Senate Inquiry Supplementary Submission on the ATSB Findings of the Ditching of the Westwind II VH-NGA off Norfolk Island on 18 November 2009

This sixth submission is made under Parliamentary Privilege 18 March 2013

by Bryan Aherne in a private capacity

1. Introduction.

I thank the committee for allowing me to add this sixth supplementary submission. It is self explanatory throughout.

In this submission, my commentary to answers provided by the ATSB is in red font.

Answers Provided by the ATSB to

Written Questions on Notice – Friday, 15 February 2013
CANBERRA, ACT

1	-	ATSB	Senator Xenophon	25/02/13
2	-	ATSB	Senator Xenophon	25/02/13
3	-	ATSB	Senator Xenophon	25/02/13
4	-	ATSB	Senator Xenophon	25/02/13
5	-	ATSB	Senator Xenophon	25/02/13
6	-	ATSB	Senator Xenophon	25/02/13
7	-	ATSB	Senator Xenophon	25/02/13
8	-	ATSB	Senator Xenophon	25/02/13
9	-	ATSB	Senator Xenophon	25/02/13
10	-	ATSB	Senator Xenophon	25/02/13

11	-	ATSB	Senator Xenophon	25/02/13
12	-	ATSB	Senator Xenophon	25/02/13
13	-	ATSB	Senator Xenophon	25/02/13
14	-	ATSB	Senator Xenophon	25/02/13
15	-	ATSB	Senator Xenophon	25/02/13
16	-	ATSB	Senator Xenophon	25/02/13

SENATE RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

Inquiry into aviation accident investigations

Written Questions Taken on Notice – Australian Transport Safety Bureau from Public Hearing – Friday, 15 February 2013

Written Questions on Notice- Senator Xenophon

Questions in relation to previously in-camera documents

1. An email on 9 Feb 2010 appears to show that you were looking for a way to assist CASA with their early intervention with Mr James. Can you explain that please?

2. Is this level of consultation around reports standard practice? Are reports routinely compared in this way? What if a major difference is found?

3. Were you aware of any internal CASA concerns regarding their oversight of The operators prior to your report being published?

4. Did the ATSB think to obtain some independent analysis of fatigue levels from another investigation bureau/aviation authority? Were you aware that CASA asked the UK Civil Aviation Authority to analyse the fatigue levels of the crew?

5. What is a 'normal' number of reviews for a draft report?

Questions around public information

6. What has the aviation industry learnt from this report?

7. The ATSB says it focuses on obtaining its own evidence. You obtained the various The operators manuals but found no safety issues in respect of CASA's oversight. Given what we know from the CASA Special Audit, does that show a lack of expertise or do you just trust that if CASA has approved a manual, it must be right?

8. How has the ATSB satisfied itself that the deficiencies listed in the CASA Special Audit have been addressed? Do you just trust they have been based on the list of actions provided? As we now know CASA had a history of accepting actions had occurred which had not, do you check whether CASA has checked the actions have been completed?

9. You connected the dots between the ATSB report and the CASA Special Audit after you received the latter. Given that your review of the Special Audit did not lead you to make

significant changes to your report prior to publishing, is the committee to understand that, in your view, nothing of any great import to your investigation came out of CASA's audit?

10. In relation to collecting your own evidence, the ATSB mentioned in answers to question on notice that you obtained a copy of the operators fatigue risk management system (FRMS) 'but did not conduct a detailed review of the operator's FRMS'. How does this support collection of your own evidence if you don't conduct a detailed review of it?

11. Do you stand by the new 'beyond Reason' methodology you are using? Is it international best practice?

12. Can you provide the committee with an outline of the 'beyond Reason' methodology the ATSB now applies to conduct its investigations and produce its reports?

13. Do your investigators undertake investigation courses with overseas counterparts?

14. In answers to questions on notice regarding safety equipment you note that 'no safety issue was identified in respect of the adequacy of the safety equipment standards affecting the flight'. You also note no issues with servicing. These answers just ignore the issues that the crew had in the water. Why?

15. In answers to questions on notice you note the discrepancies in the CASA and ATSB report about the levels of fatigue reported by the crew and say 'the existence of both reports provided some doubt regarding how much sleep was obtained'. Why given the ATSB report acknowledges that "there was insufficient evidence available to determine the level of fatigue" did the ATSB not see the need for further fatigue analysis?

16. In light of CASA material published by the committee and discussed at the hearing on 15 February, do you believe a review of and changes to your report are warranted?

Written Questions on Notice- Senator Xenophon

Questions in relation to previously in-camera documents

1. **An email on 9 Feb 2010 appears to show that you were looking for a way to assist CASA with their early intervention with Mr James. Can you explain that please?**

   ATSB response: The email exchange was in the context of a discussion about the complementary but distinct roles of CASA and the ATSB in maintaining aviation safety. The interest of the ATSB officer involved was in CASA's concentrating on improvements to the regulatory and other guidance for the future safety of such flights as the Norfolk Island one. He was of the view that this would be the most effective way for CASA to address the issues arising from the investigation. My response was to advise him that CASA's assessment of what was required was now focussing on compliance-related interventions, rather than changes to the regulatory framework.

   Comment:
   The ATSB as a key component of Australia's State Aviation Safety program (SASP) must consider systemic issues when examining aviation safety. However the email below written on the 10th of February 2010 indicates the ATSB attempted to align itself to some degree with the approach CASA had advised it was **going to** take-which was not one examining systemic issues but more one examining whether there had been regulatory breaches.

   Refer to the email shown below, it shows that:
   The Chief Commissioner originally had '***confidence'*** that CASA would be taking a systemic approach, but on the 9th of February he had a conversation with CASA where CASA advised it would be hardening its view that a regulatory breach had been committed and needed to be addressed. The word '**confidence'** suggests that the ATSB and CASA originally had a common view that the accident should be investigated focussing on systemic issues. One such systemic issue was the need for CASA to clarify/ improve on its guidance regarding in- flight decision making following changes to weather forecasts used at the planning stage of the flight. After The Chief Commissioner's conversation with CASA he advised the ATSB Investigating Officer that CASA stated that what was now **required** was a focus on compliance related interventions rather than changes to the regulatory framework.

   However CASA and ATSB assert that influence was not exerted on ATSB by CASA, there was less focus on systemic issues however, and it would appear from the content of the final report that this is the message that was understood by the ATSB. The ATSB appeared to neglect its responsibilities as part of the State Aviation Safety Program to investigate focussing on systemic issues.

From: Dolan Martin
Sent: Wednesday, 10 February 2010 1:31 PM
To: ATSB Officer
Cc: Sangston Ian;
Subject: RE: Norfolk Island and CASA [SEC=UNCLASSIFIED]

Thanks very much for this. My discussion yesterday with John McCormick gave me some confidence that CASA was looking for systemic answers and amenable to our approach. Since then, CASA has changed its rhetoric and seems to be hardening its view that there has been a regulatory breach that needs to be addressed.

I think it would be helpful if you and other addressees could meet with me so that we can agree the best way to manage our relationship with CASA in the course of this investigation.

[– could you please try and find a time (up to an hour) where we all have space in our diaries.]

Thanks

2. **Is this level of consultation around reports standard practice? Are reports routinely compared in this way? What if a major difference is found?**

   ATSB response: The level of consultation with all directly involved parties (DIPs), including the Civil Aviation Safety Authority (CASA) is in accordance with the ATSB's Safety Investigation Quality System (SIQS). In addition, a Memorandum of Understanding between the two organisations seeks to optimise each agency's separate but complementary safety functions. This includes in the conduct of safety education initiatives, establishing lines of communication in the case of parallel investigations, identifying the possibility for each agency to provide assistance to the other, setting protocols for the management of evidence, and so on.

   Comment
   Although, apparently not clear to the ATSB and CASA, the MOU is attempting to encourage the maximum sharing of data pertinent to an investigation. What is intended is that each organisation shares the facts of the matter **not the conclusions that it intends to draw from those facts**. This should be an obvious point. To maintain investigative objectivity, data should be shared but opinions should not, lest they improperly influence the direction of an investigation.

   There was therefore no need under the MOU for CASA to share its **belief** that the accident stemmed from regulatory breaches at such an early stage of the process. Especially since this was done prior to having established **all** the relevant facts and certainly prior to the ATSB completing their investigation and report. In a court of law CASA's statement to the ATSB would be seen to have prejudiced a fair 'trial'.

   In terms of consultation with CASA about the ATSB's investigation reports, this is consistent with the requirements of the SIQS and is applied to the ATSB's consultation with all DIPs to an investigation. This process is not 'comparative', and was described in pages 29 to 34 of the ATSB's initial submission to the Committee: *Communications between Agencies and Directly Involved Parties during an Investigation*. As indicated in that submission, the DIP process is more correctly an opportunity for those parties to:

   - Present evidence in support of what they view to be factual inaccuracies or omissions in the ATSB's draft investigation report.
   - Indicate that their interests, rights or legitimate expectations may be adversely affected by the release of a final report.
   - Provide information on, or updates to any safety action taken or proposed in response to an identified safety issue.

   All DIP submissions, including any supporting evidence, are formally assessed against information previously gathered by the ATSB during an investigation. This assessment may result in changes to a draft report. If these changes are substantive in terms of report changes will be provided to DIPs and further submissions sought.

3. **Were you aware of any internal CASA concerns regarding their oversight of The operators prior to your report being published?**

   ATSB response: Not specifically, although the ATSB was generally aware that CASA was conducting an internal review of its regulatory oversight.

4. Did the ATSB think to obtain some independent analysis of fatigue levels from another investigation bureau/aviation authority? Were you aware that CASA asked the UK Civil Aviation Authority to analyse the fatigue levels of the crew?

Comment
Before considering the ATSB response which follows, the reader should be made aware of a few facts which were not brought up in the ATSB report.

Fatigue- A Problem for the Regulator
Regulators around the world have a conundrum with regards to fatigue. In most jurisdictions if a pilot were to report for duty with a blood alcohol concentration (BAC) of .02% it would be grounds for dismissal and or licence suspension. This is certainly the case in the EU and Australia. In some jurisdictions there is a zero tolerance policy.
A problem has arisen however, since scientific studies have showed that fatigue can induce degradations in performance well correlated with the degradation attributed to Blood Alcohol Concentration (BAC). The correlation was made[1] in order to provide for society to easily understand why fatigue needs to be managed.
Please refer to the table below [2] which shows the relationship between fatigue index, BAC and the extent to which performance is degraded.

Samn-Perelli Fatigue index	**Blood Alcohol Concentration**	**Degradation in response time on complex tasks**	**Degradation In missed responses**	**The** Level of Alertness Reached after xx hrs **after starting fresh**[3]
2.7	0.005	12%	9.53%	6.4 hours
3.5	0.027	39.5%	18.88%	11.2 hours
4.1	.05	71%	30%	11.7 hours
4.9	0.086	129%	45.5%	16.4 hours
5.6	0.135%	250%	62.35%	21 hours

One such model of fatigue called SAFE[4] was developed by QinetiQ (for the Ministry of Defence) in the UK, it drew on work done by the United States Air Force and NASA. Laboratory results have been validated in an operational environment by several airlines including Brittania and Air New Zealand

[1] Nicole Lamond, Drew Dawson,DOI: 10.1046/j.1365-2869.1999.00167. **Quantifying the performance impairment associated with fatigue.**

> More importantly, equating the performance impairment in the two conditions indicated that, depending on the task measured, **approximately 20–25 h of wakefulness produced performance decrements equivalent to those observed at a blood alcohol concentration (BAC) of 0.10%.** Overall, these results suggest that moderate levels of fatigue produce performance equivalent to or greater than those observed at levels of alcohol intoxication deemed unacceptable when driving, working and/or operating dangerous equipment. **By using alcohol as a reference point, such studies have provided more easily grasped results regarding the performance impairment associated with such substances.** Indeed, the findings of this study suggest that after only 20 h of sustained wakefulness, in the early hours of the morning, performance impairment may be equivalent to that observed at a BAC of 0.10%.

[2] Correlation is based on data contained in the SAFE Bio mathematical Model v 4.0

[3] These levels of alertness will be reached more quickly if there is cumulative fatigue or less sleep than the ideal(7-8hrs) has been attained beforehand.

[4] System for Aircrew Fatigue Evaluation

over many years. The correlation between Fatigue and Blood Alcohol Concentration can be found in respected scientific journals such as 'New Scientist' and Medical Journals such as "The Lancet" (see below).

The SAFE Bio Mathematical model (BMM) provides several indicators of point –in- time fatigue using a variety of scales (Karolinska, Samn Perelli) and importantly an indication of **cumulative** fatigue shown in a Nicholson Curve.

It is important to note that the bio mathematical models to the best of my knowledge do not account for the reduced oxygen partial pressure environment in which flight crew operate. That is, flight crew operate in a 'low oxygen' environment so the model's fatigue predictions may not be conservative enough!

The UK CAA has apparently established a fatigue' limit' of 5.0 using the SAFE model on the Samn-Perelli scale. This correlates roughly with the legal BAC limit for driving in the UK.
If Australia were to set a limit corresponding to its BAC limit of .05% it would mean operators using the SAFE model would have to adopt a fatigue limit of 4.2 on the Samn -Perelli scale. Refer screen shot 7 in the Appendix. The problem for operators is that neither the regulatory authorities nor ICAO have set a limit on fatigue. They have recommended that operators shall manage fatigue safely using a Fatigue Risk management System (FRMS) based on science, but without fatigue limits being imposed by the regulator the whole issue is somewhat arbitrary.

A Societal Issue for the Committee
The science of fatigue has been well documented. It is by no means perfect, but it is here to stay and is the way of the future. The State must decide what level of fatigue to accept in its pilot's, doctors, truckies, nurses etc. If our drink driving limit is to be used as a fatigue **datum** as it has been used in the UK then work must begin now to enable operators, hospitals, trucking firms to make the necessary adaptations to their businesses processes so that employee fatigue is managed such that it does not exceed the equivalent BAC of .05%. Alternatively we can adopt the UK CAA de-facto limit of .08%

The Operator
Pel-Air's pilots operated in a varying and unpredictable environment. They were required to be on standby (reportedly 24/7) for extended periods- sometimes weeks on end!
They were not issued flight duty rosters and so had no way to plan their sleep periods in advance.
They flew a limited number of hours each year which had the potential to create instrument rating recency issues.

The operator managed its crews' flight duties using the Fatigue Audit Inter-Dyne (FAID) Bio Mathematical Model (BMM) as part of their Fatigue Risk Management System (FRMS).
Reasons as to whether flights were legal (within the scope of the company's FRMS) were not made visible to the pilots by the operator. That is, the pilots could not cross check the results being generated by the FAID system.
There was a FAID fatigue limit established by the company which was reportedly set at 75.
The derivation of a fatigue limit of 75 on the FAID scale (as in any other BMM) had no basis in law or in the recommendations laid down by ICAO. It was a limit set by the operator and accepted /approved by CASA.
The operator's crew rostering officer had limited experience in aviation and was given two days training in rostering and the use of FAID. He/ she was not a qualified Human Factors expert.
When assessing whether a flight duty was acceptable within the operator's FRMS, the rostering officer would enter the 'planned' duty into the FAID model and if the value exceeded 70 it would supposedly be passed up the management chain for review / approval. Flight crew that have had experience of the fatigue levels associated with either a FAID score of 75 and the equivalent SAFE scores can attest that they are **significantly worse** than the word pictures used in the models to describe fatigue, such as : 'moderately tired, let down'. Operating at or even close to these 'limits'makes flight crew **very prone to microsleep**. The seriousness of this is not conveyed in the word picture descriptors used in the bio mathematical models to describe levels of fatigue, such as :

'moderately tired, let down'.

The rostering officer reported that although she / he relied on the FAID score to judge the crews' level of fatigue …it was up to the crew to say whether they were fatigued or not.
This necessary safeguard, introduces a fundamental flaw into the FRMS (and ICAO has not addressed the implications in Its guidance material) since:

- **Humans are a very poor judge of their own level of fatigue.**
- **Humans are especially poor at estimating whether they will be fatigued at some later point in time (hence the need for BMM).**
- **If a pilot misjudges his or her level of fatigue or expected level of fatigue he/she may find themself in a difficult position many hours hence- battling weather, system and, operational issues and also fatigue. I'm quite certain that the travelling public would not be happy with this state of affairs which markedly increases the chance of error.**

The FAID system at the time did not account for time zone differences. That is, the extent to which there is a mismatch between an individual's learned circadian rhythm and the local time of day they may be experiencing as a result of travel. This is a function of longitude . The difference in longitude between Sydney and Apia is 20.6 degrees which would create a circadian mismatch of about 1 hour and 20 minutes (although the difference according to standard time would be 2 hours). So although an imperfection of the FAID system at the time it probably wasn't significant in this case-although it could have been a straw that 'broke the camel's back'.

More c**ritically however-the system also did not allow the input of the actual sleep periods achieved into the model**. So even if the pilot's had advised the crewing officer that they hadn't slept well or long, she/he had no way of using the model to account for that.
So the system relied on the judgement of the crew as to their fatigue state and an imperfect BMM. Throw in the Emergency Medical Service (EMS) nature of the operation and the pilot's desire / need to fly:

- For financial reasons
- For other reasons pertaining to licence qualification (recency)
- Through a sense of responsibility to the patients being carried

… and you had a system that was predisposed to 'miscalculation' shall we say.

Every FRMS must be accompanied by sound administrative practices. For example the company policy that would be applied to individuals that report fatigue; what contingency plans would be enacted by the company for various scenarios. It is also **essential** in any FRMS that a company crewing officer or operations controller is **contactable** at all times, since:

- an inability to contact a company prevents a pilot from cross checking his / her fatigue level using an objective tool such as FAID or SAFE
- an inability to contact the company decreases the likelihood that a pilot will report fatigued since flight crew would be well aware that an operator will not be able to enact contingency plans if it doesn't know that an aircraft won't be returning home due to flight crew fatigue.
- **In my opinion any FRMS that is not supported by sound administrative practices is rendered INVALID**.

The Pilot in Command's Wake vs. Sleep Period

What is of primary importance when evaluating fatigue is actual time awake vs. actual time asleep.
If a flight duty is scheduled from 1900 to 0540 for example, the fatigue models predict what sleep should have been achieved prior to commencing the duty. However if that prediction is wrong it must be overwritten by the crewing officer with the actual sleep time that was achieved. The FAID model did not allow this to be done. The SAFE model allows it to be done.

Reconstructed sleep wake cycle for the pilot in command[5]:

Day	Date 2013	Duty	Duty Period	Actual Sleep	Sleep Period
1	15 November	Standby	24 hrs	0000-0700 +2300-2359	8hrs
2	16 November	Standby	24 hrs	0000-0700 +2300 -0000	8 hours
3	17 November	YSSY-YSNF NSAP	2000-0540	0000-0700	7 hours
4	18 November	NSAP-YSNF-YMML	1430-2156 (30 minutes after accident time)-0200 (planned)	0830-1100 interrupted 1130-1400	5 hours

Notes to Table:

- Actual sleep estimate based on statements made by pilot in command (also stands to circadian rhythm reason).
- End of duty 30 minutes after landing time is standard practice
- Napping countermeasure: Times unknown. Napping has a significant recuperative effect but is somewhat complicated by sleep inertia. Most airlines require crew to provide a 30 minute buffer before recommencing duty to allow for sleep inertia.
- **From 0700 on Day 3 to the time of the accident 2126 on Day 4 the pilot in command had been awake consecutively for about 25 hours and in total for 33 out of 38 hrs.**

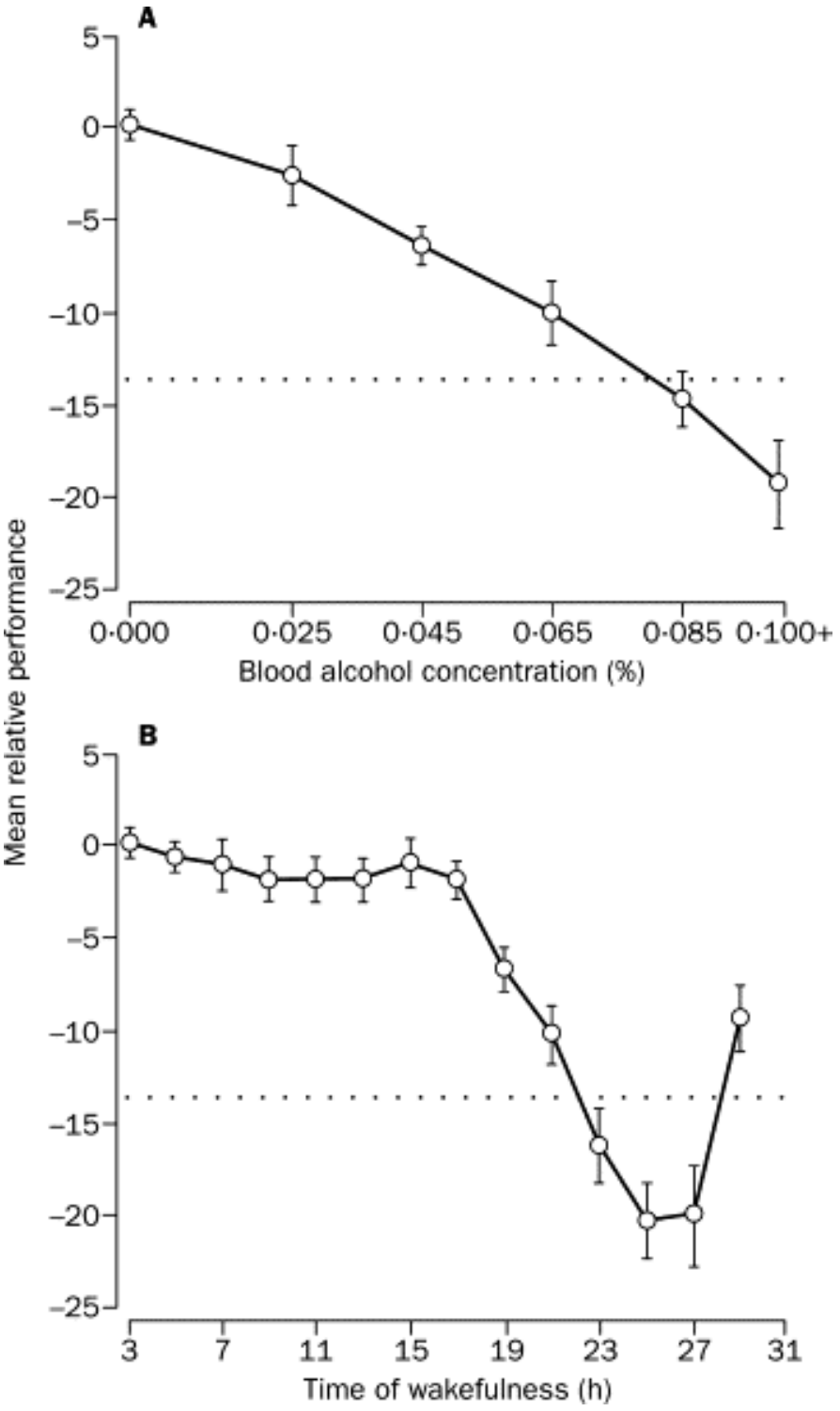
The ATSB:
Sound Investigative Process?

1. The ATSB never assured itself that the fatigue model used by the operator was sound or whether it was being in a manner that assured fatigue could be managed safely. Therefore they could make no comment on its status as a safety factor.
2. The ATSB appears not to have obtained or developed a reasonable estimate of the flight crews' sleep vs. wake periods. If they have it is certainly not clearly presented to the reader in their report. How could their Human Factors experts have developed their opinions and judgements without this key data?
3. The ATSB never conducted any cross check of its estimates of the fatigued state of the flight crew using any bio mathematical model. When they finally did use a model they used the SAFE model simply in an attempt to rebut the argument put forward by the CAA UK. It would have been sound practice to primarily use the fatigue model on which the operator based its decisions. FAID! Far more relevant to the accident sequence.
4. The ATSB did not document which values it used in the SAFE model. Nor have they stated whether they modified any of the default assumptions built into the model. If the model they used assumed sleep occurred between 0700 and 2000 on the 17th of November when this is not what actually happened then the resulting point in time fatigue values (Samn Perelli) AND the cumulative fatigue values (Nicholson) would be affected.
5. For a complete and thorough analysis using SAFE the ATSB could have presented the screen shots showing the reader exactly the values used / assumed. Followed by screen shots of the resulting fatigue values at various points in the flight duty period. But for some reason it chose not to do this.
6. The ATSB did not enter in to any analysis of fatigue in the Analysis section of the report. What analysis was conducted, was done in a cursory manner under the 'General' subheading in the Factual Information section of the report.
7. That superficial analysis stated, that on the return flight the flight crew (pilot) were… *likely to have been suffering the effects of fatigue*. ..However they did state how they came to this conclusion. Even if the statement was based on the judgement of its Human Factors experts the ATSB should have documented the basis for their judgement.

[5] Estimate

8. Lastly the ATSB having determined that fatigue was likely to have been affecting the flight crew they did not draw any conclusions as to how this may have affected the accident sequence. This was / is bizarre.

THE LANCET
Volume 358, Issue 9286, 22 September 2001, Pages 999–1005



The ATSB Response to the question took three paths:

1. **An attempt to discredit the use of bio mathematical models**
2. **Attempt to show that even if bio mathematical models were used that the results were within 'limits'. Incorporate false assumptions and do not disclose source data**
3. **Later (in questions 10,and 15) attempt to state that no conclusions can be drawn as to how fatigue- to the extent that it existed- affected the accident sequence**

The ATSB Response to the question begins here:

ATSB response: The ATSB has several human factors specialists.

Comment
How many HF specialists have experience as a flight crew member in back of the clock airline operations, EMS aerial work or charter operations ?
How many ATSB Investigators have used Bio-Mathematical Models in an operational environment?

…ATSB response cont'd…
During the course of investigation activities, the ATSB will on a case-by-case basis obtain information and advice from external specialists in a specific human factors area, such as fatigue, when provision of this advice is necessary or will enhance the ATSB's understanding of an issue. **With regard to this investigation, the ATSB did not obtain any independent analysis of fatigue levels, nor did it think it was necessary to do so.**

Comment
Unless the ATSB conducted some sort of corroboration of the fatigue scores generated by the operator using FAID in relation to the duty periods before and on the day of the accident how could it assure itself that the operator had managed fatigue at all let alone in accordance with the terms of its FRMS?

…ATSB response cont'd…
The ATSB was not previously aware that the UK Civil Aviation Authority (CAA) had provided CASA with an analysis of the fatigue levels associated with the accident flight (which was provided in the email titled 'Air Amb Supp' from a UK CAA officer to a CASA officer on 11 December 2009). The ATSB notes that the analysis did not appear to warrant inclusion in CASA's Accident Investigation Report.
With regard to the UK CAA analysis, there are several aspects that would limit its usefulness. Firstly, it is based only on using a bio-mathematical model of fatigue (BMMF), and secondly it appears to use data inputs that are significantly incorrect.

Use of bio-mathematical models of fatigue

As previously stated in the ATSB's answer to Question on Notice 14 from 12 November 2012:

A bio-mathematical model was not used as part of the ATSB's assessment. As noted in the ATSB's submission to the Inquiry of 11 November 2012, there are limitations associated with such models. It is generally regarded that these models are best used as part of an FRMS [fatigue risk management system] to evaluate differences between various rosters, and are inappropriate to use for evaluating the fatigue level of specific individuals. The ATSB assessment of the crew's potential fatigue levels considered all of the factors that are incorporated into such models.

Comment
It is far more likely that a BMM was not used by the ATSB because they did not hold any valid licences for the supporting software. This should be confirmed by the Inquiry. Did the ATSB hold any BMM software licences at the time of the investigation?

Comment

The ATSB believes its human factors investigators would have considered all the factors relevant to determining the existence of fatigue, this is probably true, but what the bio mathematical models allow is more than simply consideration of all the relevant factors they allow an integration of these factors based on scientific modelling that is not easily achieved otherwise. One could argue the BMM produce a better result than human factors expert because of their ability to consistently integrate data. Certainly now that the models such as SAFE[6]/ SAFTE can account for individual sleep practices, napping, actual sleep achieved as well as caffeine use, one could argue they produce a consistent, well integrated, science based, quantifiable measure of fatigue.

Furthermore most airlines are using BMM as part of their FRMS. It is far better for the ATSB and CASA and the airlines to use a common 'language' of fatigue. Bio- mathematical models provide that language by using numeric indices which are well cross referenced to plain language descriptors and sometimes to commonly understood concepts of blood alcohol concentration (BAC) impairment values such as .02% or .05%. This removes doubt arising from less clearly defined descriptions of fatigue. What exactly do words such as 'significant' when used by the ATSB to describe fatigue, actually mean?

Lastly the bio mathematical models are very robust on many levels. CASA's 2010 assessment of the various model [7]for example showed they can account for:

- Homeostatic sleep drive
- Circadian process
- Chronic sleep restriction
- Circadian phase adaptation
- Sleep inertia
- Individualisation
- Caffeine
- Time on Task

*The ATSB's lack of method here is a disgrace. They expect the industry to manage fatigue according to scientific principles . The industry has interpreted this to mean make maximum use of bio mathematical models and yet the ATSB expects the aviation community to accept their poorly integrated , subjective and unsubstantiated and mostly undocumented **judgements regarding** fatigue.*

…ATSB response cont'd…
Similarly, a recent paper (Dawson, D., et al., 2012, 'Modelling fatigue and the use of fatigue models in work settings', *Accident Analysis and Prevention*, vol. 43, pp. 549-564) stated:

Fatigue 'predictions' can be reasonable for group data in highly controlled lab settings, but the models do not yet have high levels of validity for chronic partial sleep restriction protocols at the individual level and/or when used to predict fatigue in the workplace. Thus, their use for the prediction of actual fatigue associated with an individual's line of work or in the analysis of a specific incident is probably inappropriate at this stage.

Comment

The year quoted by the ATSB for the above work by Drew Dawson, Ian Noy, Harma M and Akerstedt

[6] *The models have been developed by Several Universities/ QinetiQ/ NASA/USAF over time and validated by several major airlines.*

[7] Bio mathematical Fatigue Modelling in Civil Aviation Fatigue Risk management, CASA Human Factors Section March 2010

T, Belenky G as 2012 is not correct.
An extract of the abstract obtained via the internet gives the publication date as 2011:

The abstract of the work quoted refers to chronic partial sleep restriction protocols (whatever that means) and concludes by stating:-
"…. The third part of the review looks at the current use of fatigue models in field settings by organizations and regulators. Given their limitations it is suggested that the current generation of models may be appropriate for use as one element in a fatigue risk management system…"

The important words used by Mr Dawson is …*current generation*…the reader has no idea which generations of the models Mr Dawson is referring to and the ATSB does not attempt to educate the reader. The latest versions of SAFE v5.5 are very well validated in operational environments. When using them be certainly conservative but ignore them at your peril.

…ATSB response cont'd…
Similarly, the CASA 2010 document titled 'Bio mathematical fatigue modelling in civil aviation fatigue risk management: Application guidance' stated:
probabilities from a population average rather than an instantaneous fatigue levels of a specific individual, incomplete description of all fatigue physiology factors, qualitative data being misinterpreted as quantitative data and limited validation against aviation specific data.
In short, BMMFs deal with average, estimated levels of fatigue for a given population rather than predict fatigue levels for a specific individual in a specific situation, and the estimated levels of fatigue are often derived from sleep data from laboratory studies in a controlled environment. Such models do not consider all of the factors that can influence fatigue, and they are also based on many assumptions that need to be clearly understood prior to using them for any purpose

Comment
These statements by the ATSB are based on old information. Modern versions of the SAFE and SAFTE model are well validated and modelled and now incorporate personalising variables such as ACTUAL sleep obtained, quality of sleep, caffeine intake, napping.
Once again they are the best models available by which to determine the likelihood of fatigue. Of course they are not perfect and there are individual differences (though these are not as large as is postulated) but they are an invaluable tool for managing fatigue and developing a common language surrounding fatigue. They are the way of the future. The ATSB downplays their importance somewhat out of ignorance and partly because they have to justify their decision not to use the models- which was probably made for financial not operational reasons.

Comment:
So much for the models! The ATSB should keep pace with industry, not stay behind its' developments. BMM are here to stay and they are getting better all the time.
What is difficult to derive from any analysis of fatigue is to what extent it impairs performance (and by inference to what extent fatigue contributes to accidents and incidents).
Studies do vary slightly when determining the effect of fatigue on cognitive and psycho motor performance. However there is ***little to no doubt that fatigue slows down response times and delays decision making.*** *This is not to say decisions when made are necessarily worse but the critical point to the aviation environment is that time and motion problem solving is made more difficult when problem evaluation and solution forming takes longer.*
To the extent that time management or time pressure (self-imposed or otherwise) can be said to contribute to an accident it is logical to say that those time management issues or pressure could have been caused by fatigue.

…ATSB response cont'd…

UK CAA analysis

The UK CAA analysis of 11 December 2009 was conducted using a BMMF called SAFE (System For Aircrew Fatigue).

Comment:
Actually it's called the System for Aircrew Fatigue Evaluation (SAFE).

…ATSB response cont'd…
The model was developed based on research sponsored by the UK CAA. The ATSB is not aware of what information CASA provided to the UK CAA at the time. However, based on the information in the email, it appears the UK CAA used inappropriate data inputs into the model. More specifically:

- First duty (including the trip Sydney-Norfolk Island-Samoa): the UK CAA analysis appeared to use a duty period starting at 0900 local (Sydney) time on 17 November and finishing at 0700 on 18 November. The crew were first contacted for the task at 2000 Sydney time and probably did not sign on for duty until about 2100 (the aircraft departed at 2230). In addition, the aircraft landed at Samoa at 0510, and the duty probably finished at about 0530 (all times Sydney time). Therefore a duty time of 2100 to 0530 is more appropriate to use in the model than 0900 to 0700.

Comment
No it definitely is NOT. All models of human alertness are based primarily on **hours awake vs. sleep achieved** . The assigned start of duty time has absolutely nothing to do with fatigue. Given the flight crew were on 24 hour standby for the two days prior to the first flight it is highly likely (and this is backed up statements made by the pilot in command) that they would wake at the normal time for their location. Call it 0700 local time, although it could have been earlier. The pilot in command did not report taking an afternoon nap and was not in the habit of doing so. It is unlikely that he slept at any time from waking to being called on duty at 2000 till after having breakfast in Apia and going to his hotel room.

So the UK CAA are entirely correct to use a 'start of duty' time of 0900 on 17th . If they did not the system would insert an assumed sleep time during the day and an evening nap- which would be incorrect. Alternatively the UK CAA could have inserted a start of duty time of 2100 and then edited out the assumed sleep period during the day which the system would have inserted. Either way the result would have been the same.

As for the end of duty time a time of 0540 would be more correct (30 minutes after landing), however the time spent travelling to the hotel and waiting for a room must be factored into the fatigue calculations. Most airlines will accept adjust for these impediments to sleep by increasing the rest time required before commencing a next duty (after all one cannot get adequate rest in a crew bus or if a hotel room has not been prepared). The ATSB does not examine what should have happened under the Pel Air operation manual in this case.

A start of duty of 0900 and end of duty of 0540 in Apia produces a result of 5.7 on the Samn Perelli scale. Refer to screen shot 6 in the Appendix.

- Second duty (Samoa-Norfolk Island-Melbourne): the UK CAA analysis appeared to use a duty period starting at 1430 and finishing 2145 (all times Sydney time).

Comment:
The ATSB here means the UK CAA showed that the flight was terminating in Norfolk Island at 2145. This is logical since the duty period did in fact finish in Norfolk Island however a more accurate local time to have used would be 2156.

The crew arranged to meet in the hotel lobby at 1500 and did not depart for the airport until after 1530. However, the pilot in command commenced flight planning prior to 1530. The 1430 time start time therefore could be used to be most conservative. However, the full expected duty period extended to 0200 the next day (estimated end of duty after arriving at Melbourne). It is important to use the full duty expected by the crew as this can significantly affect the amount of sleep estimated (by the fatigue model) to occur in Samoa. Therefore, a duty period of 1430 to 0200 is more appropriate to use in the model when

considering the crew's suitability to undertake the duty.
Agreed

In the UK CAA email, it is stated that its analysis assumes the crew received 5 hours good quality sleep at Samoa. This is not the case. Recreating the analysis using the same inputs produces the same Samn-Perelli scores, but it also indicates under these (incorrect) conditions, an average crew would be estimated to obtain less than 2 hours sleep. If the planned duty period was longer (as was the case), it estimates a crew would use the available opportunity and obtain more sleep.

Explanation:
What the ATSB is trying to say is that because the UK CAA input to the SAFE model had the flight terminating in Norfolk Island (rather than Melbourne) the BMM system would default to a lesser sleep period in Samoa. That default would be 2 hrs and produce higher fatigue values as a result.
However this is clearly not the case. The default sleep assumption, even after setting YSNF as the destination, was about 5 hours. Refer screen shot 1 in the Appendix.

Furthermore the SAFE model allows a user to input the actual sleep period achieved and overwrite the default sleep period assumed by the model so there is no need for the ATSB to guess at these things. The ATSB should have clearly established the actual sleep and wake periods of the flight crew (as I have attempted to do) and then inserted that actual data into the SAFE model.
If there continues to be a difference of opinion between the ATSB, the UK CAA and others as to the level of flight crew fatigue I suggest that the Committee approach an independent and well qualified authority to arbitrate. QinetiQ perhaps.

…ATSB response cont'd…

Revised SAFE analysis

Using the revised inputs into SAFE (and with two crew and two sectors per duty) produces the following Samn-Perelli scores:

- at 2230, when the flight departed Sydney – 2.8
- at 0500, when aircraft landed at Samoa – 4.7 (gradually increasing up until that time)
- at 0530, the end of the first duty – 4.8 (not 5.7 as reported)
- at 1500, when flight planning for the return flight to Norfolk Island – 2.4
- at 1645, when departing Samoa – 2.5
- at 1900, when the SPECI call was provided – 2.8
- at 2100, about the expected time into Norfolk Island – 3.4
- at 2145, the time used by the UK CAA – 3.5 (not 4.4 as reported)
- at 0200, the expected end of second duty in Melbourne – 4.7.

Comment:

- Regarding the flight from Sydney to Apia, the ATSB is wrong. The values produced by the CAA UK are more accurate for the flight from Sydney to Apia. That is, the pilot landed in Apia with a fatigue score around 5.7 on the Samn Perelli scale Or BAC of .135%!!! Refer to screen shots 5 and 6 in the Appendix.
  I dispute the ATSB values because I believe they have allowed the SAFE model to insert the default sleep period s on the 17th November despite clear statements by the pilot that he did not sleep during the day.

- For the return flight from Apia to Melbourne the fatigue scores generated by the ATSB are also incorrect Refer screen shot 1 in the Appendix. *It shows a fatigue index of 3.6 at time*

2041 whereas the ATSB shows a fatigue index of 3.4 at time 2100. Remember a fatigue index of 3.6 corresponds to a BAC of .03% and degradation in complex task reaction time of 40% over the baseline values. Would this alone not serve to prompt an investigative body to more fully examine fatigue as a contributing factor to the event?

- **But Wait, Where's the Nicholson Curve?**
  Conspicuous by its absence however is an assessment by the ATSB of the pilot's **cumulative fatigue**. Had they done so using the SAFE model (easily done) it would have shown that the pilot exceeded the Nicholson Curve fatigue maxima on the return flight. Refer to screen shot 9 in the Appendix.

…ATSB response cont'd…
It should be noted that when using the standard settings, SAFE assumes a crew will sleep normally prior to the first duty. The model also estimates a short (45-minute) sleep period at 1715 prior to the first duty. If this sleep period is deleted…

Comment
As it should be, since the pilot reported that he did not have a nap before the flight…

…. the scores at the end of the first duty increase slightly (by about 0.3 points) but the scores for the second duty are not affected. Similarly, if a short nap is included during the first duty (which reportedly occurred and would be expected), the scores at the end of the first duty reduce slightly (about 0.3 points). The same would apply for scores during the return trip if a short nap was undertaken.

Using the revised inputs, the standard SAFE model assumes a sleep period of 4.5 hours in Samoa. The accident flight crew's reports to the ATSB shortly after the accident indicated that they received more than this estimated sleep period. The information provided by the pilot in command to CASA indicates that he may have got slightly less than this estimated period (4 hours total).

Using a scenario where a crew member obtained no nap in the afternoon prior to the first duty, a 30-minute nap during the first duty and only 4 hours sleep in Samoa, would result in an estimated Samn-Perelli score of 2.5 at 1500, 2.9 at 1900, and 3.4 at 2100 on 18 November. Using a scenario where 5 hours sleep was obtained in Samoa produced scores of 2.2, 2.6 and 3.1 respectively.

As previously stated, the ATSB did not use a bio-mathematical model when conducting its assessment of potential fatigue levels, and it cautions against using such models to estimate individual levels of fatigue in this way. However, the results of the above revised analyses appear to be broadly consistent with what ATSB would have expected.

In summary, the UK CAA analysis appeared to use inappropriate inputs into SAFE, which indicated that the crew were on duty for 12 hours prior to them actually commencing duty at about 2100 on 17 November 2009.

Comment
As stated before, rostered duty has nothing to do with it, the human body propensity for fatigue is correlated to total hours awake vs. hours sleep attained prior to duty. The rostered sign on time is absolutely irrelevant. The ATSB assumptions for the first flight are wrong and therefore so are their fatigue values.

You do not need an advanced degree in human factors to realise that if a pilot is awake for 25 hours then sleeps for about 5 then is awake again for another 8 hours that he has been awake for about 33 hours in 38 hours. This is an undesirable state of affairs to anyone with common sense.

The ATSB have failed in their responsibility under the SASP and possibly the TSI Act to address safety issues such as fatigue.

…ATSB response cont'd…
Accordingly, its analysis produced much higher estimated fatigue levels for an average crew than would be expected from the actual duties undertaken by the accident flight crew. Overall, for a crew undertaking the duty that occurred on 17-18 November 2009, the estimated fatigue levels using SAFE near the end of both duty periods were approaching but not exceeding the reported UK CAA limit of 5.0, and the estimated fatigue level for the accident flight itself was much lower.

For background information, SAFE actually produces a predicted level of alertness, which the program then equates to a Samn-Perelli score. The Samn-Perelli scale is used in research to obtain subjective estimates of alertness. The 7-point scale is defined as:

1.0 fully alert, wide awake
2.0 very lively, responsive, but not at peak
3.0 okay, somewhat fresh
4. 0 a little tired, less than fresh
5.0 moderately tired, let down
6.0 extremely tired, very difficult to concentrate
7.0 completely exhausted, unable to function effectively.

Comment
The ATSB chooses to correlate the fatigue values in the nicest possible way. They could also be correlated to blood alcohol content (which puts the effect of fatigue in a different context) as follows:

Samn-Perelli Fatigue index	**Blood Alcohol Concentration**	**Degradation in response time on complex tasks**	**Degradation In missed responses**	**The** Level of Alertness Reached after xx hrs **after starting fresh**[8]	
2.7	0.005	12%	9.53%	6.4 hours	
3.5	0.027	39.5%	18.88%	11.2 hours	
4.1	.05	71%	30%	11.7 hours	
4.9	0.086	129%	45.5%	16.4 hours	
5.6	0.135%	250%	62.35%	21 hours	

Comment:
Even if we accept the ATSB's belated calculations (despite their sleep assumptions not being clearly presented and which are probably inaccurate) we are left with a position where the pilot in command took off from Sydney and landed in Samoa having been awake for nearly 25.5 before getting about 5 hours interrupted sleep. He wakes to commence the return to Norfolk Island and is awake for about 8 hours prior to the accident. Had he landed successfully in Norfolk island and refuelled the aircraft before proceeding to Melbourne as originally scheduled he would have landed with a performance impairment approaching that of a person with a BAC of .08%.

It appears the ATSB are happy with this, and of most concern, is how many other investigations

[8] These levels of alertness will be reached more quickly if there is cumulative fatigue or less sleep than the ideal(7-8hrs) has been attained beforehand.

have had "not identified fatigue as an issue"?

Conclusion

Even if the reader ignores:

- the fact that the pilot would not have been able to contact the operator to advise that he was fatigued (which invalidated their FRMS) and
- the fact the ATSB did not conduct any assurance checks regarding the operators ability to roster crews to safely using the FAID system and
- the issues as to whether the ATSB had in its possession a bio mathematical model with which to conduct an analysis and
- the erroneous ATSB assumption regarding the wake and sleep times used in the fatigue calculations on the first day and
- the absence of any point- in- time scientifically derived fatigue values (Samn Perelli) in the final ATSB report and
- the absence of any cumulative fatigue statement (Nicholson curve) and
- the fact the ATSB failed to evaluate fatigue using the FAID model as used by the operator at the time thereby and
- the ATSB reliance on the **judgement** of its HF investigators and
- the fact the ATSB never sought to examine whether the flight would have met the requirements of CAO 48.0 in an effort to understand why the CASA auditors believed that had CASA's oversight been better the accident might have been avoided (see question 7 below) and
- the absence of any fatigue analysis in the Analysis section of the report

Even if the reader ignores **all** the points above , the reader cannot ignore the ATSB's reluctance to develop any analytical arguments regarding fatigue and its potential contribution to the accident sequence despite its statement regarding fatigue in the final report[9] , that … **it was likely** that on the return flight the pilot in command **was experiencing fatigue**.

Here **the ATSB acknowledges fatigue was likely to have been an issue** but fails to draw any conclusion as to the likely effect on the flight crew's performance.

This contrasts quite starkly with the definitive conclusions drawn from the pilots alleged poor in-flight management and pre-flight planning, where the ATSB concluded most emphatically that the pilot in command contributed to the accident since it meant that when a decision had to made under time pressure (to divert to Noumea) the pilot was unable to do so in the window of opportunity that existed due to that lack of preparation and in-flight management [10].

What is odd however is the ATSB's inconsistency. Its HF investigators would know full well that the effect of fatigue varies from individual to individual, that there is a difference of opinion on how fatigue affects the quality of decision making. One thing on which there is general agreement is that fatigue slows down the decision making process in all individuals.

Given this fact it is inconsistent for the ATSB to speculate that lack of planning contributed to the pilots' inability to make a decision in a timely manner when it was required but to not acknowledge that fatigue might have had something to do with the same.

---

[9] Pages 14,15 AO-2009-072 ….. *likely he was experiencing fatigue on the return flight at a level likely to have had at least some effect on performance*

[10] Note, this line of reasoning would be valid had it been possible to deduce from the available information that a safe landing could not be made in Norfolk Island but the ATSB cannot make that assumption where given exactly the same amount of information and more the licenced trained professional weather forecasters for the BoM was unable to do so. That is even at 1000z where the weather was OVC @2-300ft the BOM issued a forecast predicting that the cloud would be BKN @5000ft. The ATSB CANNOT hold a pilot to a higher forecasting standard than the BOM.

5. **What is a 'normal' number of reviews for a draft report?**

   ATSB response: As indicated in the ATSB's initial submission to the Committee, the draft report review and approval process includes internal team, peer and management reviews and then review and approval for release by the Commission. These reviews take place before a draft report is forwarded to directly involved parties (DIP) for comment and, apart from the peer review, after consideration and incorporation as required of any DIP comments.

Questions around public information

6. **What has the aviation industry learnt from this report?**

   ATSB response: The safety issues and action to address them and the safety message from the investigation are summarised in the *Safety Summary* section of the investigation report (see page iii of investigation report AO-2009-072). The investigation findings are developed in the *Analysis* section of the investigation report (pages 37 to41) and listed at pages 43 and 44.

   Importantly, the *Safety Action* section of the report discusses the safety issues identified by the ATSB and the safety action proposed or being taken by the respective parties in industry in order to prevent a recurrence of the accident.

   Comment
   The ATSB should however have made the following recommendations:

   1. The BoM should review its forecasting models for Norfolk Island.
   2. The BoM should review the process by which amendments are made to forecasts and the timeliness in which they are provided to the end users.
   3. The BoM should consider providing forecast reliability data to operators so that they can manage any associated risks appropriately based on that data.
   4. Regulator to prescribe methods by which fatigue can be evaluated independently by other than a fatigued individual.
   5. Regulator to modify guidance regarding inflight decision making following changes to forecast weather.
   6. Regulator/ ASA to examine the responsibility for the proactive provision of flight information services (FIS)
   7. The regulator to determine fatigue limits appropriate to the BMM fatigue models (and the writer suggests that one corresponding to a .05% BAC limit would be appropriate)
   8. ASA and CASA to define and consistently use terminology throughout the AIP/ CAR/CAO CAA/ CASR
   9. ASA to document the communication protocols used by non-Australian ATS providers to the extent that they differ from our own.
   10. CASA to mandate read back of ATC transmission of safety critical data (SPECI, SIGMET etc.)

7. **The ATSB says it focuses on obtaining its own evidence. You obtained the various The operators manuals but found no safety issues in respect of CASA's oversight. Given what we know from the CASA Special Audit, does that show a lack of expertise or do you just trust that if CASA has approved a manual, it must be right?**

Neither. The ATSB focuses on establishing safety factors and issues that contributed to the occurrence under investigation. There is nothing in the CASA special audit that would establish CASA oversight as a contributing safety factor to the accident. A lack of regulatory compliance or oversight is not the sole determinant for establishing whether a safety issue exists. See Part 3 (page 11) of ATSB (44 page) initial submission.

Comment:
The ATSB evades the second part of the question as to why they did not independently establish that there were deficiencies in CASA's oversight of the operator by implying (but not explicitly stating) that this was because such issues were not contributory and therefore did not warrant inclusion in the report. **Was CASA's oversight of the operator evaluated by the ATSB at <u>any time</u> prior to the receipt of the special audit?? YES or NO???**

The ATSB stated that regulatory oversight deficiencies would not necessarily be included in any report unless it could be demonstrated that they were contributing or considered a safety issue. Again this creates the impression in the mind of a reader that the ATSB actually did identify the oversight deficiencies but failed to include it in the report due to relevance. Note the ATSB is not explicitly stating that they did identify the safety deficiencies. This is being evasive. **Was CASA's oversight of the operator evaluated by the ATSB at any time prior to the receipt of the special audit?? YES or NO???**

Furthermore when CASA's own audit team stated that… 'had CASA's oversight been better the accident may have been averted'… it tests the bounds of believability of the ATSB statements above.
For example; CASA's Human Factors FRMS Special Audit of the operator stated that:
*…No evidence was found that supported the claim that the operator (sic) had **<u>ever</u> managed fatigue risk to a standard** considered appropriate, particularly for an operator conducting adhoc back of the clock operations*.

At the very least, had the ATSB independently discovered this fact, it would have warranted inclusion at least in the factual information section of the report. If it was later determined not to be a safety factor then it could have been dismissed in the Analysis section. However this was not done, which strongly suggests that the ATSB did not independently uncover this evidence and lends credence to the Committee's assertions as to a present lack of expertise in the ATSB.

Had the ATSB thoroughly examined the issue of inadequate oversight by CASA they would **have had to consider the question**: <u>If CASA had, at an earlier time determined that the operators' FRMS was not meeting the required standard, what would have happened, would the accident have been averted?</u>
Had CASA at an earlier stage determined that the operators' FRMS was inadequate they would have required the operator to revert to complying with the provisions of CAO 48.0. (The prescriptive legislation governing flight and duty limitations.) until they could demonstrate that they had improved their FRMS to meet the required standard.

The ATSB should at least have examined the effect a reversion to CAO 48.0 <u>would have had on the scheduling of flights</u> leading up to and on the accident date. CAO 48.0 amongst other restrictions does not allow Reserve time at home (also now referred to a Standby) to exceed 1 continuous period of 16 hours. AND the rest period required prior to commencing the return leg would have been at least 10 hours.
It is quite possible that because CASA's audits did not uncover the operators FRMS

deficiencies at an early stage that their inadequate oversight **may have contributed** to the accident (if we accept that the pilot was experiencing cumulative fatigue and that the fatigue contributed to slowed decision making at a critical time in the flight sequence).

The ATSB apparently never considered this potential.

8. **How has the ATSB satisfied itself that the deficiencies listed in the CASA Special Audit have been addressed? Do you just trust they have been based on the list of actions provided? As we now know CASA had a history of accepting actions had occurred which had not, do you check whether CASA has checked the actions have been completed?**

ATSB response: CASA's special audit was a regulatory/compliance audit against which action was proposed or taken by the operator. CASA could be expected to have assessed whether the regulatory/compliance deficiencies and observations in the special audit were adequately addressed by the operator.

The ATSB's safety investigation identified a safety issue in respect of the operator's procedures and flight planning guidance as it affected the operator's aeromedical operations to remote islands. Safety action in response to that safety issue is reported at pages 48 and 49 of the investigation report.

As indicated on page 28 of the ATSB's initial submission to the Committee, where the ATSB is advised that safety action in response to identified safety issues is in progress or is proposed to be undertaken, the safety action is placed on 'Monitor' pending finalisation/implementation of the safety action. Once an organisation has taken safety action, an assessment of the residual safety risk is undertaken to determine whether the level of risk has reduced to an acceptable level. If this level of risk remains significant, the ATSB will consider whether there is a realistic prospect of reducing the risk further and if necessary pursue further safety action.

9. **You connected the dots between the ATSB report and the CASA Special Audit after you received the latter. Given that your review of the Special Audit did not lead you to make significant changes to your report prior to publishing, is the committee to understand that, in your view, nothing of any great import to your investigation came out of CASA's audit?**

ATSB response: The CASA special audit was undertaken for a different purpose than the ATSB investigation. It identified a number of concerns with the operator's processes, and initiated significant safety action by the operator to address these problems. The stated scope of the audit was very broad, and covered many areas that were not related to the circumstances of the accident and therefore were not considered in the ATSB investigation.

Comment
The ATSB keeps repeating that CASA investigates for different purposes to the ATSB. However that does not mean that CASA does not investigate with a mind to identifying safety deficiencies in order to improve safety. In fact the vast majority of CASA's activities are focussed on safety enhancement. Even the enforcement process!. To allege that CASA information derived through surveillance, enforcement, audit , whatever, is not germane to every ATSB investigation is pure fantasy. So any audit by CASA is of relevance to safety and should have been seen as such by the ATSB.

As indicated in the ATSB's supplementary submission of 19 October 2012, the ATSB considered the content of the special audit and relevant factual information and analysis resulting from that examination was included in the final investigation report. This information was highlighted in tabular form in Appendix A to that supplementary submission. An updated table was provided in the ATSB's response to the Questions Taken on Notice of 21 November 2012 showing that a large proportion of the information had already been included in the ATSB's draft report before the special audit was obtained.

10. **In relation to collecting your own evidence, the ATSB mentioned in answers to question on notice that you obtained a copy of the operators fatigue risk management system (FRMS) 'but did not conduct a detailed review of the operator's FRMS'. How does this support collection of your own evidence if you don't conduct a detailed review of it?**

ATSB response: The ATSB obtained Pel Air's full operations manual as a routine part of its investigation process, and the manual contained the FRMS manual. As is normal practice, the investigation team focussed its review of the operations manual on sections relevant to the scope of the investigation. As previously stated in ATSB's answer to question on notice 13 from 21 November 2012, the available evidence led the ATSB to conclude that establishing fatigue as a contributing factor was unlikely. In addition, the ATSB was aware that CASA was conducting a review of the operator's FRMS as part of its special audit conducted in November 2009, and the operator was modifying its FRMS as a result, and therefore the safety enhancement value of the ATSB considering the issue further in its investigation was limited.

Comment

The ATSB should not presume that a CASA audit will identify **all the deficiencies** present in a FRMS. It is supposed to be an independent safety investigator. It must presume to some extent that CASA has a conflict of interest whenever it conducts an investigation and may not be predisposed to findings that reflect poorly on itself (CASA). If the ATSB doesn't recognise the need for it to be independent and to independently conduct an investigation then it needs assistance from the Department to help clarify its role.

Furthermore whether something may or may not become a 'contributing factor' in any investigation should not solely determine whether there is value in investigating an issue further. Whether fatigue is considered contributory or not does not detract from the obvious learning opportunity the event presented to the ATSB. That is :- **'it is inadvisable for an operator to place the burden of responsibility on the flight crew to determine their level of fatigue prior to commencing a duty and make a prediction as to their likely level of fatigue many hours hence'** -when the available studies argue that a fatigued individual is a poor judge of their own level of fatigue.

This is a **stand-alone finding** worthy of highlight **regardless** of whether it **contributed** to the accident or not!

Lastly for the sake of consistency, if the ATSB believes lack of preparation and in-flight management of the flight were contributory because they increased the time taken by the pilot to make a critical decision in a very small window of opportunity then they should acknowledge that since fatigue can have exactly the same effect on decision making that it could quite easily be considered a contributing factor.

Safety investigations are not audits, and it is not within the default scope of any investigation to review all of an operator's manuals or conduct a full audit on an operator's systems.

11. **Do you stand by the new 'beyond Reason' methodology you are using? Is it international best practice?**

    ATSB response: In response to question 32 of the questions on notice from 21 November 2012, the ATSB stated:

    The ATSB's analysis methodology is based on best-practice elements, where any exist, from a range of different fields. The methodology has also been presented at several industry forums and conferences, both in Australia and overseas. Informal feedback from other organisations and investigators has generally been very positive.

    Provide examples !

    The ATSB's analysis methodology is international best practice. It should also be noted that, as far as the ATSB is aware, the ATSB has explicitly included Reason-model concepts into its analysis methodology more than any other similar, independent transport safety investigation agency.

12. **Can you provide the committee with an outline of the 'beyond Reason' methodology the ATSB now applies to conduct its investigations and produce its reports?**

    ATSB response: The ATSB provided an outline of its analysis approach in its initial submission of 12 October 2012 (Sub03_ATSB, parts 2 and 3). It also provided additional information in response to question 32 of the questions on notice from 21 November 2012.

13. **Do your investigators undertake investigation courses with overseas counterparts?**

    ATSB response: Yes, some ATSB courses conducted in Australia have had attendees from our collegiate agencies in Indonesia, Singapore, New Zealand and PNG. In addition, ATSB investigators have attended overseas training offered by other agencies. The last of these was the attendance by a Senior Transport Safety Investigator at an investigation course that was administered by the French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) in Noumea in August 2012.

14. **In answers to questions on notice regarding safety equipment you note that 'no safety issue was identified in respect of the adequacy of the safety equipment standards affecting the flight'. You also note no issues with servicing. These answers just ignore the issues that the crew had in the water. Why?**

    ATSB response: The survivability aspects of the accident were addressed in the ATSB's supplementary submission of 11 November 2012. That submission related the performance of the safety equipment that was used by some of the aircraft's occupants in the context of a very traumatic, disorienting, and life-threatening situation in which the aircraft had partially broken up and was submerging.

    The as-reported recollections of the performance of the lifesaving equipment varied among the survivors and some of the performance issues identified may have been as a result of the dark night and other ambient conditions; the occupants' difficulty exiting the aircraft; to snagging, tangling or damage of equipment during that exit; a potential inadvertent deflation of life jacket inflation chamber and so on. For example, and as reported in the 11 November supplementary submission:

    - Whereas the pilot in command reported that the nurse's life jacket light was not working, the nurse reported that her light was generally underneath the patient.
    - The pilot in command also reported that one of the whistle lanyards was too short and was unusable. It was not possible to determine whether this was due to the tangling or snagging of the lanyard.
    - The passenger reported that whistles were not available on two jackets. The possibility that these whistles might have snagged and detached on exit from the wreckage could not be discounted.

- The doctor reported that all three jackets that were taken from the aircraft worked satisfactorily and that, once near rescue, he wasn't sure that a whistle would have helped.

Comment
Here the ATSB makes specific reference to the fragility of eyewitness testimony to postulate that life jackets **may** have in fact been fully serviceable post-accident or at least capable of fulfilling all their design functions. Strangely enough this argument also helps the ATSB's justify its lack of thoroughness in its investigation of the matter and avoids the need for the ATSB to communicate with life jacket manufacturers and or operators that use similar devices.

The fragility of memory with respect to the pilots varying testimony as to how much sleep he had on the day of the accident is used to infer that the pilot was unreliable. This unreliability was developed further to postulate that any investigation of fatigue was unlikely to yield anything of value. Again this argument just happens to suit the ATSB's lack of investigative rigour.

Instead of conducting these thought experiments above why didn't the ATSB do its job and establish the facts of these matters?

The survivor's life jackets were available. The ATSB could have conducted an examination of them. The ATSB thought experiments are not "evidence" of the life jacket's serviceability.

The serviceability of the safety equipment was certified by qualified technical staff as part of the aircraft's routine technical inspections prior to the accident. The issues with the equipment as reported by the aircraft occupants occurred after a difficult exit from a damaged and submerging aircraft. In this context, it was not possible to discount that equipment damage during exit from the aircraft precluded its subsequent normal operation once on the surface.

Comment:
This is an analytical fallacy. An argument based on a conviction.
Of course it is possible to determine whether the life jackets were damaged during the accident sequence.

With regard to establishing the serviceability and operability of the life jackets it is a fundamental part of the ATSB's job to investigate thoroughly and make a determination.

1. Did the lifejackets comply with the standards?
2. Were a sufficient number of serviceable lifejackets on board and available to the crew and passengers?
3. Did the lifejackets suffer damage during egress?
4. Are there any design changes that could be contemplated that could prevent snagging etc. if indeed that's what occurred to damage the life jackets?
5. Did the crew and passengers know how to use the lifejackets correctly?
6. If the lifejackets were not damaged during egress what explanation can the ATSB offer to explain the reported unserviceability or partial unserviceability of the life jackets?

The ATSB could quite easily establish whether the lifejackets were ripped or whether the inflation cylinders had suffered damage but they have not done so and yet they postulate that the lifejackets could have been fully serviceable but damaged during the exit from the aircraft. Of course this is possible, but it is unacceptable for the ATSB to not make a positive determination.
What if the ATSB are wrong and that there is in fact a serviceability issue with those particular lifejackets? A serviceability issue which could potentially affect a large section of the industry.

Do the ATSB not have a responsibility to establish with certainty whether the life jackets were serviceable or not. It would be expected by the TSI Act to answer-YES they do!

15. In answers to questions on notice you note the discrepancies in the CASA and ATSB report about

the levels of fatigue reported by the crew and say 'the existence of both reports provided some doubt regarding how much sleep was obtained'. Why given the ATSB report acknowledges that "there was insufficient evidence available to determine the level of fatigue" did the ATSB not see the need for further fatigue analysis?

ATSB response: It is worth noting that the pilot in command's reports to both the ATSB and CASA about his level of fatigue was the same – to both agencies he indicated that he did not believe he was fatigued. However, he provided different information about the amount of sleep he obtained in Samoa.

The inability to more precisely determine the estimated level of fatigue was not due to a lack of analysis, but due to limits in the consistency of a key piece of information – the amount of sleep obtained in Samoa. In terms of evaluating the likely fatigue level during the accident flight, the answer would be somewhat different depending on how much sleep a crew member obtained. The pilot in command provided one answer to the ATSB, shortly after the accident and different information to CASA, over 1 month after the accident.

Here the fragility of memory is used to excuse the ATSB's superficiality.

If the pilot in command obtained a similar amount of sleep as the reported by the co-pilot (5 to 6 hours), then it would seem that the level of fatigue during flight planning and the flight from Samoa to Norfolk Island was at least minor, but not significant, as would be expected after a recent sleep opportunity.

Comment:
The words' minor' and 'significant' have no meaning in fatigue literature.

If the pilot in command actually obtained 4 hours of sleep, then his fatigue level would have been slightly higher but still not significant. The answer to question 4 above provides a relative indication of the likely fatigue at different points of time of the planned duties, although caution should be taken to avoid considering such figures from a bio-mathematical model as accurate answers. See also the ATSB's answer to question on notice 14 (a) from 21 November 2012.

In summary, the crew members were likely experiencing at least a minor level of fatigue prior to and during the accident flight, as would be expected with any such trip involving night operations. However, the available evidence is not reliable enough to conclude that the pilot in command's fatigue level was actually higher, and none of the available evidence is sufficient to conclude that either crew member was significantly affected by fatigue during the accident flight (Samoa to Norfolk Island).

Comment:
The ATSB determined that the pilot in command contributed to the accident and implied it was due to a sub-standard performance. Yet they offer no explanation as to why that performance could have been substandard! Common sense would suggest that at the time of 0800z (when the TAF for Norfolk was amended and which is considered a critical moment in the development of the accident) having been awake since about 0700 local the previous day whether the pilot in command had achieved about 5 hours sleep in Samoa he had effectively been awake for about 32 hours in 38.

The ATSB , had it utilised a BMM such as SAFE, had the ability to retrospectively input every combination of sleep and wake period for the flight crew and express their potential fatigue levels as a range of values using terminology and indices emanating from the scientific studies which underpin such models. Yet they did not do it and expressed fatigue in vague and unprofessional terms such as *minor* or *significant*.

The ATSB adjudged that

… none of the available evidence was sufficient to conclude that either crew member was significantly affected by fatigue during the accident flight. …

This is bizarre when considered against the evidence available through scientific studies which is reflected in the bio mathematical models. Even if we accept the ATSB's belated and incorrect analysis of fatigue using SAFE the pilot in commands fatigue level at Norfolk Island was 3.5 on the Samn Perelli scale. It doesn't sound like much, and is less than the UK CAA's fatigue maximum, but what it actually translates to is a degradation of performance over the baseline levels of about 39% in relation to complex tasks and about an 18% degradation in missed responses-when expressed in terms of BAC a level about .027% (which would get you fired if you turned up for work and were subject to a drug and alcohol test).

Furthermore the ATSB's analysis when using the SAFE model did not compare the pilot's cumulative fatigue against the maxima defined by the Nicholson curve.

This was either a deliberate omission or incompetence.

16. In light of CASA material published by the committee and discussed at the hearing on 15 February, do you believe a review of and changes to your report are warranted?

ATSB response: The implications for the ATSB investigation and report of the content of the Chambers report were discussed in the ATSB's response to the written questions on notice from the ATSB's appearance on 15 February 2013.

In respect of the email between the UK CAA and CASA on 11 December 2009, the ATSB considers that no changes to its report are warranted (see answer to question 4 above for more information).

With regard to the CASA FRMS audit, the ATSB notes that the audit report provides more detailed information and evidence to support the FRMS findings listed in CASA's Special Audit (which were briefly summarised in the CASA Accident Investigation Report). The CASA FRMS audit identified several important issues associated with Pel Air's FRMS. However, the audit report did not provide any new information that would assist with determining the
level of fatigue associated with the accident flight, and the main themes of the report do not appear to be associated with the circumstances of the accident.

As noted in the ATSB's answer to question on notice 13 from 21 November 2012, the judgement regarding whether to include matters that are not contributory in the scope of a safety investigation involves considering a range of factors. In this case, the ATSB was aware that CASA was conducting a review of the operator's FRMS. Accordingly, the safety enhancement value of the ATSB considering the issue in its investigation was limited.
Some of the key themes discussed in the FRMS audit are discussed below:

- Many safety check processes within the FRMS appear not to have been followed: The content of the FRMS audit suggests that this finding was primarily associated with cases where crews conducted duties in excess of 15 hours and the relevant form and follow-up actions were not completed. This situation did not apply to the accident flight.

Comment:
Yes it did, although their rostered duty on the previous day did not commence until about 2100 They were only contacted at about 2000 and told of the duty. The crew had effectively been on standby up till that point. That is – they had been on duty. This is acknowledged in the Civil Aviation Orders and CAAP 48.0.

It simply stands to reason that for purposes of calculating fatigue the most important factor from the human body's perspective is time awake vs. time asleep and on that score the crew had effectively incurred a sleep debt on the flight from Sydney to Apia on the first night which was not paid off in the short rest period available on the 18th November. Cumulative fatigue can be easily calculated using the SAFE model again and displayed as a Nicholson curve.

- Over-reliance by operations staff on the FAID bio-mathematical modelling score to provide a fly/no-fly decision: Unfortunately this is not a novel finding for many organisations in aviation or rail in Australia. Accordingly, regulatory agencies in Australia have issued guidance information and alerts regarding the use of BMMF in general, and FAID in particular. In this case the assignment of the duty was based on a low anticipated FAID score, and also that there would be a minimum rest break in Samoa of 10 hours. There was an obligation on the crew to report if they were fatigued, but they did not believe they were.
- From the interviews conducted with crew, it appears that permanent standby has resulted in 'psychological fatigue'. The content of the FRMS audit suggests that this finding was primarily associated with situations where crews were on continuous standby for several weeks at a time. This was not the case with the accident flight crew. The ATSB acknowledges that in some situations, extended periods of standby could lead to stress and therefore fatigue. However, in this case the pilot in command was on his second day of standby (after 2 days off duty), and the co-pilot was on her first day of standby. Both reported sleeping normally prior to being contacted for the duty. In addition, it is worth noting that the crew were conducting minimal actual flying duties in the weeks prior to the accident, which reduces one potential source of fatigue.
- Lack of FRMS policy regarding fatigue management for multiple time zone changes: The accident trip involved flying from Sydney to Samoa and return to Melbourne. This involved a time zone change of 2 hours. Given that the period in Samoa was relatively short, and all during the daytime, the effects of time zone changes were not likely to have been problematic.

Comment:
There would be no need for the ATSB to guess at these things if they had used a BMM to do a fatigue evaluation in the first place. Many models underpinned by comprehensive scientific data would have incorporated the time zone effects. The ATSB ventures *opinions* on these matters while CASA (ICAO recommends) requires operators to manage fatigue using scientific principles. The airlines have rightly interpreted this to mean –use a BMM fatigue model- but apparently the ATSB does not need to do so!

The FRMS audit clearly indicates concern with the processes used by the operator to manage fatigue risk to an appropriate standard. In terms of assessing whether a particular trip was acceptable in terms of fatigue risk, the operator's processes had limitations. However, it is unlikely that, even if the operator had more robust processes, a different decision about whether to conduct this trip would have been made. There was elevated risk associated with the flight from Norfolk Island to Samoa (due to the hours awake) and there would have been

elevated risk on the flight from Norfolk Island to Melbourne (due to factors such as likely hours sleep in the last 24 hours and circadian factors). The flight from Samoa to Norfolk Island was associated with less inherent fatigue risk. However, with suitable risk controls in place, the risk of these flights could have been reduced to an acceptable level for the type of operation. As previously noted by the ATSB in its answer to question on notice 14 from
21 November 2012, the crew appeared to be managing the potential risk by using strategic naps and taking advantage of their sleep opportunity in Samoa. These practices were consistent with the FRMS.

Appendix E of the FRMS Audit discusses a mock trial of the operator's FRMS system. This trial involves applying the prior sleep wake model (PSWM) to a scenario with some similarities to the

accident trip. Under the operator's FRMS, the PSWM appeared to be only required to be used to assess extension of duty periods (more than 15 hours), and therefore was not required to be used for the 17-18 November 2009 duty periods. Based on hypothetical prior sleep and wake data, the mock trial concluded that some crew members should not be allowed to conduct the duties associated with the scenario trip. However, it needs to be noted that the scenario used had the aircraft departing from Samoa at 2000, which would lead to a significantly higher risk level towards the end of the trip than the actual duty period relevant to the accident flight (aircraft departing at 1645). Applying the PSWM to the actual trip from Sydney to Samoa or from Samoa to Melbourne would have probably indicated an elevated but not unacceptable risk if suitable risk controls were applied.

Comment:
The ATSB's response here exemplifies the problems in the organisation (ATSB). They appear to use judgement and inference to determine that the actions of the flight crew were contributory yet other safety factors are not considered contributory unless the highest standard of proof can be offered. And the ATSB certainly doesn't appear to want to be the organisation that has to go to the trouble of gathering evidence, especially when it does not suit their pre -conceptions. (Outcome bias)

The following issues were not explored in anything like the depth expected of an august body such as the ATSB (used to be):

- Clarity and receipt of radio transmissions
- Responsibility to provide safety related information (including hazardous weather) to flight crew
- Adequacy of ATC procedures to determine whether safety critical information has been received by flight crew
- Adequacy of regulatory guidance material with regard to alternate aerodromes
- Adequacy of regulatory fuel guidance with regard to remote / isolated aerodrome
- Adequacy of operators guidance material
- Adequacy of training
- Adequacy of the BoM forecast accuracy
- Adequacy of the provision of FIS
- Fatigue
- Adequacy of Operator's flight crew support structures
- Commercial realities – availability of alternate aerodromes in the context of the availability of fuel services and Operations specifications imposed by other regulators.
- Adequacy of the aircraft within the operators commercial limiters in the context of EMS operations

Questions & Answers – at Friday, 15 February 2013 hearing.
CANBERRA, ACT,

1	25	ATSB	Senator Fawcett	25/02/13
2	30 – 31	ATSB	Senator Xenophon	25/02/13

3	34	ATSB	Senator Fawcett	25/02/13
4	34	ATSB	Senator Xenophon	25/02/13

SENATE RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

Inquiry into aviation accident investigations

Public Hearing – Friday, 15 February 2013

Questions & Answers – Australian Transport Safety Bureau

1. HANSARD, PG 25

Senator FAWCETT: …Have you had a chance to read the chamber's report?

Mr Dolan: I received it at most half an hour ago, so I have only had a chance to look at the broad headings in it.

Senator FAWCETT: I accept that. I also accept that so far you have not had a look at the fatigue special audit, because that is still being redacted prior to being distributed. Perhaps you could take this on notice: the committee would appreciate getting your feedback as to the content of those two reports and whether that would have changed some of your decision points in terms of the scope of the investigation.

I take you to emails of 9 and 10 February, between one of your officers and yourself, with a CC to Mr Sangston, where the officer talks about the fact that, from the systemic investigation perspective, there are three separate slices of the James Reason defences—that being the flight crew, the operator and the rule maker—and that it is important to look at all of those.

As I follow through the email traffic, it becomes clear to me that the scope of the operator and the rule maker appears to be reduced as a function of a lack of evidence. There is some discussion around evidence tables and what is hearsay versus what is clear evidence, and so those things are, essentially, scoped out of the report.

Mr Dolan: On the basis that we can only work on facts and evidence, Senator, and not on speculation, yes.

2. HANSARD PG 30 - 31

Senator XENOPHON: It is a pretty big deal to do a special audit request of CASA, isn't it?

Mr Sangston: I am aware of two. One being this investigation and the other one being the Canley Vale investigation.

Senator XENOPHON: When were those special audit requests made with respect to the issue date of the final report? Do you want to take that on notice?

Mr Dolan: I think we have already answered that question for this investigation.

Mr Sangston: It is in our most recent submission.

Mr Dolan: But we can get you the answer on the other investigation.

---

3. HANSARD PG 34

Senator FAWCETT: Also, in terms of that, was it the Canley Vale special audit that you mentioned, Mr Sangston?

Mr Sangston: Yes.

Senator FAWCETT: How did you become aware of that? Did CASA offer that up to you, did you have to seek it or did a third party tell you it existed? How did you come to be aware of it?

Mr Sangston: It was attained by what we call a section 32 request form, under our—

Senator FAWCETT: But how did you become aware of it? Did CASA tell you that they had done it?

Mr Sangston: I would have to take that on notice and get back to you, because I have not had that discussion with the investigator in charge.

---

4. HANSARD PG 34

Senator XENOPHON: Did you only ask for it [the Canley Vale special audit] after the *Four Corners* program was broadcast in September 2012?

Mr Sangston: My recollection is that it was after that.

Senator XENOPHON: So it was just a coincidence that it was only asked for after the *Four Corners* report?

Mr Dolan: Senator, we can get back to you with when we sought that report and any context we can supply after a conversation with the investigator in charge as to why that information was sought.

Senator FAWCETT: Sure. The more important question from our perspective is: were you apprised of the existence of the report by CASA, or did you find out about it through a third party and then request it? I fully accept the fact you requested it when you did.

Mr Dolan: We will take that on notice. I would like to just verify exactly what went on there.

Senator FAWCETT: Sure.

SENATE RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

Inquiry into aviation accident investigations

Public Hearing – Friday, 15 February 2013

Questions Taken on Notice – Australian Transport Safety Bureau

1. HANSARD, PG 25

Senator FAWCETT: …Have you had a chance to read the chamber's report?

Mr Dolan: I received it at most half an hour ago, so I have only had a chance to look at the broad headings in it.

Senator FAWCETT: I accept that. I also accept that so far you have not had a look at the fatigue special audit, because that is still being redacted prior to being distributed. Perhaps you could take this on notice: the committee would appreciate getting your feedback as to the content of those two reports and whether that would have changed some of your decision points in terms of the scope of the investigation.

I take you to emails of 9 and 10 February, between one of your officers and yourself, with a CC to Mr Sangston, where the officer talks about the fact that, from the systemic investigation perspective, there are three separate slices of the James Reason defences—that being the flight crew, the operator and the rule maker—and that it is important to look at all of those.

As I follow through the email traffic, it becomes clear to me that the scope of the operator and the rule maker appears to be reduced as a function of a lack of evidence. There is some discussion around evidence tables and what is hearsay versus what is clear evidence, and so those things are, essentially, scoped out of the report.

Mr Dolan: On the basis that we can only work on facts and evidence, Senator, and not on speculation, yes.

1. ATSB Response:

The ATSB has reviewed the Chambers Report to see whether it contained evidence that might support substantive changes to the report of the investigation into the Norfolk Island ditching. In this context, it should be noted that the ATSB had already, as part of its investigation, assessed the content of

CASA's special audit of Pel-Air and had regard to that audit in finalising its report. It should also be noted that the primary (but not sole) purpose of an ATSB investigation is to establish the factors that contributed to an accident, and that the Chambers Report does not contain any new evidence that organisational factors were likely to have contributed to the accident.

In the view of the ATSB, there is insufficient additional material within the Chambers Report to support changes to the existing findings of the ATSB report or to require new findings. As regards the accident flight, the Chambers Report reflected what was separately reported (and available to the ATSB) in the reports of CASA's accident investigation and of its special audit of Pel-Air.

The Chambers Report could have been an indicator to the ATSB of potentially relevant organisational issues within Pel-Air and CASA. The report's availability to the ATSB investigation would likely have led to a review of the scope of the investigation to determine whether there needed to be further examination of possible organisational factors in the accident. That said, it is unlikely that the Chambers report would have led to substantive re-scoping of the investigation, since the CASA accident investigation report already indicated the existence of organisational deficiencies and the ATSB safety factor identification processes include the consideration of organisational factors as part of the scope of an investigation.

The ATSB does not consider that lack of access to the Chambers Report was a constraint or limitation to the ATSB investigation and its assessment of factors contributing to the accident.

The ATSB has also reviewed the CASA fatigue audit. The ATSB notes that it provides more detailed information and evidence to support the FRMS findings listed in CASA's Special Audit (which were briefly summarised in the CASA Accident Investigation Report). The CASA FRMS audit identified several important safety issues associated with Pel Air's FRMS. However, the audit report does not provide any new information that would assist with determining the level of fatigue associated with the accident flight, and the main themes of the report do not appear to be associated with the circumstances of the occurrence.

As the ATSB has previously advised the Committee, any judgement about whether to include, within the scope of a safety investigation, matters that are not contributory to the occurrence involves considering a range of factors. In this case, the ATSB was aware that CASA was conducting a review of the operator's FRMS. Accordingly, the ATSB judged that the safety enhancement value of considering this non-contributory issue in its investigation was limited.

Comment:
How could the ATSB have known it would be non-contributory before reading the content of the CASA FRMS Audit? The ATSB's arguments are circular.

It beggars belief that, where the CASA Special Audit of FRMS of the operator stated the following that the ATSB did not consider a deeper level investigation of fatigue was warranted:

1. ***…It is evident that the fatigue reporting culture is deficient.***

2. ***…The FRMS is largely reactive, in that an event must occur before action is taken.***

3. ***…There were a number of breaches including a critical breach involving a crew member who was allowed to conduct a duty totalling 23 hrs 45 minutes.***

4. ***…Pel-Air holds an international AOC and FRMS yet there remains no policy on how to manage time zones changes and circadian adaptation.***

5. ***…No evidence was found that supported the claim that Pel Air FRMS had ever managed fatigue risk to a standard considered appropriate particularly for an operator conducting adhoc back of the clock medivac operations.***[11]

The ATSB states that ….*However, the audit report does not provide any new information that would assist with determining the level of fatigue associated with the accident flight, and the main themes of the report do not appear to be associated with the circumstances of the occurrence.*

Comment
The ATSB's fatigue investigation did not make any use of Bio Mathematical models and did not substantially and thoroughly consider the potential for impaired performance due to fatigue.

The ATSB's fatigue investigation comprised the following statements in the Factual Information section of the report:

General
Both flight crew members underwent a crew resource management education program that was conducted by the operator in March 2009. They had not received any threat and error management

[11] Page 3 of the FRMS Special Audit.

(TEM)[32] training as part of that program, nor was there any regulatory requirement for them to have done so.
The flight crew had been awake for over 12 hours before being called on duty at 0900 for the departure from Sydney on the previous day, and they had been awake for over 22 hours when they landed at Samoa. After having breakfast they had about 8 hours opportunity at a hotel for rest prior to returning to the airport. The captain initially reported to the ATSB that he slept for most of this period and was well rested, but later reported to the Civil Aviation Safety Authority (CASA) that he had only about 4 hours sleep but did not feel fatigued. The first officer advised of having 5 to 6 hours sleep and feeling well rested.
Based on this information, it is likely that the flight crew were experiencing a significant level of fatigue on the flight to Samoa, and if the captain only had 4 hours sleep then it is likely he was experiencing fatigue on the return flight at a level likely to have had at least some effect on performance. However, there was insufficient evidence available to determine the level of fatigue, or the extent to which it may have contributed to him not comprehending the significance of the 0800 SPECI..
… The co-pilot reported that she could have been taking a scheduled 'short sleep' at the time of the radio communication with ATC. Short sleeps were an authorised component of the aircraft operator's fatigue management regime. The co-pilot did not recall receipt of the 0800 SPECI.

Comment

There was NO analysis of fatigue in the Analysis Section of the report. So how the ATSB incorporated fatigue issues into its thinking on this accident is difficult to comprehend since conclusions and findings are generally derived from analysis!

A thorough report would at least have analysed fatigue using the FAID system employed by the operator and then cross checked its results against another system (say SAFE or SAFTE).

The report could have developed tables of predicted fatigue values for varying scenarios of duty time and rest and arrived at a likely conclusion.

Not only did the ATSB not do this they also:

1. Interviewed the crew regarding the incident well after the useful memory (recall time had elapsed)
2. When they interviewed the crew they asked questions which drew an answer from the crew to the effect that*… 'they did not feel fatigued prior to commencing duty'.*
   This type of question is fundamentally flawed since as the ATSB well knows:

   a. A fatigued individual is not a good judge of their level of fatigue
   b. Asking crew whether they commenced a duty when knowingly fatigued is inviting them to incriminate themselves. Therefore any information provided from this line of questioning is of very little value.

For these reasons alone the ATSB fatigue examination could be described as cursory at best and unlikely to have yielded any new information.

Having now been presented with the FRMS Special Audit the ATSB still maintains that it wouldn't have added anything to their investigation –is an embarrassment.

It should at the very least have prompted a review.

In fact this is what was proposed by one ATSB Officer but he was deterred from doing so because it was… "*too late to deviate from the target*"

2. HANSARD PG 30 - 31

Senator XENOPHON: It is a pretty big deal to do a special audit request of CASA, isn't it?

Mr Sangston: I am aware of two. One being this investigation and the other one being the Canley Vale investigation.

Senator XENOPHON: When were those special audit requests made with respect to the issue date of the final report? Do you want to take that on notice?

Mr Dolan: I think we have already answered that question for this investigation.

Mr Sangston: It is in our most recent submission.

Mr Dolan: But we can get you the answer on the other investigation.

2. ATSB Response:

The ATSB has requested copies of CASA special audits in respect of two other investigations. The first was the investigation into the collision with terrain that occurred on 15 June 2011 near Canley Vale, New South Wales on 15 June 2010 (investigation AO-2010-043). In this case, the ATSB requested the special audit on 5 September 2012 and the final investigation report was released on 20 December 2012.

The second was the investigation into the descent below minimum safe altitude south of Avalon Airport, Victoria on 30 June 2011 (investigation AO-2011-076). In this instance, the ATSB requested the CASA special audit on 4 October 2012. The final investigation report is expected to be released to the public in April 2013.

3. HANSARD PG 34

Senator FAWCETT: Also, in terms of that, was it the Canley Vale special audit that you mentioned, Mr Sangston?

Mr Sangston: Yes.

Senator FAWCETT: How did you become aware of that? Did CASA offer that up to you, did you have to seek it or did a third party tell you it existed? How did you come to be aware of it?

Mr Sangston: It was attained by what we call a section 32 request form, under our—

Senator FAWCETT: But how did you become aware of it? Did CASA tell you that they had done it?

Mr Sangston: I would have to take that on notice and get back to you, because I have not had that discussion with the investigator in charge.

3. ATSB Response:

The ATSB was aware of the CASA special audit in respect of the Canley Vale investigation on 24 July 2010, about was five weeks after the accident. CASA issued a media release on 24 July 2010. This media release advised of an investigation into the operator.

4. HANSARD PG 34

Senator XENOPHON: Did you only ask for it [the Canley Vale special audit] after the *Four Corners* program was broadcast in September 2012?

Mr Sangston: My recollection is that it was after that.

Senator XENOPHON: So it was just a coincidence that it was only asked for after the *Four Corners* report?

Mr Dolan: Senator, we can get back to you with when we sought that report and any context we can supply after a conversation with the investigator in charge as to why that information was sought.

Senator FAWCETT: Sure. The more important question from our perspective is: were you apprised of the existence of the report by CASA, or did you find out about it through a third party and then request it? I fully accept the fact you requested it when you did.

Mr Dolan: We will take that on notice. I would like to just verify exactly what went on there.

Senator FAWCETT: Sure.

4. ATSB response:

The ATSB requested the CASA special audit to confirm the completeness of the evidence collected during the investigation. A review of the special audit confirmed the completeness of the ATSB's evidence. The ATSB was aware of the fact that CASA was conducting a special audit of Pel-Air from a comparatively early stage of the investigation.

Comment

It would have made more sense to request the Canley Vale special audit to 'verify the completeness of the ATSB investigation" **well prior** to producing the Draft report for DIP comment. As I understand it the Draft report was provided to the DIPs with a planned closing date for comment around the end of August 2012. A one week extension was made to the closing date for DIP comment. It was in this extension period that the request for the special audit was made. Again without having been aware earlier of the content of the special audit the ATSB would have had no way of determining its relevance prior to producing its Draft final report and any investigator worth his or her salt would not issue a draft report knowing that they hadn't taken account of information contained in a special audit conducted by the regulator.

The request by the ATSB was clearly an afterthought and one which reflects poorly on the ATSB's thoroughness as an investigative body.

The lack of transparency and clarity in the ATSB's explanations during the course of this Inquiry must also cast doubt on their integrity.

ATSB risk matrix for application when considering the risk associated with an identified safety issue:

The following tables were initially described to the Committee as part of the ATSB's original submission of October 2012 (see pages 21 and 22 of that submission) and are used to assess the risk associated with a safety issue. This assessment is of the worst credible scenario, which is the worst occurrence – in terms of the severity of its consequences – that could occur as a result of a safety issue after consideration has been made of the risk controls and management processes in place to minimise risk. These risk controls and management processes will generally reduce the level of adverse consequences associated with the worst possible scenario. In other words, the worst credible scenario has to be a plausible, feasible or reasonably believable scenario.

Consequence table

	Minimal	Moderate	Major	Catastrophic
Aviation				
Air transport > 5,700 kg (fare-paying passengers)	Minor incident only (e.g. birdstrike)	Incident	Accident; Serious incident; Incident with many minor injuries	Accident with multiple fatalities, or aircraft destroyed plus fatalities / serious injuries
Air transport > 5,700 kg (freight); Air transport < 5,700 kg (fare-paying passengers)	Incident	Accident; Serious incident; Incident with many minor injuries	Accident with multiple fatalities, or aircraft destroyed plus fatalities / serious injuries	N/A
Other commercial operations	Accident; Serious incident; Incident with many minor injuries	Fatal accident; Accident with aircraft destroyed or multiple serious injuries	N/A	N/A
Private operations	Accident with aircraft destroyed or multiple serious injuries	Fatal accident	N/A	N/A

Likelihood table

Level	Descriptor	Description	Indicative frequency
A	**Frequent**	Is expected to occur	One (or more occasions) per year
B	**Occasional**	Probably will occur in the medium-term future	One in 10 years
C	**Rare**	Could occur in some circumstances	One in 100 years
D	**Very rare**	Not expected to occur except in exceptional circumstances	One in 1,000 years (or less)

The table below shows the risk matrix to calculate the level of risk once the consequence and likelihood levels have been identified.

		Consequences			
		Minimal	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Frequent**	Significant	Significant	Critical	Critical
	Occasional	Minor	Significant	Significant	Critical
	Rare	Minor	Minor	Significant	Critical
	Very rare	Minor	Minor	Minor	Significant

Comment:
It is notable in this explanation that the ATSB do not state exactly what likelihood and consequence they ascribed in order to determine the risk rating (of minor). Nor do they elucidate on the classification of the operators' EMS operation. (The reader is left to assume that it is- other commercial- as shown in the consequence table)

Leaving this evasiveness aside, there is a fundamental problem with the ATSB's use of the matrix.

1. Risk matrices are not standard (which means in some sense they are arbitrary). The ATSB risk matrix is unique when compared to those used by other key participants in Australia's State Aviation Safety Program (SASP) and their contemporaries overseas, in that a fatal accident attracts a ***Moderate*** consequence rating whereas in other risk models a fatal accident will always attract a ***Major*** consequence rating.

2. The likelihood of the threat posed by a lack of clear guidance affecting in-flight decision making is evidenced by the general importance placed by operators and the regulator on Standard Operating Procedures. Making clear what is to be done, by whom, how and when (through clear guidance) has been fundamental in achieving accident and incident reduction of the years. It is axiomatic that the threat posed by a lack of clear guidance (in general and as evidenced by the ditching at Norfolk Island) is at least ***occasional*** but probably ***frequent***.

3. The combination of likelihood and consequence therefore using the ATSB risk matrix should yield at least a **significant** rating and if another SASP key player's consequence rating was used it would be ***significant*** to ***critical***

4. It is imperative to be aware that any estimate of likelihood and consequence are predictions. The estimates should therefore err on the safe side. The ATSB did not do so here when reclassifying the safety issue from ***critical*** to ***minor***!

5. There are further mystifying aspects of the ATSB risk matrix. Why would air transport freight operations > 5700 kg. warrant a higher consequence rating than other (passenger carrying) commercial operations? This in effect would mean that the ATSB believe the risk posed by a Beechcraft 1900 engaged in air transport freight operations represents a higher risk than the same aircraft carrying 19 passengers on a charter flight. **It defies logic**.

6. What does it say about the ATSB risk rating system where the consequence **will** change by an order of magnitude or two simply because CASA proceeds to change the rules such that aerial work operations will be reclassified as air transport as is intended? Risk should be independent of the classification of the operation. Is a life of a passenger in the aerial work category worth less than the life of someone in the air transport category?

7. The ATSB should not be getting involved in risk assessments except as far as to determine the risk to itself. The ATSB should define the **threat** (call it safety issue). An operator (and possibly the regulator) should define the risk since it alone is most aware of the intricacies of its operation.

8. If the ATSB wants to utilise risk management, it should be defining the worst credible risk across the industry (since a large aircraft operator must deal with the threat of insufficient in-flight decision making guidance just as much as a small operator). Large commercial aircraft have ditched into the ocean in the past (for complex reasons) and it is entirely plausible and demonstrable (as in this event) that lack of in-flight guidance could be a safety factor in future such occurrences. In fact the ATSB acknowledges this by listing it as a safety factor in this event (the Pel- Air ditching). So there exists some likelihood for which the consequence could be multiple fatalities and the loss of the aircraft as occurred in 1970[12]. Surely (if the ATSB wants to be in the business of defining risk) this represents at least a **significant** risk rating using the matrix above (very rare +catastrophic)

I thank the committee for its tireless work on a very important public safety issue.

Yours sincerely

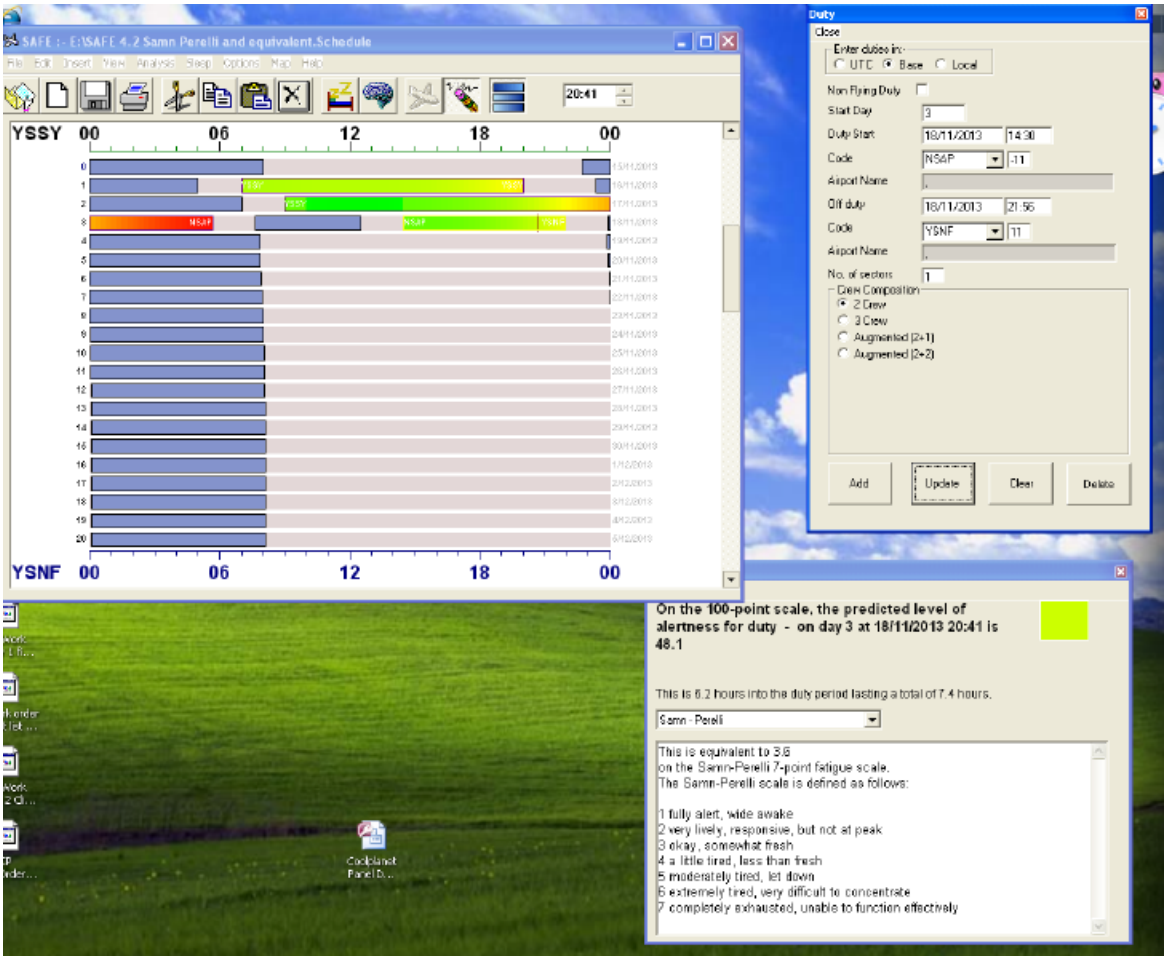
Bryan Aherne

[12] On 2 May 1970, ALM Flight 980 (a McDonnell Douglas DC-9-33CF), ditched in mile-deep water after running out of fuel during multiple attempts to land at Princess Juliana International Airport on the island of Saint Maarten in the Netherlands Antilles under low-visibility weather. Insufficient warning to the cabin resulted in several passengers and crew still either standing or with unfastened seat belts as the aircraft struck the water. Of 63 occupants, 40 survivors were recovered by U.S. military helicopters.[19]

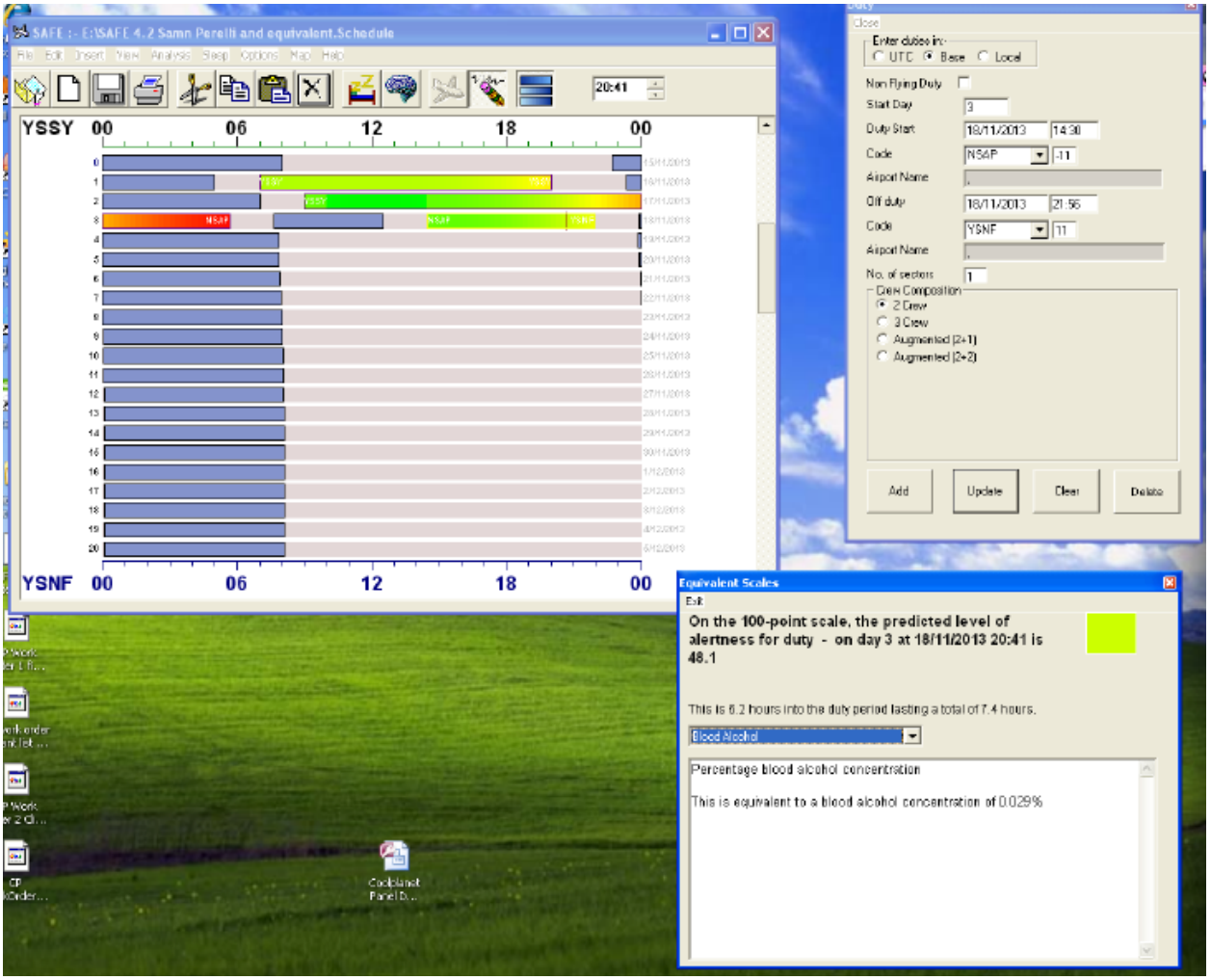
Appendix: SAFE Snapshots. Based on SAFE v4.0

1. Samn Perelli Fatigue Level at 20:41 on 18 November 2009.

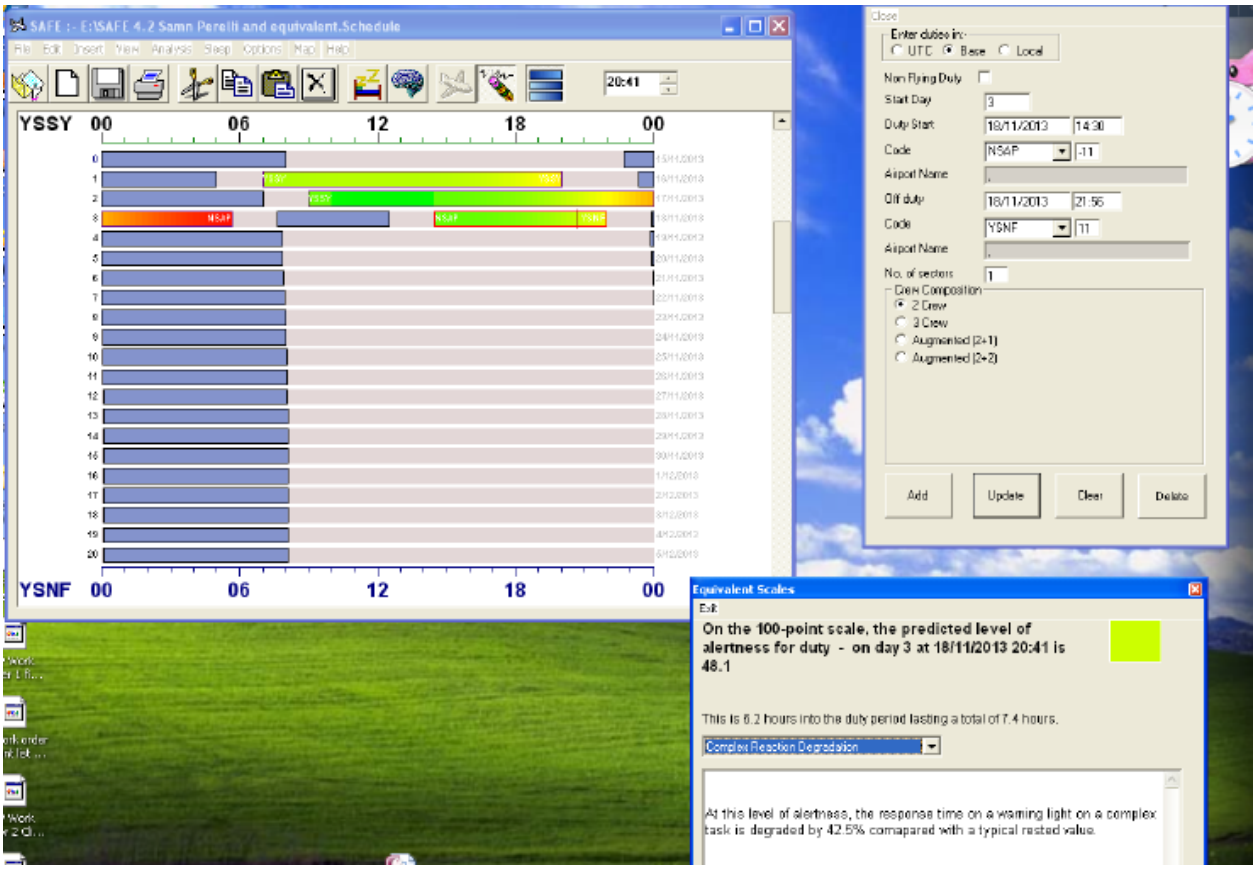
   This shows a fatigue rating of 3.6 at 20:41 (a critical time for planning and decision making). It also shows that a 5 hour sleep period in Samoa was assumed by the system. The sleep period is shown as a blue/grey bar between the end of duty in NSAP-Apia (coloured red) and the Start of duty in Apia (coloured green).



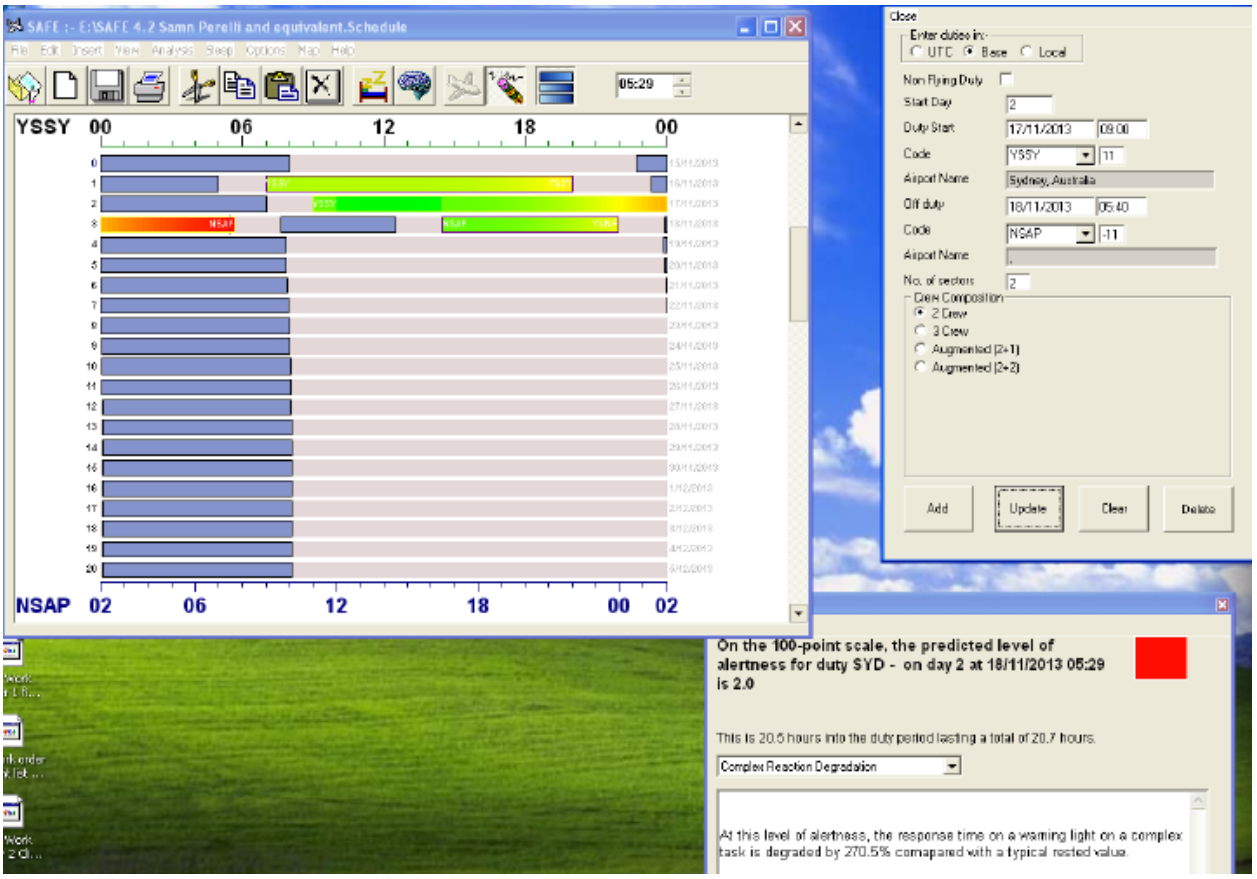
2. Blood Alcohol Concentration of .029% Equivalent Fatigue Level at 20:41 on 18 November 2009



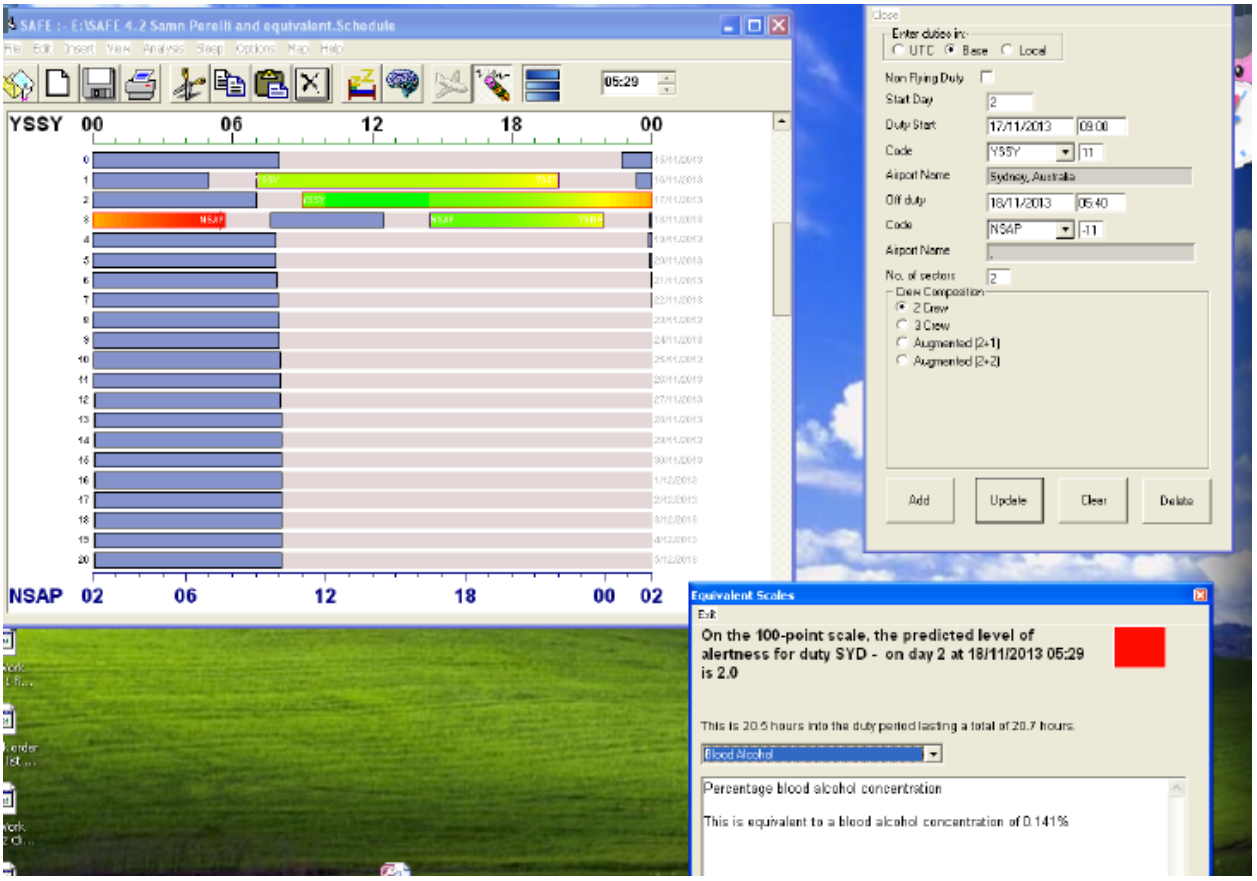
3. Complex Reaction Degradation of 42% at 20:41 on 18 November 2009



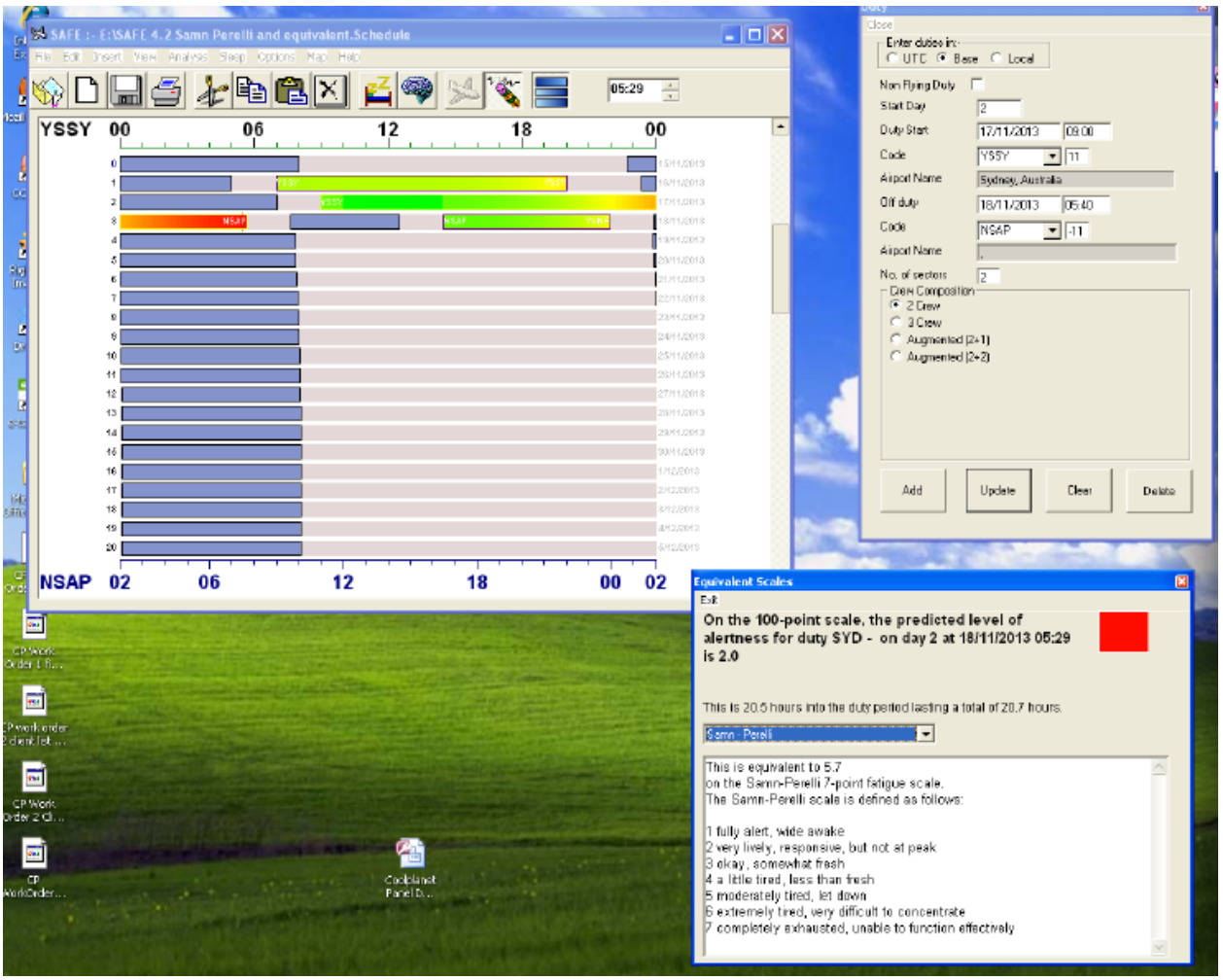
4. Complex Reaction Degradation of 270% at 05:291 on 18 November 2009



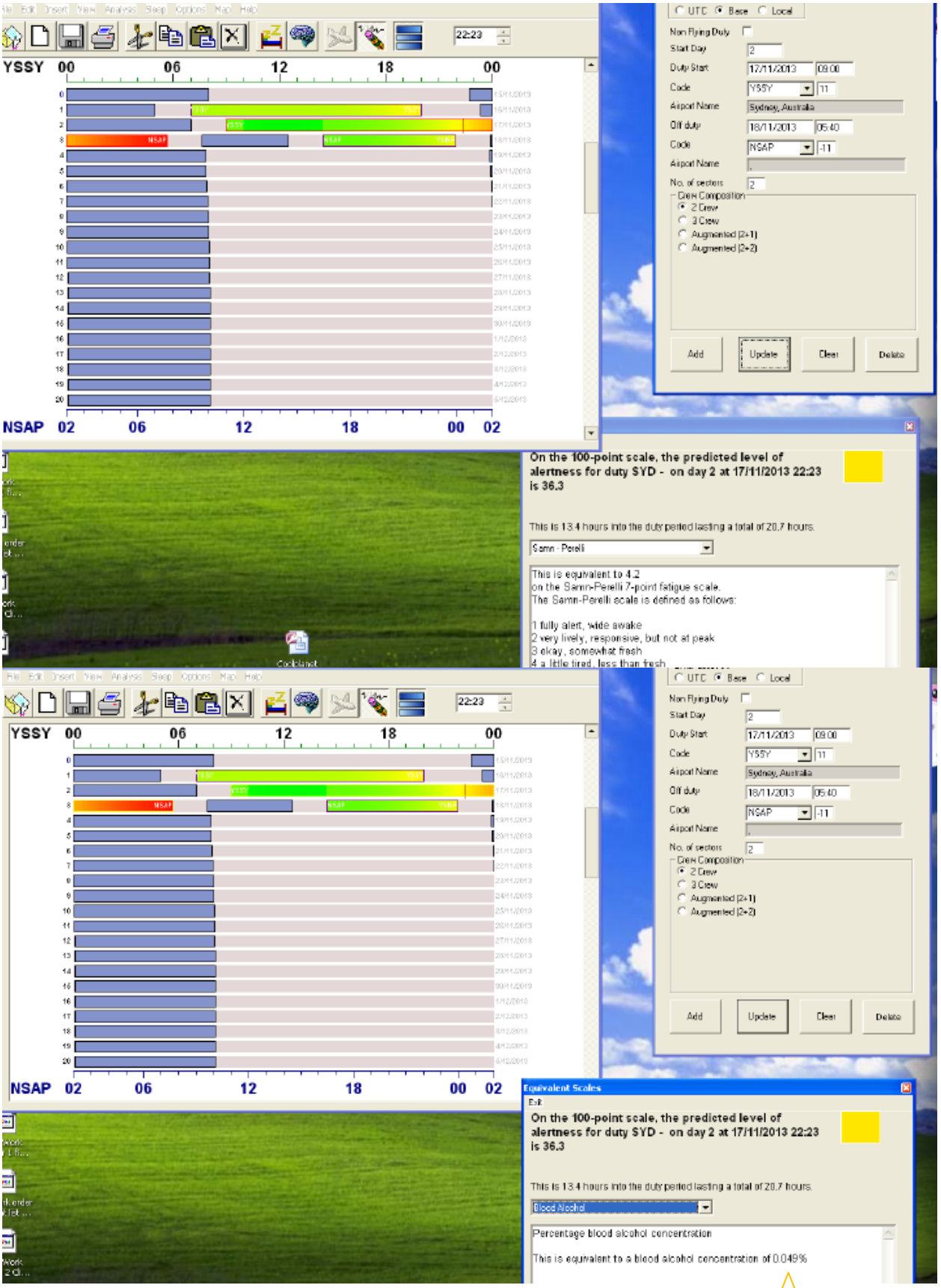
5. Blood Alcohol Concentration of .14% Equivalent Fatigue Level at 05:29 on 18 November 2009



6. Samn Perelli (5.7) Fatigue Level at 05:29 on 18 November 2009

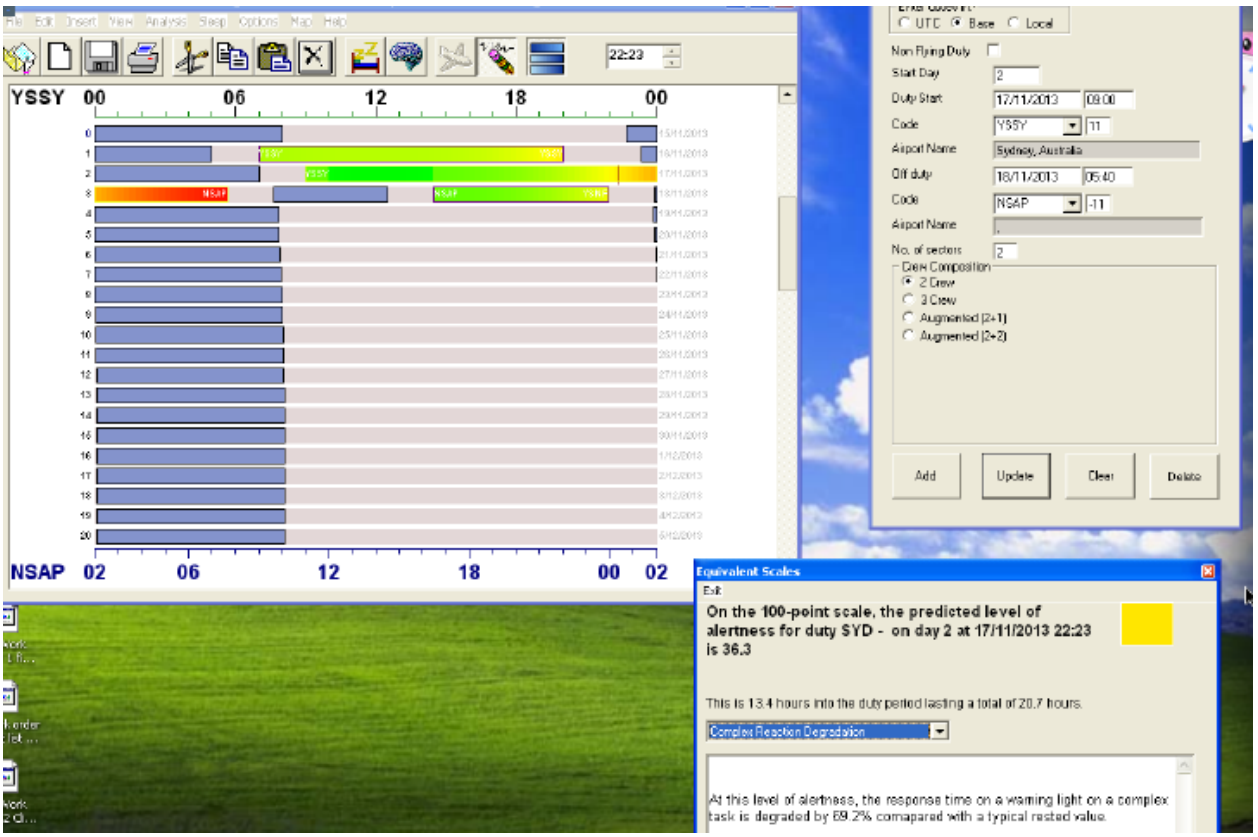


7. Samn Perelli (4.2 Equates to a Blood Alcohol Concentration of .049%) achieved at 22:23 on the 17 November 2009



This is equivalent to a BAC of 0.049%

8. Complex Reaction Degradation (69%) Equivalent Fatigue Level at 20:41 on 18 November 2009



9. Nicholson Curve Cumulative Fatigue Maxima (Green Dotted Line). Actual cumulative fatigue 16-18 November 2009 shown as blue/ purple line.