Geoff Grint – Presentation

3rd Meeting of the Technical Advisory Panel on Accidental Aircraft Crash Risk
3rd April 2013 – Redgrave Court

Attendees

Tim Allmark (TA)	Technical Lead – ONR
Peter Ackroyd (PA)	Meeting Facilitator – ONR
Joanna Cook (JC)	Business Support – ONR
Matt Lloyd Davies (MLD)	Technical Note-taker – ONR
Geoff Grint (GG)	Office for Nuclear Regulation
[redacted]	Independent
Ian Dugmore (ID)	UK Airprox Board
Malcolm Goodwin (MG)	ABS Consulting
Sid Hawkins (SH)	Air Accident Investigation Branch
Roger Jackson (RJ)	AMEC – Representing DNSR
David Pitfield (DP)	Loughborough University
Malcolm Spaven (MS)	Aviatica
Roberto Trotta (RT)	Data Fusion Consultants Ltd & Imperial College London

Apologies

Alan Farmer – DNSR
Matthew Greaves – Cranfield

Introduction

- TA welcomed attendees and introductions took place around the table for the benefit of new attendees Matt Lloyd-Davies and Peter Ackroyd, and guest presenters Roberto Trotta and Geoff Grint.

Domestics & Changes to Meeting Arrangements

- TA explained that to improve efficiency and ensure progress is made, MLD would be joining the panel as Technical Secretary, and PA, a Human Factors specialist, would be acting as meeting facilitator during this and future meetings of the panel.

Notes and Actions of the Previous Meeting

- The notes of the previous meeting were sent for comment prior to the meeting to avoid lengthy discussion during this meeting. A number of comments were received and the notes amended accordingly.

Actions Review

Action No.	Details	On	Status
15/11 - 01	ONR to advise forum in which the cross departmental issues can be dealt with. Update - TA advised that a response will be given by ONR Policy Team shortly. Review at TAP meeting 4.	ONR	Ongoing – See details column.
15/11-03	TA to ask a colleague specialising in ALARP to confirm that the information is correct or identify any specific errors.	TA	Complete – GG attending this meeting to present on this matter.
15/11-04	Consider Inclusion of Lockerbie at	All	Complete – TA

	meeting 3		comments on this later in meeting
15/11-04	All TAP members to see if they can identify any other extant models for modelling of Accidental Aircraft Crash Rates	All	Complete – TA slide covers later in this meeting
01/02 - 01	All to agree a clear statement of objective for the TAP	All	Ongoing – Park until item 12 (next steps)
01/02 – 02	MGR to circulate a one page spec to the TAP	MGR	Ongoing
01/02- 03	DP to distribute a copy of his model and present it at the next meeting	DP	Complete
01/02 - 04	SH to investigate what the CAA could provide the TAP and if possible, present to the next meeting	SH	Complete – Presented at this meeting
01/02 - 05	[redacted] to provide JC with Dr Trotta's contact details	[redacted]	Complete
01/02 - 06	JC to invite Dr Trotta to the next meeting of the TAP	JC	Complete – Dr Trotta in attendance
01/02 - 07	All to send details of their availability for the 3rd meeting to JC	All	Complete

ALARP/Target 9 Presentation

- GG delivered a presentation on ALARP/Target 9 to the TAP. The presentation slides are appended.
- [redacted] queried how SAPs Paragraph 51 fits with ONR's decision not to evaluate the outcome of an aircraft crash on Dungeness nuclear facilities Paragraph 51 says that if the consequences of an event are very much bigger than Target 9 there may be a need to reduce the allowable frequency of an event. [redacted] queried how ONR could determine that there is no need to determine the consequences on the grounds of low frequency as this would seem to present a circular argument.
- In a post meeting clarification, GG responded that Paragraph 51 applies to both BSLs and BSOs and for obvious reasons ONR is going to be much more concerned at frequencies near BSLs rather than BSOs. Paragraph 51 does not and was not intended to give any commitment that further work would be necessary or would be done. ONR's aim is to put down a marker that it may require further analysis by the Licensee. It would be much more likely that such further analysis would be sought at frequencies near BSLs rather than BSOs. GG also noted that Paragraph 52 recognises that target 9 is a guide to judging whether further analysis may be warranted, it is not a mechanistic rule.
- [redacted] asked for confirmation that if there is a choice, and in the absence of gross disproportion, the lowest risk option should be selected (SAPs paragraph 50). GG explained that an optioneering process should be undertaken. The safest option should be selected and tested for reasonable practicability. If the option is not reasonably practicable, the next safest option should be selected and so on.
- GG noted that the drive to reduce the risks ALARP applies to anything below the BSL but regulatory effort is only applied for situations which fall between the BSL and BSO.
- [redacted] asked GG to clarify the legal basis for targets and limits. GG clarified that targets are HSE/ONR policy whilst limits derive from a legal framework e.g. the Ionising Radiation Regulations.
- [redacted] asked if SAPs paragraphs 35-37 mean the risk should be considered across the entire site. GG replied that an overall consideration of the site should be made in determining whether or not risks have been controlled and reduced ALARP.
- [redacted] asked if BSLs/BSOs should be applied across the entire site. GG confirmed that this need not always be the case and that risk should be based on the area affected. [redacted] asked if the total risk should be the sum of the individual risk elements of the site. GG confirmed that risk should only be summed over the area affected.

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- ID asked for clarification on the regulatory responsibilities of HSE and ONR in the nuclear industry. GG explained that ONR regulates installations and not the whole industry - ONR cannot enforce a balance between economic undertakings. For example, ONR has no regulatory *vires* to require a reactor site to transfer spent fuel to Sellafield.
- MS asked what ONR's expectations would be for a facility with aircraft risk between the BSL and BSO. GG stated that ONR would expect the licensee to consider which aspects of the facility might be vulnerable e.g. cooling water supply, electrical switchgear, and what can be done to protect them in terms of redundancy, diversity and segregation.
- MG asked why there was a difference between reasonable practicability and achievability. GG said that more can always be done.
- RT pointed out that it is important and unavoidable to define quantitative thresholds to determine in which region of the risk chart a certain aspect lies. Furthermore, it is not only necessary to pinpoint numerically a location in the chart, but it is also mandatory to estimate the uncertainty associated with it. This is because a large uncertainty might move risk across thresholds.
- GG explained that ONR would require a demonstration of the sensitivity of a PSA study by, for example, requiring a Monte Carlo simulation. ONR may also require the calculation of importance values for example, reliability on list data fed into PSA. RT asked whether such sensitivity checks had been carried out for aircraft crash risk at uk nuclear sites. GG answered that they had not
- In order to bring the discussion to a close, PA asked GG what he thought the panel needs to take from the presentation to aid its deliberations. GG said the panel should put numerical targets in context and provide a legal basis for decision making. TA commented that risk acceptance criteria are set out in the SAPs and do not form part of the Byrne methodology.
- [redacted] stated that clarification was required in relation to SAPs para 136 on always seeking inherent safety. GG commented that the principle of inherent safety should minimise the need for and reliance on active safety systems, but that passive safety was not the same as inherent safety. If inherent safety cannot be achieved, fault tolerance should be ensured.
- [redacted] asked for confirmation that the BSO and BSLs for Target 9 apply to the total of all events that could result in more than 100 deaths. This was confirmed to be the case. GG noted the other Target 9 events to be flooding and earthquakes (not asteroids for example). He confirmed that one has to sum all of these contributors before making comparison with BSLs and BSOs. He noted that both flooding and earthquakes fall between the BSO and BSL but there was an attempt to then dismiss aircraft crash on grounds that it is below the BSO.

ACTION: The panel should consider GG's comments on [redacted] papers in light of the ALARP presentation.

Tim Allmark – Data/model consensus slides

- TA asked the panel to comment on the slides he had circulated in an attempt to reach a consensus on the current position. The panel asked for clarification on the term 'mechanistic model'. A discussion was had in which [redacted] commented that the ESRT 2009 report referred to the term mechanistic model. The ESRT report refers to a specific site and was not discussed further.
- [redacted] commented that the slides were looking too far ahead and that [redacted] had prepared a preface that was forwarded to the panel. No panel members had had the opportunity to review [redacted] preface and following a short discussion, it was considered that it would not be possible to make progress on this topic.

Presentation by Roberto Trotta

- RT delivered a presentation on Statistical Modelling of crash probabilities. A PDF of the presentation is appended. A PDF of the presentation was circulated to TAP members following the meeting and is also saved at TRIM 2013/122618.

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- SH asked to what extent we can rely on data today compared to data from 20 years ago. RT recognised that this was a very important point and that it applying reliability weights based on expert opinion may be a possible way forward. Including appropriately weighted past data is preferable to simply excluding them, since the latter generically introduces systematic bias which would otherwise go unaccounted for and undetected. RT also noted that including weighted past data might increase the statistical error of the predictions with respect to the case when all past data are blindly included without appropriate weighting.
- [redacted] queried the validity of data which was based on an incomplete data set. RT replied that it would depend on what data had been omitted and the choice made in terms of how to select data was crucial and should be regarded as part of the model itself.
- RJ questioned the compounding of uncertainty with models that go on to calculate statistical deaths. RT said this reinforced the point that there will always be large uncertainty in these calculations, but that it was important to understand and quantify the uncertainty to understand the domain in which the risks exist.
- [redacted] queried the impact of omitting outlying data points and the sensitivity of a given model to omitting data. RT said that statistical uncertainty increases with distance from the location of the empirical data. RT also made the point that on top of the statistical uncertainty, omitting certain data points with arbitrarily chosen criteria also increases the systematic uncertainty. The latter is much more difficult to counter as it is hidden by the model's output
- TA commented that conservatism had not been mentioned in any discussions so far today. RT replied that the Byrne model is not conservative and in fact it underestimates the uncertainty associated with its output and therefore it is likely to underestimate the associated risk.

Presentation by Sid Hawkins

- MS asked how the data on hours was obtained. SH replied that there was some uncertainty over this but that most was taken from flight plans.

Presentation by David Pitfield

- DP's presentation is not appended to these minutes due to space restrictions. However, a copy can be obtained from DP or JC. A summary of the salient points from the presentation follows;
- The results presented were the output from three doctorate studies investigating the modelling of frequency, location and consequences of accidental aircraft crash.
- Data was obtained from a very broad range of international sources, with preliminary statistical analysis being conducted by a third party in the US.
- Modelling accidental aircraft crashes involves three components: a frequency model, a location model and a consequences model. Detailed results were presented for the frequency and location models which have been developed to a greater extent than the consequences model.
- RT asked if any parameter reduction techniques such as principal component analysis, had been undertaken on the parameters given that there are so many. DP replied that there had not.
- [redacted] and RT asked what the probability criteria applied to the airfield safety zone example. DP replied that this was based on an equation with many parameters but that he did not remember what the numerical value was.
- DP believes the work undertaken by Loughborough and continued by ACRP in developing a framework for modelling frequency, location and consequences, has merit. However, DP believes the location models could be improved if greater attention was paid to causality but that difficulties with data exist. For example, meteorological influences on distance and inaccurate recording of lateral deviations from the runway. It was also recognised that the influence of excess distance i.e. the difference between runway length and the required distance for the operation, on location should also be accounted for.

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- DP concluded that consequence modelling is likely to have local elements that will dominate and that it is perhaps best to deal with these on a case by case basis. However, variation in aircraft type, wingspan and speed should be included together with runway construction i.e. factors that will influence aircraft deceleration.
- DP closed his presentation by recommending two additional areas that deserved attention in accidental aircraft crash modelling, namely: accidents that occur over 2000ft, but within 10 miles of the runway, and impacts on third parties.
- RT commented that the safty zone defined by DP's model is limited to the immediate proximity of the runway and hence it would not be a suitable tool to define probabilities of crashes very far away from the airfield.

ACTION: DP to send ACRP reports to JC.
ACTION: JC to circulate ACRP reports to the panel.

M Greaves Update

- MGR was unfortunately unable to attend the meeting and therefore this agenda item will be parked until the next meeting.
- MGR has undertaken some work in relation to calculating *en route* crash rates using World, Europe and UK figures for aircraft over 2.3 tonnes to obtain a crash rate per square kilometre. MGR was not available to make his presentation.

ACTION: TA to circulate MGR's work to the panel.

[redacted] – Technical Points Raised

- Due to time constraints, [redacted] was unable to present as had been intended.
- TA reminded the panel that it is considering events where the risks are typically 10-8 to 10-7. It is unwise therefore to conjecture on specific risk factors without considering the risk magnitude in this context. [redacted] repeated RT's comments that uncertainty could push risk above the BSO.
- MS stated that it would be important to look at specific site when considering various modelling options. TA expressed concern that this may appear to be the TAP doing the work of the Licensee.
- MS suggested a checklist approach to identifying risk factors.
- PA suggested that the panel needed to consider what the next steps are.
- It was agreed that [redacted] would deliver a presentation to open the next meeting of the TAP.

Status Review (where are we) and Future Meetings

- TA commented that up until now, the meetings have been primarily about gathering information. TA feels that the TAP now have a sufficient level of information and understanding to be able to have informed discussion on how the TAP goes forward from here. The next meeting will be arranged to take place on the next available date, within 5 weeks time and prior to this TA and PA will discuss and formulate a clear structure for this meeting which will be more of a panel deliberation session.

Other points

- SH said that the CAA had responded positively to the work of the TAP and that they would be happy to provide any available data that the TAP considers would be beneficial to its deliberations.
- TA informed the TAP of the inaccuracy recently identified via a review of the Byrne model. This was detailed in some of TA's presentation slide (attached) but there was insufficient time to discuss the presentation in its entirety.
- [redacted] suggested it was invalid to model the data in two different ways and then add them together.
- TA suggested that this was a conservative approach. MS pointed out that this is not necessarily valid especially when, in advising the government on planning applications,

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ONR justifies its decision not to object on grounds that the background crash rate dominates. If by removing wrongly assigned background crashers, the airfield crash rate then stands proud, this invalidates the suggestion that the ambient dominates.

Actions

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01/02 - 01	All to agree a clear statement of objective for the TAP	All	Ongoing – Park until item 12 (next steps)
01/02 – 02	MGR to circulate a one page spec to the TAP	MGR	Ongoing
03/04 - 01	The panel should consider GG's comments on [redacted] papers in light of the ALARP presentation	All	Ongoing
03/04 – 02	DP to send ACRP reports to JC.	DP	Complete
03/04 - 03	JC to circulate ACRP reports to the panel.	JC	Complete
03/04 - 04	TA to circulate MGR's work to the panel.	TA	Ongoing
03/04 - 05	All to send details of their availability for the 4th meeting to JC	All	Complete - Provisional date established.