thus judged to have a low negative safety impact.

Option 2 implies that the WOCL encroachment is already taken into account in the basic FDP and that the effect of working during the WOCL is compensated by the more effective rest during the WOCL. Therefore there is no need to include additional limit for the extended FDP based on WOCL encroachment. A modelling exercise with SAFE appears to support this approach (see Section 7.1.7).

The TNO report recommends the allowable extension should depend on whether the crew is acclimatised. However, in relation to the section on time zone crossing, all related options already take account of the acclimatisation in the basic FDP calculation. Following the same logic as for the WOCL, no option includes additional limitation for non-acclimatised crew.

Concerning the credits for rest depending on rest facilities, Options 2 and 3 reflect the recommendations of the available scientific studies.

e) Use of depart window to optimise crew alertness during critical phases of flight

Research shows that best start time could be used in order to optimise crew alertness. This could be use as guidance material. Included in all options.

f) Requirement of prior notification of crew position for optimal rest planning (operating or relief crew)

Industry best practice. Included in all options.

g) Limit the number of sectors

Some national regulations (France) include additional limitations on the number of sectors reflected in Option 1, and some do not (UK) as in Options 2 and 3. Scientific data is missing in this area. FDP sector reduction being already taken into account in the basic FDP calculation, the need for further limitations as in Option 1 seems difficult to justify.

h) Augmented Cabin Crew

Moebus Aviation (2008) recommends that 'From the viewpoint of general health, physiological needs, and required levels of alertness, the same requirements for cockpit and cabin crew should be applied'. It also indicates that 'there are no specific data concerning the total number of flight attendants needed in case of an extended FDP and there are no specific data of in-flight rotation practices. Therefore, we cannot give a science-based recommendation'.

Options 1 and 3 reflect current practice (UK, France) and scientific evidence that the same rules should apply for flight and cabin crew as concerns the FDP extension. Option 2 reflects a differentiated approach for Cabin Crew, taking into account airlines' operational experience.

Concerning the need to augment or not the *number* of cabin crew, it is considered that the subject is already addressed by the EU-OPS (and future EASA OPS) requirements on the minimum number of cabin crew. This is also reflected by all options.

i) Minimum rest at destination

No scientific data. All three options are based upon current DGAC-F rules: The duration of the preceding duty period or 14 hours, whichever is greater. No difference in safety impact between the options.

Safety impact summary: As a key feature all three options require the extension to be based on the type of rest facility onboard. Options 2 and 3 provide a higher level of safety as they do not allow in-flight rest in economy seats. While Option 3 better reflects the scientific data on FDP credit per in-flight rest time, Option 2 includes lower limits for the FDP extensions. For

these reasons Options 2 and 3 are considered to have a similar, low positive safety impact (+1).

5.6.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

The set of options developed for duty extensions with augmented crew does not contain a reference option as this area was left to the Member States ('Article 8 provisions'). It is therefore only possible to assess the relative merit of the options defined.

Both network carriers and charter airlines operate routes that require FDP beyond 14 hours. The economically most relevant difference between the options above is in the type of rest facility (Class A, B and bunks in Option 1; Class 1, 2 or 3 in Options 2 and 3, as defined above) available to the member of crew resting and the associated FDP extension possible, as well as the minimum rest per crew member.

Option 1 allows for 3 different seat classes, including an economy seat, and associated levels of FDP. This provides the greatest flexibility to the operators. The possibility to schedule 15 hours with a Class B seat can be expected to have a positive impact on charter operators which serve long haul destinations, but would otherwise have to fit additional rest facilities on their aircraft. Overall, Option 1 is therefore considered to have a low to medium positive economic impact when allowed for all European operators.

Option 2 does not allow an economy seat as in-flight rest facility and therefore can be expected to have overall a medium negative economic effect, mainly on certain charter operators. Standard long-range aircraft operated by legacy carriers are usually equipped with Class 1 in-flight rest facilities. They are therefore allowed to operate up to 17 hours with 3 pilots and 18 hours with 4 pilots. As the current requirements for augmented crew differ from Member State to Member State it is difficult to give a full picture on how this would impact the European aviation industry. At least eight Member States did not require a certain percentage of in-flight rest to calculate the allowable FDP extension as proposed in Option 2. As this included Member States with significant traffic this applied to 30% to 50% of European long haul traffic. For the other half the introduction of Option 2 would therefore have a low positive economic impact as in-flight rest requirements would no longer apply. As a careful estimate, the Agency therefore assigns a low negative economic impact (-1) to this option.

Option 3 is the most complex option to assess. As the option allows for an FDP extension based on the available rest per crew member, a number of assumptions are necessary to estimate the available rest: Pre-flight duty and buffer (1.5 hours), taxi and ascend (1 hour), descend and taxi (1 hour). In other words, FDP was reduced by 3.5 hours or block time by 2 hours in order to estimate the available rest time. For the purpose of calculating the available in-flight rest per crew **it is assumed that the third crew member is only used as a relief crew during cruise and does not perform the landing** (dead heading, or positioning). Therefore this crew member may 'burn' his/her whole FDP before in-flight rest.

For this reason, the available in-flight rest per crew has not been computed by dividing the available rest time by three, but, by taking the minimum of the two limits below:

- Limit 1 is the available rest time divided by 2.
- Limit 2 is given by the non-extended max FDP, minus pre-flight duty and buffer (1.5 hours), taxi and ascend (1 hour)³⁸, divided by 2.

A similar calculation is made for augmented crew flight with 4 crew members.

³⁸ This limit corresponds to the time when the third flight crew has « burnt » his FDP and therefore, must go to the rest facility

Table 12 to Table 14 show the required number of flight crew to operate under Option 3 at different reporting times and required FDPs to reach a certain destination. The table shows that 3 crew operations are possible up to about 16 hours required FDP when the basic maximum FDP is 13 hours, i.e. at reporting times between 06:00 and 13:00. Beyond 16 hours 4 pilots are required. 18 hours are only possible if the 1-hour extension is used (see Table 15 to Table 17).

At the reporting times where the basic FDP is reduced due to the WOCL encroachment, 4 pilots are required for flights which require an FDP between 14.30 and 18 hours. The same is true for Class 2 seats, see Table 12.

Table 12: Required number of pilots for augmented crew operations with Class 1 rest facilities (Option 3)

		Class 1 - bunk											
		Reporting time 13.00						Reporting time 17.00 - 03.59					
Assumptions	1 Required FDP	13:30	15:00	16:00	17:00	18:00	11:30	12:30	13:30	15:00	16:00	17:00	18:00
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00	22:00
	3 Max FDP without extension	13:00	13:00	13:00	13:00	13:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00
	4 Max FDP plus extension - limit	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00
	5 Share of rest to account for extension	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	6 No of flight crew	3	3	3	4	4	3	3	3	4	4	4	4
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00
Calculations	11 Block time (1-7)	12:00	13:30	14:30	15:30	16:30	10:00	11:00	12:00	13:30	14:30	15:30	16:30
	12 Available In-flight rest time (10-8-7)	10:00	11:30	12:30	13:30	14:30	8:00	9:00	10:00	11:30	12:30	13:30	14:30
	13 In-flight rest per crew (Limit 1)	5:00	5:45	6:15	13:30	14:30	4:00	4:30	5:00	11:30	12:30	13:30	14:30
	14 In-flight rest per crew (Limit 2)	5:15	5:15	5:15	10:30	10:30	4:15	4:15	4:15	8:30	8:30	8:30	8:30
	15 In-flight rest per crew (min [13;14])	5:00	5:15	5:15	10:30	10:30	4:00	4:15	4:15	8:30	8:30	8:30	8:30
	16 FDP extention (13*5)	3:45	3:56	3:56	7:52	7:52	3:00	3:11	3:11	6:22	6:22	6:22	6:22
	17 Extended FDPmax	16:45	16:56	16:56	18:00	18:00	14:00	14:11	14:11	17:22	17:22	17:22	17:22

Table 13: Required number of pilots for augmented crew operations with Class 2 rest facilities (Option 3)

		Class 2											
		Reporting time 13.00						Reporting time 22.00					
Assumptions	1 Required FDP	11:30	12:30	13:30	14:30	15:00	16:00	11:30	12:30	13:30	14:30	15:00	16:00
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00
	3 Max FDP without extension	13:00	13:00	13:00	13:00	13:00	13:00	11:00	11:00	11:00	11:00	11:00	11:00
	4 Max FDP plus extension - limit	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00
	5 Share of rest to account for extension	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%
	6 No of flight crew	3	3	3	3	3	3	3	3	3	4	4	4
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00
Calculations	11 Block time (1-7)	10:00	11:00	12:00	13:00	13:30	14:30	10:00	11:00	12:00	13:00	13:30	14:30
	12 Available In-flight rest time (10-8-7)	8:00	9:00	10:00	11:00	11:30	12:30	8:00	9:00	10:00	11:00	11:30	12:30
	13 In-flight rest per crew (Limit 1)	4:00	4:30	5:00	5:30	5:45	6:15	4:00	4:30	5:00	11:00	11:30	12:30
	14 In-flight rest per crew (Limit 2)	5:15	5:15	5:15	5:15	5:15	5:15	4:15	4:15	4:15	8:30	8:30	8:30
	15 In-flight rest per crew (min [13;14])	4:00	4:30	5:00	5:15	5:15	5:15	4:00	4:15	4:15	8:30	8:30	8:30
	16 FDP extention (13*5)	2:14	2:31	2:48	2:56	2:56	2:56	2:14	2:22	2:22	4:45	4:45	4:45
	17 Extended FDPmax	15:14	15:31	15:48	15:56	15:56	15:56	13:14	13:22	13:22	15:45	15:45	15:45

For Class 3 seats the rule has a more significant impact as only 25% of the in-flight rest is allowed to extend the FDP. The table below shows that if an airline chooses to use in-flight rest with Class 3 seats, 4 pilots are necessary for FDPs beyond 15 hours at reporting times without WOCL reduction. At the maximum WOCL reduction (reporting times after 17:00) the rule does not allow operations of more than 14 hrs FDP, even with 4 pilots.

Table 14: Required number of pilots for augmented crew operations with Class 3 rest facilities (Option 3)

		Class 3												
		Reporting time 13.00						Reporting time 22.00						
Assumptions	1 Required FDP	11:30	12:30	13:30	14:30	15:00	16:00	11:30	12:30	13:30	14:30	15:00	16:00	
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00	
	3 Max FDP without extension	13:00	13:00	13:00	13:00	13:00	13:00	11:00	11:00	11:00	11:00	11:00	11:00	
	4 Max FDP plus extension - limit	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	
	5 Share of rest to account for extension	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	
	6 No of flight crew	3	3	3	4	4	4	3	4	4	4	4	4	
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	Calculations	11 Block time (1-7)	10:00	11:00	12:00	13:00	13:30	14:30	10:00	11:00	12:00	13:00	13:30	14:30
		12 Available In-flight rest time (10-8-7)	8:00	9:00	10:00	11:00	11:30	12:30	8:00	9:00	10:00	11:00	11:30	12:30
		13 In-flight rest per crew (Limit 1)	4:00	4:30	5:00	11:00	11:30	12:30	4:00	9:00	10:00	11:00	11:30	12:30
		14 In-flight rest per crew (Limit 2)	5:15	5:15	5:15	10:30	10:30	10:30	4:15	8:30	8:30	8:30	8:30	8:30
		15 In-flight rest per crew (min [13;14])	4:00	4:30	5:00	10:30	10:30	10:30	4:00	8:30	8:30	8:30	8:30	8:30
		16 FDP extension (13*5)	1:00	1:07	1:15	2:37	2:37	2:37	1:00	2:07	2:07	2:07	2:07	2:07
		17 Extended FDPmax	14:00	14:07	14:15	15:37	15:37	15:37	12:00	13:07	13:07	13:07	13:07	13:07

Table 15: Required number of pilots for augmented crew operations with Class 1 rest facilities — using the 1-hour extension (Option 3)

		Class 1 - bunk												
		Reporting time 13.00						Reporting time 17.00 - 03.59						
Assumptions	1 Required FDP	13:30	15:00	16:00	17:00	18:00	11:30	12:30	13:30	15:00	16:00	17:00	18:00	
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00	22:00	
	3 Max FDP without extension	14:00	14:00	14:00	14:00	14:00	14:00	12:00	12:00	12:00	12:00	12:00	12:00	
	4 Max FDP plus extension - limit	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	
	5 Share of rest to account for extension	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	
	6 No of flight crew	3	3	3	3	3	3	3	3	3	4	4	4	
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	Calculations	11 Block time (1-7)	12:00	13:30	14:30	15:30	16:30	10:00	11:00	12:00	13:30	14:30	15:30	16:30
		12 Available In-flight rest time (11-10-9)	10:00	11:30	12:30	13:30	14:30	8:00	9:00	10:00	11:30	12:30	13:30	14:30
		13 In-flight rest per crew (Limit 1)	5:00	5:45	6:15	6:45	7:15	4:00	4:30	5:00	5:45	12:30	13:30	14:30
		14 In-flight rest per crew (Limit 2)	5:45	5:45	5:45	5:45	5:45	4:45	4:45	4:45	4:45	9:30	9:30	9:30
		15 In-flight rest per crew (min [13;14])	5:00	5:45	5:45	5:45	5:45	4:00	4:30	4:45	4:45	9:30	9:30	9:30
		16 FDP extension (15*5)	3:45	4:18	4:18	4:18	4:18	3:00	3:22	3:33	3:33	7:07	7:07	7:07
		17 Extended FDPmax	17:45	18:00	18:00	18:00	18:00	15:00	15:22	15:33	15:33	18:00	18:00	18:00

Table 16: Required number of pilots for augmented crew operations with Class 2 rest facilities — using the 1-hour extension (Option 3)

		Class 2												
		Reporting time 13.00						Reporting time 22.00						
Assumptions	1 Required FDP	11:30	12:30	13:30	14:30	15:00	16:00	11:30	12:30	13:30	14:30	15:00	16:00	
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00	
	3 Max FDP without extension	14:00	14:00	14:00	14:00	14:00	14:00	12:00	12:00	12:00	12:00	12:00	12:00	
	4 Max FDP plus extension - limit	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	
	5 Share of rest to account for extension	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%	56%	
	6 No of flight crew	3	3	3	3	3	3	3	3	3	3	4	4	
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	Calculations	11 Block time (1-7)	10:00	11:00	12:00	13:00	13:30	14:30	10:00	11:00	12:00	13:00	13:30	14:30
		12 Available In-flight rest time (11-10-9)	8:00	9:00	10:00	11:00	11:30	12:30	8:00	9:00	10:00	11:00	11:30	12:30
		13 In-flight rest per crew (Limit 1)	4:00	4:30	5:00	5:30	5:45	6:15	4:00	4:30	5:00	5:30	11:30	12:30
		14 In-flight rest per crew (Limit 2)	5:45	5:45	5:45	5:45	5:45	5:45	4:45	4:45	4:45	4:45	9:30	9:30
		15 In-flight rest per crew (min [13;14])	4:00	4:30	5:00	5:30	5:45	5:45	4:00	4:30	4:45	4:45	9:30	9:30
		16 FDP extension (15*5)	2:14	2:31	2:48	3:04	3:13	3:13	2:14	2:31	2:39	2:39	5:19	5:19
		17 Extended FDPmax	16:00	16:00	16:00	16:00	16:00	16:00	14:14	14:31	14:39	14:39	16:00	16:00

Table 17: Required number of pilots for augmented crew operations with Class 3 rest facilities (Option 3)

		Class 3												
		Reporting time 13.00						Reporting time 22.00						
Assumptions	1 Required FDP	11:30	12:30	13:30	14:30	15:00	16:00	11:30	12:30	13:30	14:30	15:00	16:00	
	2 Reporting time	13:00	13:00	13:00	13:00	13:00	13:00	22:00	22:00	22:00	22:00	22:00	22:00	
	3 Max FDP without extension	14:00	14:00	14:00	14:00	14:00	14:00	12:00	12:00	12:00	12:00	12:00	12:00	
	4 Max FDP plus extension - limit	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	
	5 Share of rest to account for extension	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	
	6 No of flight crew	3	3	3	3	3	4	3	3	4	4	4	4	
	7 Pre-flight duty and buffer	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	1:30	
	8 Post-flight duty	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	0:30	
	9 Taxi+Climb	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	10 Decend+Taxi	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	
	Calculations	11 Block time (1-7)	10:00	11:00	12:00	13:00	13:30	14:30	10:00	11:00	12:00	13:00	13:30	14:30
		12 Available In-flight rest time (11-10-9)	8:00	9:00	10:00	11:00	11:30	12:30	8:00	9:00	10:00	11:00	11:30	12:30
		13 In-flight rest per crew (Limit 1)	4:00	4:30	5:00	5:30	5:45	12:30	4:00	4:30	10:00	11:00	11:30	12:30
		14 In-flight rest per crew (Limit 2)	5:45	5:45	5:45	5:45	5:45	11:30	4:45	9:30	9:30	9:30	9:30	9:30
		15 In-flight rest per crew (min [13;14])	4:00	4:30	5:00	5:30	5:45	11:30	4:30	9:30	9:30	9:30	9:30	9:30
		16 FDP extension (15*5)	1:00	1:07	1:15	1:22	1:26	2:52	1:00	1:07	2:22	2:22	2:22	2:22
		17 Extended FDPmax	15:00	15:07	15:15	15:22	15:26	16:00	13:00	13:07	14:22	14:22	14:22	14:22

As the requirements for augmented crew are differed from Member State to Member State is difficult to give a full picture on how this would impact the European aviation industry. At least eight Member States did not require a certain percentage of in-flight rest to calculate the allowable FDP extension. As this included Member States with significant traffic, this rule could negatively impact on 30% to 50% of European long haul traffic.

Long haul traffic is dominated by legacy carriers, so they would be most affected by the rule. The most important cost driver would be if an airline has to schedule 4 instead of 3 flight crew members. This would represent an increase of 33% of crew costs. If long haul routes are assumed to represent about 30% of the traffic and 10% of those would be affected by the new rule, requiring 4 pilots instead of 3 the additional annual cost could be estimated initially at about 44 million EUR. Option 3 is therefore estimated to have a medium negative economic impact.

Table 18: Annual cost estimate for Option 3³⁹

Crew	Estimated No of Employees (A)	Typical Annual Salary (B)	Total Cost Employees (A x B)	Change in crew requirements (C)	Affected crews (D)	Change in Labour Cost (AxBxCxDxF)
Flight Crew	24,608	€ 164,544	€ 4,049,142,400	+33.0%	3%	€ 44,095,161
Total						€ 44,095,161

c) Regulatory coordination and harmonisation

The FAA proposes a maximum FDP of 13 hours with a 3-hour extension for unforeseeable circumstances beyond the carrier’s control permitted once in a 168-hour period for augmented operations.

³⁹ Source: Column A: Table 1 legacy carriers; Column B: Table 3 legacy carriers; Column C: see text above; Column D: other estimate.

For acclimated augmented flight crew the FAA proposal is depicted in the table below. In addition, acclimated operations are capped at 16 hours if only a three-pilot crew is available and 18 hours if a four-pilot crew is available. For unacclimated crew the numbers in the table are reduced by 30 minutes.

Time of start (home base)	Maximum flight duty period (hours and minutes) based on rest facility and number of pilots					
	Class 1 rest facility		Class 2 rest facility		Class 3 rest facility	
	3 pilot	4 pilot	3 pilot	4 pilot	3 pilot	4 pilot
0000–0559	14	16	13	14.5	12	12.5
0600–0659	15	17.5	14	15.5	13	13.5
0700–1259	16	18	15.5	17	14	14.5
1300–1659	15	17.5	14	15.5	13	13.5
1700–2359	14	16	13	14.5	12	12.5

Furthermore, the FAA proposes to amend the existing regulations by varying the levels of augmentation credit depending on the quality of the rest facility, except that no credit would be given for rest in coach seats. The level of extensions would also vary based on when the flight takes place to account for circadian rhythms and whether the flight crew is acclimated. Domestic augmentation would be permitted if a sufficient rest opportunity is provided. Finally, all flight crew members would have to be type-rated as a second-in-command (SIC) or pilot-in-command (PIC) and throughout the flight at least one crew member on the flight deck would have to be type-rated as PIC. The FAA would also continue to permit extensions in flight time based on the number of flight crew members, with greater credit given for four-pilot crews than for three-pilot crews.

5.6.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:	-1	1	1	:	-3	3	3
Environment	2	:				:			0
Social	1	:				:			0
Economic	1	:	1	-1	-3	:	1	-1	-3
Proportionality	1	:				:			0
Regulatory coordination and harmonisation	1	:				:			0
Total							-2	2	0

Option 2 is the preferred option because:

- it achieves a higher level of safety than Option 1, and at a lower cost to the industry than Option 3.

Sensitivity analysis: The preferred option is providing a comparable level of safety with Option 3 at lower costs and a higher level of safety than Option 1. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 2 being more cost-effective than Option 3.

Further research needed on:

- The use of Class B seats for in-flight rest.

5.7 Positioning and excessive travelling time

5.7.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Position duties to count as FDP when immediately prior to an FDP	Count in full as FDP			/
b) Post-FDP positioning should be limited to prevent an excessive duty day	No limit	No limit Guidance: After 18 hours of duty crew member should chose if they want to proceed to positioning or take minimum rest	No limit	/
c) The FDP and all post-FDP positioning to be taken into account for subsequent rest period	Positioning counts in full as duty and it is the length of the 'duty' period that creates the required rest period (subject to a minimum required rest).			/
d) Require a set home base (define) with a maximum travelling time beyond which crew are recommended to have alternative accommodation closer to base	None	One airport Possibility of extension to two with NAA approval.	a) The home base may be a multiple airport location when the distance between any of these airports does not exceed a driving distance of 50 km and the related travelling time does not exceed 60 minutes under normal conditions. (b) 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 point of landing back to the initial location of the start of the duty shall count as positioning.	/
e) Limit travelling time out of base	None (protected 8 hours sleep opportunity)	Over 60 mn should be counted as DP before he flight and counted as DP afterwards	None (protected 8 hours sleep opportunity)	/

5.7.2 Safety impact

a) Position duties to count as FDP when immediately prior to an FDP

No scientific studies available on this subject, but there is a consensus that positioning should count as FDP when immediately prior to an FDP — this is reflected by **all options**.

b) Post-FDP positioning should be limited to prevent an excessive duty day

Subpart Q (Option 0) and Option 2 do not limit post-FDP positioning. No scientific studies are available on this subject. **Option 1** includes additional guidance similar to that which has been implemented for many years by the Hong Kong CAD, which could have a marginal positive safety impact.

c) The FDP and all post-FDP positioning to be taken into account for subsequent rest period

No scientific studies available on this subject, but **all options** reflect the fact that Subpart Q and CAP 371 concur on this subject.

d) Require a set home base (define) with a maximum travelling time beyond which crew are recommended to have alternative accommodation closer to base

No scientific studies available on this subject. **Options 1 and 2** include the possibility to extend the home base to one (Option 1) or more (Option 2) additional airports. Option 1 is based upon CAA-UK operational experience. Option 2 may include more airports but includes a prescriptive limit in terms of maximum distance. Both options are expected to have no safety impact.

e) Limit travelling time out of base

No scientific studies available on this subject. **Option 1** is based upon Spanish regulations. Option 2 aligns with Subpart Q (Option 0), by providing an 8-hour sleep opportunity irrespective of the travelling time to the hotel. There is no evidence that one option would have a more positive impact than the others.

Safety impact summary: Option 2 offers guidance on how post-FDP positioning should be limited to prevent an excessive duty day and thus a potential impact on cumulative fatigue. However, this is considered only a marginal safety improvement. Overall, all options are expected to maintain the current level of safety under Subpart Q (Option 0).

5.7.3 Other impacts

(a) Social

There is a potential negative social impact should crews have to move as a result of a wider definition of home base in Options 1 and 2 (score -1).

(b) Economic

Option 1 is expected to have a low negative economic impact due to the more restrictive home base definition.

(c) Regulatory coordination and harmonisation

According to the proposal of the FAA, an FDP begins when a crew member is required to report for duty that includes a flight, series of flights, or positioning flights (including Part 91 ferry flights) and ends when the aircraft is parked after the last flight and there is no plan for further aircraft movement by the same crew member. This is comparable to all three options proposed.

5.7.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3				:				:
Environment	2				:				:
Social	1		-1	-1	:		-1	-1	:
Economic	1		-1	1	:		-1	1	:
Proportionality	1				:				:
Regulatory co-ordination and harmonization	1				:				:
Total						0	-2	0	

Option 2 is the preferred option because:

- it maintains a high level of safety and gives operators more flexibility when assigning a home base.

Sensitivity analysis: The preferred option is providing an equivalent level of safety with more flexibility to the operator. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate.

5.8 Extension by on-ground break (split duty)

5.8.1 Options identified

The provisions for FDP extension due to on-ground break are currently subject to EU-OPS Article 8 provisions, i.e. the definition of requirements are left to the Member States' Competent Authorities. For this reason there is no reference option 0 in this block of options.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Require a minimum number of consecutive hours for the break	Article 8	Min 3 hours Guidance: <ul style="list-style-type: none"> Timing of the break within the duty Split duty should be planned in advanced and be placed in the roster in order for the crew member to prepare in advance for such type of operation 	Min 3 hours Minimum 5 hours sleep per night + if one of the sectors starts or ends in WOCL, 6 hours. Guidance: <ul style="list-style-type: none"> Timing of the break within the duty Split duty should be planned in advanced and be placed in the roster in order for the crew member to prepare in advance for such type of operation 	
b) Establish maximum FDP based on the length of the break and the time of the day	Article 8	Max FDP increased by 50% of the break, minus 30 min (FDP continuous from initial report) Duty hours count in full	Max FDP increased by 50% of the break (FDP continuous from initial report) below 6 hours and 66% above Duty hours count in full	Max FDP increase of 4 hours or 50% of the time in the rest facility, whichever is most restricted Duty hours count in full
c) Suitable accommodation for the break	Article 8	Accommodation should not be open to the public, should be quiet and comfortable, have temperature and light control. Where break over 6 hours a suitable accommodation must be provided. A suitable accommodation is a separate room for each crew member located in a quiet environment, equipped with a bed, sufficient ventilation and/or a device for regulating temperature and light intensity. A suitable accommodation is required overnight for breaks over 3 hours (Airline best practice).		
d) Take account of split duty for subsequent rest calculation	Article 8	Split duty counts in full for the subsequent rest calculation No split duty after reduced rest	Split duty counts in full for the subsequent rest calculation No split duty after reduced rest or before No reduced rest is allowed after split duty Split duty use is not compatible with FDP extension by in-flight relief	
e) Limitation on the number of sectors after the split	Article 8	No limit but continuous FDP from report and therefore it is reduced from report so this becomes self-limiting.	2 sectors if any of the sectors starts or ends in WOCL, including positioning	

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
f) Limit the number of consecutive split duties	Article 8	None		No more than 3 in a 7-day period
g) Take account of (non) acclimatisation	Article 8	No	Crew must have spent at least 48h in the time zone where the split duty begins, if a preceding duty was more than 3 time zones away from home base	No allowed with non-acclimatised crews. No time zone crossed utilization

5.8.2 Safety impact

a) Require a minimum number of consecutive hours for the break

Moebus Aviation (2008) recommends FRMS and 'that the break between the two sub-duties should be at least one third of the length of the total flight duty period'; however, no justification is given as to the reason for this 'one third'.

Option 1 (derived from CAP 371) uses a threshold of 3 hours, which can be seen as equivalent to the Moebus Aviation recommendation. It is more protective for shorter FDPs.

Additional limitation in case of WOCL encroachment may be found in other regulations (minimum 5 hours sleep per night). This is supported by scientific research (Caldwell) and reflected in **Options 2 and 3**. While these provisions may be seen as more protective than Option 1, this approach questions the very possibility of split duty for night operations and would contradict the provisions for in-flight rest in the case of augmented crew, where 3 hours minimum rest at night is recommended by all options and also supported by scientific evidence [see IV(b) above].

b) Establish maximum FDP based on the length of the break and the time of the day

Moebus Aviation (2008) states that 'no scientific study on the impact of split duty on aircrew is available and studies are required before this question can be properly addressed'. However, it recommends that 'the total flight duty period of a split duty should never start before 06:00 or end after 22:00'. The reason for such a limitation is not provided by the report.

According to *A fatigue study of consecutive nights and split night duties during air cargo operations* (QinetiQ, 2004) 'split night duties are effective in limiting the development of fatigue overnight, and have no adverse effect on subsequent duty periods' (note: applies to night duties as a mitigating factor: no FDP extension).

Both French and UK regulations increase the max FDP by 50% of the break, minus 30 minutes. This is reflected in **Option 1**.

Option 2 includes the possibility of 66% increase above 6 hours break. This option is half way between the French and UK approach, and the Scandinavian approach, where the FDP increase may be 100% above 4 hours.

Option 3 includes a limitation of 4 hours for the max FDP extension, based on Spanish regulations.

No scientific evidence was found that would support any of the options from a scientific point of view.

c) Suitable accommodation for the break

Moebus Aviation (2008): "Adequate sleeping facilities must be provided by the operator if the break does not take place where the crew lives".

All three options include the same provision to address this issue.

d) Take account of split duty for subsequent rest calculation

Moebus Aviation (2008) recommends that 'In the case of consecutive split duties, the total FDP of a split duty should never be extended beyond 14 hours in order to allow an absolute minimum of 10 hours daily rest'. This recommendation ignores Subpart Q rest requirements, which guarantee a minimum rest of 14 hours in the case of a 14-hour FDP.

In fact the provisions included in all three options, based on CAP 371, and combined with the Subpart Q rest requirements, are more protective than the Moebus Aviation recommendation, as the split would count in full in subsequent rest calculation.

All three options forbid split duty after reduced rest — based on French regulations and consensus in the Group.

Option 3 includes additional limitation in terms of combination. Further research would be needed to confirm the possible safety impact of those combinations. At this stage the Agency could not identify a significant safety difference between the options.

e) Limitation on number of sectors after the split

No scientific evidence is available on this subject. Option 3 includes a sector limitation based on current Spanish regulations. Options 1 and 2 (based on CAP 371) do not include any limit: FDP being counted continuously from initial reporting time, the number of sectors and FDP after the split is considered self-limiting. Therefore, no significant safety difference is identified between the options.

f) Limit the number of consecutive split duties

Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airlines Operations (Co, E., 1999) addresses CDOs, which is the particularity of night split duty: 'Continuous-Duty Overnights (CDOs), another regional scheduling practice, consists of flying one or more evening flights, spending the night on duty at a destination, then flying one or more flights the next morning. Several CDOs, also called "stand-up overnights", can be scheduled consecutively. Officially, pilots remain on duty through the night (i.e., the "stand-up" portion) because the ground time is not long enough for a rest period.' *Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airlines Operations* (Co, E., 1999) observes a cumulative effect on successive CDO: 'Continuous-duty overnights (CDOs) entail flying during much of the night and sleeping during the day, especially when CDOs are scheduled consecutively', but does not issue any precise recommendation in this regard.

No limit in Options 1 and 2. Option 3 includes a limit based on Spanish rules, but scientific substantiation is lacking. Therefore, no significant safety difference is identified between the options.

g) Take account of (non) acclimatisation

No scientific evidence is available. UK, French and Spanish approaches (reflected respectively in Options 1, 2 and 3) are significantly different. Scientific research is lacking in order to assess which option is the best. Therefore, no significant safety difference is identified between the options.

Safety impact summary: There has been no evidence available to differentiate the options in terms of safety. All options appear to provide an equivalent level of safety (0).

5.8.3 Other impacts

(a) Social

Options 1 and 2 allow split duty across Europe. It can be assumed that more airlines would use this possibility once available. This would mean that more crew members across Europe would have long working hours and thereby limiting their social lives. Option 3 is more limiting and is

thus considered to have a negligible social impact. Stakeholders are invited to provide more input on this issue.

(b) Economic

For the mitigation measures related to split duty there is no reference situation as EU-OPS under Article 8 allowed for national requirements on this issue. Therefore the options identified can only be assessed relative to each other.

Nine European countries (AT, BE, CH, IR, IT, LT, MT, SLO, UK) currently apply a similar approach to split duty, where the FDP extension may be up to 50% of the on-ground break. The Scandinavian countries NO, DK and SE allow for an FDP extension of 100% of the on-ground break. FI, DE and NL allow for a fixed extension period irrespective of the duration of the break on-ground (beyond a minimum break period). FI and NL have low limits for the extension (2 and 2.5 hours respectively). In DE the limit is 4 hours.

Option 1 allows split duty across Europe based on current UK CAP 371 requirements. The option would therefore not significantly affect operators from the nine European countries currently working under similar rules. Requirements will become more restrictive for operators from NO, DK, SE and DE. This option is considered the most cost-effective of the options identified and is thus taken as the reference option (score 0).

Option 2 is more restrictive than Option 1 both on the maximum FDP calculation and related to acclimatisation of the crew. This option is therefore considered to have a low negative economic impact (score -1).

Options 3 limits the possibility of using split duty at night, puts a maximum limit on the FDP extension and is not allowed with acclimatised crew. The number of operators affected is likely to be limited, but the option could result in significant adjustment costs for those affected. It is therefore considered a low to medium negative economic impact (-3). Stakeholders are invited to provide more information on this issue.

(c) Regulatory coordination and harmonisation

Under the FAA proposal § 117.17 on Flight duty period: Split duty a certificate holder may extend and a flight crew member may accept a flight duty period up to 50 percent of time that the flight crew member spent in a suitable accommodation up to a maximum flight duty period of 12 hours provided the flight crew member is given a minimum opportunity to rest in a suitable accommodation for 4 hours, measured from the time the flight crew member reaches the rest facility.

For augmented crew the split duty period limits may be extended.

In essence the FAA proposal differs from all options proposed in this NPA in that it is intended to cover split duty only at night.

5.8.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:				:			
Environment	2	:				:			
Social	1	:	-1	-1		:	-1	-1	
Economic	1	:		-1	-3	:		-1	-3
Proportionality	1	:				:			
Regulatory coordination and harmonisation	1	:				:			
Total							-1	-2	-3

Option 1 is the preferred option, because:

Due to the lack of scientific evidence related to safety, it has not been possible to clearly differentiate between the options in terms of safety impact. Based on the long term experience of CAP 371 implementation (on which this option is based), **Option 1** has been taken as the preferred option for this NPA. Furthermore, it has a less negative economic impact than Options 2 and 3.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to the other options. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 1 being the most cost-effective.

Research subjects have been identified:

- The combination of split duty with augmented crew, time zone crossing, etc.
- The combination of non-acclimatisation on split duty.
- The combination of split duty with FDP extension by in-flight relief.

5.9 Commander's discretion

5.9.1 Options identified

Possible mitigation measures	Option			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Adapt schedules or crewing arrangements when actual operation exceeds planning over a defined period of time	Change schedule or crewing arrangement at the latest where the actual operation exceeds the maximum FDP on more than 33% of the flights in that schedule during a scheduled seasonal period		Change schedule or crewing arrangement at the latest where the actual operation exceeds the maximum FDP on more than 33% of the flights in that schedule during a scheduled seasonal period. Guidance material: <ul style="list-style-type: none"> • Best practice: Exceed max FDP: adapt schedules after season but adapt crewing arrangements (i.e. augment crew, change crew at stopover) after shorter period • Scheduled (pre-planned seasonal basis)/ ad hoc charter recommend planning buffers and/or demonstration of operational robustness of that specific schedule using known data to set the maximum use of discretion 	
b) Process for Commander to extend an FDP based on the circumstances on the day and of his/her crew	2 hours basic — 3 hours augmented	2 hours basic — 3 hours augmented Non-punitive process to be described in the Operations Manual	2 hours basic — 3 hours augmented Non-punitive process to be described in the Operations Manual Guidance: <ul style="list-style-type: none"> • Operations should not be planned in such a way that Commander's discretion is required at the outset • Include Policy for Exercising Commander's Discretion • Take account of flight and cabin crew schedule synchronisation 	2 hours above the basic FDP It is not compatible with Split Duty nor with FDP extension by in-flight relief 2/3 hours of commander's discretion cannot be applicable in a linear way; it has to take in account reduction by added leg and WOCL encroachment Non-punitive process to be described in the Operations Manual Require concurrence from other crew members Guidance: <ul style="list-style-type: none"> • Operations should not be planned in such a way that Commander's discretion is required at the outset • Include Policy for Exercising Commander's Discretion • Take account of flight and cabin crew schedule synchronisation

Possible mitigation measures	Option			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
c) Process for Commander to reduce a rest period based on the circumstances on the day and of his/her crew	Limit = 10 hours out of base	Limit = 10 hours out of base	Limit = 10 hours out of base Adapt the limit to home base: 12 hours or, in case of back to back operations: 10 hours in the allocated hotel Non-punitive process to be described in the Operations Manual Include Policy for Exercising Commander's Discretion. Use within SMS/FRMS Guidance	Limit = 10 hours out of base Recover reduced rest time at the next rest Adapt the limit to home base: 12 hours or, in case of back to back operations: 10 hours in the allocated hotel) Limit to 3 hours reduction Non-punitive process to be described in the Operations Manual Include Policy for Exercising Commander's Discretion. Use within SMS/FRMS Guidance
d) Process for the Commander to reduce FDP and/or increase rest in case of risk of fatigue	No limit	No limit	No limit Non-punitive process to be described in the Operations Manual	
e) Report to NAA above a certain threshold	Above 1 hour + keep record of any extension			No threshold
f) Focused oversight by NAA	None	None	Guidance for NAA on oversight of repeated Commander's discretion on re-dispatched flight	
g) Establish limits on the number of Commander's discretion	None	None	None Guidance for NAA on oversight of Commander's discretion	

5.9.2 Safety impact

a) *Adapt schedules or crewing arrangements when actual operation exceeds planning over a defined period of time*

No scientific data available on this subject. The current Subpart Q approach is not questioned. This is reflected in all **four options**.

Option 2 and 3 include further guidance, some based on CAP 371, which could have a low positive safety impact.

b) *Process for Commander to extend an FDP based on the circumstances on the day and of his/her crew*

The NASA Study [*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996)] recommends that 'to support operational flexibility, an extended flight duty period can be increased by up to a maximum of 2 hours due to unforeseen circumstances beyond the control of the operator. The subsequent required off-duty period should be increased by the time by which the flight duty period is increased'. Current Subpart Q provisions reflect these recommendations. Subpart Q foresees to increase the extension up to 3 hours in case of augmented crew, which seems coherent with the added fatigue management possibilities offered by the additional crew. This is reflected by Options 0, 1 and 2.

Option 3 forbids the combination of commander's discretion with split duty and augmented crew, but scientific data is missing to support this approach. Further research in this field may be needed.

Option 3 also proposes not to apply commander's discretion in a linear way. This would raise the following difficulties: first how to determine, on a scientific basis, which non-linear formula to be applied; second, this would go against the general principle that in order to be properly understood and implemented, rules should remain as simple as possible. This is particularly the case of commander's discretion, which is by definition an unplanned decision relying solely upon the crew.

Options 2 and 3 include additional guidance which may have a low positive safety impact

c) Process for Commander to reduce a rest period based on the circumstances on the day and of his/her crew

The NASA Study [*Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996)] recommends that 'to support operational flexibility, it is recognised that due to circumstances beyond the control of the operator, it may be necessary to reduce an off-duty period to 9 hours. This reduction would occur only in response to an unforeseen operational requirement. In this situation, the subsequent off-duty period should be extended to 11 hours'.

Subpart Q provisions are more protective than the NASA recommendations. The reduction to 10 hours out of base is reflected in all four options.

Options 2 and 3 include similar provision for back to back operations, which is neutral from a safety point of view.

Options 2 and 3 also include the need for a non-punitive process, a company policy for the use of commander's discretion, and the need to monitor its use through SMS/FRMS provisions. Together with the guidance from the other sections, this is expected to provide a low positive safety impact.

Option 3 includes additional limitations based upon current Spanish regulations (e.g. 3 hours max reduction), which are not supported by scientific data and therefore not considered for the safety impact.

d) Process for the commander to reduce FDP and/or increase rest in case of risk of fatigue

No scientific data available on this subject. There is no reason to change this Subpart Q provision, which is a significant safety net.

Options 2 and 3 include the requirement for a non-punitive process to be described in the OPS manual. This would ensure that no undue pressure is exercised on the crew to prevent the use of this provision. In conjunction with the additional requirements above, this is deemed to have a low positive safety impact.

e) Report to NAA above a certain threshold

Subpart Q provisions seem appropriate, as reflected in Options 0 to 2. Option 3 differs in that it would require reporting the use of commander's discretion in all cases. This is seen by the Rulemaking Group as an undue burden for both the Operator and the NAA. Subpart Q requirement to record all use of commander's discretion is deemed sufficient as it allows checks and audits to be performed by the NAA at any time and on the full set of data.

f) Focused oversight by NAA

In relation to the point above, Options 2 and 3 include the need to develop further guidance on the NAA oversight of commander's discretion. In conjunction with the safety improvements above, this is expected to have a low positive safety impact

g) Establish limits on the number of Commander's discretion

No scientific data is available which would support the limitation of the number of commander's discretion. However, further guidance on oversight by the NAA may have a low positive safety impact in conjunction with the other safety improvements identified above (Options 2 and 3).

Safety impact summary: Options 2 and 3 offer additional requirements relating to NAA oversight and further guidance for the commander and operators. This package is expected to result in a low positive safety impact (+1) for Options 2 and 3.

5.9.3 Other impacts

(a) **Social**

All options are deemed to have no negative social impact.

(b) **Economic**

Option 3 would place additional administrative burden on operators and NAAs for reporting and is thus expected to have a low negative economic effect.

(c) **Regulatory coordination and harmonisation**

On Schedule Reliability, the FAA approach differs from all four options proposed in this NPA:

According to § 117.9, the FAA NPRM requires that:

(a) *each certificate holder must adjust within 60 days —*

(1) *Its system-wide flight duty periods if the total actual flight duty periods exceed the scheduled flight duty periods more than 5 percent of the time, and*

(2) *Any scheduled flight duty period that is shown to actually exceed the schedule 20 percent of the time.*

At commander's discretion, both the FDP extension and the rest reduction provisions are equivalent to those proposed in this NPA.

5.9.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3			1	1			3	3
Environment	2								
Social	1								
Economic	1				-1				-1
Proportionality	1								
Regulatory coordination and harmonisation	1								
Total						0	0	3	2

Option 2 is the preferred option because:

- it provides an improved level of safety by introducing more guidance for oversight on commander's discretion;

- it achieves this level of safety at lower costs to the industry than Option 3.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 3 and a higher level of safety than Option 1. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 3 being less cost-effective than Option 2.

5.10 Airport standby

5.10.1 Options identified

The provisions for airport standby are currently partly subject to EU-OPS Article 8 provisions, i.e. the definition of the requirements are left to the Member States' Competent Authorities. For this reason there is not always a reference option 0 in this block of options.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Take account of airport standby time in duty/flight duty period and rest calculation	Airport standby counts in full in cumulative duty hours Article 8 for FDP	Airport standby counts in full in cumulative duty hours 100% of time spent on airport standby should count as FDP for the standby period beyond 6 hours		100% of time spent on airport standby should count as FDP
b) Quality and type of airport standby facilities	Quiet and comfortable place not open to the public	Define 'appropriate standby facilities' as: Require rest facilities suitable for split duty — quiet; comfortable, not open to the public and ability to control light and temperature with access to food and drink.		No required rest facilities
c) Limit on standby duration	None	None — self-limiting due to the FDP reduction beyond 6 hours standby	12 hours	Maximum Airport Standby = 12 hours if = 100% FDP 72 hours in 28 consecutive days, 400 in calendar year
d) Minimum rest after standby with no FDP	Article 8	The duration of the previous duty or 10 hours, whichever is greater	11 hours	12 hours

5.10.2 Safety impact

a) Take account of airport standby time in duty/flight duty period and rest calculation

Moebus Aviation (2008) notes that there is 'no scientific evidence to suggest that airport standby should be considered as any less fatiguing than flight duty and that further research is needed in this area'. It concludes that 'time spent in airport standby should normally count 100% as flight duty when calculating the maximum FDP'.

Moebus Aviation (2008) further recommends that standby count as 50% FDP if adequate rest facilities are provided, and FRMS is in place. Here again detailed scientific justifications are missing.

However, from an empirical point of view, it is also difficult to understand how standby at airport could be just as tiring as flight duty. Furthermore, the *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) contradicts Moebus Aviation's conclusions and recommends that 'airport standby should be considered as duty'.

Options 1 and 2 follow the *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) recommendations and repeat the Subpart Q provision that airport standby should count as duty.

Option 3 follows the Moebus Aviation (2008) recommendations that standby should count as FDP.

Options 1 and 2 also include the French regulation's provision that beyond 6 hours standby should count as 100% FDP. This is considered as having a significant positive safety impact as opposed to Option 0, where in the absence of such a provision, associated with the fact that there is no standby limit, in theory a 18-hour standby could be followed by a 14-hour FDP.

b) Quality and type of airport standby facilities

No scientific data available in this field. Options 1 and 2 propose some improvement from the Option 0 definition of standby facilities. Option 3 does not include any rest facility requirement, which is in line with the fact that standby would count as 100% FDP. All options are considered to provide a marginal safety improvement.

c) Limit on standby duration

Flight Attendant fatigue, Part V: A comparative Study of International Flight attendant (Avers, 2009) notes that 'the maximum period a flight attendant was allowed to spend on standby for the regulations (34%) and CLAs (31%) was approximately 12 hrs, but 66% of, the regulations and 69% of the CLAs had no maximum allowable standby period provision' and NASA proposes to limit the standby duration to 12 hours. This is reflected by Options 2 and 3. Option 1 does not include any limit, but considers that the FDP reduction beyond 6 hours standby is self-limiting. Options 1, 2 and 3 are considered to have a positive safety impact.

d) Minimum rest after standby with no FDP

No scientific data is available on this issue, but Subpart Q logic would be that as standby would count as duty, the rest requirements would be equivalent to the previous duty period or minimum rest, whichever is greater. With this, the rest after standby would be as protective as if it were after the same duration of DP including FDP.

Option 1 proposes to clarify this Subpart Q logic. Options 2 and 3 reflect some national practices, but are in fact less protective than Subpart Q.

Safety impact summary: Options 1, 2 and 3 provide clear requirements on the quality and type of standby facilities at the airport. Option 3 requires 100% of standby time to be counted as FDP. On the other hand it is less protective than Options 1 and 2 as regards the minimum rest after standby. Option 1 requires that beyond 6 hours standby should count as 100% FDP and maintains the minimum rest requirements after standby without FDP from Subpart Q (rest = DP). On balance, Options 1 and 3 are therefore both expected to have a medium positive safety impact (+3).

5.10.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

Under the current conditions, nine EASA countries do not have a maximum time limit on standby at the airport (CH, DE, FI, DE, IE, MT, NO, ES and SE). These countries represent about 50% of the European traffic.

Option 1 is providing some additional protection in terms of facility requirements and FDP reduction which may induce costs for operators working under less restrictive schemes. On the other hand there will be operators which will benefit from Option 1 being less restrictive than their national rules. On balance, Option 1 is not expected to incur limited costs and benefits to European operators, depending on current national requirements

Option 2 limits standby to 12 hours. In order to assess the effects of such a provision the Agency received information from eight European airlines on the actual use of standby. The actual use of pilot standby ranges between 2 days per pilot and year and 33 days. If the

highest value is considered an outlier, the range is still likely to be between 2 and 10 days per year and crew, i.e. between 0.4% and 3% of total crew days.

For the countries without regulation the Agency assumes that the total standby period applied by the operators is 24 hours. If this is reduced to 12 hours, the standby period per crew would need to be doubled and thus result in productivity reduction of 0.4% to 3% for 50% of European crew. Again 50% of this standby is assumed to be airport standby.

As regards cabin crew, the range of standby use is not that wide, and as an average 1.7% can be assumed based on the information provided by operators.

Based on the above information the additional crew costs were estimated, assuming that adequate facilities for airport standby are available to the operators. In relative terms this is estimated to represent a cost increase between 0.3% and 0.7%. Overall, **Option 2** is therefore estimated to have a low negative economic impact.

Table 19: Relative annual cost estimate for airport standby reduction to 12 hours (Option 2)⁴⁰

Personnel Category	Additional Staff Requirements (A)	Share of Personnel Costs in Total Costs (B)	Share of CC and FC Cost in Total Personnel Cost (C)	Affected fleet	airport standby/home standby	Change in Total Cost (A×B×C)
Cabin Crew (CC)	+1.7%		25%			0.02%
		18%		50%	50%	0.01%
Flight Crew (FC)	+0.4%		35%			0.05%
	+3%					

Option 3 is the most restrictive and considers the full standby time as FDP. This would considerably limit the applicability of standby provisions as it would most strongly limit the subsequent FDP. A medium negative economic impact is therefore assumed.

(c) Regulatory coordination and harmonisation

According to **§ 117.21 b0 of the US NPRM proposal for airport standby**, all time spent in a reserve status is part of the flight crew member's flight duty period. In addition for short call reserve, the reserve availability period may not exceed 14 hours.

⁴⁰ Source: Column A: Information from operators; Column B: Figure 1; Column C: Operators' annual reports; Column D: Based on the traffic in the affected countries, see text.

5.10.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:	3	1	3	:	9	3	9
Environment	2	:				:			
Social	1	:				:			
Economic	1	:		-1	-3	:		-1	-3
Proportionality	1	:				:			
Regulatory coordination and harmonisation	1	:				:			
Total		:				:	9	2	6

Option 1 is the preferred option because:

- it ensures the highest level of safety with the lowest cost to the industry;
- Option 1 provides the highest level of safety, because it applies Subpart Q logic to minimum rest after standby, i.e. the minimum rest is defined as the preceding duty period or 10 hours, whichever is greater.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 3 and a higher level of safety than Option 1. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 3 being more cost cost-effective than Option 2.

5.11 Standby other than airport

5.11.1 Options identified

The provisions for standby other than airport are currently subject to EU-OPS Article 8 provisions, i.e. the definition of the requirements are left to the Member States' Competent Authorities. For this reason there is no reference option 0 in this block of options.

Possible mitigation measures	Option			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Take account of standby time in duty/flight duty period and rest calculation	Article 8	No impact on duty and FDP	25% impact on duty, none on FDP The maximum number of standby hours shall not exceed 72 hours in any 7 consecutive days	FDP reduces after 6 hours by the length of time spent on standby over 6 hours. FDP always starts on report Standby at home and not called out or disturbed, counts as 50% DP If more than 8 hours standby, followed by minimum rest
b) Standby callout requirements		Must be scheduled and announced in advance	Consider further FDP reduction depending on the callout time	Immediate readiness standby counts in full as duty/FDP Contactable does not count but is not a Day off
c) Quality and type of standby facilities	Article 8	Suitable accommodation — a separate room for each crew member located in a quiet environment, equipped with a bed, sufficient ventilation and/or a device for regulating temperature and light intensity with access to food and drink		
d) Limit on standby duration	Article 8	24 hours renewable In any series of consecutive duties including standby at home, shall be included: 1. A protected and predicted sleep opportunity of 8 hours in a period of 24 hours 2. The opportunity shall be communicated at least 24 hours in advance 3. Two scheduled sleep opportunities shall not be separated by more than 18 hours	12 hours	12 hours
e) Calculations of cumulative duty hours dependent on type of standby and whether crew are called out or not	Article 8	Not counted as DP or FDP	25% impact on duty, none on FDP	Dependent on the callout notice period, min 50%, max 100% Standby overnight no callout 50%.

5.11.2 Safety impact

a) *Take account of standby time in duty/flight duty period and rest calculation*

Very little scientific research covers this topic. However, T. Akerstedt/Gillberg have shown that there is a direct effect on being on standby and the effect on the quality of recuperative sleep.

Furthermore, 'Standby other than at airport' covers a great variety of possibilities, which makes it difficult to address through standard mitigating measures. This variety is reflected by Option 3.

Option 1 proposes that no impact on DP and FDP be counted, which, considering the above appears to provide a lower level of safety.

Option 2 limits the duty period and Option 3 also limits the subsequent FDP. Option 2 introduces an additional mitigation measure by limiting the maximum number of standby hours to 72 hours in any 7 consecutive days. Overall, Option 2 and 3 are considered to provide an equivalent level of safety in this respect.

b) *Standby callout requirements*

A study made on five engineers in the Swedish merchant navy (*Disturbed sleep while being on-call: an EEG study of sleep engineers* (Torsvall, 1988) demonstrated that 'on-call conditions will disturb sleep, not only through the actual time spent out of bed, but also through more indirect effects during sleep, possibly associated with apprehension'. This may indicate that for standby at night, some impact on the subsequent maximum allowable FDP could be considered. However, the NASA Study [*Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airlines Operations* (Co, E., 1999)] reports a limited impact on the quality of rest: 'Subjects reported that, when on reserve status at home and not called out, they usually get 7.7 h of sleep at home.'

Options 2 and 3 provide mitigation measures to this issue and are therefore expected to have positive safety impact in countries where no such rules exist.

c) *Quality and type of standby facilities*

No scientific data is available on this issue; the three options reflect current national regulations and industry best practices. This harmonisation of rules is expected to have a positive safety impact.

d) *Limit on standby duration*

The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) does not consider 'on call reserve status' as duty, but recommends that 'a protected 8 hour sleep opportunity' should be protected from interruption by assignment to a flight duty period.

Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airlines Operations (Co, E., 1999) notes that: 'The nature of flying on reserve means that crewmembers must respond when called for duty, thus creating unpredictability in their schedules. This unpredictability can lead to sleep loss, for example, when a call for duty occurs when a sleep period was planned. As evidence that sleep loss occurred, crewmembers reported getting 5.6 h of sleep before duty on average—2.3 h less than their normal average sleep. Sometimes (about once a month according to responses), the rest period that a crewmember must be given was assigned retroactively. That is, when called for duty, the crewmember was told that the previous hours constituted the required rest period. Clearly, this may add to the problem of planning a sleep schedule. These factors may result in flight crewmembers starting duty sleep deprived.'

Options 1 does not include a limit for the standby (24 hours renewable). Options 2 and 3 propose to limit the standby to 12 hours (CAP 371 provisions) in order to protect the 8 hours sleep opportunity.

Options 2 and 3 are deemed more protective than Option 1, because under these options the total time standby + FDP is limited by the fact that FDP starts counting from the 6th hour of standby.

e) Calculations of cumulative duty hours dependent on type of standby and whether crew are called out or not

No scientific data is available on this issue. Current national practices vary: France does not count it as FDP or DP, and the UK counts it between 50% and 100%. Option 2 counts 25% of standby for DP. Options 2 and 3 are considered to provide an equivalent level of safety.

Safety impact summary: Options 2 and 3 limit the standby duration to 12 hours. This ensures that the sleep opportunity is protected. These options also include a part of the standby time in cumulative duty period calculation. Option 2 adds an additional mitigation measure by introducing a weekly limit on standby. Therefore, Options 2 and 3 are considered to have a medium positive safety impact (+3) compared to Option 0 (24 hours standby, renewable).

5.11.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

As there is currently no common European requirement in this area, no reference situation is available. The available options thus need to be analysed relative to each other.

Option 1 is the least protective and would allow standby for a 24-hour period. As in most Member States the current rules are more restrictive, this option is assumed to induce a low positive economic impact.

Option 2 limits the standby period to 12 hours. Under the current conditions, three EASA countries allow 24 hours standby at the airport (AT, DE and FR). These countries represent about 30% of the European traffic.

As discussed in the previous chapter, the use of standby varies significantly between different operators. The Agency received information from eight European airlines. The actual use of pilot standby ranges between 2 days per pilot and year and 33 days. If one considers the highest value an extreme case, the range is still likely to be between 2 and 10 days per year and crew, i.e. between 0.4% and 3% of total crew days.

For the countries which currently allow 24 hours of home standby, Option 1 could require operators in these countries to double their standby and thus result in additional crew requirement, i.e. an additional 0.4% to 3% of crew hours. 50% of this standby is assumed to be home standby and 30% of crew is assumed to be affected.

As regards cabin crew, the range of standby used is not that wide, and as an average 1.7 % can be assumed based on the information provided by operators.

The crew costs increase was estimated based on the above information, assuming that adequate facilities for airport standby are available to the operators. In relative terms this is estimated to represent less than 0.4% of cost increase across Europe. For most operators this would mean no increase at all since 70% of the European crews are estimated not to be affected as similar rules already apply. Overall, Option 2 is therefore estimated to have a low negative economic impact.

Table 20: Relative annual cost estimate for home standby limitation to 12 hours (Options 2 and 3)⁴¹

Personnel Category	Additional Staff Requirements (A)	Share of Personnel Costs in Total Costs (B)	Share of CC and FC Cost in Total Personnel Cost (C)	Affected fleet (D)	airport standby/home standby (E)	Change in Total Cost (A×B×C)
Cabin Crew (CC)	+1.7%		25%			0.01%
		18%		30%	50%	
Flight Crew (FC)	+0.4% +3%		35%			0.00% 0.03%

Option 3 is the most restrictive and considers the full standby time as FDP. This would considerably limit the applicability of standby provisions as it would most strongly limit the subsequent FDP. A medium negative economic impact is therefore assumed.

(c) Regulatory coordination and harmonisation

The FAA NPRM distinguishes between short call and long call reserve. For long call reserve the NPRM states that:

- (1) The period of time that the flight crew member is in a reserve status does not count as duty.
- (2) If a certificate holder contacts a flight crew member to assign him or her to a flight duty period or a short call reserve, the flight crew member must receive the required rest period specified in § 117.25 prior to reporting for the flight duty period or commencing the short call reserve duty.
- (3) If a certificate holder contacts a flight crew member to assign him or her to a flight duty period that will begin before and operate into the flight crew member's window of circadian low, the flight crew member must receive a 12-hour notice of report time from the air carrier.

An air carrier may shift a reserve flight crew member's reserve availability period under the following conditions:

- (1) A shift to a later reserve availability period may not exceed 12 hours.
- (2) A shift to an earlier reserve availability period may not exceed 5 hours, unless the shift is into the flight crew member's window of circadian low, in which case the shift may not exceed 3 hours.
- (3) A shift to an earlier reserve period may not occur on any consecutive calendar days.
- (4) The total shifts in a reserve availability period in paragraphs (e)(1) through (e)(3) of this section may not exceed a total of 12 hours in any 168 consecutive hours.

Overall, the FAA NPRM proposal is closer to Options 2 and 3 than Option 1 in terms of standby limitations.

⁴¹ Source: Column A: Information from operators; Column B: Figure 1; Column C: Operators' annual reports; Column D: Based on the traffic in the affected countries, see text.

5.11.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:		3	3	:		9	9
Environment	2	:				:			
Social	1	:				:			
Economic	1	:	1	-1	-3	:	1	-1	-3
Proportionality	1	:				:			
Regulatory coordination and harmonisation	1	:				:			
Total							1	8	6

Option 2 is the preferred option, because:

- it ensures a high level of safety by limiting standby to 12 hours and including 25% of the standby time in cumulative duty calculations;
- it achieves this level of safety at lower costs than Option 3.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 3 and a higher level of safety than Option 1. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 2 being more cost-effective than Option 3.

Further research is needed on

- The impact of standby other than airport on allowable FDP and calculated DP.

5.12 Basic rest

5.12.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Prepare and publish rosters giving crews time to adapt and recover from cumulative fatigue	/	Guidance: Good rostering practices		No re-planned advancing of early starts
b) Focused oversight by NAA	/	Focused oversight on repeated use of re-planning on days off		
c) Set a minimum rest period and recuperative sleep opportunity between duties	<ul style="list-style-type: none"> — At home: 12 hours or the length of the preceding duty period — Away from base at least the length of the preceding duty period or 10 hours with 8-hour sleep opportunity — Operator must take due account of travelling and other physiological needs 		<ul style="list-style-type: none"> — At home: 12 hours or the length of the preceding duty period — Away from base: at least the length of the preceding duty period or where 12 hours or less, minimum can be 11 hours where travelling does not exceed 30 minutes. 	<ul style="list-style-type: none"> — At home: 12 hours or the length of the preceding duty period — Away from base: at least the length of the preceding duty period or 12 hours 8 x 36 hours (including 2 local nights) days off in any 28 consecutive days
		Guidance: Variation. Due to circadian rhythms a rest break will not have the same benefits across the day. <i>When</i> the rest break occurs may be more important than the <u>amount of time</u> scheduled		
d) Minimum number of sleep hours over a specific preceding period of time	8 hours sleep opportunity		Must allow 8 hours TIB (time in bed) in 24 hours	— Must allow 8 hours TIB (time in bed) and 10 hours in the allocated room in 24 hours

5.12.2 Safety impact

a) Prepare and publish rosters giving crews time to adapt and recover from cumulative fatigue

Options 1 and 2 reflect industry best practice and are expected to have a positive safety impact.

Option 3 reflects the Moebus Aviation recommendation on re-planning of early starts. However, its scope is far more limited than Options 1 and 2 and therefore is considered to have a limited positive safety impact.

b) Focused oversight by NAA

All three options reflect NAA best practice.

c) Set a minimum rest period and recuperative sleep opportunity between duties

Scientific studies agree upon the fact that 8 hours of sleep opportunity should be provided every day. Minimum rest requirements are based on this element, plus the fact that longer duties require longer recovery periods. Slight variations can be observed in different regulations but no scientific data would support one approach against the other. In this

respect, there is no element available that would question the Subpart Q approach, reflected in Options 0 and 1. Options 2 and 3 are based upon CAP 371.

Options 1 to 3 include additional guidance which is expected to contribute to a positive safety impact in conjunction with the other elements of this section.

d) Minimum number of sleep hours over a specific preceding period of time

Research on sleep generally recommends 8 hours of sleep every 24 hours. *From laboratory to flight deck: promoting operational alertness* (Rosekind, 1997) observes that 'the critical foundation for optimal performance and alertness during operations is established by an appropriate quantity and quality of sleep prior to duty'.

The *Principles and guidelines for duty and rest scheduling in Commercial Aviation 'NASA Study'* (Dinges, 1996) notes that 'the first critical component of the off-duty period is an 8-hour sleep opportunity' and recommends that 'the off-duty period should be a minimum of 10 hours uninterrupted, to include an 8-hour sleep opportunity'.

This is reflected by Options 0, 1 and 2.

Option 3 includes an additional provision for 10 hours in the allocated room. However, the added value of this provision is questionable as long as the 8-hour sleep opportunity is protected.

Safety impact summary: The most important safety requirement is the same in all options: minimum rest periods protecting the 8-hour sleep opportunity and making rest proportionate to duty. Options 1 and 2 include additional guidance and reflect best industry practices on publication of rosters. They are therefore expected to have a medium positive safety impact (+3).

5.12.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

Options 2 and 3 are more restrictive in the way they attempt to protect the 8-hour sleep opportunity. They are therefore considered to have a low negative economic impact.

(c) Regulatory coordination and harmonisation

The FAA proposal on rest periods (§ 117.25) foresees the following:

No certificate holder may assign and no flight crew member may accept assignment to any reserve or duty with the certificate holder during any required rest period.

(b) Before beginning any reserve or flight duty period, a flight crew member must be given at least 30 consecutive hours free from all duty in any 168 consecutive hour period, except that:

(1) If a flight crew member crosses more than four time zones during a series of flight duty periods that exceed 168 consecutive hours, the flight crew member must be given a minimum of three physiological nights rest upon return to home base.

(2) A flight crew member operating in a new theater must receive 36 hours of consecutive rest in any 168 consecutive hour period.

(c) No certificate holder may reduce a rest period more than once in any 168 consecutive hour period.

(d) No certificate holder may schedule and no flight crew member may accept an assignment for reserve or a flight duty period unless the flight crew member is given a rest period of at

least 9 consecutive hours before beginning the reserve or flight duty period measured from the time the flight crew member reaches the hotel or other suitable accommodation.

(e) In the event of unforeseen circumstances, the pilot in command and certificate holder may reduce the 9 consecutive hour rest period in paragraph (d) of this section to 8 consecutive hours.

Overall, the FAA NPRM provisions are less protective in terms of rest than all four options proposed under this NPA.

5.12.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		3	3	1		9	9	3
Environment	2								
Social	1								
Economic	1			-1	-1			-1	-1
Proportionality	1								
Regulatory coordination and harmonisation	1								
Total						0	9	8	2

Option 1 is the preferred option because:

- it ensures an equivalent level of safety compared to Option 2 at lower costs to the industry than Option 2.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 2 and a higher level of safety than Options 0 and 3. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 1 being more cost-effective than Option 2.

5.13 Reduced rest

5.13.1 Options identified

The provisions for reduced rest are currently subject to EU-OPS Article 8 provisions, i.e. the definition of the requirements are left to the Member States' Competent Authorities. For this reason there is no reference option 0 in this block of options.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Minimum duration of reduced rest	Article 8	Minimum 7h30 including 2 hours in the WOCL + FRMS	If reduced rest is shorter than 12 hours, the entire WOCL should be included <ul style="list-style-type: none"> • Minimum of 9 hours at the suitable accommodation • Reduction not allowed: pre or post-FDP is extended and/or time zone crossing at the previous or next FDP 	Reduced rest periods not allowed
b) Augmentation of rest period following reduced rest	Article 8	Subsequent rest is augmented by the shortfall. It includes one local night.	Rest is augmented by the shortfall but not less than 2 hours. It includes one local night.	Reduced rest periods not allowed
c) Reduced maximum FDP	Article 8	FDP following reduced rest is reduced by the shortfall		Reduced rest periods not allowed
d) Limit the number of reduced rest occasions	Article 8	Maximum 2 reduced rest between 2 periodic rests taken according to OPS 1.1110 §2.1	3 times scheduled in 90 days	Reduced rest periods not allowed
e) Limit the length and number of sectors under reduced rest	Article 8	— Maximum 5 sectors before the reduced rest and maximum 3 sectors after — Block time for any flight during FDP < 3 hours		Reduced rest periods not allowed
f) Limit the effect of time zone desynchronisation under reduced rest	Article 8	FDP of maximum 2 time zones equivalent distance from home base		Reduced rest periods not allowed
g) Limit the possibility of interaction of split duty and reduced rest	Article 8	Split duty before reduced rest only allowed if the break is > 4 hours Maximum 4 sectors before reduced rest Maximum 1 sector after No split duty after reduced rest	No combination with split duty allowed	Reduced rest periods not allowed

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
h) Publish roster (day on/day off only?) sufficiently in advance	Article 8	Guidance based on industry practice: 2 weeks in advance (schedule and charter)	7 days notice of days off	Reduced rest periods not allowed
i) Establish conditions for applicability of reduced rest	Article 8	Not allowed after one hour planned FDP extension		Reduced rest periods not allowed

5.13.2 Safety impact

a) *Minimum duration of reduced rest*

Option 1 is based on the French rules, as reviewed by the STARE Study.

Option 2 includes Moebus Aviation recommendations and elements coming from the Spanish regulation.

Option 3 forbids reduced rest periods.

b) *Augmentation of rest period following reduced rest*

Pending the publication of the STARE study, no scientific data is available. This was acknowledged by Moebus Aviation (2008). This report recommends that 'any reduced rest that is less than 12 hours long should include the entire WOCL period'. However this is not supported by any scientific study and no other possible mitigating measures (reduced FDP, increased subsequent rest) have been envisaged and reviewed.

Finally, Moebus Aviation '... would recommend that reduced rest is only allowed as part of a comprehensive FRMS'.

The preliminary summary of the STARE study (French Civil Aviation Authority, 2010] notes that 'attention must be paid to the position of reduced rest in schedules... Yet no major issue for reduced rest found within the framework of this study (French regional airlines – French regulation). FRMS to be used as a mitigation to overcome possible emerging issues'.

Option 1 reflects the French provisions, as reviewed by the STARE Study.

Option 2 includes additional provisions, but in the absence of scientific evidence there is no certainty that they are more protective than Option 1 provisions.

Option 3 reflects the provisions in place in some countries, where reduced rest is not authorised. However, there is no evidence that this would be significantly more protective than the reduced rest provisions with appropriate mitigating measures.

The results of the SAFE modelling simulation (see RIA Option Analysis using the SAFE Model, para. 1.1.6) support the findings from the STARE study and indicate that the rules for reduced rest as applied in France for regional operations work effectively as mitigation measures against fatigue hazards. No conclusions can be drawn for other types of operations, which may wish to apply reduced rest provisions.

As concerns the subsequent items:

- c. *Reduced max FDP;*
- d. *Limit the number of reduced rest occasions;*
- e. *Limit the length and number of sectors under reduced rest;*
- f. *Limit the effect of time zone de-synchronisation under reduced rest;*
- g. *Limit possibility of interaction of split duty and reduced rest;*
- h. *Publish roster (day on/day off only?) sufficiently in advance;*

i. Establish conditions for applicability of reduced rest.

Option 1 reflects the current French provisions, as reviewed by the STARE Study; Option 2 includes some variants, based among others on the Spanish regulations; and Option 3 forbids reduced rest.

Safety impact summary: There has been no evidence to differentiate the options available in terms of safety. All options appear to provide a sufficient level of safety (+0).

5.13.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

The possibility to allow reduced rest under certain mitigating measures is currently left to National Authorities. There is therefore no reference situation ('Option 0') and the options can only be assessed relative to each other.

Option 1 allows reduced rest under certain mitigation measures. This would allow for any operator in Europe to apply the reduced rest scheme. This is expected to generate a low positive economic impact.

Option 2 allows reduced rest only in more restrictive conditions. This will have a positive effect on some operators and a negative effect on others. Overall the option is expected to bring a low negative economic impact.

Option 3 does not allow any reduced rest. This will affect only the European operators that can currently apply this possibility based on their national rules. For those operators a discontinuation of the rule could have a significant economic impact.

Overall, at European level, Option 3 is therefore estimated to have a medium negative economic impact.

(c) Regulatory coordination and harmonisation

The FAA NPRM does not contain any reduced rest provisions, as in Option 3 discussed above.

5.13.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:	:	:	:	:	:	:	:
Environment	2	:	:	:	:	:	:	:	:
Social	1	:	:	:	:	:	:	:	:
Economic	1	:	1	-1	-3	:	1	-1	-3
Proportionality	1	:	:	:	:	:	:	:	:
Regulatory coordination and harmonisation	1	:	:	:	1	:	:	:	1
Total							1	-1	-2

Option 1 is the preferred option because it ensures an equivalent level of safety by applying a reviewed set of mitigation measures and creates some economic benefits to the industry.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to other options. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 1 being the most cost cost-effective.

5.14 Extended and recovery rest

5.14.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Regulations around duty construction with restrictions on number of early/late/night transitions in a work block	Guidance (Subpart Q OPS 1.1090 3 states that Operators shall manage these areas)	Guidance: Rest periods between 18 and 30 hours to be avoided, or restriction on the FDP		
b) Extended rest periods to mitigate against duty transitions	Guidance (Subpart Q OPS 1.1090 3 states that Operators shall manage these areas)	34 hours free of mixing duties	36 hours off duty with 2 local nights (from series of late to early)	Transition from late/night arrivals to early starts to include 1 local night at home base
c) Consistent scheduling, limiting mix of day/night duties	Guidance (Subpart Q OPS 1.1090 3 states that Operators shall manage these areas)	Guidance: Rest periods between 18 and 30 hours to be avoided, or restriction on the FDP		
d) Duty restrictions for a set period of time or based on rest period based on the number of time zones	General guidance	Allowable FDP determined by length of time since departure (and therefore on sleep opportunity) Table B CAP 371 and CAD 371 (Hong Kong) Table B	Allowable FDP determined by length of time since departure (and therefore on sleep opportunity) Table B CAP 371 and CAD 371 (Hong Kong) Table B	General guidance
e) Limit maximum FDP according to daytime and acclimatisation	Covered by standard provisions	More than 3 zones and less than three local nights: the subsequent flight duty periods shall be calculated as follows: The maximum flight duty period for a flight crew member shall be limited to 11 hours and 30 minutes and for a cabin crew member to 12 hours and 15 minutes. b) For each sector, calculated from the second sector onwards, the period in a) is reduced by 30 minutes per sector.	Use unacclimatised crew tables See CAP 371 Not acclimatised table with 18–30 hours rest Consider fully and partially acclimatised.	Covered by standard provisions
f) Minimum time set before a crew could be considered time zone adjusted or acclimatised	Beyond 3 time zones WOCL refers to home base time for the first 48 hours and to local time thereafter	Out stations more than 3 time zones: three consecutive local nights	4 x local nights within 1 time zone 2 hours wide	Beyond 3 time zones WOCL refers to local time after: <ul style="list-style-type: none"> the minimum rest, or three consecutive local nights and to home base time before

5.14.2 Safety impact

a) *Regulations around duty construction with restrictions on number of early/late/night transitions in a work block*

The *CAA Paper 2005/04 Aircrew fatigue: a review of research undertaken on behalf of the UK Civil Aviation Authority* (UK CAA, 2005) addresses early, late and night, but not the transition between them. CAP 371 recommends avoiding rest periods between 18 and 30 hours, or restricting the FDP. However, this guidance should strictly be used in the context of flights without time zone de-synchronisation, when the effect of such principles could be counter-productive. This is reflected in Options 1 to 3 and is deemed to have a positive safety impact.

b) *Extended rest periods to mitigate against duty transitions*

Option 1 recommends 34 hours free of mixing duties, but is less protective than Options 2 and 3. The STARE study recommends 36 hours including two local nights, which is reflected by Option 2. Option 3 recommends including 1 local night between any transition between early/late/night. This is based on the following observation:

- Early to late transition is automatically protected by one local night.
- Late to early transition could result in two successive night finishings and then starting in the WOCL.

The requirement to insert one local night would protect against this case. There is no evidence that this would be less protective than Option 2, but this should be confirmed by further research. For this RIA both Options 2 and 3 are expected to have an equivalent positive safety impact.

c) *Consistent scheduling, limiting mix of day/night duties*

No scientific evidence is available on this issue. Options 1 to 3 reflect current UK-CAA guidance.

d) *Duty restrictions for a set period of time or based on rest period based on the number of time zones*

The logic of Options 1 and 2 is based on CAP 371, which introduces a specific FDP table for non-acclimatised crew. Option 3 is based on Subpart Q (Option 0), where the FDP values for non-acclimatised crew are those from the place of origin.

No scientific elements were available to determine if any option could result in a positive safety impact as compared to Option 0. Therefore all options are considered to provide an equivalent level of safety related to this mitigation measure.

e) *Limit maximum FDP according to daytime and acclimatisation*

Moebus Aviation (2008) proposes to address acclimatisation as follows: 'As a general rule, the rate of synchronization could be approximated by the use of a factor that assumes a one-hour adjustment per day', but notes: 'However, in some circumstances this may overestimate the time required for adaptation to the new time zone'; and concludes:

'The information outlined above emphasises the complexity of flight time limitations and the fact that it is very difficult to propose simple maximum FDP limits that properly account for all the relevant variables (e.g., duty start time, number of consecutive duty days, number of sectors, duration of duty periods preceding the current duty, degree of acclimatization, etc.). In summary, the provisions for the maximum FDP proposed by EU-OPS are not supported by the available data. To formulate more precise limits further studies are required'.

Two different approaches are envisaged for the calculation of FDP:

- Subpart Q logic is binary (see Options 0 and 3): either the crew member is acclimatised or not. If they are acclimatised, the maximum allowable FDP is calculated on the basis of the time zone of arrival. If they are not acclimatised, the maximum allowable FDP is calculated on the basis the time zone of departure. This approach is very approximate but has also the merit

of being very simple. Scientific studies would recommend a more complex approach, introducing for instance the notion of partial acclimatisation; however the actual impact of the simplified approach taken by Subpart Q has not been scientifically measured so far. Additional research should be conducted in this respect

Other approaches include e.g. the use of unacclimatised crew tables. This is reflected by Options 1 and 2. This is probably more protective than Options 0 and 3.

f) *Minimum time set before a crew could be considered time zone adjusted or acclimatised*

According to Moebus Aviation (2008), 1 to 6 local nights are needed, depending on the maximum time difference and the duration of layover.

The TNO reports recommends: 'When a crew member has spent 4 consecutive local nights on the ground within a time zone of 2 hours wide, centered on home base, and is able to take uninterrupted night sleep. The crew members will remain acclimatised thereafter until a duty period finishes at a place where local time differs by more than 2 hours from that point of departure.'

The United Kingdom Civil Aviation Authority (2005) also observes that for certain patterns; 'Difficulties in sustaining performance were observed for at least six days after the flight.', in particular for 'very large time zone transitions'.

Subpart Q provisions in Option 0 clearly do not concur with scientific research, especially for large time zone transitions.

Options 1 and 2, based on CAP 371 and the TNO report respectively, would have a low to medium positive safety impact.

Option 3 is based on the three local night requirement from CAP 371, and introduces the additional criterion that, out of base, the crew should be considered acclimatised after taking the minimum TZC rest required at home base. It should be noted that this approach is consistent with the proposal made by the FAA in its NPRM. This is also more in line with research and would have a low to medium positive safety impact.

Safety impact summary: Options 2 and 3 require additional rest between duty transitions from early/late/night. Option 2 and 3 also require a minimum time before a crew is considered time zone adjusted. They are therefore expected to have a medium positive safety impact (+3).

5.14.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

Option 0 will not induce any additional cost to the industry as it is based on Subpart Q.

Option 1 only includes guidance material and a requirement to keep 34 hours free of mixing duties. Duty restrictions are implemented for time zone de-synchronisation based on CAP 371 tables. The package is considered to imply a low negative economic impact (–1).

Option 2 proposes to extended rest as a mitigation measure against duty transitions (36 hours off duty with 2 local nights). Additionally, Option 2 requires 4 local nights before a crew member would be considered time zone adjusted. This is considered to bear a medium negative economic impact (–3).

Option 3 requires one local night at home base to mitigate the impact of duty transitions. The minimum time for time zone adjustments is modelled after the Subpart Q approach: Beyond 3 time zones the WOCL refers to local time. However, the option adds additional conditions for this rule by requesting minimum rest or three consecutive local nights for this to apply. This is estimated to have low negative economic impact (–1).

Stakeholders are invited to provide additional information to this basic assessment.

(c) Regulatory coordination and harmonisation

See FAA proposal explained under 15.12.2.

5.14.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		1	3	3		3	9	9
Environment	2								
Social	1								
Economic	1		-1	-3	-1		-1	-3	-1
Proportionality	1								
Regulatory coordination and harmonisation	1								
Total						0	2	6	8

Option 3 is the preferred Option because it ensures an improved level of safety at lower costs than Option 2.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 2 and a higher level of safety than Options 0 and 1. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute value of the cost estimate, but to the relative assessment of Option 3 being more cost cost-effective than Option 2.

Further research is needed on:

- The appropriate mitigating measures for early to late and late to early transitions;
- The effectiveness of Subpart Q provisions for (partially) non-acclimatised crew.

5.15 Time zone crossing

5.15.1 Options identified

The provisions for time zone crossing are currently subject to EU-OPS Article 8 provisions, i.e. the definition of the requirements are left to the Member States' Competent Authorities. For this reason there is no reference option 0 in this block of options.

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Minimum rest/days off requirements at home base following time zone crossing	Article 8	If one sector includes 4 time zones or more, minimum rest is 36 hours including 2 local nights	For flight duty periods that cross 4 or more time zones, and that involve 48 hours off duty or more away from home base/domicile zone time, a minimum of 48 hours off duty shall be allowed upon return to home base/domicile	At least 4.5 times the difference in local times between the home base and the location with the greatest local time difference. Subsequently, minimum time for rest as per OPS 1.1110 point 2.1
b) Additional minimum rest at destination away from home base	Article 8	For 4 time zones or more, rest = max[duty, 14 hours]	For 4 time zones or more: minimum rest 14 hours (or the same length like a previous duty) + 30 minutes for each time zone beginning on the 5th zone	Rest periods with the addition of the difference in time zones from the location of the previous rest period. This extended rest period does not need to exceed 15 hours
c) Avoid or limit in number per month alternating east-west and west-east rotations	Article 8	Operators shall monitor acceptable limits or combinations of rotations + guidance from research		
d) Additional rest between home base-west-home base & home base-east-home base rotations	Article 8	1 additional (to minimum established rest after TZC) local night at home base between alternating east-west and west-east rotations Or use of FRMS to demonstrate acceptable limits or combinations of rotations + guidance from research	1 additional (to minimum established rest after TZC) local night at home base between alternating east-west rotations	CAP 371 Annex E CAD 371 Table X limitations

5.15.2 Safety impact

a) Minimum rest/days off requirements at home base following time zone crossing

The NASA Study (Dinges, 1996) recommends that 'for flight duty periods that cross 4 or more time zones, and that involve 48 hours off-duty or more away from home-base/domicile zone time, a minimum of 48 hours off-duty be allowed upon return to home base/domicile'.

Option 1 is based on current French regulations. It includes a lower threshold (36 hours), which however protects the local night sleep opportunity. It differentiates between flights with and without augmented crew. Overall, it is deemed to bring the same level of protection as proposed by NASA.

Option 2 reflects the NASA study recommendation.

Option 3 reflects a more complex approach, possibly using tables. There is no evidence that it would provide a higher level of protection than Options 1 and 2.

b) Additional minimum rest at destination away from home base

Moebus Aviation (2008) recommends 14 hours rest on layover after significant time zone crossing. Option 1 reflects the Moebus Aviation recommendation (rest = max [duty, 14 hours]).

Option 2 also includes a minimum rest of 14 hours but includes an additional rest of 30 minutes per sector above 4 zones. However, this additional protection is not supported by scientific research.

Option 3 presents a slightly different approach based on Scandinavian regulations but limits it to 15 hours. It is therefore considered *less protective* than Options 1 and 2.

c) Avoid or limit in number per month alternating east-west rotations

The United Kingdom Civil Aviation Authority (2005) addresses the difference between eastward and westward flight, but transition between east and westward flight would deserve further research. All three options recommend Operators to monitor acceptable limits or combinations of rotations.

d) Additional rest between home base-west-home base & home base-east-home base rotations

Research is also lacking in this area. The Spanish rules require one additional local night at home base between alternating east-west rotations. This is reflected in Option 2.

Option 1 includes the same provision, or as an alternative, the use of FRMS to demonstrate acceptable limits or combinations of rotations. This is deemed to provide at least the same level of protection as Option 2, and adds flexibility to the operator.

Option 3 is based upon CAP 371 tables, and it is difficult to compare its impact on safety with Options 1 and 2 as it follows a different concept. The level of safety is considered equivalent to the other options on this mitigation measure d).

Safety impact summary: Options 1 and 2 increase the rest at destination to 14 hours after significant time zone crossing. They also introduce mitigation against the effects of east-west rotations. Therefore, Options 1 and 2 are expected to have a medium positive safety impact (+3). Option 3 does not include the same level of protection regarding minimum rest and is therefore considered to have a low positive safety impact.

5.15.3 Other impacts

(a) Social

All options are deemed to have no negative social impact.

(b) Economic

Time zone crossing was not previously addressed by European regulation. For this issue there is therefore no common reference. Options will have to be judged relative to each other. Due to the less restrictive minimum rest requirements, Option 1 is considered more-cost effective (0) than Options 2 and 3 (-1).

(c) Regulatory coordination and harmonisation

See FAA proposal explained under 15.12.2. For non-acclimatised crew the FAA proposes to reduce the maximum FDP by 30 minutes.

5.15.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3	:	3	3	1	:	9	9	3
Environment	2	:				:			
Social	1	:				:			
Economic	1	:		-1	-1	:		-1	-1
Proportionality	1	:				:			
Regulatory coordination and harmonisation	1	:				:			
Total							9	8	2

Option 1 is the preferred option, because it ensures safety of operations at the lowest costs.

Sensitivity analysis: The preferred option is providing an equivalent level of safety compared to Option 2 and a higher level of safety than Option 3. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the absolute cost estimate, but to the assessment that Option 1 is more cost-effective than Options 2 and 3.

Further research is needed on:

- The appropriate mitigating measures for eastward-westward and westward-westward transitions.

5.16 Other elements

5.16.1 Options identified

Possible mitigation measures	Options			
	Option 0 Subpart Q	Option 1	Option 2	Option 3
a) Include meal and drink opportunity (ground/flight) in planning	A meal and drink opportunity must occur, especially when the FDP exceeds 6 hours (EU-OPS 1.1130)	A meal and drink opportunity must occur, especially when the FDP exceeds 6 hours Protocol in all airlines to address nutrition (b) Guidelines on protocol	A meal and drink opportunity must occur, especially when the FDP exceeds 6 hours. Protocol in all airlines to address nutrition (b) Guidelines on protocol Monitor through their SMS/FRMS how they have planned this opportunity.	The break shall be at least 30 minutes. When the duty time exceeds 10 hours a new break must occur. When the work excludes a normal break the meal break may occur onboard.
b) Provide fatigue management training	/	Require all Operators to develop fatigue management and countermeasure training for all staff involved in this area Include NAA's, Management, Scheduling staff and all crew members	Require all Operators to develop fatigue management and countermeasure training for all staff involved in this area Include NAA's, Management, Scheduling staff and all crew members	Require all Operators to develop fatigue management and countermeasure training for all staff involved in this area Include NAA's, Management, Scheduling staff and all crew members
c) Implementation of effective SMS/FRMS	1.1090 3.2/3.3/3.6 creates a current requirement for the demonstration of fatigue management	FRMS required to plan reduced rest and/or split duty and other issues identified above NAA to oversee SMS/FRMS and audit all AOC Holders implementation Provide suitable sanctions where appropriate NAA training on FRMS		
d) Reporting on fatigue-related issues	1.1090 4.1 creates a requirement for crew not to operate fatigued but no method to report this	Requirement for crew not to operate fatigued Require there to be an agreed fatigue reporting processes	Requirement for crew not to operate fatigued Require there to be an agreed fatigue reporting processes) Provide Fatigue Reporting Forms	Requirement for crew not to operate fatigued Require there to be an agreed fatigue reporting processes Provide Fatigue Reporting Forms Establish a Confidential Reporting System within EASA

5.16.2 Safety impact

a) *Include meal and drink opportunity (ground/flight) in planning*

Option 0 is consistent with recommendations from available research. Options 1 and 2 require a protocol in all airlines to address nutrition and propose guidelines. This would have a low positive safety impact. Option 3 is based on current Scandinavian regulations, but there is no evidence that it would be more protective than Options 1 or 2.

Option 2 requires SMS/FRMS monitoring, which would have a low positive safety impact.

b) *Provide fatigue management training*

No scientific research or operational data available on this subject, but there is a general agreement that the proposal in Options 1 to 3 would have a low to medium positive safety impact.

c) *Implementation of effective SMS/FRMS*

Options 1 to 3 clarify the use of SMS FRMS.

d) *Reporting on fatigue-related issues*

Options 1 to 3 require the crew to report when operating fatigued. This is more a clarification than a new requirement, as this should be mandatory in any Safety Management System.

Option 3 includes the requirement for a confidential reporting system to EASA; however, this possibility is not foreseen in the Basic Regulation (reporting to the NAA).

Safety impact summary: Option 2 introduces the need for a protocol in airlines on a meal and drink opportunity and proposes guidelines. Option 2 is therefore considered to have a medium positive safety impact (+3).

5.16.3 Other impacts

(a) **Social**

All options are deemed to have no negative social impact.

(b) **Economic**

Options 1 to 3 require operators to develop fatigue management training as well as the possibility to report fatigue. It is assumed that the fatigue management training can be integrated in other training activities and thus will not require additional off-time for the crew member.

Option 3 additionally sets a minimum period for a break. Options 1, 2 and 3 are therefore considered to induce a low negative cost to the industry.

(c) **Regulatory coordination and harmonisation**

The FAA proposal does not foresee any regulation on meal and drink opportunities.

5.16.4 Conclusion

Objectives / Criteria	Weights	Scores (unweighted)				Scores (weighted)			
		Option 0	Option 1	Option 2	Option 3	Option 0	Option 1	Option 2	Option 3
Safety	3		1	3	1		3	9	3
Environment	2								
Social	1								
Economic	1		-1	-1	-1		-1	-1	-1
Proportionality	1								
Regulatory coordination and harmonisation	1								
Total						0	2	8	2

Option 2 is the preferred option, because:

- it provides the highest level of safety by requiring SMS/FRMS monitoring and a protocol on the meal and drink opportunity;
- it creates comparable costs contrary to the alternative options.

Sensitivity analysis: The preferred option is providing the highest level of safety compared to the other options. The result is sensitive to the assessment of the level of safety provided by each option. The result is not sensitive to the cost estimate.

6 Summary and recommendations

The Regulatory Impact Assessment for this rulemaking task followed a safety risk management approach by identifying the fatigue hazards and related potential mitigation measures. At mitigation measures level, a range of options was developed by the rulemaking group OPS.055. This allowed for a very detailed discussion of alternative options and choices at the level of hazards in order to identify the most effective AND cost-effective mitigation measure to be proposed. The Agency believes that this approach resulted in a proposal with significant safety benefits and well justified costs.

The following overview summarises the safety improvements and other impacts of the preferred options to allow for a quick overview.

6.1 Impact summary of the recommended options

The preferred options include the following safety improvements:

General

- Uniform level of safety across all EU-27 + 4 by introducing uniform safety requirements for all FTL rules.

Cumulative fatigue (5.2)

- Weekly rest exemption deleted. Earliest reporting time after weekly rest will be 06:00 (currently 04:00 reporting time is possible if rest is 40 hours or more).
- Additional rolling limit of 1 000 block hours per 12 consecutive months introduced.
- Preferred option ensures safety while allowing for operational flexibility and increased harmonisation with the FAA.

Maximum allowable flight duty period (5.3)

- Increase of the weekly rest to 48 hours when two or more duty periods encroach all or any portion of the WOCL.
- Requirement for the Operator to specify the duration of post-flight DP in the OPS Manual.
- Guidance on breaks and meal opportunities.
- Preferred option achieves the improved level of safety with relatively limited costs to the industry.

Consecutive night duties and duty transitions (5.4)

- Additional rest after 2 night duties: 48 instead of 36 hours weekly rest.
- Mitigation against the effect of early to late and late to early transitions: one local night at home base.
- Guidance on breaks and meal opportunities.
- The preferred option achieves the safety improvements at lower costs than all other options.

Planned duty extensions (5.5)

- Guidance material introduced related to the notification period for the 1-hour extension.
- FRMS monitoring required for extensions between 18:00 and 22:00.
- The preferred option achieves the safety objective at the lowest cost to the industry.

Duty extension due to in-flight rest (4.6)

- Harmonised rules in all EU-27 + 4 countries.
- Extension to be based on the type of rest facility onboard.
- Extension due to in-flight rest in economy seats *not allowed*.
- The preferred option achieves a high level of safety at a lower cost to the industry than the alternative Option 3.

Positioning and excessive duty time (4.7)

- No adjustments proposed.

Split duty (4.8)

- Harmonised rules in all EU-27 + 4 countries.
- Due to the lack of scientific evidence related to safety, it has not been possible to clearly differentiate between the options in terms of safety impact.
- Based on the long term experience of CAP 371 implementation (on which this option is based), the option based on this regulation is the preferred one.
- The preferred option is more cost-effective than all other available options.

Commander's discretion (5.9)

- Non-punitive reporting process.
- Guidance material for the commander and operators.
- Guidance material for NAA oversight.
- The preferred option is not expected to incur significant cost to the industry.

Airport standby (5.10)

- Harmonised rules in all EU-27 + 4 countries.
- Clear requirements on the quality and type of standby facilities at the airport.
- Beyond 6 hours standby counts as 100% FDP. Standard minimum rest requirements after standby (Rest = duty period).
- The preferred option is not expected to incur limited costs and benefits to European operators, depending on current national requirements.
- The preferred option incurs the least cost to the industry of all available options.

Standby other than airport (5.11)

- Standby duration limited to 12 hours.
- 25% of the standby time is included in cumulative duty period calculation.
- Weekly limit on standby.
- The preferred option achieves a higher level of safety at lower costs than the alternative option.

Basic rest (5.12)

- Guidance for NAA oversight.
- Guidance on good rostering practices.
- The preferred option achieves the equivalent level of safety at lower costs than the alternative option.

Reduced rest (5.13)

- Harmonised rules in all EU-27 + 4 countries.
- There has been no evidence to differentiate the options available in terms of safety.
- The preferred option has been reviewed by a scientific study.
- The preferred option applies a reviewed set of mitigation measures, including FRMS and creates some economic benefits to the industry.

Extended recovery and rest (5.14)

- Additional rest between duty transitions between early/late/night duties.
- Minimum time before a crew is considered time zone adjusted.
- The preferred option ensures an improved level of safety at lower costs than the alternative option.

Time zone crossing (5.15)

- Increased rest at destination to 14 hours after significant time zone crossing.
- Mitigation against the effects of east-west rotations.
- The preferred option reduces the safety risk at lower costs than the alternative option.

Other elements (5.16)

- Requirement for operators to develop a protocol on a meal and drink opportunity.
- Requirement to provide fatigue management training.
- The preferred options create comparable costs to the alternative options with the same level of safety.

6.2 Further research needs identified

The need for further research has been identified for the following subjects:

- Health effects of long duty periods followed by long rest periods.
- The cumulative effect of duties of more than 10 hours by day and 7 by overnight.
- The cumulative effect of duty of more than 100 hours per 14 days.
- The possible impact of a high level of sectors (>6) on crew alertness.
- The impact of disruptive schedules on cumulative limits.
- The use of Class B seats for in-flight rest.
- The combination of split duty with augmented crew and time zone crossing.
- The combination of non-acclimatisation on split duty.
- The combination of split duty with FDP extension by in-flight relief.
- The impact of standby other than airport on allowable FDP and calculated DP.
- The appropriate mitigating measures for early to late and late to early transitions.
- The effectiveness of Subpart Q provisions for (partially) non-acclimatised crew.
- The appropriate mitigating measures for eastward-westward and westward-eastward transitions.

7 Annexes

7.1 RIA Option Analysis using the SAFE Model

7.1.1 Application of SAFE in OPS.055: Options and scenarios

Key options developed by the OPS.055 rulemaking group were assessed using the safe model based on certain operational scenarios, usually assuming a 'worst case scenario', i.e. the maximum possible flight duty period according to Subpart Q.

The options to be assessed are given in Table 21.

Table 21: Options for assessment with SAFE

Mitigation No.	Mitigation measure description	Option 0 — Q	Alternative Option 1
5.2(b)	14-day rolling limit on duty period	None	100 hours (Option 3)
5.3(h)	Basic maximum FDP — Reduce maximum FDP for WOCL ⁴² encroachment	13 hours + WOCL reduction	
5.3(l)	Allowable FDP reduced in function of the number of sectors flown	30 minutes reduction from the 3rd sector on	30 minutes reduction from the 2nd sector on (Option 2)
5.5(b)	Limit company planned duty extensions	1 hour, 2 times per seven days	1 hour, 3 times per month (Option 2)
5.5(a)	Allowable FDP reduced in function of the number of sectors flown	30 minutes reduction from the 3rd sector on	30 minutes reduction from the 2nd sector on
5.13	Limits on reduced rest	None — Article 8	French rule (Option 1)

The scenarios were modelled in isolation, following days off and with no other duties surrounding them to try and give a pure 'best case' picture of alertness.

The Samn-Perelli alertness scale was applied with 1 being fully alert and 7 being unable to function effectively. 5.0 and above is generally accepted as the cut-off point.

The cut-off point must be seen as an orientation mark only. When developing regulations for use in real operations, account needs to be taken for the other areas that affect the crew on the day, such as stress, hassle and delays (use of commander's discretion). Having quoted a cut-off point does not mean that a definite conclusion on 'safe' or 'unsafe' can be drawn. The model only gives a mean score, there will be people who are higher than this and lower than this and the variation in individual performance tends to be greater the higher the mean level.

For each of the above policy options certain scenarios were assessed using the SAFE model. The scenarios differ in the assumed reporting time, the number of sectors performed in a flight duty period and the assumed rest periods before and after the duty.

7.1.2 Cumulative Duty — 14-day rolling limit on duty period — 5.2(b)

A 14-day rolling limit on duty period has been proposed in order to ensure that the duty is spread out more evenly and high workload is not clustered within a short period. The latter is believed to cause cumulative fatigue issues.

⁴² Window of Circadian Low (WOCL): Period between 02:00 and 05:59.

In order to test this proposition, an example of 3 blocks of 5 early duties (05:00–06:00) x 59 hours a block = 177 hrs in 19 days was used. A weekly break was given between the blocks plus a 'local day' (24 hrs) due to the rolling weekly total hours. The first block's alertness started at 3.6 and finished at 4.8, the second at 3.7 and finished at 4.8, and the third at 3.7 and finished at 4.9. They could only operate 3 more hours in the next 9 days.

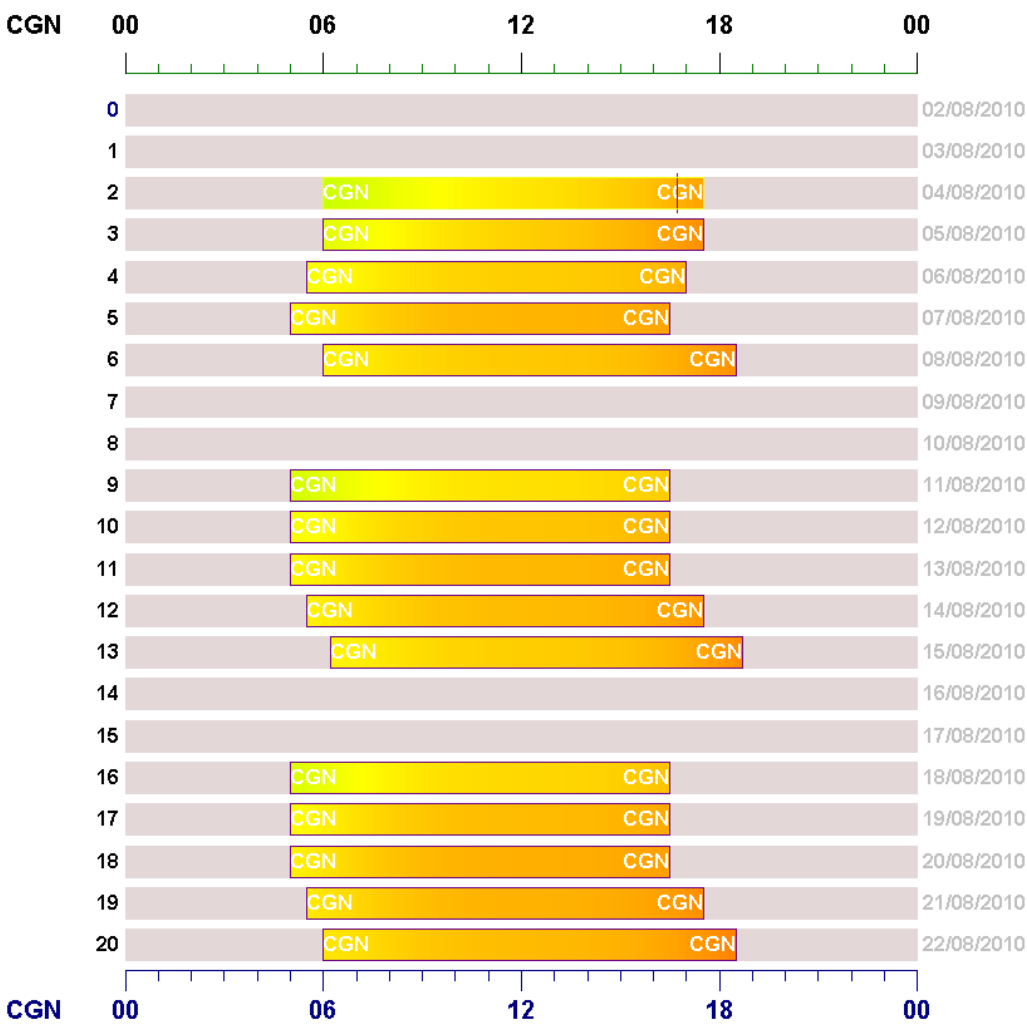
On this scenario a 14-day limit was then imposed as Option 1.

Conclusions

Only a minor improvement (-0.1) in alertness at the end of the block could be seen in the model when Option 1, a 100-hour limit in 14 days, was applied. It is important to note, however, that the blocks of work used in the analysis were very stable, alertness may be more affected where the duty length as well as start and end times are all very irregular.

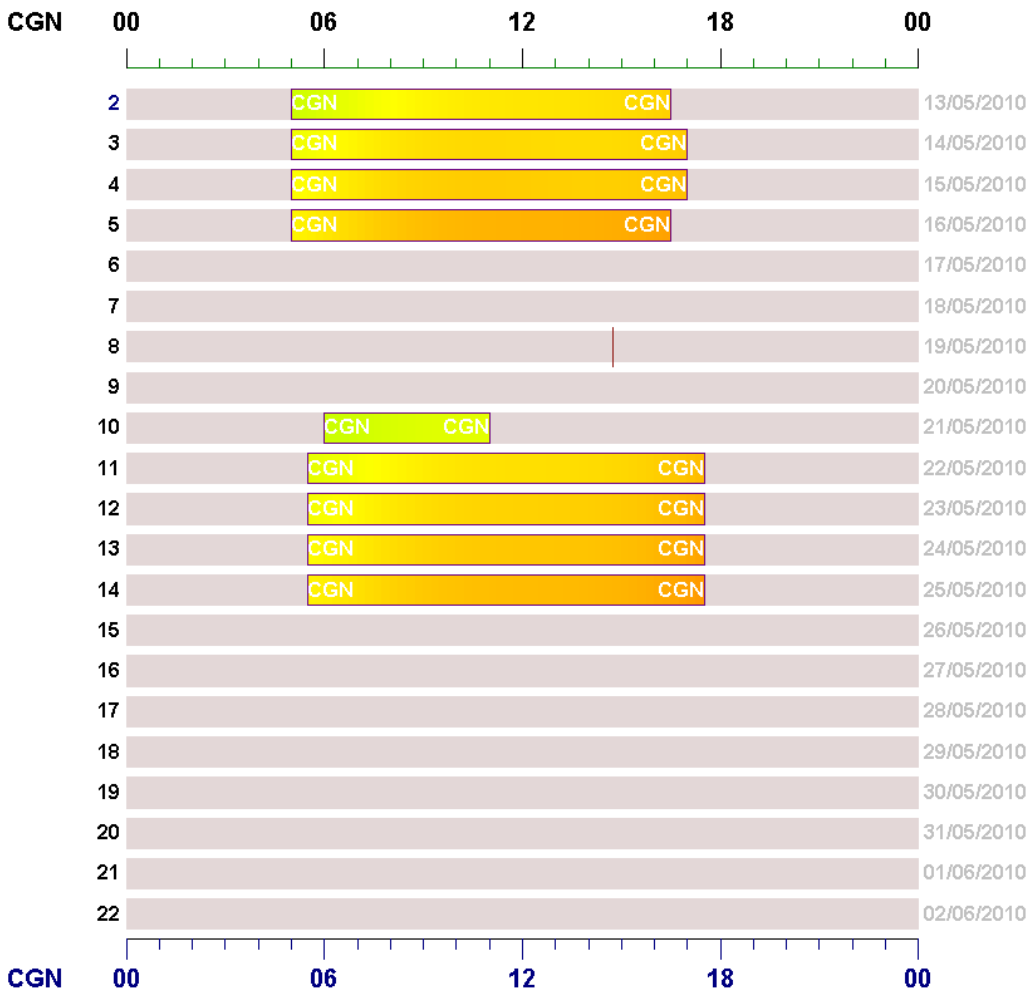
All duties are non-extension and have a 30-minute post-flight duty period and are 4-sector days, except for the duties on day 2 and 3, which are 6-sector days.

Figure 7: Results of the SAFE alertness analysis for Option 0 — Subpart Q



These duties are 4-sector days, except for day 3 and 4 which are 3-sector days, and day 10 which is 2 sectors. They all have a 30-minute post-flight duty.

Figure 8: Results of the SAFE alertness analysis for Option 1 — 14-day-limitation



7.1.3 Basic maximum FDP — WOCL reduction — 5.3(h)

In this scenario a single sector flight is assumed with the maximum allowable flight duty period according to Subpart Q at different reporting times. Rest periods are assumed to be optimal, i.e. flight crew is fully rested when taking up duty. As a reference, the alertness scores for a 13-hour FDP at any reporting time is given. The system assumes at least an hour nap (between 1 and 4 hours) is taken before all evening/morning departures that finish 2 hours before report.

Table 22: SAFE results single sector FDP

Reporting Time	Option 0 — Subpart Q		
	Alertness score with 13 hours FDP (start/finish)	Hours FDP (max. allowable)	Alertness score (start/finish)
0600	3.6 / 4.1	13	
0700	3.4 / 4.0	13	
0800	3.1 / 3.9	13	
1000	2.6 / 3.9	13	
1200	2.4 / 4.4	13	
1300	2.3 / 4.6	13	
1400	2.3 / 4.8	12:30	2.3 / 4.6 (−0.2)
1600	2.3 / 5.1	11:30	2.3 / 4.8 (−0.3)
1700	2.3 / 5.1	11:00	2.3 / 4.9 (−0.2)
1800	2.4 / 5.2	11:00	2.4 / 4.9 (−0.3)
2000	2.6 / 5.1	11:00	2.6 / 5.0 (−0.1)
2200	3.0 / 4.8	11:00	3.0 / 4.9 (+0.1)
0000	3.3 / 4.5	11:00	3.3 / 4.7 (+0.2)
0200	3.5 / 4.1	11:00	3.5 / 4.2 (+0.1)
0400	3.6 / 4.0	11:00	3.6 / 4.0 (same)
0500	3.6 / 4.1	12:00	3.6 / 3.9 (−0.2)

Table 23: SAFE results single sector FDP with extension

Reporting Time	Option 0 — Subpart Q		
	Alertness score with 13 hours FDP (start/finish)	Hours FDP (max. allowable)	Alertness score (start/finish)
0600	3.6 / 4.3	14	
0700	3.4 / 4.2	14	
0800	3.1 / 4.1	14	
1000	2.6 / 4.2	14	
1200	2.4 / 4.6	14	
1300	2.4 / 4.8	14	2.4 / 4.7 (-0.1)
1400	2.3 / 5.0	13:30	2.3 / 4.9 (-0.1)
1600	2.3 / 5.2	12:30	2.3 / 5.0 (-0.2)
1700	2.3 / 5.2	12:00	2.3 / 5.0 (-0.2)
1800	2.4 / 5.2	12:00	2.4 / 5.1 (-0.1)
2000	2.6 / 5.1	12:00	2.6 / 5.1 (same)
2200	3.0 / 4.8	12:00	3.0 / 4.9 (+0.1)
0000	3.3 / 4.5	12:00	3.3 / 4.6 (+0.1)
0200	3.5 / 4.1	12:00	3.5 / 4.2 (+0.1)
0400	3.6 / 4.1	11:00	3.6 / 4.0 (-0.1)
0500	3.6 / 4.2	12:00	3.6 / 4.0 (-0.1)

Conclusions

The model analysis shows that reporting times between 1600 and 2000 result in alertness scores above 5. When Subpart Q FDP reductions for WOCL encroachment are applied, the alertness scores are 5 or less. The results therefore indicate that the WOCL reduction is an effective mitigating measure for single sector flights.

The results also indicate that for a single sector FDP, the alertness score for reporting times between 0400 and 0600 are comparable and well below the critical levels. This suggests that early starts under these conditions are not safety critical.

Furthermore, the results suggest that for single sector flights with extension, the alertness levels are not significantly above the levels without extensions. However, alertness levels do reach 5.0 for reporting times between 1600 and 2000.

Note that for reporting times between 0000 and 0200 the WOCL reduction appears to increase fatigue at the end of the Flight Duty Period. This is due to the underlying circadian rhythm, which would be in a more alert phase when landing later.

7.1.4 Basic maximum FDP — Allowable FDP reduced in function of the number of sectors flown — 5.3 (I)

Reduction of allowable FDP depending on the number of sectors has been proposed by research in order to mitigate the additional fatigue caused by workload. For the analysis 6 scenarios were assessed defined by reporting time: 0600, 0800, 1200, 1600, 2300, and 0400.

Table 24: Scenario assessed against 06:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30-minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hours FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty (diff. to Option 0)
1	4.1	13:00		13:00	
2	4.1	13:00		12:30	4.0
3	4.3	12:30	4.2 (-0.1)	12:00	4.1 (-0.1)
4	4.5	12:00	4.3 (-0.2)	11:30	4.3 (0)
5	4.6	11:30	4.4 (-0.2)	11:00	4.4 (0)
6	4.8	11:00	4.6 (-0.2)	10:30	4.5 (-0.1)

Table 25: Scenario assessed against 08:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30-minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hrs FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty
1	3.9	13:00		13:00	
2	3.9	13:00		12:30	
3	4.1	12:30	4.0 (-0.1)	12:00	3.9 (-0.1)
4	4.3	12:00	4.0 (-0.3)	11:30	3.9 (-0.1)
5	4.4	11:30	4.1 (-0.3)	11:00	4.0 (-0.1)
6	4.6	11:00	4.2 (-0.4)	10:30	4.1 (-0.1)

Table 26: Scenario assessed against 12:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30-minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hours FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty
1	4.4	13:00		13:00	
2	4.4	13:00		12:30	4.2
3	4.5	12:30	4.4 (-0.1)	12:00	4.3 (-0.1)
4	4.7	12:00	4.4 (-0.3)	11:30	4.3 (-0.1)
5	4.9	11:30	4.5 (-0.4)	11:00	4.3 (-0.2)
6	5.1	11:00	4.5 (-0.6)	10:30	4.4 (-0.1)

Table 27: Scenario assessed against 16:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30-minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hours FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty
1	4.8	11:30		11:30	
2	4.8	11:30		11:00	4.7
3	5.0	11:15	4.9 (-0.1)	10:45	4.8 (-0.1)
4	5.2	11:00	4.9 (-0.3)	10:30	4.7 (-0.2)
5	5.3	10:45	5.0 (-0.3)	10:15	4.9 (-0.1)
6	5.5	10:30	5.0 (-0.5)	10:00	4.9 (-0.1)

Table 28: Scenario assessed against 23:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30-minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hours FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty
1	4.8	11:00		11:00	
2	4.8	11:00		10:30	3.8 (no change)
3	5.0	10:30	5.0 (no change)	10:00	5.0 (no change)
4	5.2	10:00	5.2 (no change)	09:30	5.2 (no change)
5	5.3	09:30	5.3 (no change)	09:00	5.3 (no change)
6	5.5	09:00	5.5 (no change)	08:30	5.4 (-0.1)

Table 29: Scenario assessed against 04:00 reporting time

No. of sectors	Alertness score at end of duty (13-hour FDP)	Option 0 — Q (30 minute reduction from the 3rd sector on)		Option 1 30-minute reduction from the second sector on	
		Hours FDP (max. allowable)	Alertness score at end of duty	Hours FDP (max. allowable)	Alertness score at end of duty
1	4.0	11:00		11:00	
2	4.0	11:00		10:30	4.0 (no change)
3	4.1	10:30	4.1 (no change)	10:00	4.1 (no change)
4	4.3	10:00	4.3 (no change)	09:30	4.3 (no change)
5	4.5	09:30	4.5 (no change)	09:00	4.5 (no change)
6	4.7	09:00	4.7 (no change)	08:30	4.7 (no change)

Conclusions

In the tested scenarios there is either little or no difference in alertness between one and two sectors flown. The 1200 start is the only one where the sector reduction in allowable FDP maintains the same level of alertness at the end of the duty as if only 1 or 2 sectors were operated. However, at all reporting times, the results show improved alertness by reducing the allowable FDP in function of the number of sectors flown.

The results indicate that for reporting times between 0800 and 1600 Option 0 results in alertness scores of 5 or less. The reduction after the first sector (Option 1) does not affect duties with 2 sectors, but indeed improves alertness for duties with more than 3 sectors, albeit only by 0.1 points.

For reporting time 0400 (early start), the results indicate that the alertness levels at landing are not at critical levels for more than 2-sector flights.

For flights with reporting time at 2300 the alertness is poor and remains poor as the model puts a lot of weight on the improvement of circadian rhythm to improve alertness and rather less on the reduction of duty to try and improve alertness for these times of day.

The model indicates that operating more than 3 sectors over night (reporting time 2300) can result in more critical alertness levels (alertness score 5.2 to 5.5). At the same time the reduction in FDP appears not to be an effective mitigating measure as the fatigue level remains unchanged with reduced FDP.

7.1.5 Operator planned duty extensions — 5.5(b)

This scenario is the same as the previous one except that the 1-hour operator extension is applied. Option 1 and 2 are not considered separately as it does not make any difference for an individual FDP.

Reporting Time	Alertness score with 14-hour FDP (start / finish)	Option 0 — Q Hours FDP (max. allowable)	Alertness score (start/finish)
0600	3.6 / 4.3	14:00	
0700	3.4 / 4.2	14:00	
0800	3.1 / 4.1	14:00	
1000	2.6 / 4.2	14:00	
1200	2.4 / 4.6	14:00	
1300	2.4 / 4.8	14:00	2.4 / 4.7 (−0.1)
1400	2.3 / 5.0	13:30	2.3 / 4.9 (−0.1)
1600	2.3 / 5.2	13:30	2.3 / 5.0 (−0.2)
1700	2.3 / 5.2	13:00	2.3 / 5.0 (−0.2)
1800	2.4 / 5.2	12:00	2.4 / 5.1 (−0.1)
2000	2.6 / 5.1	12:00	2.6 / 5.1 (same)
2200	3.0 / 4.8	11:45	3.0 / 4.9 (+0.1)
0000	3.3 / 4.5	11:00	3.3 / 4.6 (+0.1)
0200	3.5 / 4.1	11:00	3.5 / 4.2 (+0.1)
0400	3.6 / 4.1	11:00	3.6 / 4.0 (−0.1)
0500	3.6 / 4.2	12:00	3.6 / 4.0 (−0.1)

Conclusions

The model analysis shows that reporting times between 1600 and 2000 result in alertness scores above 5 as in the case of 13 hours FDP. When Subpart Q FDP reductions for WOCL encroachment are applied, the alertness scores are 5 or less for reporting times before 1800 and higher for reporting times between 1800 and 2000, albeit only by 0.1 on the Samn-Perelli scale. Due to the effect of the circadian rhythm, reporting times after 0000 do not appear to raise serious alertness issues.

The results therefore indicate that company extensions need to be carefully managed and monitored as they do increase fatigue near the critical level. A special focus should be on flights with reporting times between 1800 and 2200.

Note that for reporting times between 2200 and 0200, the WOCL reduction appears to increase fatigue. This is due to the underlying circadian rhythm, which would be in a more alert phase when landing later.

7.1.6 Reduced rest — Limits on reduced rest — 5.13

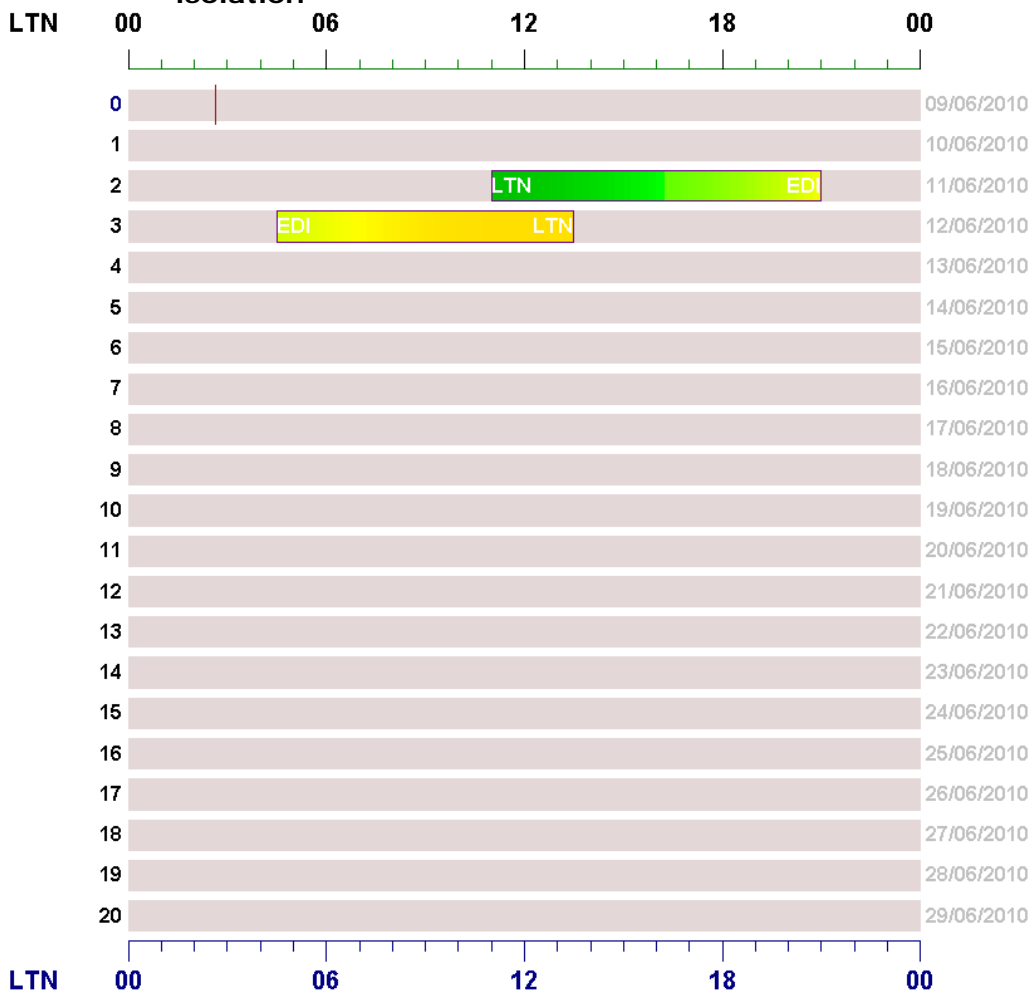
Certain NAAs introduced reduced rest as an additional flexibility usually to be used by regional airlines that need to get crew and aircraft back to base early in the morning in order to be available for connecting flights. To assess the rules on reduced rest the following scenario was developed based on the currently applicable French rules.

Day 1 — 5-sector day reporting at 1100 off duty at 2100 (09:30 FDP + 30 min post = 10 hours). Alertness score at the start of the duty 2.5, alertness score at the end of the duty 3.9.

Rest of 7 hours 30 minutes.

Day 2 — 3-sector day 2 reporting at 0430, off duty at 1330 (13 hours – 1:30 WOCL – 00:30 for sectors = 11 hours – 02:30 for reduced rest = 08:30 FDP + 30 mins post-duty = 9 hours duty). Alertness score at the start of the duty 3.7 [+0.1 higher (worse) than from normal rest period], alertness score at the end of the duty 4.2.

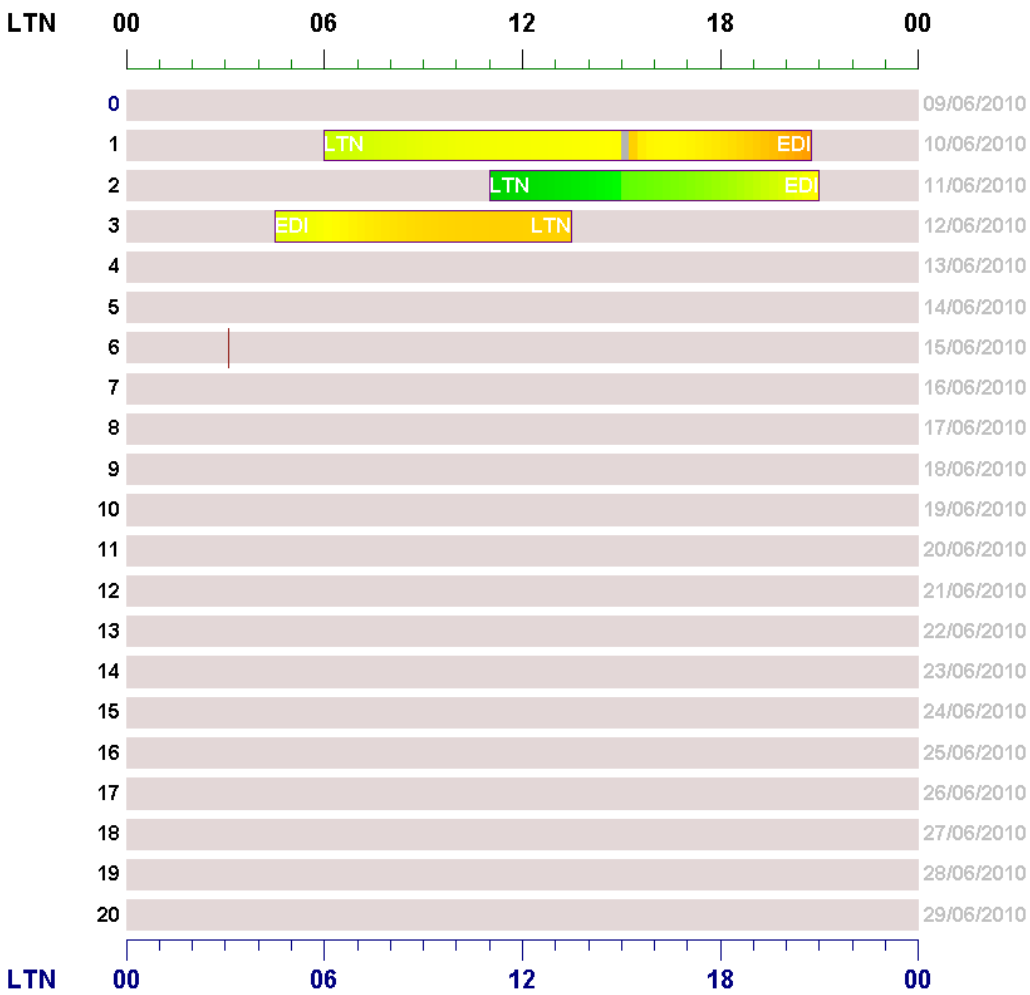
Figure 9: Results of the SAFE alertness analysis for Option 1 — French rules in isolation



The second scenario tested was a split duty and then reduced rest. It was modelled using a 0600 start for 4 sectors (12 hours), no extension used and a 4h30 split (+2:15 on the FDP) = FDP of 14:15 (start 0600, FDP end 2015, duty end 2045) total duty 14:45. The model does not include ground split duty data, so the calculation was conducted using an in-flight relief break to simulate a 'break' on ground. The grey bar in the split duty below indicates the predicted sleep that the model is using.

The only difference noticed is a decrease in alertness at the end of the last duty from 4.2 to 4.3 (0.1).

Figure 10: Results of the SAFE alertness analysis for Option 1 — Reduced rest with split duty



Conclusion

The results of this exercise support the findings from the STARE study and indicate that the rules for reduced rest as applied in France for **regional operations** work effectively as mitigation measures against fatigue hazards. No conclusions can be drawn for other types of operators, which may wish to apply reduced rest provisions.

7.1.7 Duty extension by in-flight rest (5.6)

The following six scenarios were entered to the SAFE model in order to assess the impact of having in-flight rest requirements irrespective of the WOCL (Option 2):

Augmented crew — Class 1 bunk

Scenario 1

Dep 0600 — 2 Sectors — 18 hrs FDP — 3 pilots

Scenario 2

Dep 1800 — 2 Sectors — 18 hrs FDP— 3 pilots

Scenario 3

Dep 1800 — 2 Sectors — 18 hrs FDP— 4 pilots

Augmented crew — Class 2

Scenario 4

Dep 0600 — 2 Sectors — 16 hrs FDP— 3 pilots

Scenario 5

Dep 1800 — 2 Sectors — 16 hrs FDP— 3 pilots

Scenario 6

Dep 1800 — 2 Sectors — 16 hrs FDP— 4 pilots

The analysis was performed by an experienced user, but not by the model developers. The resulting alertness scores per scenario were:

Scenario 1/ Pilot first rest 4.7 / Second 4.6 / Third 4.5

Scenario 2/ First 4.6 / Second 3.9 / Third 3.9 (Circadian rhythm pick as 1200 landing helps)

Scenario 3/ First crew rest 4.2 / Second 4.0 (The slight increase from the 3 crew scenario is possibly due to different assumptions on the time when the rest period is taken).

4/ All crew at 4.2

5/ First crew 4.8 / Second crew 4.4 / Third Crew 4.2

6/ First crew 4.6 / Last crew 4.2

This is assuming acclimatised crew. The impact of time zone crossings on these results would be very dependent on time zones, east or west, time day, length of rest down route. Therefore this is much more difficult to give a generic answer than the European time of day modelling that were performed for the other scenarios.

Overall the results indicate that the effect of working through the WOCL is to some extent compensated by the fact that sleeping during the WOCL is more effective than during the day.

7.1.8 Worst case scenarios

The following worst case scenarios were developed in order to analyse the effectiveness of the current EU-OPS FTL scheme by using extreme but legal cases. The scenarios were entered into the SAFE programme in order to assess the predicted alertness level of the crews in those difficult schedules.

These screen shots and alertness scores only serve as a guide and not as a definite outcome. The model does not have any home standby data in its algorithms, so no scenarios with home standby could be assessed.

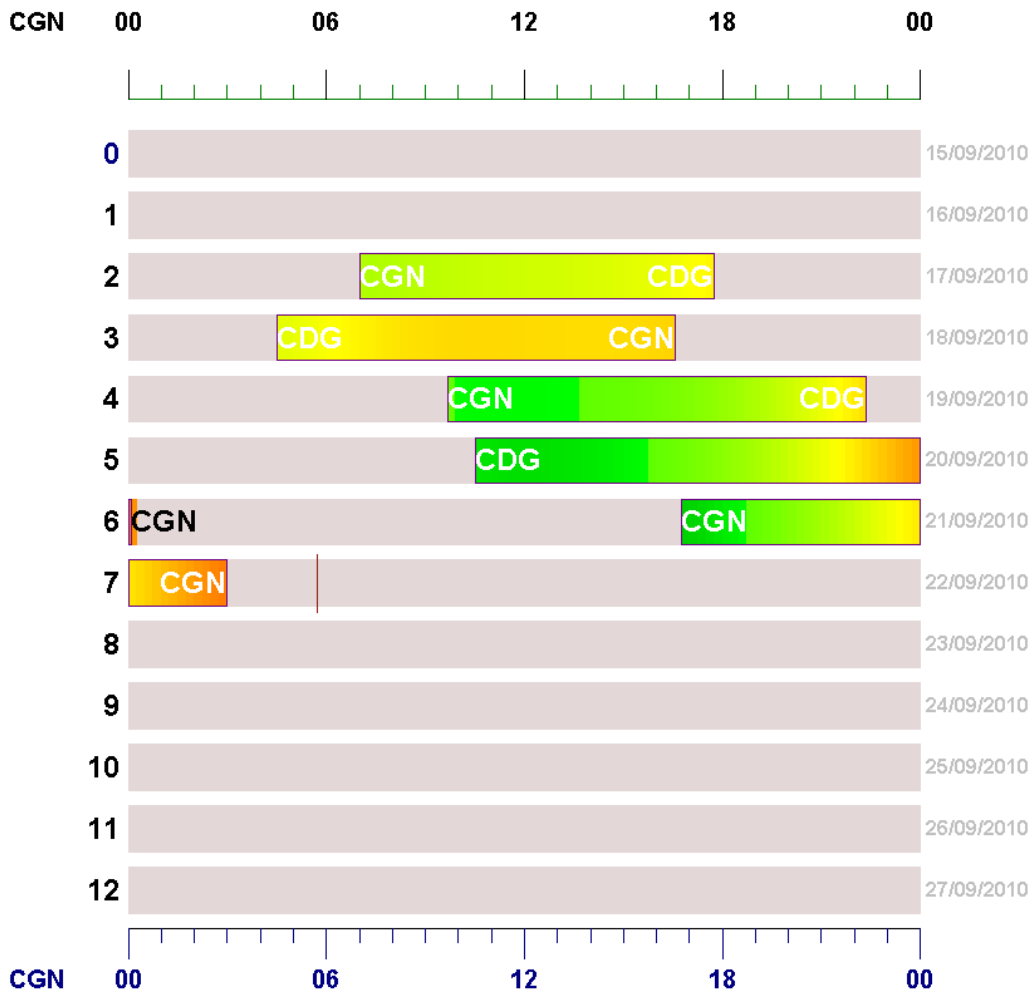
All the scenarios are shown in local time with CGN used as the base and where the pattern is away from base CDG has been used. All the patterns assume a 2-pilot acclimatised crew.

7.1.9 Medium Haul/Short Haul

This scenario is designed to show a schedule with heavy weekly workload and minimum rest periods as currently allowed under EU-OPS Subpart Q.

Table 30: Medium haul and short haul scenario

Medium Haul and Short Haul Scenario									
Day	Duty		Rest		Duty period	FDP	Block time	Rest period	Sectors flown
	Start	End	Start	End					
1	–	–	–	–	–	–	–	–	–
2	7:00	17:45	17:45	4:30	10:45	10:15	6:40	10:45	4
3	4:30	16:35	16:35	9:40	12:05	11:35	7:45	17:05	3
4	9:40	22:20	22:20	10:30	12:40	12:10	9:30	12:10	3
5	10:30	00:05	24:05	16:45	13:35	13:05	8:00	16:40	4
6	16:45	3:00	3:00	–	10:15	9:45	8:00	–	2
7	–	–	–	–	–	–	–	–	–
8	–	–	–	–	–	–	–	–	–
					59:20	56:50	39:55	56:40	



Conclusion: The result highlights that the extended duty on day five that ends just after midnight needs to be carefully managed in order to address fatigue risks.

7.1.10 Medium Haul/Long Haul

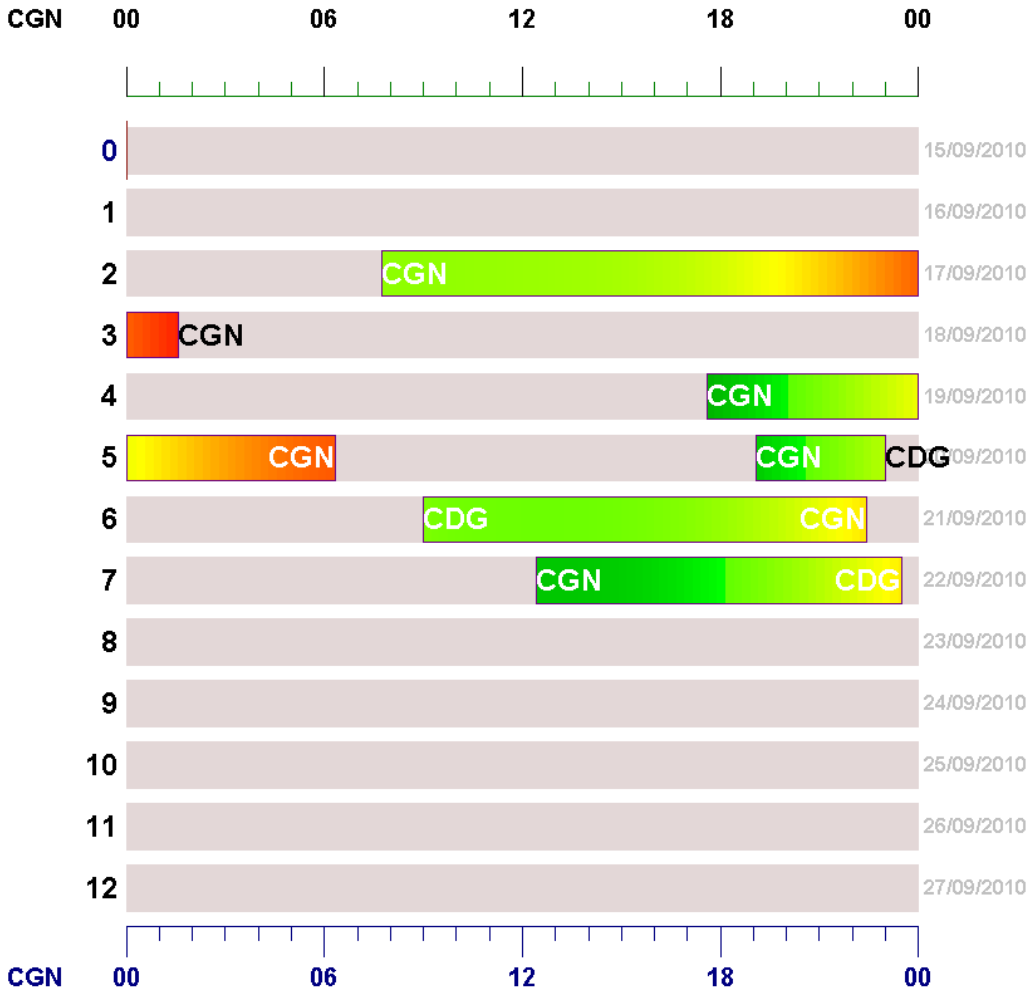
In this scenario the first duty is 4 sectors and combined with a very long duty period. It is assumed that there is a long positioning duty at the end of the FDP. The worst possible case is assumed here: the last landing with a 13-hour FDP plus 2 hours commander’s discretion.

Table 31: Long haul and medium haul scenario

Day	Duty		Rest		Duty period	FDP	Block time	Rest period	Sectors flown
	Start	End	Start	End					
1	-	-	-	-	-	-	-	-	-
2	7:45	01:35	01:35	17:35	17:50	17:20	13:45	40:00	4
3	-	-	-	-	-	-	-	-	-
4	17:35	6:20	6:20	19:05	12:45	12:15	10:30	12:45	2
5	19:05	23:00	23:00	9:00	3:55	3:25	2:25	10:00	1
6	9:00	22:25	22:25	12:25	13:25	12:55	11:00	14:00	2
7	12:25	23:30	23:30	-	11:05	10:35	9:35	-	1
8	-	-	-	-	-	-	-	-	-
					59:00	56:30	47:15	76:45	

As illustrated in figure below, the scenario returns an alertness score of 4.7 at the end of the FDP, with the score at the end of the positioning of 5.5. The second duty (day 4 to 5) gives a score of 5.1 as this is a night duty. This low alertness score is reached even though the duty extension is only 15 minutes. This result indicates that a duty extension for night duties may result in critical alertness levels.

Figure 11: SAFE modelling results

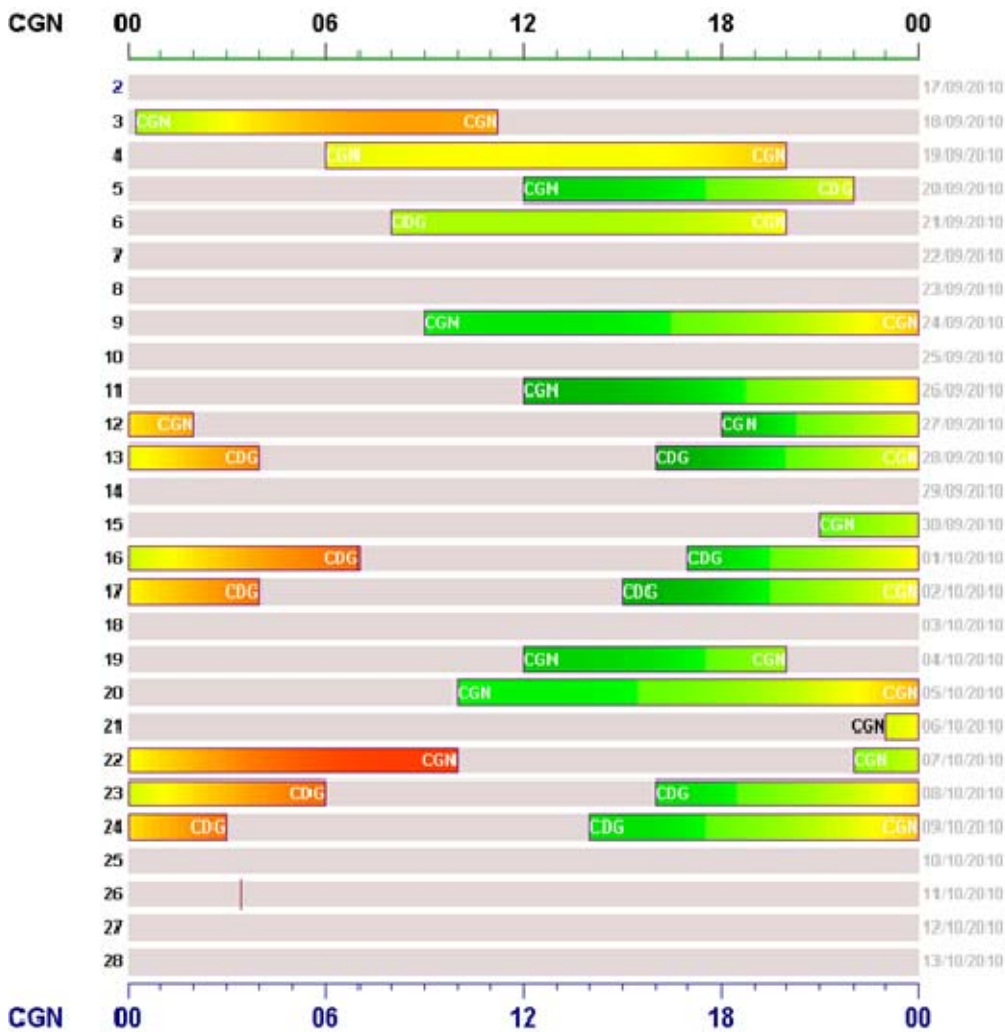


7.1.11 Worst case scenario 'Weekly rest'

This scenario has used weekly rest periods only between blocks of work to the maximum allowable duty hours. It is based on 2-pilot operations and used the maximum amount of FDP available on most days, therefore all FDP's are 2 sectors. Days 7 and 8 are standby duties and for the purposes of the duty calculations have no cumulative duty hours associated with them. As no research on home standby is included in the SAFE model, this aspect cannot be considered for the conclusions. In the first two weekly periods commander's discretion is exercised, so the weekly duty period goes beyond 60 hours.

Table 32: Worst case scenario 'Weekly rest'

Worst Case Scenario "Weekly rest"										
Example of a 28-Day Roster in Accordance with Subpart Q										
Day	Duty		Rest		Duty period	FDP	Block time	Cumulative DP	Rest period	Sectors flown
	Start	End	Start	End						
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	0:15	11:15	11:15	6:00	11:00	10:30	:	11:00	18:45	:
4	6:00	20:00	20:00	12:00	14:00	13:30	:	25:00	16:00	:
5	12:00	22:00	22:00	8:00	10:00	9:30	:	35:00	10:00	:
6	8:00	20:00	20:00	0:00	12:00	11:30	:	47:00	4:00	:
7										:
8										:
9	9:00	24:00	24:00	-	15:00	14:30	:	62:00	36:00	:
10	-	-	-	-	-	-	-	-	-	-
11	12:00	2:00	2:00	18:00	14:00	13:30	:	14:00	16:00	:
12	18:00	4:00	4:00	16:00	10:00	9:30	:	24:00	12:00	:
13	16:00	24:00	24:00	-	8:00	7:30	:	32:00	24:00	:
14	-	-	-	-	-	-	-	-	-	-
15	21:00	7:00	7:00	17:00	10:00	9:30	:	42:00	10:00	:
16	17:00	4:00	4:00	15:00	11:00	10:30	:	53:00	11:00	:
17	15:00	24:00	24:00	-	9:00	8:30	:	62:00	36:00	:
18	-	-	-	-	-	-	:	-	-	-
19	12:00	20:00	20:00	10:00	8:00	7:30	:	8:00	14:00	:
20	10:00	24:00	24:00	16:00	14:00	13:30	:	22:00	16:00	:
21	23:00	10:00	10:00	22:00	11:00	10:30	:	33:00	12:00	:
22	22:00	6:00	6:00	16:00	8:00	7:30	:	41:00	10:00	:
23	16:00	3:00	3:00	14:00	11:00	10:30	:	52:00	11:00	:
24	14:00	24:00	24:00	-	10:00	9:30	:	62:00	60:00	:
25	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-
27										
28										
					186:00	177:30				



The results show alertness scores of 5 and above for the landings on days 22–24 with 5.4, 5.1 and 4.9. This is the combination of the night duty with high workload in the previous duties.

Conclusions: As regards night duty, the scenario indicates that night duties with maximum FDP and minimum rest can result in critical alertness levels if there was a high preceding workload. The results also seem to indicate that outside night duties the minimum rest requirements are sufficient.

The use of commander’s discretion to extend the FDP in the first two periods does not seem to lead to critical alertness levels.

7.1.12 Reduced rest scenarios

Two scenarios were assessed based on actual flight schedules by crew members from European operators working under reduced rest rules similar to the ones proposed in option 1, paragraph 5.13.1, page 119. The number of duty hours in both scenarios is close to the maximum limit allowed.

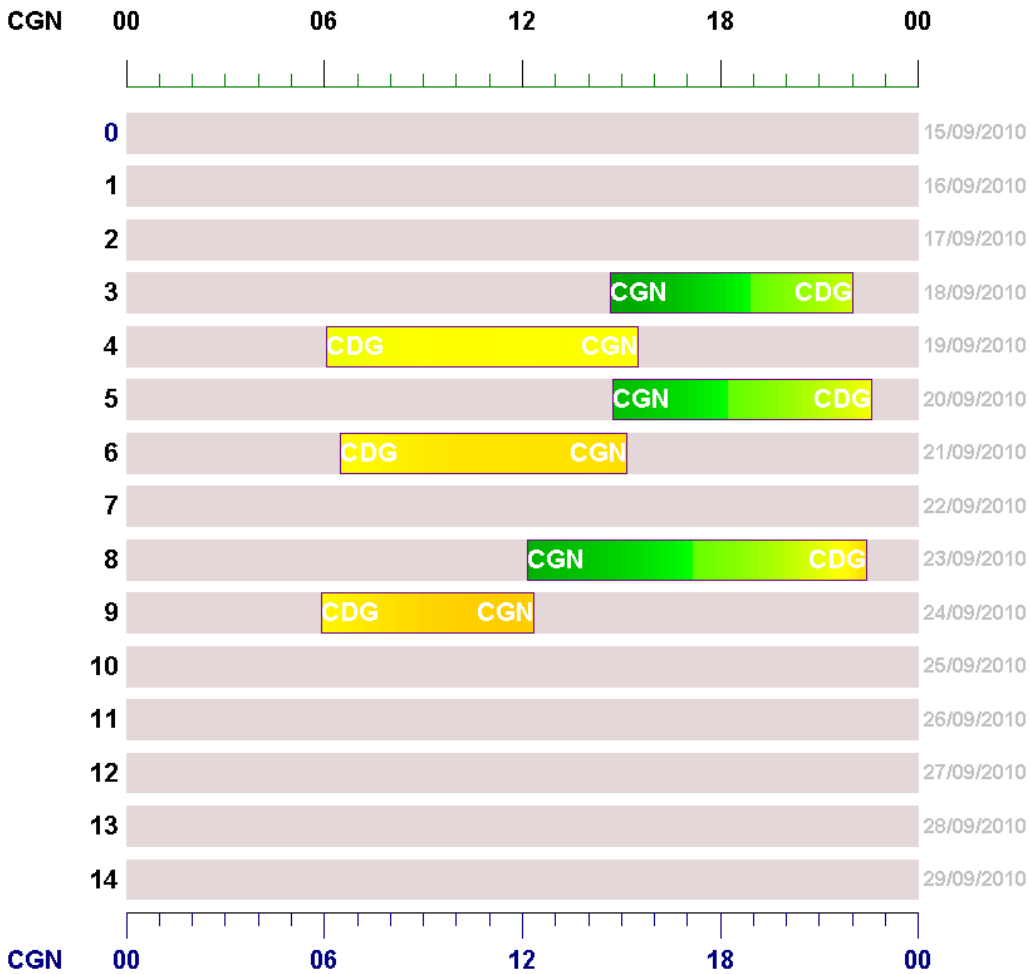
The first reduced rest scenario has 3 reduced rest blocks of work in 7 days. The way that this has been rostered by this operator is that there is a blank day between the 2nd and the 3rd block and while this is being counted as a weekly rest the operator is not showing it as a 'day off'. The crew have been actually rostered 2 days off before, and 3 days off afterwards, which appear to include full local nights.

Table 33: Reduced rest scenario 1

Reduced rest scenario 1									
Day	Duty		Rest		Duty period	FDP	Block time	Rest period	Sectors flown
	Start	End	Start	End					
Wed08	–	–	–	–	–	–	–	–	–
Thu09	–	–	–	–	–	–	–	–	–
Fri10	12:40	20:00	20:00	4:05	7:20	6:50	4:35	8:05	3
Sat11	4:05	13:30	13:30	12:45	9:25	8:55	5:10	23:15	3
Sun12	12:45	20:35	20:35	4:30	7:50	7:20	4:40	7:55	3
Mon13	4:30	13:10	13:10	10:10	8:40	8:10	5:45	55:10	3
Tue14	–	–	–	–	–	–	–	–	–
Wed15	10:10	20:25	20:25	3:55	10:15	9:45	5:35	7:30	5
Thu16	3:55	10:20	10:20	–	6:25	5:55	3:25	–	3
Fri17	–	–	–	–	–	–	–	–	–
Sat18	–	–	–	–	–	–	–	–	–
Sun19	–	–	–	–	–	–	–	–	–
					49:55	46:55	29:10	101:55	

The current proposal for reduced rest limits the number these duties can be done as 2 between weekly rests rather than over 7 consecutive days. This scenario falls into this requirement but also shows that you could do 3 in 7 days. The cumulative fatigue score shows an increase as the number of reduced rest duties is rostered closely together. Scores on the duty after the reduced rest at the start of the duty and estimated last landing time are for the first block (3.9/4.0), second block (4.0/4.1), third block (4.1/4.3).

Figure 12: SAFE results reduced rest scenario 1

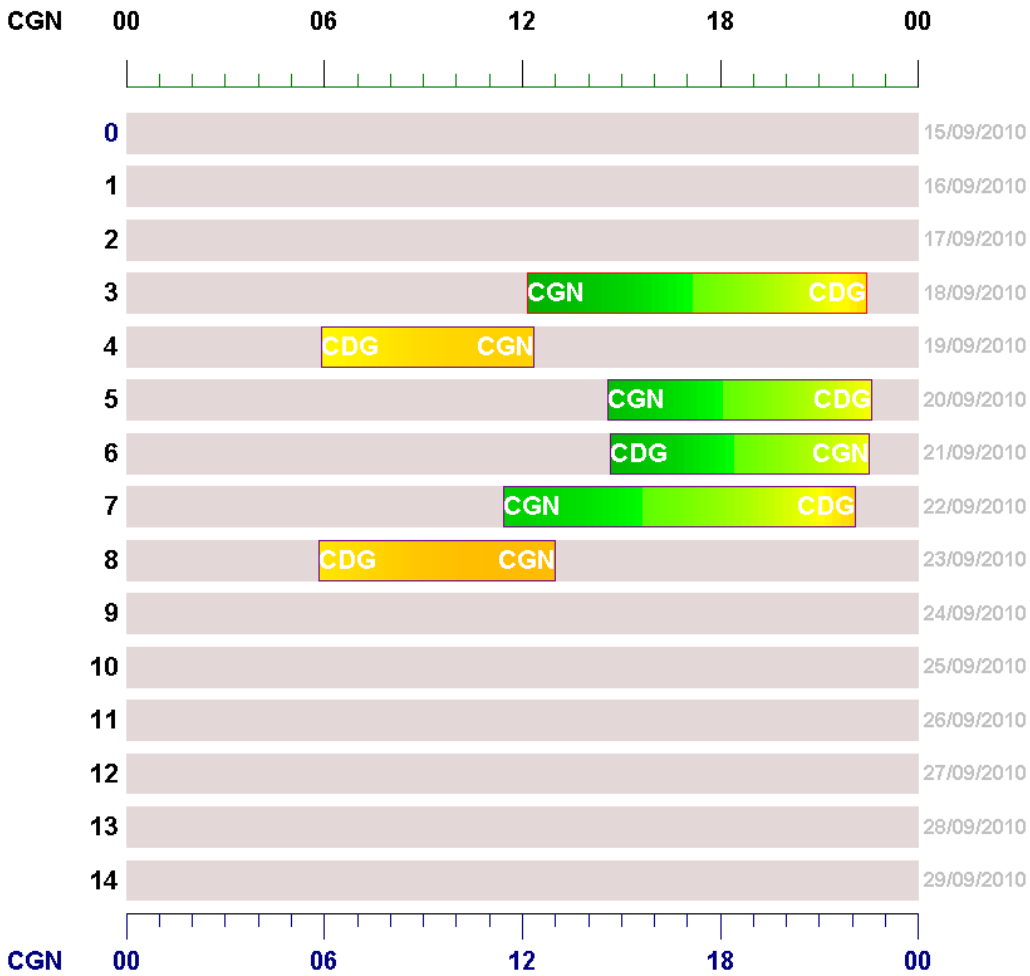


The second scenario shows the impact of mixing 2 reduced rests and 2 'normal' duties in a block of work between days off. The second reduced rest in the second scenario does show cumulative fatigue as the score starts and finishes higher than the first one. The first one scores (4.1 and 4.3) and the second scores (4.2 and 4.5) but it would be expected that the longer the block of work between weekly rest periods, the more it would have a cumulative impact on fatigue and on the alertness scores.

Table 34: Reduced rest scenario 2

Reduced rest scenario 2									
Day	Duty		Rest		Duty period	FDP	Block time	Rest period	Sectors flown
	Start	End	Start	End					
Wed08	–	–	–	–	–	–	–	–	–
Thu09	–	–	–	–	–	–	–	–	–
Fri10	10:10	20:25	20:25	3:55	10:15	9:45	5:35	7:30	5
Sat11	3:55	10:20	10:20	12:35	6:25	5:55	3:25	26:15	3
Sun12	12:35	20:35	20:35	12:40	8:00	7:30	4:50	16:05	3
Mon13	12:40	20:45	20:45	9:25	8:05	7:35	4:50	12:40	3
Tue14	9:25	20:05	20:05	3:50	10:40	10:10	6:30	7:45	5
Wed15	3:50	11:00	11:00	–	7:10	6:40	4:10	–	3
Thu16	–	–	–	–	–	–	–	–	–
Fri17	–	–	–	–	–	–	–	–	–
Sat18	–	–	–	–	–	–	–	–	–
Sun19	–	–	–	–	–	–	–	–	–
					50:35	47:35	29:20	70:15	

Figure 13: SAFE results reduced rest scenario 2



Conclusion: The analysis did not identify any flight duty period where alertness was degraded to a critical level.

Annex 4: Acronyms and Definitions

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7.3 Detailed tables

Table 35: Airport standby regulations in EASA countries

	Max time for stby at Airport	% of Airport stby vs FDP	Rest after Airport standby	Max time for stby at Hotel	% of Hotel stby vs FDP (and DP)	Max time for stby at Home	% of Home stby vs FDP (and DP)
Austria	12 hrs	0% (< 6 hrs stby) 100% (> 6 hrs stby)	If no duty, min 10 hrs rest	24 hrs	Not regulated (Only 50% vs yearly max)	24 hrs	Not regulated (Only 50% vs yearly max)
Belgium (by EBAA)	8 hrs	0% (< 2hrs) 100% (> 2 hrs)	—	12 hrs	0% (< 4 hrs) 50% (> 4 hrs)	12 hrs	0% (< 6 hrs) 50% (> 6 hrs)
CH	Not regulated	50% (if comfortable room)	Min 10 hrs rest after Airport standby	Not regulated	0%	Not regulated	0%
Czech Republic	12 hours 72 hrs/28 days 400 hrs/year	50% FDP 100% DP	Same like previous duty or 12 (10) hours	12 hours	0% FDP 50% DP	12 hours	0% FDP 50% DP (> 4 hrs stby)
Denmark	Not regulated	100%	If no call out, rest period as per OPS 1.1110	14 hrs	50% 0% (first 4 hrs if not called)	14 hrs	50% 100% vs DP
Finland	Not regulated	Not regulated	—	12 hrs (< 6 hrs notify) 18 hrs (> 6 hrs notify)	50% (> 4 hrs standby)	12 hrs (< 6 hrs notify) 18 hrs (> 6 hrs notify)	50% (> 4 hrs standby)
France	12 hrs	0% (< 6 hrs stby) 100% (> 6 hrs stby)	If no duty, same as for out of base	24 hrs	0%	24 hrs	0%
Germany	Not regulated	4 hrs (up to max 18 hrs FDP) (> 3 hrs)	Considered as duty	—	0%	—	0%
Greece	12 hrs	50% FDP 100% DP	—	12 hrs	0% FDP 50% DP	12 hrs	0% FDP 50% DP (> 4 hrs)
Ireland	Not regulated	100%	—	12 hrs	vs FDP: 50% vs DP: 25% (< 6hrs) vs DP: 1,5 hrs + 50% (> 6 hrs) Max FDP: 100% (< 6 hrs) OPS 1.1105 minus (Stby hrs minus 6 hrs) (> 6 hrs)	12 hrs	vs FDP: 50% vs DP: 25% (< 6hrs) vs DP: 1,5 hrs + 50% (> 6 hrs) Max FDP: 100% (< 6 hrs) OPS 1.1105 minus (Stby hrs minus 6 hrs) (> 6 hrs)
Italy	12 hrs	50%	—	14 hrs	50%	14 hrs	50%
Latvia	13 hrs	vs FDP: 100% vs DP: 100%	If no duty, min 10 hrs rest	13 hrs	vs FDP: 50% vs DP: 50%	13 hrs	vs FDP: 50% vs DP: 50%
Malta	Not regulated	100%	If no call out, 100% duty vs OPS 1.1110	12 hrs	0% (< 6 hrs) 50% of > 6 hrs (>6 hrs)	12 hrs	0% (< 6 hrs) 50% of > 6 hrs (>6 hrs)

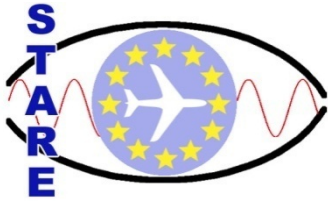
NL	Same as for max FDP	100%	If no call out, rest period as per OPS 1.1110	12 hrs	0-2 hrs vs FDP (table) 50% vs DP	12 hrs	0-2 hrs vs FDP (table) 50% vs DP
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	Max time for stby at Airport	% of Airport stby vs FDP	Rest after Airport standby	Max time for stby at Hotel	% of Hotel stby vs FDP (and DP)	Max time for stby at Home	% of Home stby vs FDP (and DP)
Norway	Not regulated	100%	If no call out, rest period as per OPS 1.1110	14 hrs	50% 0% (first 4 hrs if not called)	14 hrs	50% vs FDP 100% vs DP
Poland	—	—	—	—	50% (> 4 hrs)	—	50% (> 4 hrs)
PT (by EBAA)	12 hrs	—	—	12 hrs	—	12 hrs	—
Slovenia				12 hrs	0% < 6 hrs 50% > 6 hrs	12 hrs	0% < 6 hrs 50% > 6 hrs
Spain	12 hrs	—	—	12 hrs	0% < 6 hrs 0% FDP > 6 h 100% DP > 6 h	24 hrs	0% < 12 hrs 0% FDP > 12 h 50% DP > 12 h
Sweden	Not regulated	100%	If no call out, rest period as per OPS 1.1110	14 hrs	50% 0% (first 4 hrs if not called)	14 hrs	50%
UK	12 hrs	100%	Min 12 hrs	12 hrs	100% (short call) 50% (> 3 hrs notice)	12 hrs	100% (short call) 50% (> 3 hrs notice)

7.4 Notes on crew estimates

- The **Number of aircraft** and the **Number of operators** come from the Ascend CASE database. 2008 figures were chosen because in early 2010 the 2009 personnel, fleet and financial figures had not been reported to ICAO.
- In order to attribute a business model to an airline, the following sources were used:
 - Ascend CASE database (mostly for Business airlines and All-cargo operators);
 - List of ERA member airlines;
 - List of top 25 Legacy, LCC and Charter operators in the Analysis of the European Air Transport Market by DHL;
 - List of AEA member airlines for legacy carriers;
 - List of ELFAA airlines for LCCs;
 - Eurocontrol publication on LCCs (Low-Cost Carrier Market Update);
 - Airlines websites and all available information online.
- The **total number of flights in EASA countries** is Eurocontrol data. Eurocontrol uses only five business models. It was assumed that regional operators are largely included in the figure for legacy carriers.
- ICAO data was used on personnel by carrier type. However, only around half of legacy and low-cost carriers, and one third of business airlines report both their personnel data AND their traffic data to ICAO. The share of airlines that also report financial data is even lower.
- For the estimation of flight crew and cabin crew, we had to use different methods for different business models because of lack of data.
 - For legacy, low-cost and business carriers we assumed that employment is a function of traffic, so we extrapolated ICAO reporting airline personnel numbers based on their share of total Eurocontrol flights of the given business model. We assumed that if 13 993 pilots operate 47.7% of legacy take-offs, then 100% of the take offs is operated by $13\,993/0.477$, and so on.
 - For charter airlines we based our estimate for Flight Crew and Cabin Crew numbers on the Personnel and Traffic data reported to ICAO by 9 charter airlines. Again, we extrapolated ICAO reporting airline personnel numbers based on their share of total Eurocontrol flights. The 9 airlines operated 33.1% of all Eurocontrol charter flights.
 - For regional operators the estimate was based on the personnel numbers reported to ICAO by 10 regional airlines. They indicated approximately 6.3 FC and 5.5 CC per aircraft. The Ascend database had 1 016 aircraft for regional carriers (ERA member airlines had a very similar number of aircraft on 31 December 2008: 1 046). For FC: $1\,016 \times 6.28 = 6\,385$ and for CC $1\,016 \times 5.48 = 5\,570$. Although regional carriers use smaller aircraft (mostly below 100 passengers), it is not clear why they employ fewer CC than FC per aircraft.
 - For All-cargo airlines we followed the same methodology as for regional operators: we multiplied the average number of FC per ICAO reporting airlines with the number of All-cargo aircraft in the Ascend database ($445 \times 4.61 = 2\,050$).
- The result of the above extrapolations was scaled down in order to meet the overall figures as indicated in the European Commission — DG TREN (2009): Effects of EU Liberalisation on Air Transport Employment and Working Conditions.

7.5 STARE Study — Executive Summary



Air Transport Safety and Fatigue Risk Management



This project was carried out with the collaboration of three regional French airlines:



1 — INTRODUCTION AND OBJECTIVES

This document summarises the methods used and results obtained during the STARE project (Air Transport Safety — Fatigue Risk). The project was commissioned by the French Civil Aviation Authority (DGAC) in the context of the directive relating to crew rest requirements, dated 2 May 2007 (Official Gazette). The directive stipulates that companies wishing to benefit from the specific provisions relating to crew rest must set up a Fatigue Risk Management System (FRMS). This system, part of the operator's Safety Management System (SMS) as defined by ICAO, is intended to ensure that these specific provisions allow for maintaining a level of safety that meets the requirements of European regulations ([EU-OPS](#)) in regard to fatigue risk.

Although fatigue constitutes a risk to safety in the sense of the order dated 22 December 2008 on Safety Management Systems, it does differ in some respects from other risk factors. Briefly, five particular properties must be considered to ensure that the fatigue risk is adequately controlled by the FRMS:

- Sources of fatigue are both occupational and extra-occupational. In particular, we have analysed the impact of crew commuting.
- Occupational sources of fatigue are multidimensional and relate just as much to work hours as to the nature and context of the activity.
- There are significant individual differences in susceptibility to fatigue and ability to manage fatigue.
- The link between fatigue and the safety level is not linear: fatigue management strategies change according to the level of fatigue.
- Bearing in mind the interactions among flight crew members, it would also seem relevant to analyse the fatigue risk for the crew as a whole.

2 — REGULATORY AND METHODOLOGICAL FRAMEWORK

Airline operators are required to implement an FRMS immediately they resort to split duties or reduced rests. The main characteristics of these operations are as follows⁴³:

- split duty specifies that if a flight duty is interrupted by a break period between 03.00 and 09.59, the flight duty period can be increased by half the break time, less 15 minutes;
- reduced rest allows rest to be reduced to a minimum of 7 hours 30 minutes (if rest is taken in a hotel located less than a quarter of an hour from the airport). The flight duty period prior to the reduced rest period must not include more than five sectors. The next flight duty period shall be limited to three sectors maximum, and flight duty hours reduced by the rest shortfall (difference between nominal rest stipulated in EU-OPS and the reduced rest period). The next rest period shall be extended by this shortfall and shall include a local night. A maximum of two reduced rests can be scheduled between two regulatory periodic rests.

This study was carried out based on real data supplied, measured or collected on a voluntary basis by three French regional airlines. The relevance of the study, aimed at developing a scientific basis for an FRMS, must therefore be evaluated in regard to the type of operations they carry out. Thus, the fatigue risk assessment is based on short-haul operations with split duty and reduced rest in a French context.

This project was carried out in close collaboration with Airlinair, Britair and Regional who made significant contributions by supplying data and facilitating in-flight observations. These companies will not be mentioned by name in the remainder of this document in the interests of data confidentiality.

⁴³ See the order dated 25 March 2008, amended in regard to detailed regulatory requirements.
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3 — FATIGUE RISK MANAGEMENT SYSTEMS

Airlines prevent fatigue by complying with a prescriptive approach that sets limitations on duty periods and calculating the minimum rest periods. This approach was first adopted at the beginning of the 20th century and was suited to physical fatigue that tends to set in and increase in a linear fashion. It seems to be significantly less applicable to activities that are predominantly cognitive. This is because the onset of and recuperation from mental fatigue has a non-linear dynamic (Dawson and McCullough, 2004⁴⁴). The variations associated with our biological rhythms mean that the recuperative potential of a rest period depends on the time of day at which the rest is taken. The regulations specify high-level criteria in which these variations are only very rarely taken into account (Cabon and coll., 2002⁴⁵). EU-OPS was taken as the regulatory basis for this study and it does partially incorporate chronobiological criteria. However, it is thought that simultaneously incorporating all the scientific criteria would make the regulations very complex, and perhaps even impossible to apply.

Prescriptive approaches are also limited by the fact that they are generally poorly suited to dealing with the enormous diversity of situations encountered within the airlines, and the versatility required to design turnarounds in a highly competitive market segment. In addition, work hours represent a major factor in social relations within the airline company. To deal with these pressures, the system can resort to derogations allowing reductions in rest times or extensions of duty. The way in which this impacts safety should be measured, together with the compensatory measures put in place.

These observations gave rise to the idea of Fatigue Risk Management Systems (FRMS) intended to complement and even partially or fully replace the prescriptive limitations on duty periods and rest requirements. In other words, the limits would no longer be fixed on the basis of universal regulatory criteria, but according to the fatigue risk, assessed case-by-case. A history and review of these FRMS systems is given in Gander and et al.⁴⁶ (in press).

In air transport, the New Zealand Civil Aviation authorities were pioneers in this field.

The FRMS principle was also recently implemented by two airline companies: first, by Singapore Airlines for the introduction of Ultra Long-Range flights of more than 16 hours

⁴⁴ Dawson, D. & McCullough, K. (2005). Managing fatigue: It's about sleep. *Sleep Medicine Reviews*, 9, 365-380.

⁴⁵ Cabon, P., Bourgeois-Bougrine, S., Mollard, R., Coblenz, A., & Speyer, J.J. (2002). Flight and Duty Time Limitations in Civil Aviation and Their Impact on Crew Fatigue: A comparative Analysis of 26 National Regulations. *Human Factors and Aerospace Safety: An International Journal*, 2(4), 379-393.

⁴⁶ Gander, P., Hartley, L., Powell, D., Cabon, P., Hitchcock, E., Mills, A., Popkin, S. Fatigue Risk Management I: Organizational Factors. *Accident analysis and Prevention*.

flight time and/or 18 hours Flight Duty Period (Spencer and Robertson, 2007⁴⁷). Then, EasyJet did the same for putting in place new short-haul rosters (Steward, 2006⁴⁸). These systems have one thing in common: they use predictive fatigue models to assess the a priori fatigue risk associated with duty periods, and also continuous or periodic monitoring of safety indicators and fatigue assessments (questionnaires, observations, etc.).

On an international scale, in 2009 ICAO created a 'Fatigue Risk Management System Task Force' bringing together operators, authorities and experts to develop a framework for future development of FRMS systems.

The aim of the STARE project is to study the conditions under which a French intra-European regional air transport fatigue-related safety observatory could be put in place, and to examine the development of scientific bases for a future FRMS applicable to cases of reduced rest and split duty, all within the EU-OPS regulatory framework. The consequences of this type of operation for crew fatigue levels, in particular, have been analysed.

⁴⁷ Spencer, M.B., & Robertson, K.A. (2007). The application of an alertness model to ultra-long-range civil air operations. *Somnologie*, 11, 159-166.

⁴⁸ Stewart, S. (2007). An integrated system for managing fatigue risk within a low cost carrier. In Proceedings of the International Aviation Safety Seminar, Flight Safety Foundation, October 23-26, Paris, France.

4 — APPROACH ADOPTED

The general principle of the STARE project approach is initially to make use of the indicators already available within the airline companies, but which are not processed with a view to monitoring fatigue risk. Other indicators have also been selected, derived from the practices of foreign organisations or from other sectors of activity.

This general approach consists of analysing the data collected using two methods:

- A systematic observatory: covers data collected systematically by the airline companies on all flights or related to company flight personnel. These data were not initially designed for monitoring fatigue risk levels, but are personnel health and safety indicators. The objective is to assess the sensitivity of these indicators specifically to fatigue-induced risk. The two indicators studied are ASRs⁴⁹ (Air Safety Reports) and FDM⁵⁰ events (Flight Data Management). The specific fatigue risk level is derived from flight schedule analysis based on a predictive fatigue model.
- A focused observatory: the data are derived from a website questionnaire, as well as information collected and observations made in flight, which naturally reflect conditions for a limited sample of flights and crews over limited periods.

This summary gives the main results that could be used within the framework of putting in place an FRMS, whether derived from an awareness of best practice or sourced from research work.

⁴⁹ Air Safety Reports.

⁵⁰ Flight Data Management.

5 – MAIN RESULTS

5.1. Systematic observatory

The objective of this observatory, set up within the framework of the STARE project, is to determine potentially usable indicators for identifying and assessing the fatigue risk factor based on data systematically gathered by the airline companies.

To calibrate for crew fatigue risk levels, a chronobiological analysis of schedules was carried out using a predictive fatigue model, or Fatigue Risk Index. This model can be used to predict the fatigue risk level based on duty period characteristics.

5.1.1. Chronobiological analysis of crew schedules

The schedules for all crews were analysed from the perspective of two categories of explanatory variables: the first relates to the biological clock and the sleep/wake rhythm⁵¹, and the second to social criteria⁵².

On this basis, the variables were used to select schedules reputed to be the most critical for 16 cabin crew (CC) members and 16 to 17 flight deck crew (FDC) members within each operator who participated in the study over a one-year period. Fatigue risk analysis was carried out on morning duties following reduced rest for the schedules selected on this basis.

After determining the limits of the analysis, the fatigue risk index (FRI) was studied. The FRI is equal to the probability of obtaining a score of 7 or higher on the Karolinska Sleepiness Scale (KSS), which consists of 9 levels ranging from 'extremely awake' (score = 1) to 'extremely sleepy' (score = 9). A KSS score of 7 or more means that an individual is sleepy but does not experience difficulty in remaining awake.

⁵¹ These criteria quantify the proportion of nights of less than 8.h45, nights of less than 11h00, split duties, duties beginning earlier than the previous duty, duties beginning before 6.00 am, periods of more than five consecutive work days, and the average number of sectors per duty.

⁵² These criteria comprise the proportion of evenings off, Saturdays off, Sundays and Public Holidays off, weekends off and nights away from home.

Thus, Figure 1 shows the distribution of the fatigue risk indices (FRI) obtained for all morning duties after a reduced rest for all critical schedules. In this sample, the FRI varies from 4.05% to 42.76%, i.e. there is a 4.05% to 42.76% probability of obtaining a KSS score of 7 or more. This score was selected as the 'critical' fatigue level in terms of performance within the framework of this study, and is also used as a threshold in other fields of activity.

It can be seen that 6% of morning duties following a reduced rest in the critical schedules subsample present a probability higher than 30% of producing a so-called 'critical' fatigue level. Less than 1% of these duties present a probability higher than 35% of producing a critical fatigue level. These proportions are lower if total reduced rests are taken into account. A qualitative study to characterise the duties potentially producing a critical fatigue level was outside the brief of the STARE project.

The wide interval between the low and high FRI scores shows the enormous diversity of schedule configurations, in particular with regard to:

- start of duty, fluctuating between 03.00 and 07.59,
- end of afternoon duty preceding the reduced rest,
- duration of morning duty after the reduced rest,
- position of the duty in the sequence after the last rest.

This extreme variability is the result of many factors, including the random sequencing of duties in individual schedules stemming from the overall planning of rosters and including rosters with reduced rests. From the perspective of FRMS systems applied to reduced rests, this result underlines the fact that it is important to manage the fatigue risk at schedule level and not just for rosters. Within the company, the model could, for example, be used to assess 'typical' schedule sequences and identify favourable and unfavourable sequences in order to help planners to best manage flight planning for flight personnel.

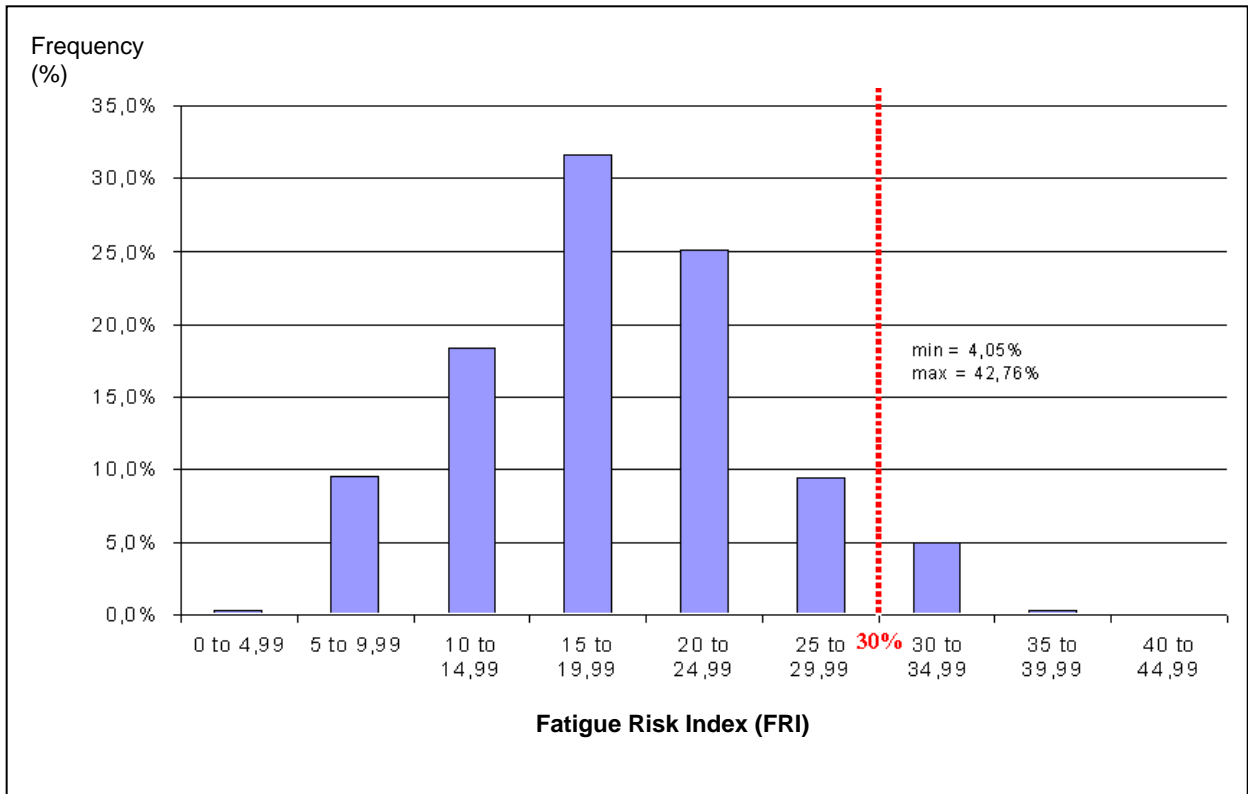


Figure 1 — Distribution of FRI scores for morning duties following a reduced rest — All critical schedules

Figures 2 and 3 give two examples of the schedules of two captains employed by the same company with duties involving reduced rest associated with a fatigue risk index below 30 and above 30. These two examples underline the fact that the fatigue risk associated with reduced rest is closely linked to the duties preceding this reduced rest. This confirms that it is more relevant to base planning on the crew’s past schedule data in order to minimise the fatigue risk.

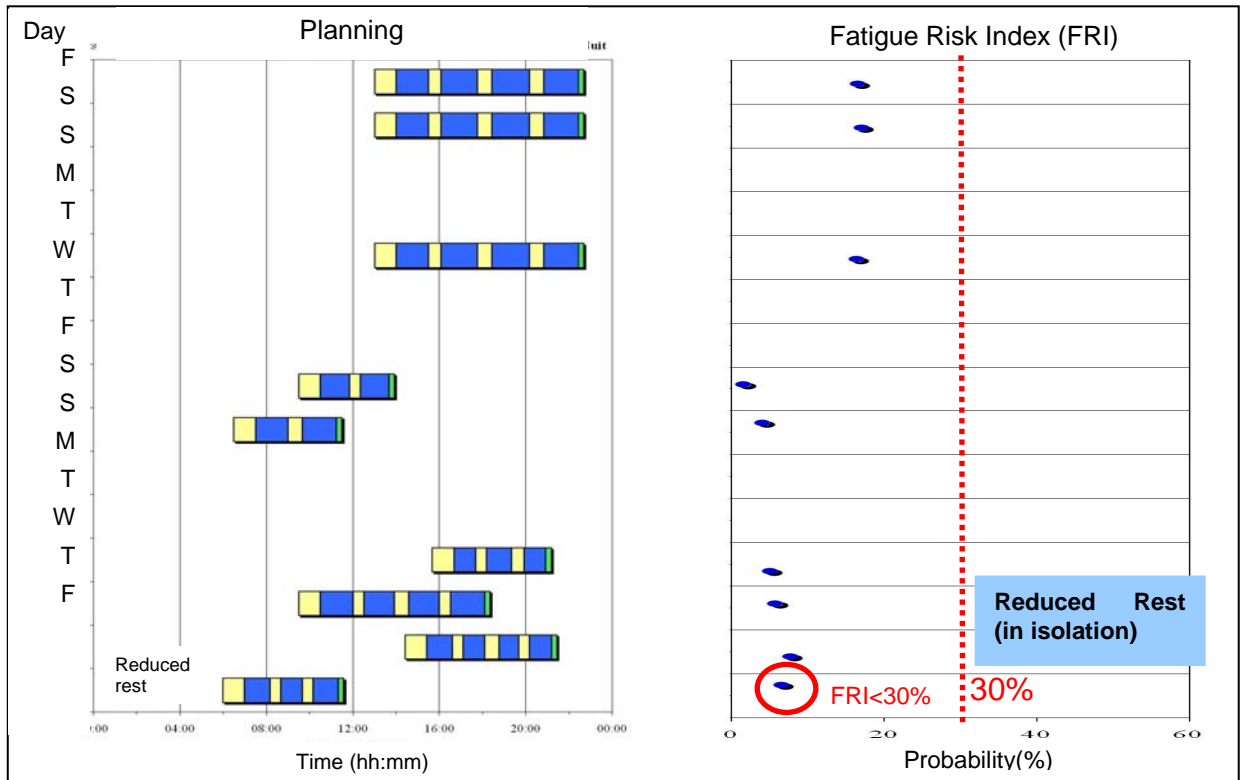


Figure 2. Sequencing of duties with associated reduced rest and FRI < 30

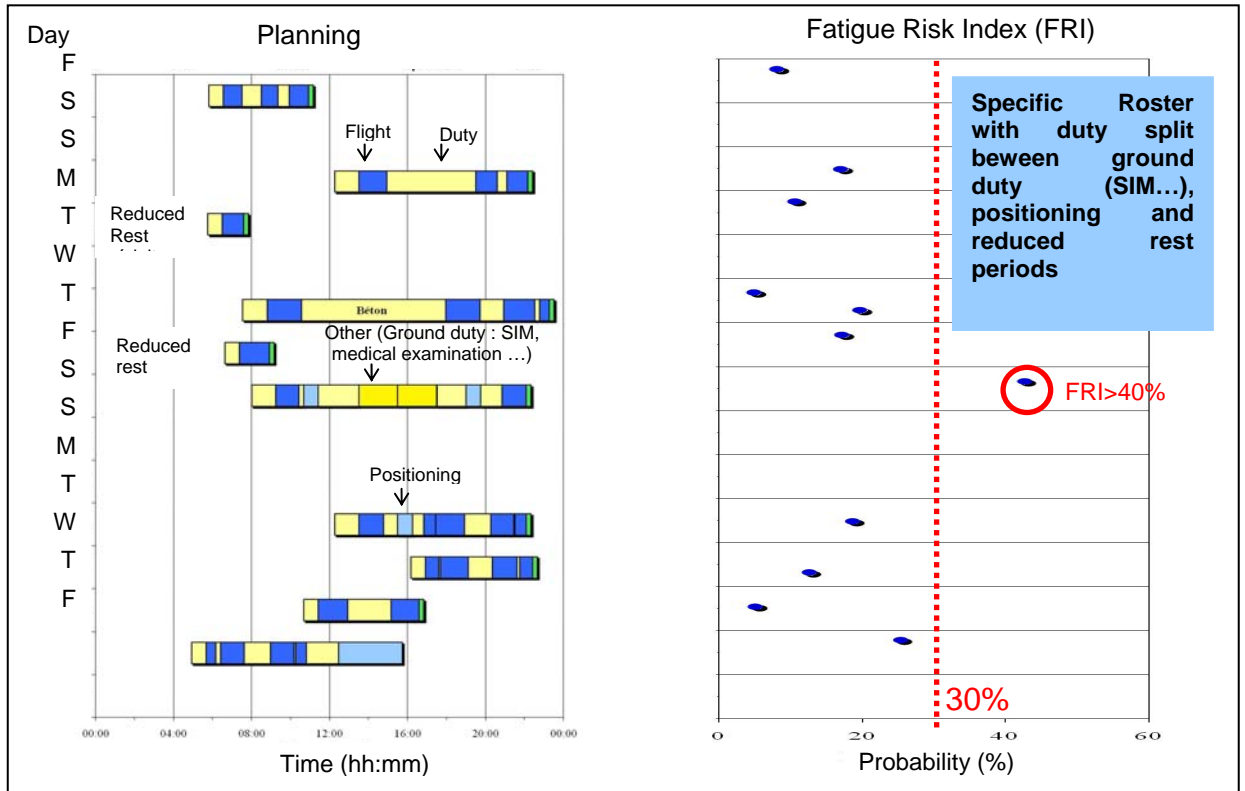


Figure 3. Sequencing of duties with associated reduced rest and FRI > 30

5.1.2 Systematic observatory and indicator monitoring

As mentioned in sections 4 and 5.1, this observatory monitors two types of indicator:

- Air Safety Report (ASR) events
- Flight Data Management (FDM) events

5.1.2.1. Air Safety Reports

ASRs are one of the essential safety indicators monitored by airline companies. They are mandatory reports filed by crew members after certain events, such as an air turn-back, incapacitation of a crew member, runway incursion or confusion, inadvertent drop below minimum safe altitude or communications failure. Some operators specifically monitor their ASRs when carrying out fatigue analysis. This applies to EasyJet (Steward, 2007) and Air New Zealand (Fallow, 2008), for example. Their aim is to use ASRs to identify events associated with reports by the crew that fatigue contributed to degradation of performance or of flight safety. In regard to the current situation with French companies, and within the scope of the STARE project, fatigue factors are not directly taken into account in ASRs, and are not included in the forms to be completed by crew members, nor in subsequent analyses carried out by the company.

Qualitative and quantitative analyses carried out in the STARE project entailed determining whether variations in ASR occurrences could be explained by crew fatigue. All the events reported were studied independently of their potential link to a fatigue level, whether assumed or reported by the crew.

Figure 4 gives a comparison of the frequency of ASRs (weighted for volume of activity) occurring after reduced rests and normal rests. The results are presented according to the duration of the duty preceding the occurrence of the event leading to the submission of the ASR.

These results indicate the following:

- For two of the three operators (X and Y), there is no significant difference between the ASR rate after reduced rest and after normal rest for events that occurred during the first three hours of flight duty;
- For all three operators, there was a significantly higher ASR rate after reduced rest than that observed after normal rest for events that occurred during the period of from three to five hours of flight duty;
- For one of the three operators (Z), there was a significantly lower ASR rate after reduced rest than after normal rest for events that occurred after the fifth hour of

flight duty. For a second operator (Y), there was no difference between the ASR rates after reduced rest and after normal rest.

In addition, in the case of reduced rest, there was a drop in the ASR rate for events that occurred after the fifth hour of flight duty for all three operators, relative to the rate observed between the third and fifth hour of duty.

The other results are not statistically significant due to the small sample size.

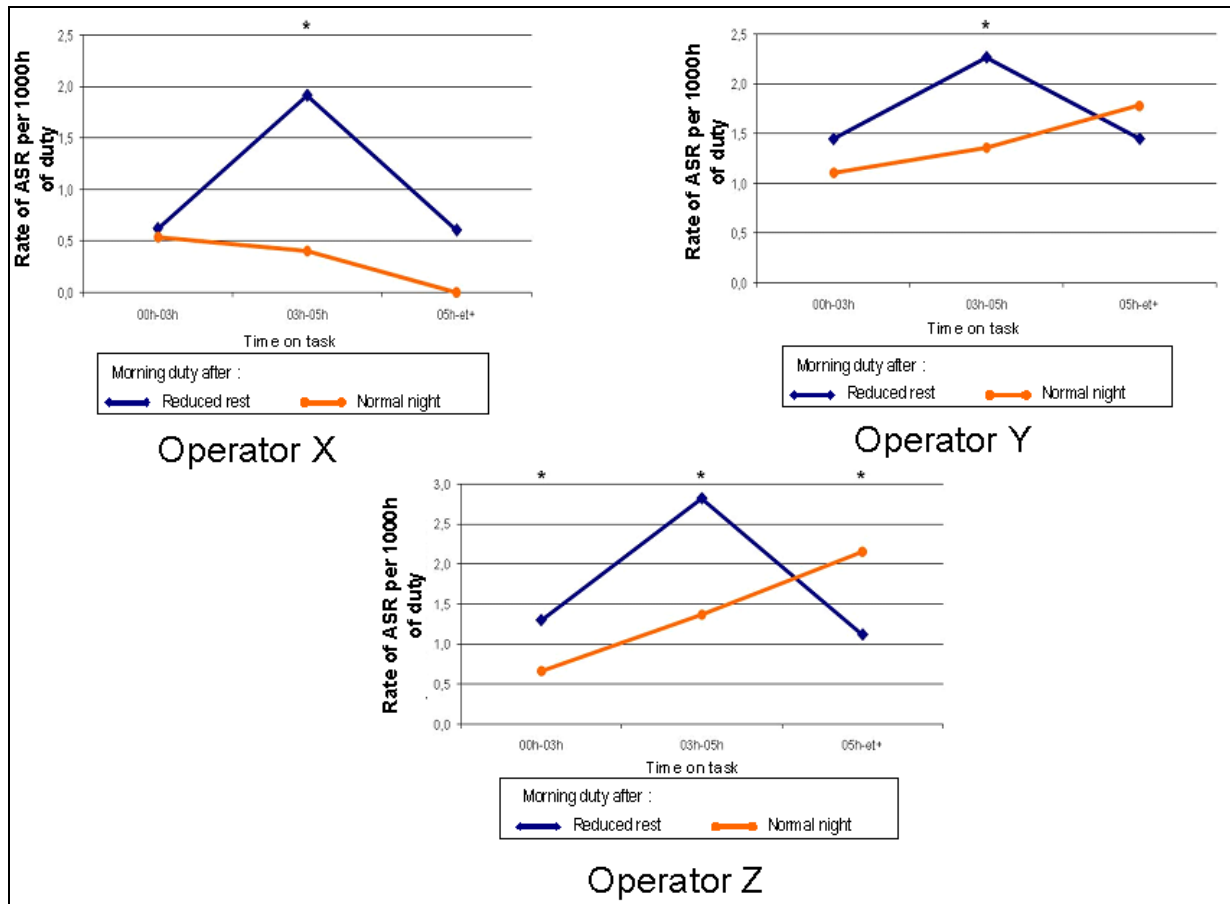


Figure 4. Comparison of ASR frequency after reduced and normal rest

These results suggest that the ASR frequency is sensitive to duty characteristics, even if there is no linear relationship with the duration of duty.

The drop in ASRs for lengthy duty periods can be explained by strategies aimed at ‘protecting’ against the effects of fatigue (more extensive use of automated processes, stricter application of procedures, increased number of cross-checks, etc.), leading to a drop in the number of events. This point is corroborated by interviews and observations carried out within the company.

Given the current state of ASR data available, it is difficult to go further in interpreting the data, but these results do suggest that ASRs are potentially relevant within the framework of an FRMS. Nevertheless, appropriate statistical analysis methods are still required, together with future enrichment of the ASR data collected in order to include more qualitative information.

Specific recommendations have been put forward, both in relation to methods for systematically taking account of fatigue when an ASR is submitted, and also in regard to statistical data analysis.

5.1.2.2. Flight Data Management (FDM)

Flight data management is used by airline companies to systematically and statistically monitor flight safety indicators. These indicators, referred to as events, correspond schematically to threshold overrun for key points in the flight. They are generally assigned three severity levels, quantifying the importance of the overrun, with level 3 as the most severe. Events are defined differently according to the type of equipment and the airline company. Systematic flight analysis has been accepted by the flight personnel representatives of only one of the three companies.

Note that these events are not conceptualised with the aim of understanding fatigue. They are based on a normative approach in terms of pilot performance or procedural non-compliance, and detect deviations from the norm. The aim of this part of the study is to define how current FDM tools available to airline companies could contribute to the FRMS, based on scientific results. A number of studies have already been carried out in this field. The study conducted by Mello et al. (2008)⁵³, was aimed at finding links between the most severe deviations and the time of day of the flight. Rosekind (2008) explores the influence of aspects of the rosters (type of duty, turnaround trip, segment of the trip) on the frequency of severity 2 or 3 events. One characterisation of fatigue based on a combination of 11 parameters derived from crew schedules is also used in this study, but there was no evidence of any significant impact on the occurrence of severity 2 or 3 events. Studies by EasyJet (Steward and coll., 2003⁵⁴) have concentrated particularly on the impact of two types of sequence: 6/3 (six consecutive morning duties, followed by three rest days, then six afternoon duties followed by three rest days) by comparison with 5/2/5/4 (five consecutive morning duties, followed by two rest days, then five afternoon duties followed by four rest days) on the frequency of events in the

⁵³ M.T. Mello & al. Relationship between Brazilian airline pilot errors and time of day. Brazilian Journal of Medical and Biological Research – 41(12), 2008.

⁵⁴ Stewart, S., Abboud, R. Flight crew scheduling, Performance and Fatigue in a UK Airline, Phase 2. Conference proceedings of Fatigue Management in Transportation Operations. 2005. Seattle, USA.

FDM system. The results show a significant drop in the number of severity 3 events using the 5/2/5/4 roster, initially conceived to minimise crew fatigue.

The approach used in the STARE project entailed finding correlations between a fatigue risk associated with crew schedules and the occurrence of events to which were assigned three severity levels (1 – least severe, 3 – most severe). Figure 5 summarises the methodology developed in this project. The central point is the combined use of aircrew-related fatigue risk assessment and FDM data. In this case, assessing the fatigue risk level is done by applying fatigue criteria to the individual schedules of pilots, captains (CAP) and first officers (FO). Each flight is then characterised by the fatigue risk level of the flight crew, i.e. combination of the fatigue risk levels for CAP and FO. It was possible to determine a total of five fatigue risk level classes for the flight crew, according to these combinations. The last stage consists of counting the number of FDM events for each of these fatigue risk level classes. This analysis was conducted on a total of 46,974 flights and 69,635 events of 19 types ('speed exc. MMO', 'speed exc. VMO', 'speed exc. VFE', etc.), categorised on 3 severity levels:

- Severity 1: 66,451
- Severity 2: 2,846
- Severity 3: 338

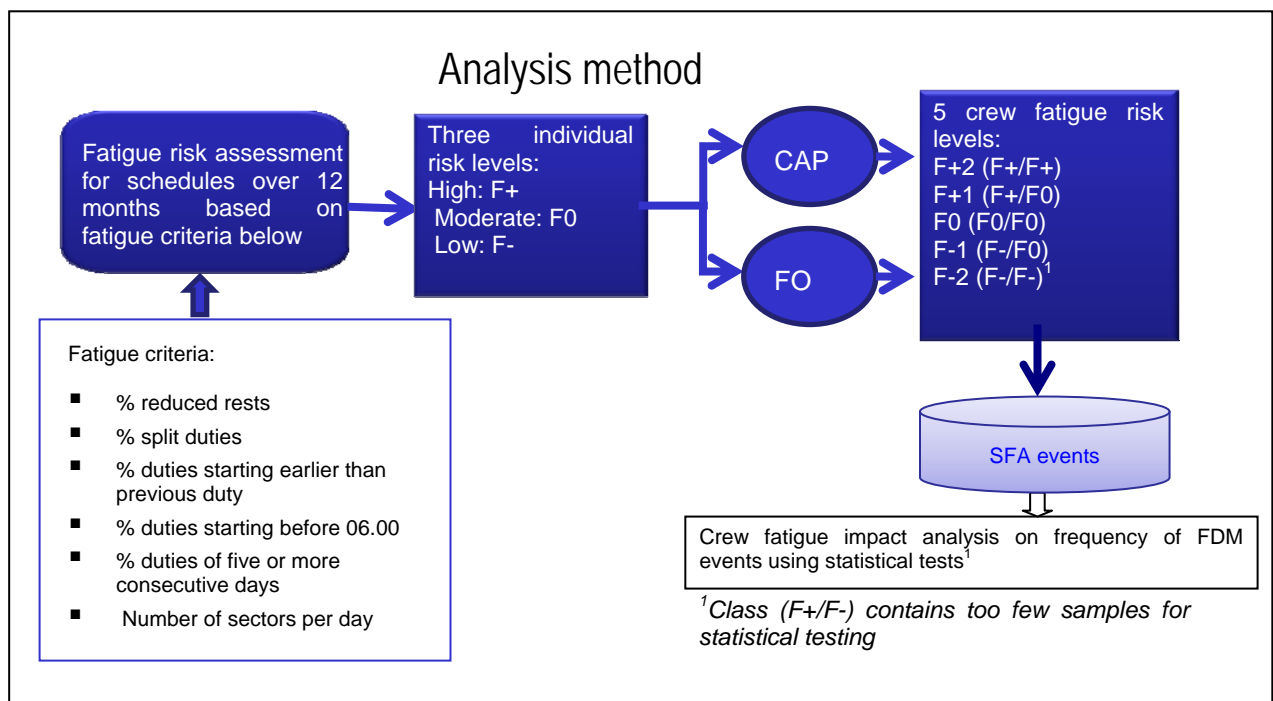


Figure 5. Method used for analysing fatigue risk level impact on FDM events.

Figure 6 shows the distribution of all events regardless of severity, as a function of the five fatigue risk level classes for the flight crew.

FDM events vary as follows:

- for all severities taken together, the more the flight crew is characterised by a low fatigue level, the higher the occurrence of events (Figure 6) ;
- for severity 1 events, the same applies, i.e. the lower the fatigue risk level for the flight crew, the more these events occur;
- for severity 2 events, the same tendency is observed, but to a lesser extent (severity 2 FDM events being associated with a single event category);
- for severity 3 events, the lower the fatigue risk level of the flight crew, the less these events occur (Figure 7).

The drop in the number of events of all severities when the crew's fatigue risk increases is linked to a drop in severity 1 and 2 events which represent the biggest proportion of the total number of events.

The results of FDM event occurrence analysis, carried out inside one company, for one type of aircraft and over a period of a year, show that crew fatigue affects operational events as they are measured by the company. However, it is worth noting that this effect is not detectable for all types of FDM event.

Thus, the variations in the number of FDM events of all severities cannot be used as a direct fatigue risk indicator for the crew. On the other hand, some of these FDM events are sensitive to this risk. It is therefore necessary to identify them if they are to be used within the context of an FRMS.

The indicators established in this way must take account of the severity of the events, since the study shows that for the majority of events sensitive to the crew's fatigue level, a high fatigue level is characterised by fewer low severity events and a greater number of high severity events.

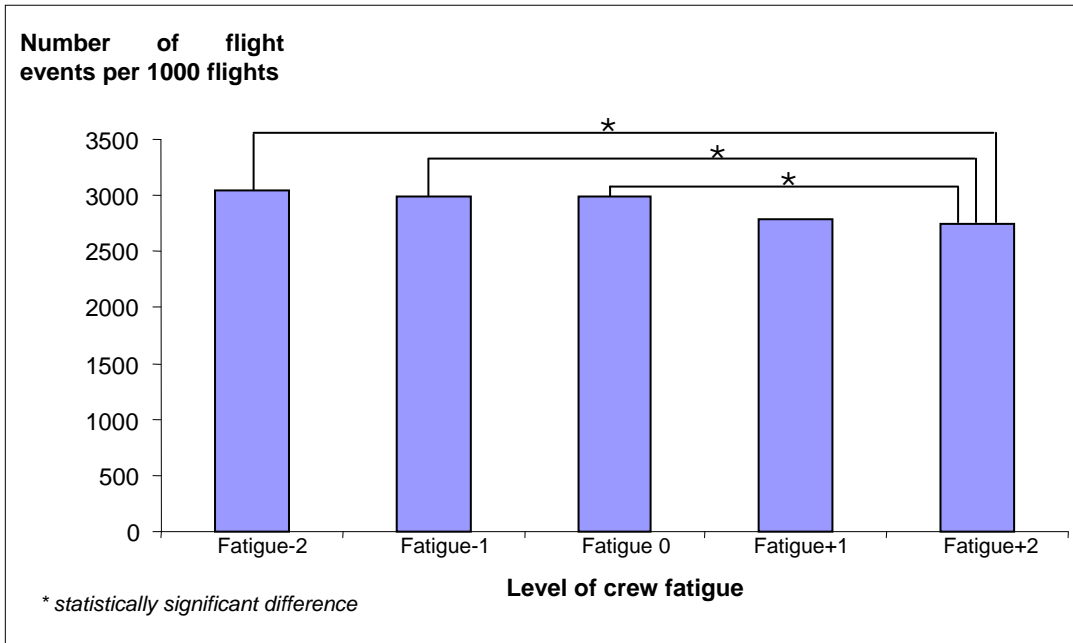


Figure 6. Impact of the flight crew's fatigue risk on the number of flight events, all severity levels taken together

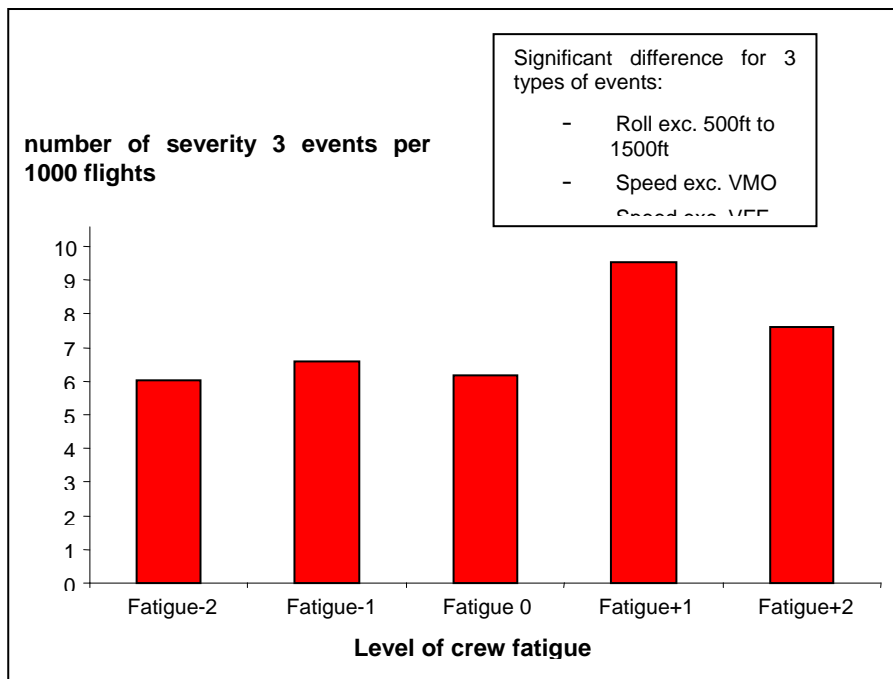


Figure 7. Impact of the flight crew's fatigue risk level on the number of severity 3 events.



5.1.3. Analysis of absenteeism

In the world of work, absenteeism is an indicator of how work affects the health of personnel. An acute or chronic state of fatigue, whether physical or mental, can result in absenteeism or favour the development of a pathology, which in turn results in absenteeism.

The analysis of absenteeism based on HR data from the companies studied, relating to 1300 absences over a one-year period, shows that it is not possible to draw conclusions concerning the impact of duty-schedule-related fatigue on absenteeism.

On a practical level, for setting up a fatigue risk observatory within an airline company, the systematic analysis of absenteeism using the currently available database is not sufficiently valid and reliable to formulate any recommendations.

5.2 Focused observatory

The focused observatory encompasses a set of resources implemented for directly assessing the fatigue felt by crews or reported by observers based on limited samples of crews and rosters. These indicators cover the techniques conventionally used:

- website survey;
- observations and collection of in-flight data.

5.2.1 Website survey

The aim of this survey is to provide data on how crews experience rosters and, more generally, their working conditions. Surveys are conventionally used in FRMS systems since they provide rapid access to information on factors that may interfere directly, to a greater or lesser degree, with crew fatigue levels, and also cover large air crew populations.

The issues covered by the questionnaire developed within the STARE project relate to:

- Fatigue perceived by air crew members in relation to:
 - o working hours
 - o sleeping habits
 - o working conditions
 - o social and family life

- Manifestations and consequences felt to be linked to fatigue
- Strategies adopted for combating fatigue.

In order to have easier access to air crew (AC), we opted to circulate the questionnaire on a dedicated website with password protection. In all, 468 air crew members responded to the questionnaire (table n°1). The total AC population employed by the three companies amounted to 2046 people at the time of the survey, and therefore the response rate was 23.7%.

Function group	Amount of returned questionnaires (%)
Captains	163 (34,8)
First officers	119 (25,4)
Cabin Crew	186 (39,7)
Total	468 (100%)

Table 1. Distribution of employee respondents per position.

The main results of this survey are as follows:

- 44.3% of AC members live a long way from their home base, and 85% of them reported having stay-over accommodation nearby.
- A very ambivalent perception of working hours which represent one of the main advantages of job, but also the primary disadvantage.
- The duties experienced as the most fatiguing, according to AC members, are consecutive morning wake-ups over 4-5 days. Next come rosters including multi-sector duties after reduced rest. AC members reported that they felt the need for associated recuperation of three and two days, respectively, for these duties. Note that, more generally, any duty, whatever the fatigue level induced, is felt as requiring a full day's recuperation.
- Sleep time perceived as more degraded during reduced rests than morning duties. This perception is more marked for cabin crew (CC) members than for flight deck crew (FDC) members.

- The disturbances associated with the outside environment, technical chance events and changes of aircraft are perceived as more fatiguing work situations, due to the 'schedule' factor.
- Pace of work, schedules and physical environments are considered the most fatiguing working conditions.
- Pace of work and schedules, in addition to the quality of the meals for CC members, are perceived as being the elements in the working conditions that have deteriorated most over the last few years.
- The signs of fatigue that they themselves are most aware of are the physical manifestations (back, head, eyes, etc.) for both FDC and CC, and the overwhelming desire to sleep for CC. Loss of interest and motivation, and lack of alertness are the first signs of fatigue detected by co-workers.
- An afternoon nap (siesta) and sleep management are the most widely used strategies for preventing fatigue, preferred by far to the use of caffeine.
- Thinking ahead and relying on co-workers are the strategies linked to occupational activity that were most reported for managing fatigue.
- Operator errors and failure to think ahead were perceived by FDC members as manifestations of the most frequent performance-related fatigue. For CC members, difficulties in concentrating, carrying out the work in a mechanical way and forgetfulness constituted the most perceived impacts of fatigue on performance. Failure to think ahead and not being able to deal with the unexpected were considered the highest risk factors for FDC and CC respectively.
- Mood swings, backache (FDC) and aching legs (CC) were the most perceived psychological and physical signs of fatigue.
- In general, flight personnel reported that they were fairly aware of their fatigue and its consequences. They were very keen to obtain information on the mechanisms of fatigue and methods of preventing it in their occupational activities.

5.2.2 Observations and data collection in flight

The second aspect of the focused observatory relates to observations and data collection in flight. It incorporates the essential tools for designing a future FRMS, since they can be used to gain a precise understanding of the impact of duty hours on sleep, fatigue and crew behaviour.

There are two essential phases in data collection:

1. In-flight observation entails monitoring sleep and fatigue over a period of 12 days using an actometer and sleep diary. The actometer measures the amount of movement using an accelerometer in a small unit worn on the non-dominant wrist. This unit records episodes of activity (characterised by numerous movements) and rest (few movements) in order to assess sleep duration and quality based on motor activity. Detection is handled by software, based on an algorithm that also detects sleep.
This 12-day monitoring period provides a basis for assessing the effects of rosters on sleep and interpreting the observations made during flight duty.
2. Data collection during flight duties :
 - a. By crews who have completed standardised rating scales for assessing their fatigue and its manifestations. These assessments were made during flight duties, the majority of which include a reduced rest and split duty.
 - b. By outside observers responsible for completing analysis charts from arrival in the aircraft to the end of duty. Noteworthy facts were then categorised and cross-referred with fatigue data to determine impact on activity.

In all, 126 AC members (75 FDC members and 51 CC members) participated in data collection. A total of 49 rosters were covered by fatigue monitoring and sleep assessment on days before and after the roster. Types of rosters are detailed in table n°2.

Type of rosters	Number
2 split duty flights	1
Duty on 4 flights and for lengthy periods	2
Duty on 4 flights	1
1/3 (1 sector - rest - 3 sectors)	1
3 split / 1 (3 sectors with split duty - rest - 1 sector)	5
3/1 (3 sectors - rest - 1 sector)	4
3/3 (3 sectors - rest - 3 sectors)	19
5/3 (5 sectors - rest - 3 sectors)	14
5/1 (5 sectors - rest - 1 sector)	1
Duty reduced to 1 flight (technical problems)	1
Total	49

Table 2. Rosters observed for fatigue assessment.

5.2.2.1 Sleep and fatigue monitoring

During the sleep monitoring phase, the STARE project confirmed a fact applicable to society as a whole and not limited to aviation: the ongoing existence of a sleep debt (or deficit) of the order of 10% for the personnel studied, outside any period of work. This should be taken into account when considering the sleep debt data in Figures 8 and 9.

Figure 8 gives the result of the sleep duration assessment as a function of the type of duty, showing a comparison of FDC and CC.

The figures are percentages representing the sleep needs reported by air crew (AC). In regard to the effect of the duty type, there is a significantly lower sleep period for reduced rests compared with other types of rest. Sleep deprivation reaches 45.9% of normal sleep for FDC and 38.8% for CC. The difference between the results for FDC and CC is statistically significant.

Figure 9 gives the same type of results, comparing air crew members living far from and close to home base. In contrast to what one might expect, there is no significant difference between these two populations. The 'distant home location' factor does not have any significant impact on sleep duration. 'Distant home location' air crew compensate for being away from home using strategies involving, for instance, getting to their home bases the day before duty (stay-over accommodation or staying with friends or co-workers).

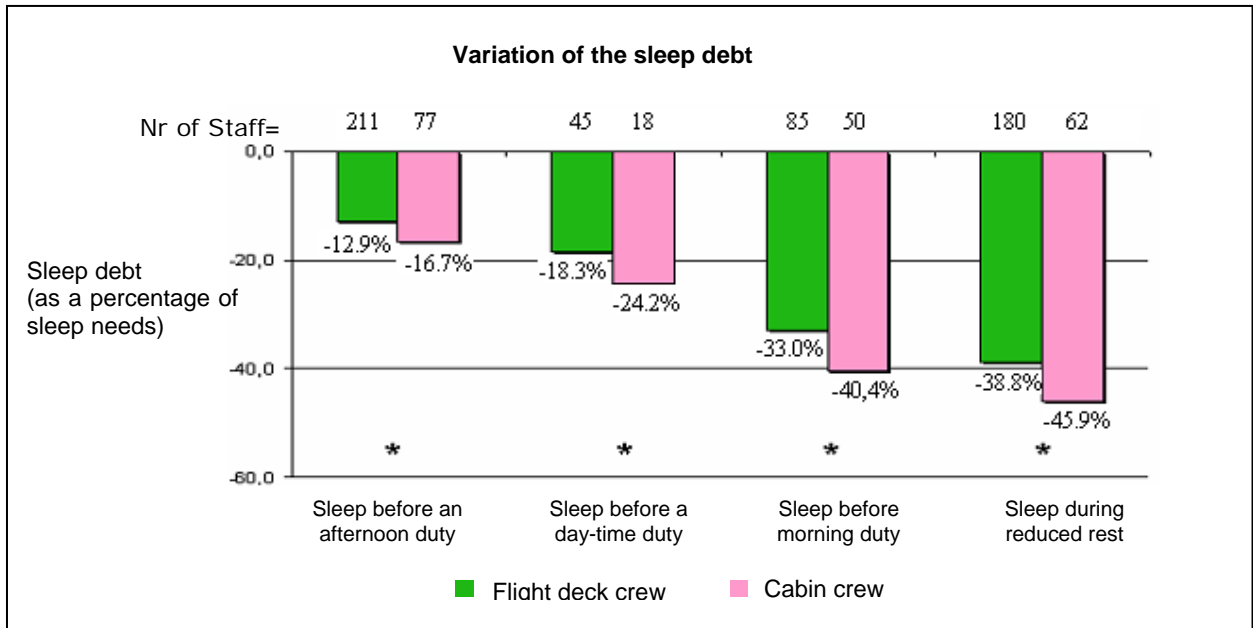


Figure 8. Sleep debt during different types of duty.
FDC/CC comparison

The following classification has been adopted:

Morning duty: start of duty between 03.00 and 7.59 – Day duty: start of duty between 08.00 and 10.59 – Afternoon duty: start of duty between 11.00 and 14.59

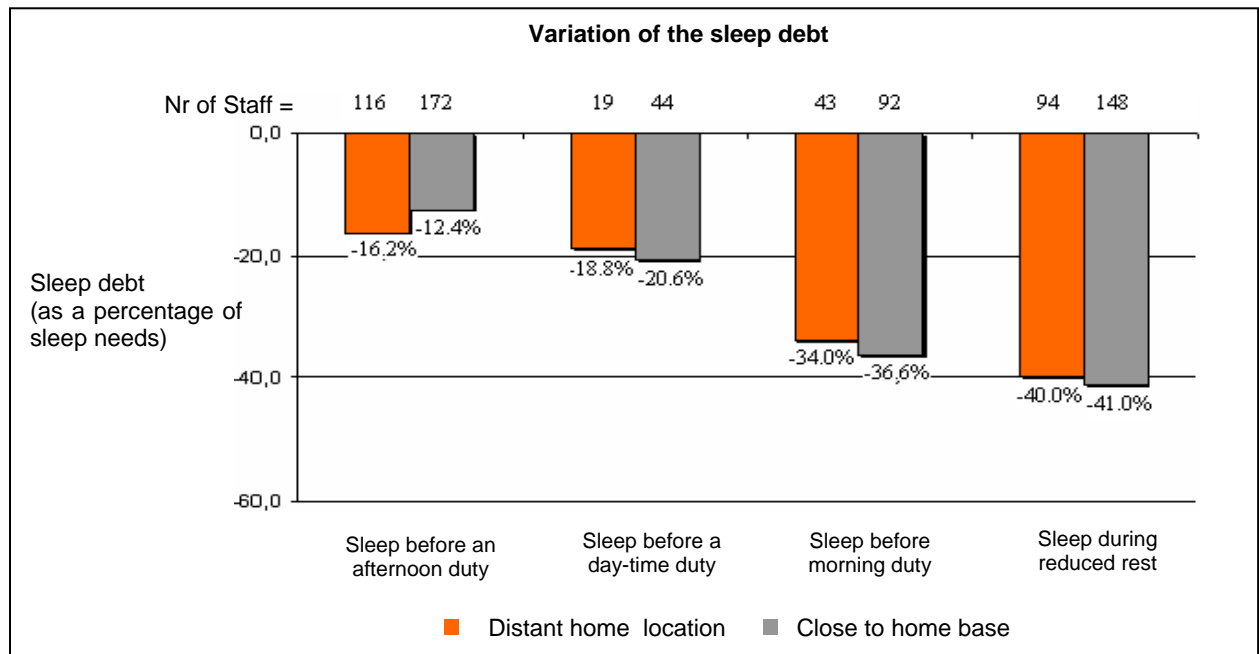


Figure 9. Sleep debt during different types of duty
Comparison of 'distant home location' air crew (AC) and AC living close to home base.

The results of measuring the sleep debt preceding morning duty (with normal rest) and preceding a duty after reduced rest, as shown above, are corroborated by air crew responses to questionnaires: 69% thought that they had insufficient sleep for morning duty (with normal rest) and 86% in cases of reduced rest. Remember that the normal period of rest is at least 10h for a layover and 12h at home base.

Sleep quality is judged good or even very good for 73% during the night preceding morning duty, whether rest is normal or reduced (see Figure 10).

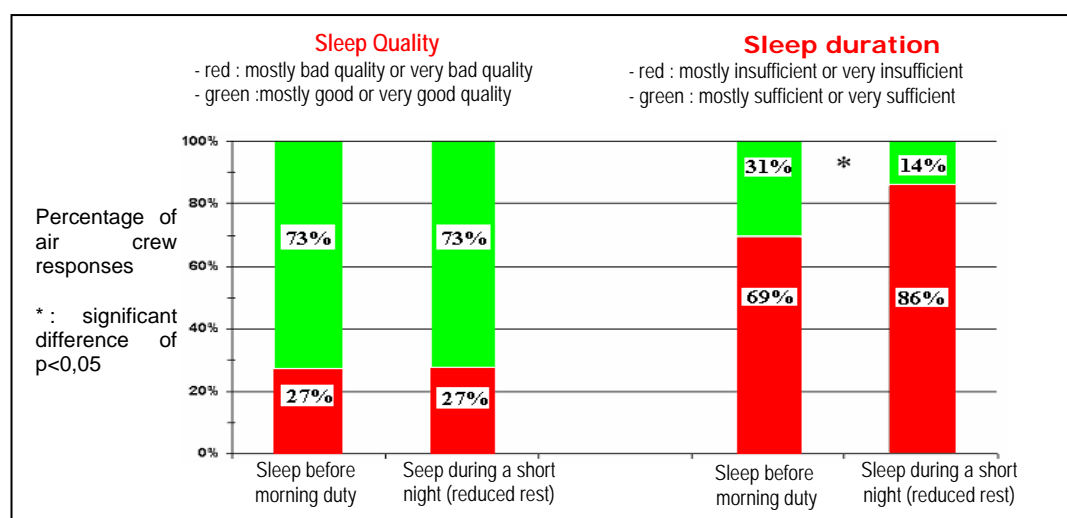


Figure 10. Sleep quality for morning duty.

5.2.2.2 Sleepiness, fatigue and manifestations of fatigue

Fatigue analysis in relation to the type of duty was conducted using the data in the diary. The fatigue level was estimated by air crew at the beginning and end of duty.

In overall terms, the results show that air crew categories do not experience the organisation of flights in the same way:

- In terms of stress, fatigue and sleepiness, FDC members did not necessarily think there was a great deal of difference between the following rosters: 3/3 (three sectors on the 1st day – reduced rest – three sectors on the 2nd day) and 5/3 (five sectors on the 1st day – reduced rest – three sectors on the 2nd day). They thought that flights after reduced rest were no more 'arduous' than the last day duty flights or consecutive mornings.
- Observations on CC members were significantly different. The 5/3 roster is experienced as disagreeable. Fatigue, sleepiness and levels of stress increase considerably as from the fourth flight of afternoon duty before reduced rest. These

levels remain high for the remainder of the sequence and go even higher than those observed during morning duty flights and consecutive morning duties.

5.2.2.3 Observations in flight

a) Method

To make the data collected as homogeneous as possible, an attempt was made to ensure that the schedules of the air crew under observation were very similar on the days preceding the observation. To do this, observation was focused on rosters including reduced rests and split duties. For practical reasons, direct observations could be made only on FDC members.

Manifestations of fatigue during work activities described in the scientific literature, whether aviation-related or not, are numerous. This information, combined with the results of interviews, allowed us to draw up a list of behaviours potentially sensitive to fatigue, as well as behaviours for detection and recuperation. On this basis and based on the precise unfolding of the duty, an observation chart was prepared in order to formalise the observations of crew activity. They comply with a very precise framework throughout the duty. The methodology is based on the 'Normal Operation Monitoring' criteria recommended by IATA and ICAO, bearing in mind that the approach adopted in the STARE project was one of scientific research.

Thus, based on the behavioural manifestations listed as potentially linked to fatigue and observable in the cockpit, the data provided scope for simultaneously reporting contextual information, the chronological unfolding of the flight (including crew actions) and observed manifestations related to changes in behaviour.

All observation charts were processed as follows. Noteworthy facts observed were collated for categorisation. Each noteworthy fact was classified in a category. This was followed by an indication of who was responsible (PF: pilot flying, PNF: pilot not flying, or crew), whether the situation had been detected and resolved, by whom and how.

Each fact observed was cross-referred (during the flight in which it occurred) with FDC fatigue self-assessments, and also with chronobiological fatigue criteria. It is therefore possible to process the data according to the level of personnel fatigue and sleepiness, and according to the sector number on short-night rosters. 874 facts were collated on 35 rosters.

b) Results

High levels of fatigue and sleepiness showed a tendency to translate into an increase in the number of facts observed (Figure 11), as well as a drop in individual self-detection. Note the differences between the PF and PNF: PFs generated fewer facts (Figure 12) and detected more facts, whereas the reverse applied to PNFs. The facts observed most often include forgetfulness (21.6% of all facts), poor or incomplete application of procedures (17.4%), execution failures, failure to perceive information and confused memorisation (each of the last three categories at slightly more than 10%).

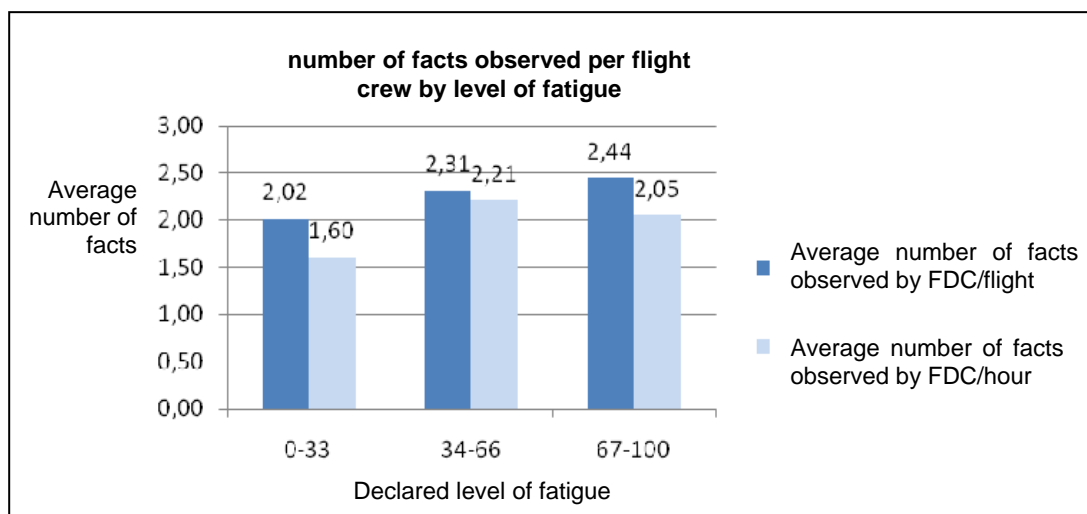


Figure 11. Facts observed per FDC according to fatigue level

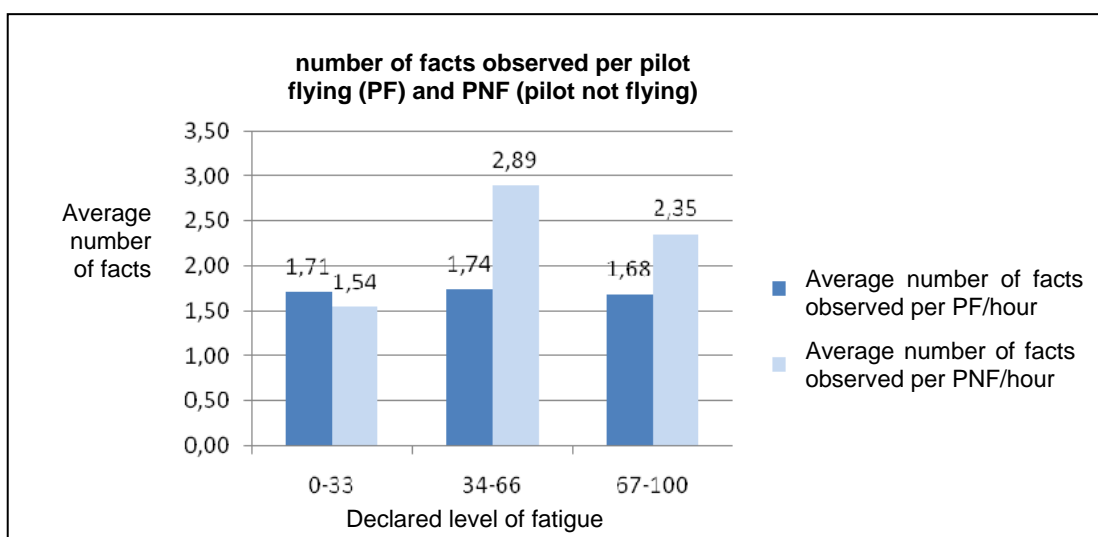


Figure 12. Facts observed per PFs and PNFs according to fatigue level

At crew level, the intermediate fatigue level is the level at which the most facts are observed. These results indicate the presence of crew-related regulatory mechanisms that are dependent on the fatigue level of each crew member and their function (PF or PNF).

Finally, if the way the number of facts observed changes as a function of fatigue level is compared for the flight crew (Figure 13) and the individuals, it can be seen that there is no summation of the number of facts observed in a crew whose members have high fatigue levels. This leads us to assume that regulatory mechanisms are implemented by crews for managing the activity when levels of fatigue are high.

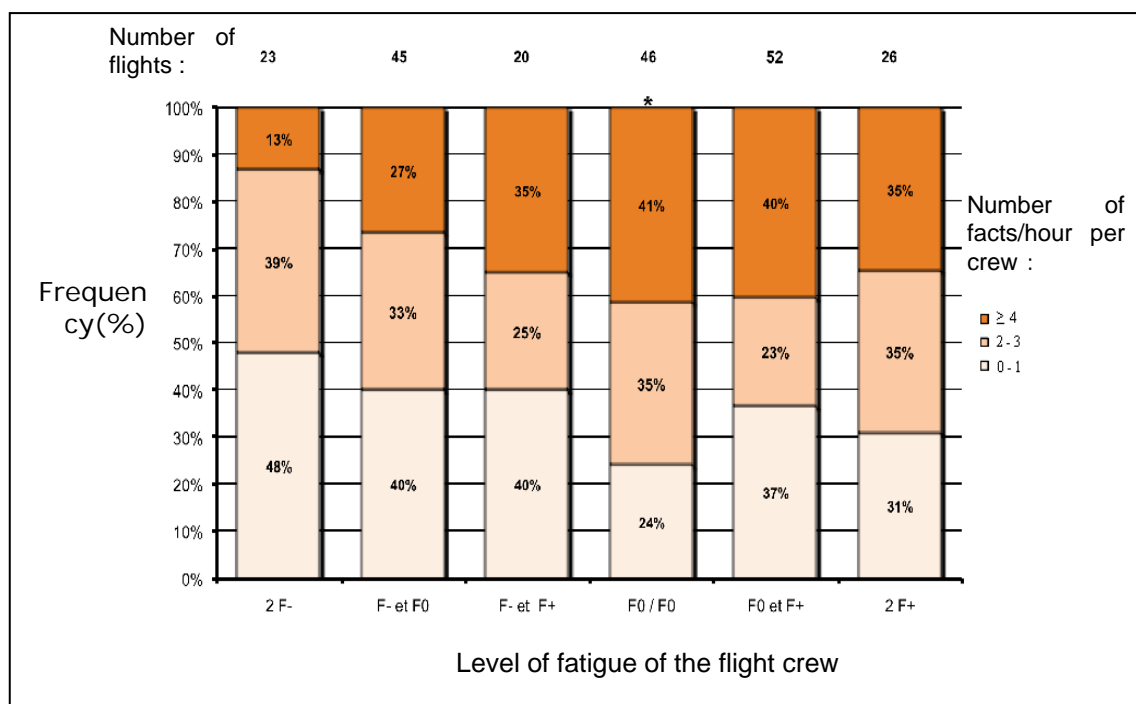


Figure 13. Changes in the number of facts per crew Analysis according to 'fatigue typologies' (see Figure 5)

The results of the observations show the usefulness of observing crews in flight to get a better understanding of behavioural changes and manifestations of fatigue. Observations should be based on certain limiting rules if they are to be valid (neutrality, strict observation protocol, IATA and ICAO international standards on 'Normal Operation Monitoring', etc.). Having said this, observation in flight cannot be used as a first-line approach within the framework of an FRMS.

5.2.2.4. Predictive approach to sleep times and levels of sleepiness

If a predictive model is to be used in Fatigue Risk Management Systems, it is important to test its capabilities, in particular with regard to its capacity to predict sleep and sleepiness levels in air crew according to different rosters. The Sleep Wake Predictor model has therefore been applied, on the one hand to the rests studied: the predicted sleep times were compared with those observed (paragraph a), and on the other hand to the assessment of sleepiness at the end of each sector in rosters with reduced rests: predicted sleepiness was compared with reported sleepiness (paragraph b).

a) Sleep times

Figure 14 is a point cloud establishing a comparison between the 'real' (reported) value for the sleep parameter and the value predicted by the model.

The point cloud highlights two sets of data, shown as a first cloud of points located around low values, corresponding to sleep times during reduced rests, and a second cloud located around clearly higher sleep times corresponding to sleep during day duties and rests.

For sleep times associated with a duty, there is a significant correlation at 0.695 (Rho Spearman = 0.7145 ; $p < 0.001$).

However, examination of the point cloud reveals considerable dispersion of values that is more marked for sleep time before a rest, with a tendency for the model to overestimate sleep times. This dispersion is due in particular to inter-individual variability.

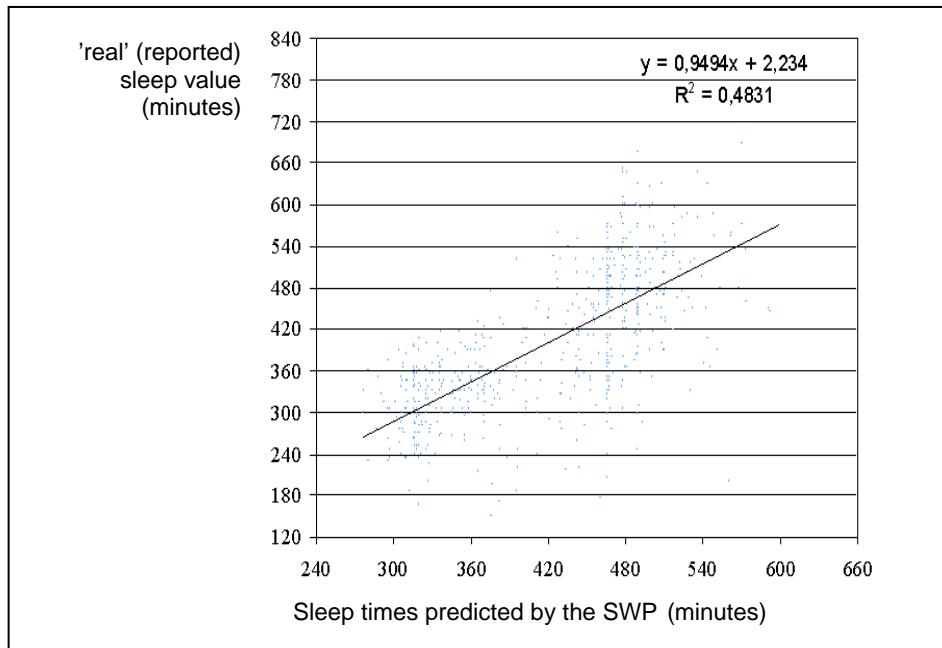


Figure 14. Correlation of sleep times predicted by the SWP model and real sleep times.

b) Sleepiness levels

The second important result relating to the data collected concerns assessments of sleepiness at the end of each sector for type 3/3 rosters including a reduced rest (Figure 15), type 5/3 rosters (Figure 16) and rosters including a split duty (Figure 17).

The results of assessments made in flight are compared with the values predicted by the SWP model. The values given correspond to subjective assessments by air crew on a scale from 0 to 9. Remember (see 5.1.1) that a sleepiness level of 7 or higher is considered critical insofar as it is associated with psychological signs of sleepiness and impairment of performance.

There is no apparent significant difference between the predicted and observed values for the 3/3 roster (Figure 15). In other words, the SWP model appropriately predicts the average level of sleepiness. However, note that the observed values are very highly dispersed around the average because of inter-individual variability and other sources of fatigue.

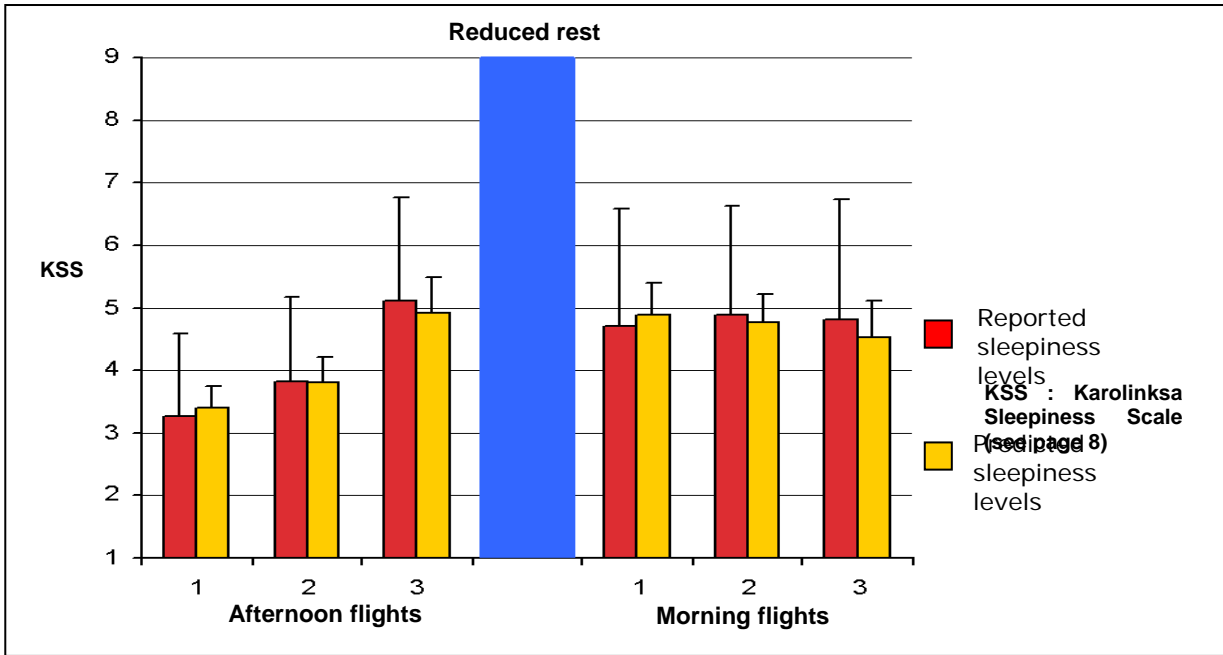


Figure 15. Comparison of reported and predicted sleepiness levels
3/3 roster – N = 57 air crew members

In regard to the 5/3 roster, significant differences can be seen during flights 1, 2 and 4 before the reduced rest (Figure 16). The model underestimates the sleepiness level at the beginning of the afternoon for flights 1 and 2. Considerable activity on the first afternoon flights could have limited the awareness of the drop in the alertness of air crew at the beginning of the afternoon.

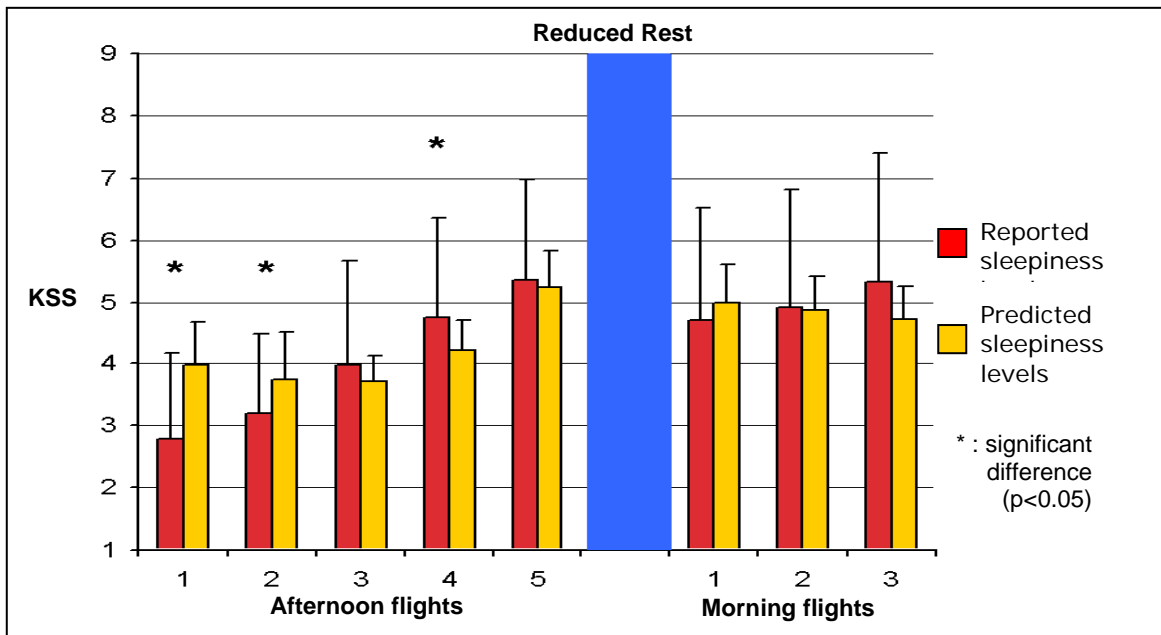


Figure 16. Comparison of reported and predicted sleepiness levels
5/3 roster – N = 45 air crew members

In contrast, during the fourth flight, the average sleepiness level reported by air crew members is significantly higher than the level predicted by the SWP model. The build-up of fatigue and weariness could be the reason for this difference. Such a difference is not observed after flight 5, at the end of duty, probably because of the motivation linked to the end of activities. Note that the assessments are made on flights prior to the reduced rest, and are not therefore affected by the reduced rest.

Finally, for the 5/3 rosters, note that the average sleepiness values for sectors after the reduced rest are mutually comparable and comparable with those of flight 5 on the first day. The same observation could be made for 3/3 rosters.

Figure 17 gives the same data for rosters including a reduced rest and split duty. Note that these results relate to a more limited number of data items (10 AC members). In the course of the day including split duty, sleepiness levels remain moderate at the end of the day, slightly lower than those obtained at the end of the first day on 3/3 and 5/3 rosters (see Figures 15 and 16). During the sector after the reduced rest, the sleepiness level is also below that observed for the 3/3 and 5/3 rosters.

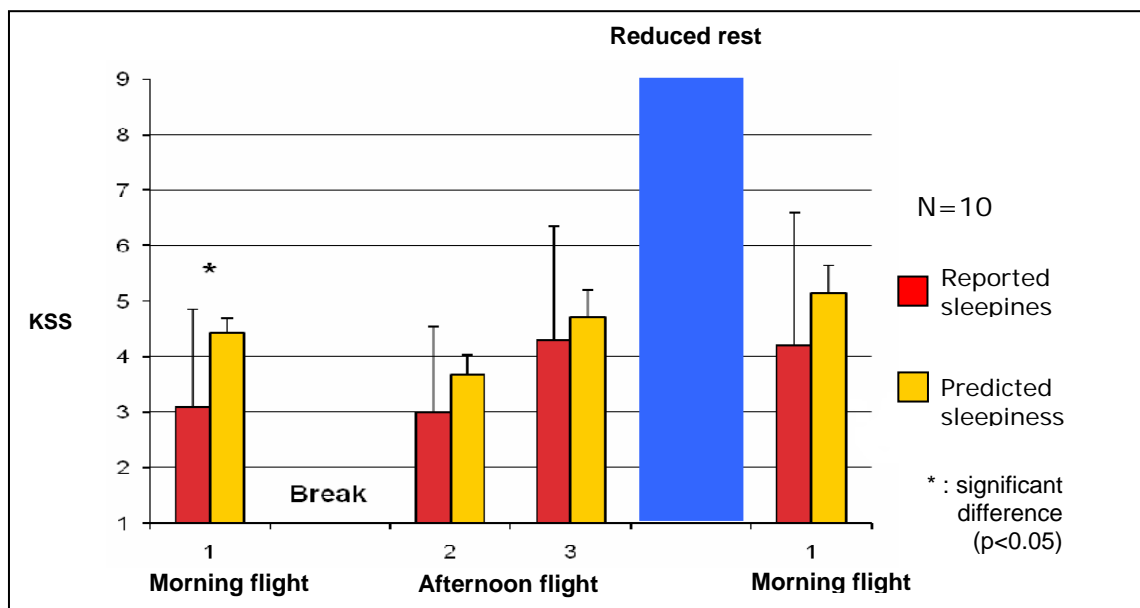


Figure 17. Comparison of reported and predicted sleepiness levels Rosters with split duty/reduced rest – N = 10 air crew members

6 — CONCLUSIONS

The objectives of this project were to validate a set of scientific methodologies suitable for use within the framework of an FRMS to meet the requirements of French airline companies operating with reduced rests and split duties.

At the end of this project, the methodology adopted was capable of specifying, confirming or invalidating some of the elements involved in assessing fatigue. The main conclusions to be drawn from the project are as follows:

- 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, 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 air crew members.
- 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, prior to reduced rest, indicating low recuperation during the rest.

On the other hand, it was not possible to establish any significant difference in sleep times between personnel living close to and far from their home base. Similarly, a systematic analysis of absenteeism did not reveal any correlation with crew fatigue levels.

Since the data used as fatigue risk level indicators were collected within the airline companies, it was possible to establish some correlations between fatigue risk levels and ASR events and FDM events. However, these data cannot be used directly for assessing fatigue risk. Significant results can be obtained only using appropriate statistical processing. The results indicate the following, in particular:

- for crews with a high assessed fatigue risk, there is a significantly lower number of FDM events of all severities and a higher number of high-severity FDM events than for crews with a low fatigue risk level. Even if these results are valid only for a specific fleet of aircraft and a specific company, they do show the advantage of this indicator for monitoring fatigue risk.
- There is no linear relationship between the duty length and the ASR rate, nor between the fatigue level of the flight crew and the number of facts (forgetfulness, execution failures, etc.) observed in flight. Thus, more ASRs are observed on intermediate flight durations and more facts are observed at intermediate fatigue levels. Thinking along similar lines, observations in flight showed that the number of facts observed in a flight crew is not equal to the sum of facts observed individually in crews whose members have high fatigue levels.

Finally, the models on average predict sleep and fatigue correctly, but some do not take account of inter-individual variability and other sources of fatigue associated with the job or social life in particular. These models can therefore be used as tools for FRMS systems, but in no circumstances can they constitute the only element. They can, however, play an important role if used in conjunction with other indicators, as established during the STARE project.

NOTICE OF PROPOSED AMENDMENT (NPA) No 2010-14C

**DRAFT OPINION OF THE EUROPEAN AVIATION SAFETY AGENCY
for a Commission Regulation establishing the implementing rules for air operations
of Community operators**

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 on Flight and Duty Time Limitations and rest requirements for
commercial air transport (CAT) with aeroplanes'***

C. Draft Opinion and Decision Part-OR (Subpart OPS)

NOTE: This NPA contains the draft Opinion on the Implementing Rules on Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes to be included as a Section VIII to Subpart OPS of Part-OR. It also contains a draft Decision with related acceptable means of compliance (AMC) and guidance material (GM). The NPA is split into four separate documents (2010-14A, 2010-14B, 2010-14c and 2010-14D) as indicated in the Table of Reference below. The documents are published in the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>.

TABLE OF REFERENCE FOR NPA 2010-14:

A.	EXPLANATORY NOTE:	SEE NPA 2010-14A
	I. GENERAL	SEE NPA 2010-14A
	II. CONSULTATION	SEE NPA 2010-14A
	III. COMMENT RESPONSE DOCUMENT	SEE NPA 2010-14A
	IV. CONTENT OF THE DRAFT OPINION AND DECISION	SEE NPA 2010-14A
	V. REGULATORY IMPACT ASSESSMENT	SEE NPA 2010-14A
	VI. EXPLANATORY MEMORANDUM ON PART-OR SUBPART OPS	SEE NPA 2010-14A
B.	REGULATORY IMPACT ASSESSMENT:	SEE NPA 2010-14B
C.	DRAFT OPINION AND DECISION:	
	I. DRAFT OPINION PART-OR (SUBPART OPS)	SEE NPA 2010-14c
	II. DRAFT DECISION AMC AND GM TO PART-OR (SUBPART OPS)	SEE NPA 2010-14c
D.	CROSS-REFERENCE TABLE:	SEE NPA 2010-14D

TABLE OF CONTENTS FOR NPA 2010-14c:

I. DRAFT OPINION PART – ORGANISATION REQUIREMENTS (PART-OR)	215
II. DRAFT DECISION AMC AND GM TO PART – ORGANISATION REQUIREMENTS (PART-OR)	231

I. DRAFT OPINION — PART ORGANISATION REQUIREMENTS (PART-OR)

Subpart OPS — Air Operations

Section VIII — Flight and duty time limitations and rest requirements

Chapter 1

General

OR.OPS.FTL.100 Scope

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

OR.OPS.FTL.105 Definitions

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

'Acclimatised': a crew member is considered to be acclimatised to the WOCL of the time zone where he/she is in when he/she has spent at least 36 consecutive hours free of duty or 72 hours conducting duties in an area within 3 hours of time. Until that time the crew member remains acclimatised to his/her previously acclimatised time zone.

'Accommodation' means, for the purpose of standby and split duty, a quiet and comfortable place not open to the public with the possibility to control light and temperature and with access to food and drink.

'Air Taxi Operations' means non-scheduled, on demand commercial operations with an aeroplane with a passenger seating configuration of 19 or less.

'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 their 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, shorter than a rest period, when the crew is free of all duties but still considered to be within duty period, being less than a rest period. A break counts as duty.

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

'Duty' means any task that a crew member is required to perform by the operator, including flight duty, administrative work, training, positioning, and 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 flight duty period starting in the period between 05:00 and 05:59 hours in the time to which the crew is acclimatised.

'Eastward-Westward and Westward-Eastward transition' means the transition at the place between a rotation encompassing 6-hour time differences or more and a rotation encompassing 4-hour time differences or more 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 a crew member.

'Flight time' means:

- for aeroplanes and touring motor gliders, the total time from the moment the aircraft first moves from its parking place for the purpose of taking off until the moment it finally comes to rest on the designated parking position at the end of the flight and all engines or propellers are stopped.

'Home base' means the location nominated 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 flight duty period finishing in the period between 01:00 and 01:59 hours in the time zone to which the crew 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 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 flight 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 request 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, seat, room, or other accommodation that provides a crew member with a sleep opportunity:

1. 'Class 1 rest facility' means a bunk or other surface that allows for a flat sleeping position and is located separately from both the flight deck and the passengers cabin in an area that is temperature controlled, 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 allows for a flat or near flat sleeping position, which is separated from passengers at least by 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 deck that reclines at least 40 degrees, 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 and defined period of time, subsequent to and/or prior to duty, during which a crew member is free of all duties.

'Split duty' means a duty period where the FDP is extended by one or more breaks on the ground within the FDP.

'Standby' means a 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 without an intervening rest period.

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

'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.

OR.OPS.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 such a way in order to enable 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 well-rested by the start of the following flight duty period;
- (g) plan local days free of duty 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 turn-around times;
- (i) change a schedule or crewing arrangements where the actual operation exceeds the maximum flight duty period on a significant proportion of flights in that schedule during a scheduled seasonal period.

OR.OPS.FTL.115 Fatigue Risk Management (FRM)

- (a) When the existence of FRM provisions are required by this Regulation, the operator shall establish, implement and maintain FRM provisions as an integral part of its management system. FRM shall ensure that the safety objectives of Annex IV of Regulation (EC) No 216/2008 are met.
- (b) FRM shall manage the operational risk(s) of the operator arising from crew member fatigue.
- (c) FRM shall correspond to the roster system or flight time specification scheme used by the operator in accordance with OR.OPS.FTL.200.
- (d) The FRM provisions shall contain the following components, where applicable 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 measures when the FRM safety assurance process shows that the required safety performance is not maintained.

Chapter 2

Commercial Air Transport Operators

OR.OPS.FTL.200 Flight time specification schemes

Operators shall establish, implement and maintain flight time specification schemes which are appropriate for the type(s) of operation, in accordance with the relevant requirements of Appendix X.

OR.OPS.FTL.205 Home Base

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

OR.OPS.FTL.210 Flight Duty Period (FDP)

- (a) The operator shall 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.
- (b) The operator shall 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.
- (c) Flight time specification schemes shall specify the following FDP elements, where applicable to the type of operation:
- (1) Maximum basic daily FDP;
 - (2) Reductions of the maximum basic daily FDP dependent on the number of sectors flown;
 - (3) Reductions of the maximum basic daily FDP when this FDP would start, end or encompass the WOCL;
 - (4) Conditions for extensions of the maximum basic daily FDP, taking into account:
 - (i) the number of sectors flown,
 - (ii) FDPs within the WOCL,
 - (iii) a maximum number of extensions for a consecutive number of days,
 - (iv) increased pre and post-flight minimum rest periods,
 - (v) break periods on ground during a single FDP,
 - (vi) the minimum of in-flight rest allocated to each crew member,
 - (vii) the type of in-flight rest facilities, and
 - (viii) the augmentation of the basic flight crew;
 - (5) Conditions under which the FDP, the flight times and duty periods may be exceeded or rest periods may be reduced by the commander after consultation with all crew members, in the case of unforeseen circumstances in flight operations after the reporting time, and the procedures used to report these modifications.

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

OR.OPS.FTL.215 Flight times and duty periods

Flight time specification schemes shall specify the following elements of flight times and duty periods:

- (a) The total duty periods to which a crew member is assigned:
- (1) in any 7 consecutive days; and
 - (2) in any 28 consecutive days;
- (b) The total flight time of the flights on which an individual crew member is assigned as an operating crew member:
- (1) in any 28 consecutive days; and
 - (2) in any calendar year; and
 - (3) in any 12 consecutive calendar months.

OR.OPS.FTL.220 Positioning

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

- (a) Positioning after reporting but prior to operating shall be included as part of the FDP but shall not count as a sector;
- (b) All of the time spent in positioning shall count as duty time.

OR.OPS.FTL.225 Split duty

- (a) Flight time specification schemes shall specify the following elements for split duty:
- (1) The minimum duration of a break on the ground;
 - (2) The relationship between the FDP extension and the duration of the break on the ground, taking into account facilities available for the crew member to rest and other relevant factors;
- (b) The break on the ground shall count as FDP;
- (c) Split duty shall not follow a reduced rest.

OR.OPS.FTL.230 Standby

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

- (a) Standby shall be rostered and the affected crew members shall be notified in advance;
- (b) The start and end time of standby shall be defined and the affected crew members shall be notified in advance;
- (c) Flight time specification schemes shall specify the following elements:
- (1) The maximum length of any standby;
 - (2) The relationship between standby and any assigned flight duty resulting from standby, taking into account facilities available for the crew member to rest and other relevant factors;
 - (3) The rest period following standby which does not lead to assignment on a flight duty;
 - (4) How standby times are counted for the purposes of cumulative duty hours.

OR.OPS.FTL.235 Rest periods

Flight time specification schemes shall specify the following rest elements:

- (a) Minimum rest periods in relation to the preceding duty period, which must be provided before undertaking an FDP starting either from home base or away from home base;
- (b) A sleep opportunity before undertaking an FDP starting away from home base, depending on the preceding duty period;
- (c) Additional rest periods to compensate for the effects of time zone differences and extensions of the FDP;
- (d) Recurrent extended recovery rest periods to compensate for cumulative fatigue.

OR.OPS.FTL.240 Nutrition

If the Flight Duty Period (FDP) exceeds 6 hours, the operator shall provide a meal and drink opportunity in order to avoid any detriment to the crew member's performance.

OR.OPS.FTL.245 Records of flight and duty times and rest periods

- (a) Operators shall maintain:
 - (1) Individual records of flight, duty and rest period for all crew members, for a period of 15 months, including:
 - (i) Flight times;
 - (ii) Start, duration and end of each duty or FDP;
 - (iii) Rest periods and days free of all duties;
 - (2) Reports by the commander on extended flight duty periods, extended flight hours and reduced rest periods, for a period of 6 months.
- (b) Upon request, the operator shall provide copies of individual records of flight and duty times and rest periods:
 - (1) to the crew member concerned;
 - (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.AH.100 in relation to crew members who perform functions for more than one operator shall be kept for a period of 15 months.

Chapter 3

Commercial Operators other than CAT

(Reserved)

Chapter 4

Non-Commercial Operators of Complex Motor-Powered Aircraft

(Reserved)

Appendix X**Flight Time Specification Schemes****Section 1****Commercial Air Transport by Aeroplane — Scheduled and Charter Operations****FTL.1.200 Applicability**

This section is applicable to commercial air transport operations by aeroplanes, other than Air Taxi, Emergency Medical Service (EMS) and single pilot operations.

FTL.1.205 Home base

- (a) The home base may be a multiple airport location when the distance between any of these airports does not exceed a driving distance of 50 km and the related travelling time does not exceed 60 minutes under normal conditions.
- (b) When the home base is a multiple airport location, and the 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 of the duty shall count as positioning.

FTL.1.210 Flight Duty Period (FDP)**1 — Maximum daily FDP**

- (a) Maximum daily FDP without the use of extensions.

The maximum basic daily FDP shall be 13 hours. This period:

- shall be reduced by 30 minutes for each sector from the third sector onwards; and
- shall be further reduced in accordance with the limits specified in the table below when the WOCL is encroached.

Table 36: Maximum daily FDP without extension

Start of FDP	1–2 Sectors	3 Sectors	4 Sectors	5 Sectors	6 Sectors or more
0600–1259	13:00	12:30	12:00	11:30	11:00
1300–1329	12:55	12:30	12:00	11:30	11:00
1330–1359	12:40	12:25	12:00	11:30	11:00
1400–1429	12:25	12:10	11:55	11:30	11:00
1430–1459	12:10	11:55	11:40	11:25	11:00
1500–1529	11:55	11:40	11:25	11:10	10:55
1530–1559	11:40	11:25	11:10	10:55	10:40
1600–1629	11:25	11:10	10:55	10:40	10:25
1630–1659	11:10	10:55	10:40	10:25	10:10
1700–1729	11:00	10:40	10:25	10:10	09:55
1730–1759	11:00	10:30	10:10	09:55	09:40
1800–1829	11:00	10:30	10:00	09:40	09:25
1830–1859	11:00	10:30	10:00	09:30	09:10
1900–0359	11:00	10:30	10:00	09:30	09:00
0400–0414	11:10	10:40	10:10	09:40	09:10
0415–0429	11:25	10:55	10:25	09:55	09:25
0430–0444	11:40	11:10	10:40	10:10	09:40
0445–0459	11:55	11:25	10:55	10:25	09:55
0500–0514	12:10	11:40	11:10	10:40	10:10
0515–0529	12:25	11:55	11:25	10:55	10:25
0530–0544	12:40	12:10	11:40	11:10	10:40
0545–0559	12:55	12:25	11:55	11:25	10:55

(b) Maximum daily FDP with the use of extensions.

The maximum daily FDP may be extended by up to 1 hour. The use of the extension shall be planned in advance, and it is limited to a maximum of:

- 5 sectors; or
- 4 sectors, when the WOCL is encroached; or
- 2 sectors, when the FDP encroaches the WOCL by more than 2 hours, with the limits specified in *Table 2* below.

Table 37: Maximum daily FDP with extension

Start of FDP	1–2 Sectors	3 Sectors	4 Sectors	5 Sectors	6 Sectors or more
0600–1259	14:00	13:30	13:00	12:30	Not Allowed
1300–1329	13:55	13:30	13:00	12:30	Not Allowed
1330–1359	13:40	13:25	13:00	Not Allowed	Not Allowed
1400–1429	13:25	13:10	12:55	Not Allowed	Not Allowed
1430–1459	13:10	12:55	12:40	Not Allowed	Not Allowed
1500–1529	12:55	12:30	12:25	Not Allowed	Not Allowed
1530–1559	12:40	12:00	12:00	Not Allowed	Not Allowed
1600–1629	12:25	Not Allowed	Not Allowed	Not Allowed	Not Allowed
1630–1659	12:10	Not Allowed	Not Allowed	Not Allowed	Not Allowed
1700–1729	12:00	Not Allowed	Not Allowed	Not Allowed	Not Allowed
1730–1759	12:00	Not Allowed	Not Allowed	Not Allowed	Not Allowed
1800–1829	12:00	Not Allowed	Not Allowed	Not Allowed	Not allowed
1830–1859	12:00	Not Allowed	Not Allowed	Not Allowed	Not Allowed
1900–0359	12:00	Not Allowed	Not Allowed	Not Allowed	Not Allowed
0400–0414	12:10	11:40	11:10	Not Allowed	Not Allowed
0415–0429	12:25	11:55	11:25	Not Allowed	Not Allowed
0430–0444	12:40	12:10	11:40	Not Allowed	Not Allowed
0445–0459	12:55	12:25	11:55	Not Allowed	Not Allowed
0500–0514	13:10	12:40	12:10	Not Allowed	Not Allowed
0514–0529	13:25	12:55	12:25	Not Allowed	Not Allowed
0530–0544	13:40	13:10	12:40	Not Allowed	Not Allowed
0545–0559	13:55	13:25	12:55	Not Allowed	Not Allowed

Extensions of the FDP starting in the period between 18:00 to 21:59 shall only be permitted in accordance with the operator's Fatigue Risk Management provisions.

Extensions may only be used up to two times in any 7 consecutive days.

If an extension is planned:

- the minimum pre-flight and post-flight rest periods shall be increased by 2 hours; or
- the post-flight rest shall be increased by 4 hours.

Where the extensions are used for consecutive FDPs the pre and post-rest between the two operations shall run consecutively.

(c) 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.

(d) Night duties

For each crew member performing three or more consecutive night duties between two recovery rest periods as defined in FTL.1.235(c), the second rest periods shall be extended to 48 hours of recovery.

For consecutive night duties, the number of sectors shall be limited to 4 per duty unless in accordance with the operator's Fatigue Risk Management provisions.

2 — Extension of FDP due to in-flight rest

- (a) The maximum FDP may be extended:
- (1) with one additional flight crew member:
 - (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;
 - (2) with two additional flight crew members:
 - (i) up to 16 hours with class 3 rest facilities;
 - (ii) up to 17 hours with class 2 rest facilities;
 - (iii) up to 18 hours with class 1 rest facilities;
- (b) The FDP shall be limited to 3 sectors. Where the FDP is 3 sectors, the limits in (a) above shall be reduced by 30 minutes.
- (c) The minimum in-flight rest period shall be a consecutive 90-minute period for each crew member and 2 consecutive hours for those crew members at control during landing.
- (d) The cruise phase of the flight above FL 200 shall be used to maximise the in-flight rest period of those crew members at control during landing.
- (e) The minimum in-flight rest for Cabin Crew shall be as specified in the table below:

FDP extension	Minimum in-flight rest		
	Class 1	Class 2	Class 3
0:00–1:00	1:30	1:30	1:30
1:00–2:00	1:45	1:50	1:55
2:00–3:00	2:00	2:10	2:20
3:00–4:00	2:30	2:50	3:10
4:00–5:00	3:00	3:30	4:00
5:00–6:00	3:30	4:10	4:50
6:00–7:00	4:00	4:50	Not allowed

- (f) All the time spent in the rest facility shall be counted as FDP.
- (g) The minimum rest at destination shall be at least as long as the preceding duty period, or 14 hours, whichever is the greater.
- (h) All flight crew members shall commence their FDP at the same reporting place if they are part of an augmented crew. No single crew member can start a positioning sector to then augment a crew on the same flight.

3 — Unforeseen circumstances in actual flight operations — commander's discretion

- (a) The conditions for the modification of the limits on flight duty, duty and rest periods by the commander in the case of unforeseen circumstances in flight operations, which starts at the reporting time, shall comply with the following:
 - (1) The maximum basic daily FDP which results after applying FTL.1.200 1(a) and (b) or FTL.1.225 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;
 - (2) If on the final sector within an FDP unforeseen circumstances occur after take-off, that will result in the permitted increase being exceeded, the flight may continue to the planned destination or alternate;
 - (3) The rest period following the FDP may be reduced but never below 10 hours or 7 hours and 30 minutes when operating under the reduced rest provisions of FTL.1.235(3), as applicable.
- (b) The commander may, in case of unforeseen circumstances which could lead to severe fatigue, reduce the actual flight duty time and/or increase the rest period in order to eliminate any detrimental effect on flight safety.
- (c) The commander shall consult all crew members on their alertness levels before deciding these modifications.

4 — Unforeseen circumstances in actual flight operations — short-term re-planning

- (a) The operator may only adjust crew schedules shortly before or after reporting time in the event of unforeseen circumstances:
 - (1) if introducing split duty, the operator shall notify the crew before the start of the break on the ground;
 - (2) if introducing a reduced rest, the operator shall notify the crew before the start of the rest.
- (b) The operator shall report to the Competent Authority the use of short-term re-planning under (a)(1) or (2).

FTL.1.215 Flight times and duty periods

- (a) The total duty periods to which a crew member is assigned shall not exceed:
 - (1) 60 duty hours in any 7 consecutive days; and
 - (2) 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 flight hours in any 28 consecutive days; and
 - (2) 900 flight hours in any calendar year; and
 - (3) 1 000 flight hours in any 12 consecutive calendar months.
- (c) The effectiveness of paragraph (a)(2) provisions shall be demonstrated by the operator.
- (d) Post-flight duty shall count as duty. The operator shall specify in its OPS Manual the minimum time period for post-flight duties.

FTL.1.225 Split duty

- (a) A break on the ground within the FDP shall have a minimum duration of 3 consecutive hours. The break shall exclude the time for post-flight duties and pre-flight duties, which shall be counted for a minimum of 30 minutes;

- (b) The maximum FDP referred to in FTL.1.210(1)(a) and (b) may be increased by up to 50% of the break;
- (c) Suitable accommodation shall be provided for breaks of 6 hours or more, and for breaks of 3 hours or more that encroach the WOCL. In all other cases, accommodation shall be provided;
- (d) Split duty may only be used before reduced rest if:
 - (1) the break on the ground is longer than 4 hours; and
 - (2) the number of sectors immediately before and immediately after the reduced rest shall be limited to 4 and 1 respectively.
- (e) Split duty shall not be used immediately after reduced rest.

FTL.1.230 Standby

1 — Airport Standby

- (a) A crew member shall be considered on standby from reporting at the reporting point until the end of the notified standby period.
- (b) Standby shall count in full as duty time.
- (c) If standby is immediately followed by an FDP, the following shall apply:
 - (1) if no accommodation is provided to the crew, the FDP shall count in full from the start of the standby;
 - (2) if accommodation is provided to the crew the FDP shall count from the start of the FDP. If the time spent on standby is 6 hours or more the maximum FDP shall be reduced by the amount of standby time exceeding 6 hours.
 - (3) The maximum FDP shall count from the standby reporting time.

2 — Other Standby

- (a) Standby other than airport standby shall be at home or in a suitable accommodation.
- (b) The maximum time for standby shall be 12 hours.
- (c) Standby times shall count as 25% of duty time for the purpose of FTL.1.215(a).
- (d) If a call to report for a duty occurs after the first 4 hours of the standby period, and the reporting time of the flight duty is within 8 hours after this call, the maximum FDP according to FTL.1.210 shall be reduced according to the table below.

Reporting time		Reduction on Max FDP
00:01	03:59	01:00
04:00	04:59	00:45
05:00	05:59	00:30
06:00	06:59	00:15
07:00	13:59	00:00
14:00	14:59	00:15
15:00	15:59	00:30
16:00	16:59	00:45
17:00	24:00	01:00

- (e) The maximum number of standby hours shall not exceed 72 hours in any 7 consecutive days.

FTL.1.235 Minimum Rest Period

1 — Basic Minimum Rest

- (a) Minimum rest period at home base

The minimum rest period provided before undertaking an FDP starting at home base shall be at least as long as the preceding duty period, or 12 hours, whichever is the greater.

- (b) Minimum rest period away from home base

The minimum rest period provided before undertaking a flight duty period starting away from home base shall be at least as long as the preceding duty period, or 10 hours, whichever is the greater. The minimum rest period away from home base shall include an 8-hour sleep opportunity taking account of travelling and physiological needs. Notwithstanding paragraph (a), the provisions of this subparagraph may also apply to home base if the operator provides a suitable accommodation to the crew.

- (c) Recurrent extended recovery rest periods

The minimum recurrent extended recovery rest period to compensate for cumulative fatigue is 36 hours including two 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.

- (d) Disruptive schedules

A transition from a late/night arrival to an early start shall include one local night of rest at home base.

2 — Time zone differences

- (a) Time zone differences shall be compensated by additional rest, as follows:

- (1) At home base, if one sector encompasses 4 time zones or more, the minimum rest shall be 36 hours including 2 local nights.
- (2) Away from home base, if one sector encompasses 4 time zones or more, the minimum rest shall be at least as long as the preceding duty period, or 14 hours, whichever is the greater. Notwithstanding paragraph (a)(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, an additional local night at home base to that established under subparagraph (a) shall be provided between alternating rotations. Alternative mitigating measures may be implemented if the operator has demonstrated an equivalent level of protection to the Competent Authority and implemented Fatigue Risk Management provisions.

- (b) Combinations of rotations in terms of their effect on crew fatigue shall be monitored by the operator.

3 — Reduced Rest

- (a) The minimum rest period under reduced rest arrangements shall be 7h30 or $7h30 + 2 \times (t-0h15)$, where 't' is the travelling time between the airport and the suitable accommodation, whichever is the greater, and shall include 2 hours in the WOCL.
- (b) The operator shall only use reduced rest in accordance with Fatigue Risk Management provisions.

- (c) The subsequent rest period shall include one local night and be extended by the time difference between the basic minimum rest of paragraph 1 and the reduced rest.
- (d) The subsequent FDP shall be reduced by the time difference between the basic minimum rest of paragraph 1 and the reduced rest.
- (e) There shall be a maximum of two reduced rests between two recurrent extended recovery rest periods as defined under paragraph 1(c).
- (f) The FDP shall include a maximum of 5 sectors before the reduced rest and a maximum of 3 sectors afterwards.
- (g) The maximum flight time for any sector under reduced rest provisions shall be 3 hours;
- (h) Time Zone Crossing shall be limited to 2 time zones from home base;
- (i) Reduced rest shall be used neither before nor after:
 - (1) the use of FTL.1.210 1-(b) 1 hour extension;
 - (2) the use of FTL.1.210 2 extension of flight duty period due to in-flight rest.

FTL.1.240 Nutrition

An operator shall specify in its Operations Manual how the crew member's nutrition during FDP is ensured.

FTL.1.250 Fatigue management training

- (a) Fatigue management training shall be provided to crew members, crew rostering personnel and concerned management personnel.
- (b) The training syllabus shall address the possible causes and effects of fatigue, and fatigue countermeasures.

Section 2

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

Section 3

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

Section 4

**Commercial Air Transport by Aeroplane — Air Taxi Operations
[Reserved]**

Section 5

**Commercial Air Transport by Aeroplane — EMS Operations
[Reserved]**

Section 6

**Commercial Air Transport by Aeroplane — Single Pilot Operations
[Reserved]**

Section 7

**Commercial Air Transport by Helicopter
[Reserved]**

II. DRAFT DECISION AMC AND GM TO PART ORGANISATION REQUIREMENTS (PART-OR)

Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Part-OR

Section VIII — Flight and duty time limitations and rest requirements

AMC1-OR.OPS.FTL.110(a) Operator responsibilities

Rosters should be published 14 days in advance.

AMC1-OR.OPS.FTL.110(i) Operator responsibilities

The operator should take action to change a schedule or crewing arrangements where the actual operation exceeds the maximum flight duty period, during a scheduled seasonal period, by more than 33% for commercial air transport operations (aeroplanes).

AMC1-OR.OPS.FTL.115(d)(1) Fatigue Risk Management (FRM)

COMMERCIAL AIR TRANSPORT OPERATORS FRM POLICY

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

- (1) The FRM policy should define the scope of FRM in terms of the operations to which it applies.
- (2) The FRM policy should:
 - (a) reflect the shared responsibility of management, flight, technical and cabin crew, and other involved personnel;
 - (b) clearly state the safety objectives of FRM;
 - (c) 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.

AMC1-OR.OPS.FTL.115(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:

- (1) FRM policy and objectives;
- (2) FRM processes and procedures;

- (3) accountabilities, responsibilities and authorities for these processes and procedures;
- (4) mechanisms for ongoing involvement of management, flight, technical and cabin crew members, and all other involved personnel;
- (5) FRM training programmes, training requirements and attendance records;
- (6) scheduled and actual flight times, duty periods and rest periods with deviations and reasons for deviations; and
- (7) FRM outputs including findings from collected data, recommendations, and actions taken.

AMC1-OR.OPS.FTL.115(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) crew fatigue surveys;
- (b) relevant flight, technical and cabin crew performance data;
- (c) available safety databases and scientific studies; and
- (d) 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-OR.OPS.FTL.115(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-OR.OPS.FTL.115(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-OR.OPS.FTL.115(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-OR.OPS.FTL.115(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-OR.OPS.FTL.210 Flight Duty Period

Scheduling factors have an important impact on a crew member's ability to sleep and to maintain a proper level of alertness. It is also the responsibility of the crew to use rest and off-duty time efficiently. When developing a workable roster, the operator has to 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.

As a good principle planned schedules should allow for flights to be completed within the maximum permitted flight duty period and flight rosters should take into account the time allowed for pre-flight duties, taxiing, the flight and turnaround times. Other factors to be considered when planning duty periods include:

1. the allocation of work patterns which avoid such undesirable practices as alternating day/night duties, the positioning of crew so that a serious disruption of established sleep/work patterns occurs, or scheduling sufficient rest periods especially after long flights crossing many time zones;
2. preparation of duty rosters sufficiently in advance with planning of days off and notification of the crew well in advance to plan adequate pre-duty rest.

GM1-FTL.1.210(1)(a) Flight Duty Period (FDP)**MAXIMUM DAILY FLIGHT DUTY PERIOD (FDP) WITHOUT THE USE OF EXTENSION**

The WOCL reduction in the FDP table is calculated as follows:

1. When the FDP starts in the WOCL, the maximum FDP is reduced by 100% of its encroachment up to a maximum of 2 hours.
2. When the FDP ends in or fully encompasses the WOCL, the maximum FDP is reduced by 50% of its encroachment.

GM1-FTL.1.210(3) Flight Duty Period (FDP)**UNFORESEEN CIRCUMSTANCES IN ACTUAL FLIGHT OPERATIONS — COMMANDER'S DISCRETION**

As general guidance when developing a commander's discretion policy, the operator should take into consideration the shared responsibility of management, flight, technical and cabin crew in the case of unforeseen circumstances. The exercise of commander's discretion should be considered exceptional and 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.

The operator's policy on commander's discretion should state the safety objectives, especially in the case of an extended Flight Duty Period (FDP) or reduced rest and should take due consideration of additional factors that might decrease crew'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,
8. Individual conditions of affected crew members (time since awake, sleep-related factor, workload, etc.),
9. Possible limitations to use commander's discretion at home base and/or company hubs where standby crew members might be available.

GM1-OR.OPS.FTL.215 Flight times and duty periods

An operator should ensure that flight and duty time limitations and rest requirements are established, implemented and maintained without prejudice to the standards set in 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.

GM1-OR.OPS.FTL.215(a)(2) Flight times and duty periods

In order to spread the time periods specified in OR.OPS.FTL.215(a)(2) as evenly as practicable, operators may include additional limitations, such as duty hours in any 14 consecutive days, if considered useful for fatigue mitigation.

GM1-OR.OPS.FTL.235 Minimum Rest periods

Responsibility for preventing the onset of fatigue cannot rest on the operator alone. It is a shared responsibility of the operator and the crew that crew are reporting for duty well-rested. 'Well-rested' means physiologically and mentally prepared and capable of performing assigned in-flight duties with the highest degree of safety.

1. In order to ensure that crew are well-rested, the operator should:
 - a. Monitor whether crew members are reporting for FDPs well-rested.
 - b. Prepare duty rosters sufficiently in advance to provide the opportunity for the crew to plan adequate pre-duty rest.
 - c. Establish minimum periods of notification of duty for crew members, or where this is not practicable due to the nature of the operation, the operator should establish in advance minimum periods of notification of days off.
 - d. When employing a crew member on an irregular basis, the operator should ensure that the crew member satisfies the provisions of the company's approved FTL scheme.
 - e. When employing a crew member who undertakes other employment, if allowed by the operator, the operator should ensure that the crew member still has the opportunity for sufficient rest periods in accordance with the applicable rules.
 - f. Implement a non-punitive process in the Operations Manual for crew members that have been too fatigued to complete a planned FDP.

2. Likewise, it is the responsibility of each crew member to:
 - a. Arrive at work well rested to every extent possible.
 - b. Make optimum use of the opportunities and facilities for rest provided, and plan and use their rest periods properly.
 - c. Before considering additional employment crew members should recognise that the responsibility for being sufficiently rested before undertaking an FDP remains with the individual.
 - d. Assess their own physical or mental condition before starting duty and to advise whether this condition renders them temporarily unfit for flying.
 - e. Be aware of commuter-induced fatigue and other lifestyle choices, e.g. extended periods awake, sleep debts, unrecovered circadian disruption, increased physical workload conditions and inadequate nutrition that can have a negative impact on the individual's alertness levels during duty.
 - f. Inform their manager or supervisor immediately prior to or during work if they know or suspect they or another crew member are suffering from unacceptable levels of fatigue.

AMC1-FTL.1.235(2)(b) Minimum Rest periods

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

AMC1-FTL.1.240 Nutrition

The Operations Manual should address the minimum duration of the meal opportunity, when a meal opportunity and a meal will be provided, in particular when the crew member's FDP covers the regular meal windows (i.e. if the FDP starts at 11:00 hours and ends at 22:00 hours two meals shall be provided and two opportunities to eat shall be given).

It should define the time frame in which a regular meal shall be consumed in order not to alter the human requirements for feeding without affecting the personal body rhythms (for example window 06:00–10:00 hours for breakfast, 12:00–14:00 hours for lunch and 19:00–21:00 hours for dinner). These time frames should be accounted in the FDP as the minimum number of meal opportunities offered to the crew member.

AMC1-FTL.1.250 Fatigue management training

The training syllabus should contain the following:

2. Applicable regulatory requirements for flight, duty and rest;
3. The basics of fatigue including sleep fundamentals and the effects of disturbing the circadian rhythms;
4. The causes of fatigue, including medical conditions that may lead to fatigue;
5. The effect of fatigue on performance;
6. Fatigue countermeasures;
7. The influence of lifestyle, including nutrition, exercise, and family life, on fatigue;
8. Familiarity with sleep disorders and their possible treatments;
9. Where applicable the effects of long range operations and heavy short range schedules on individuals;
10. The effect of operating through and within multiple time zones;
11. The crew member responsibility for ensuring adequate rest and fitness for duty.

NOTICE OF PROPOSED AMENDMENT (NPA) No 2010-14D

**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 on Flight and Duty Time Limitations and rest requirements for
commercial air transport (CAT) with aeroplanes'*

D. Cross-reference Tables

NOTE: This NPA contains the draft Opinion on the Implementing Rules on Flight and Duty Time Limitations and rest requirements for commercial air transport (CAT) with aeroplanes to be included as a Section VIII to Subpart OPS of Part-OR. It also contains a draft Decision with related acceptable means of compliance (AMC) and guidance material (GM). The NPA is split into four separate documents (2010-14A, 2010-14B, 2010-14c and 2010-14D) as indicated in the Table of Reference below. The documents are published in the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>.

TABLE OF REFERENCE FOR NPA 2010-14:

A.	EXPLANATORY NOTE:	SEE NPA 2010-14A
	I. GENERAL	SEE NPA 2010-14A
	II. CONSULTATION	SEE NPA 2010-14A
	III. COMMENT RESPONSE DOCUMENT	SEE NPA 2010-14A
	IV. CONTENT OF THE DRAFT OPINION AND DECISION	SEE NPA 2010-14A
	V. REGULATORY IMPACT ASSESSMENT	SEE NPA 2010-14A
	VI. EXPLANATORY MEMORANDUM ON PART-OR SUBPART OPS	SEE NPA 2010-14A
B.	REGULATORY IMPACT ASSESSMENT:	SEE NPA 2010-14B
C.	DRAFT OPINION AND DECISION:	
	I. DRAFT OPINION PART-OR (SUBPART OPS)	SEE NPA 2010-14c
	II. DRAFT DECISION AMC AND GM TO PART-OR (SUBPART OPS)	SEE NPA 2010-14c
D.	CROSS-REFERENCE TABLE:	SEE NPA 2010-14D

TABLE OF CONTENTS FOR NPA 2010-14D:

EU-OPS reference — EASA reference	240
EASA reference — EU-OPS reference.....	242

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 EASA rules.

EU-OPS reference	Subject	EASA reference	Subject
EU-OPS 1.1090(1)	Objective and scope	OR.OPS.FTL.100 FTL.1.200	Scope
EU-OPS 1.1090(2)	Objective and scope	OR.OPS.FTL.110	Operator responsibilities
EU-OPS 1.1090(3)	Objective and scope	OR.OPS.FTL.205 OR.OPS.FTL.110	Operator responsibilities/Home Base
EU-OPS 1.1090(4)	Crew Members' responsibility	AMC1-OR.OPS.FTL.115(d)(1) GM1-OR.OPS.FTL.210 GM1 –OR.OPS.FTL.1.210(3) GM1-OR.OPS.FTL.235 GM1-OR.OPS.FTL.235	Crew Members' responsibility
N/A	N/A	OR.OPS.FTL.115 AMC1-OR.OPS.FTL.115(d)(1) AMC1-OR.OPS.FTL.115(d)(2)(i) AMC1-OR.OPS.FTL.115(d)(2)(ii) AMC1-OR.OPS.FTL.115(d)(2)(iii) AMC1-OR.OPS.FTL.115(d)(3) AMC1-OR.OPS.FTL.115(d)(4)	Fatigue Risk Management (FRM)
EU-OPS 1.1090(5)	Objective and scope	N/A	N/A
EU-OPS 1.1095	Definitions	OR.OPS.FTL.105	Definitions
EU-OPS 1.1100(1.1)	Flight and duty limitations	OR.OPS.FTL.215(a) FTL.1.215(a)	Flight times and duty periods
EU-OPS 1.1100(1.2)	Flight and duty limitations	OR.OPS.FTL.215(b) FTL.1.215(b)	Flight times and duty periods
EU-OPS 1.1105	Maximum daily flight duty period (FDP)	FTL.1.210(1)	Flight duty period (FDP)

EU-OPS reference	Subject	EASA reference	Subject
EU-OPS 1.1110	Rest	OR.OPS.FTL.235 FTL.1.235	Minimum Rest periods
EU-OPS 1.1115	Extension of flight duty period due to in-flight rest	FTL.1.210(2)	Flight duty period (FDP)
EU-OPS 1.1120	Unforeseen circumstances in actual flight operations — commander's discretion	FTL.1.210(3)	Flight duty period (FDP)
EU-OPS 1.1125(1)	Standby	OR.OPS.FTL.230 FTL.1.230(1)	Airport standby
EU-OPS 1.1125(2)	Standby	OR.OPS.FTL.230 FTL.1.230(2)	Other standby
EU-OPS 1.1130	Nutrition	OR.OPS.FTL.240 FTL.1.240 AMC1-FTL.1.240	Nutrition
EU-OPS 1.1135(1) & (2)	Flight duty, duty and rest period records	OR.OPS.FTL.245(a) OR.OPS.FTL.245(b)	Records of flight and duty times and rest periods
EU-OPS 1.1135(3)	Flight duty, duty and rest period records	OR.OPS.FTL.245(a)(2),(3)	Records of flight and duty times and rest periods
EU-OPS 1.1135(4)	Flight duty, duty and rest period records	OR.OPS.FTL.245(a)(1)	Records of flight and duty times and rest periods
EU-OPS 1.1135(5)	Flight duty, duty and rest period records	OR.OPS.FTL.245(a)(3)	Records of flight and duty times and rest periods

EASA reference — EU-OPS reference

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

EASA reference	Subject	EU-OPS reference	Subject
OR.OPS.FTL.100	Scope	EU-OPS 1.1090(1)	Objective and scope
OR.OPS.FTL.105	Definitions	EU-OPS 1.1095	Definitions
OR.OPS.FTL.110 AMC1-OR.OPS.FTL.110(a) AMC1-OR.OPS.FTL.110(i)	Operator responsibilities	EU-OPS 1.1090(2)	Objective and scope
OR.OPS.FTL.115 AMC1-OR.OPS.FTL.115(d)(1) AMC1-OR.OPS.FTL.115(d)(2)(i) AMC1-OR.OPS.FTL.115(d)(2)(ii) AMC1-OR.OPS.FTL.115(d)(2)(iii) AMC1-OR.OPS.FTL.115(d)(3) AMC1-OR.OPS.FTL.115(d)(4)	Fatigue Risk Management	N/A	N/A
OR.OPS.FTL.200 FTL.1.200	Flight Time Specification Schemes	EU-OPS 1.1090(1)	Objective and scope
OR.OPS.FTL.205 FTL.1.205	Home Base	EU-OPS 1.1090(3)	Objective and scope
OR.OPS.FTL.210 FTL.1.210 -1 GM1-OR.OPS.FTL.210 GM1-FTL.1.210(1)(a)	FDP — Maximum daily FDP	EU-OPS.1.1105(1.3)–(1.5) EU-OPS.1.1105(2)	Maximum daily flight duty period
OR.OPS.FTL.210 FTL.1.210 -2	FDP — Extension of FDP due to in-flight rest	EU-OPS 1.115	Extension of flight duty period due to in-flight rest

EASA reference	Subject	EU-OPS reference	Subject
OR.OPS.FTL.210 FTL.1.210 -3 GM1-FTL.1.210(3)	FDP — Unforeseen circumstances in actual flight operations — commander's discretion	EU-OPS 1.1120	Unforeseen circumstances in actual flight operations — commander's discretion
OR.OPS.FTL.210 FTL.1.210 -4	FDP — Unforeseen circumstances in actual flight operations — short-term re-planning	N/A	N/A
OR.OPS.FTL.215(a) FTL.1.215(a) GM1-OR.OPS.FTL.215	Flight times and duty periods	EU-OPS 1.1100(1.1)	Flight and duty limitations
OR.OPS.FTL.215(b) FTL.1.215(b)	Flight times and duty periods	EU-OPS 1.1100(1.2)	Flight and duty limitations
OR.OPS.FTL.220	Positioning	EU-OPS.1.1105(5)	Maximum daily flight duty period
OR.OPS.FTL.225 FTL.1.225	Split Duty	EU-OPS.1.1105(5)	Maximum daily flight duty period
OR.OPS.FTL.230 FTL.1.230(1)	Airport standby	EU-OPS 1.1125(1)	Standby
OR.OPS.FTL.230 FTL.1.230(2)	Other standby	EU-OPS 1.1125(2)	Standby
OR.OPS.FTL.235 FTL.1.235 -1	Minimum rest periods — Basic Minimum Rest	EU-OPS 1.1110(1.1), (1.2) EU-OPS 1.1110(2)	Rest
OR.OPS.FTL.235 FTL.1.235 -2 AMC1-FTL.1.235(2)(b)	Minimum rest — Time zone differences	EU-OPS 1.1110(1.3)	Rest
OR.OPS.FTL.235 FTL.1.235 -3 GM1-OR.OPS.FTL.235	Minimum rest periods — Reduced rest	EU-OPS 1.1110(1.4.1), (1.4.2)	Rest

EASA reference	Subject	EU-OPS reference	Subject
OR.OPS.FTL.240 FTL.1.240 AMC1-FTL.1.240	Nutrition	EU-OPS 1.1130	Nutrition
OR.OPS.FTL.245(a) OR.OPS.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
OR.OPS.FTL.245(a)(1)	Records of flight and duty times and rest periods	EU-OPS 1.1135(4)	Flight duty, duty and rest period records
OR.OPS.FTL.245(a)(3)	Records of flight and duty times and rest periods	EU-OPS 1.1135(5)	Flight duty, duty and rest period records
OR.OPS.FTL.245(a)(2),(3)	Records of flight and duty times and rest periods	EU-OPS 1.1135(3)	Flight duty, duty and rest period records
FTL.1.250 AMC1-FTL.1.250	Fatigue management training	N/A	N/A