1st Meeting of the Technical Advisory Panel on Accidental Aircraft Crash Risk
15 November 2012 – Redgrave Court

Attendees

Colin Patchett (CP) – Introduction Only	Acting Chief Nuclear Inspector – ONR
Tim Allmark (TA)	Technical Lead – ONR
Joanna Cook (JC)	Business Support (Note-taker) – ONR
[redacted]	Independent
Steve Daniell (SD)	Magnox
Malcolm Goodwin (MG)	ABS Consulting
Matthew Greaves (MGR)	Cranfield
Sid Hawkins (SH)	Air Accident Investigation Branch
Roger Jackson (RJ)	AMEC – Representing DNSR
Malcolm Spaven (MS)	Spaven Consulting

Apologies

Alan Farmer – DNSR
David Pitfield – Loughborough University

Introduction

CP welcomed attendees and introduced the meeting, providing a brief background on the decision to form the TAP, explaining that from time to time, when evidence emerges that could serve to enhance ONR's assessment of nuclear safety, the chief nuclear inspector may decide to ask for an independent view. This may be through the commissioning of academic studies or the forming a technical advisory panel, or TAP. Such panels are asked to consider the evidence and offer independent, objective, authoritative, professional, scientific and technical views, to inform ONR's decisions

CP summarised the key deliverables for the TAP as follows;

- A view on the limitations of the existing Byrne methodology (and supporting data) and the implications for calculations of the likelihood of impact.
- Identify any available methodologies which can be seen as good practice along with their associated limitations and uncertainties
- Identify any further research needs in this area

CP stated that the TAP would not consider the management of aircraft crash risk, not criticise or stray into the mandate of other departments, not look at restricted flying zones and not look at a Minimum Separation Policy . CP explained that the ONR has strict vires which prevent this.

[redacted] flagged a concern since the Energy Minister had given a commitment to consider the proposal for a Minimum Separation Policy (MSP) prior to the inception of the panel and Chief Nuclear Inspector Mike Weightman had accepted the issues it raised onto the TAP agenda. TA later said he was uncomfortable with the reference to Mike

Weightman's commitment since he was unable to confirm this point with Mike currently being on extended special leave. [redacted] has since provided an email from Mike which indicates his support for the inclusion of these issues.

[redacted] noted that the management of aircraft crash risk is not only multidisciplinary but cross departmental. [redacted] felt CP's comments epitomise the problem raised in the MSP and read the extract:

'These comments are not intended to be overly critical of the various departments and organisations involved. It is recognised all parties work as hard as their priorities allow. The reality is any process which requires constant communication between so many different disciplines and departments will be vulnerable, however well intended the individuals who work in them may be.

Given the interdependencies and scope for human error the management question is not 'why have a minimum separation policy but how can one justify not having one as offering the simplest, safest and least bureaucratic solution to the problem?.'

[redacted] pointed out that there is evidence on the table which shows that such cross departmental problems exist. Since they will not be considered by the TAP, [redacted] asked CP if he could find out in which forum they can be addressed.

Action 15/11 -01: ONR to advise if there's a forum in which the cross departmental issues raised in [redacted] and [redacted] Minimum Separation Proposal can be addressed.

CP left the meeting following the introduction as planned.

Introductions took place around the table.

Notes of Meeting

- TA acknowledged that the Terms of Reference (TOR's) for the TAP require revision. All members were asked to review the TOR's, including the scope of work for the panel and provide feedback to TA.
  Action 15/11 – 02: All – Review TOR's and provide feedback to TA.

- There was a discussion regarding protective markings. TA clarified that the 'Restricted' marking on ESR Technology Report ESRT/d0010905/001/Draft/July 2007 Section 4 does not apply due to redactions. TA asked that all TAP members are mindful of the meanings assigned to certain protective markings by government organisations. PROTECT – COMMERCIAL should be used where material is intended for the TAP only but where a marking of RESTRICTED or above does not apply.

Safety of NPP's Against Aircraft Impact –Assessment Criteria

- TA confirmed that the applicable SAP for accidental aircraft crash is that for societal risk which has a generally acceptable level of 1×10^{-7} per year.

- TA clarified that ONR use the SAP's for their purposes and the licensee's use their own principles. The SAP's are for ONR internal guidance and allow the regulator to demonstrate to the public that a strategic, transparent, targeted and proportionate approach is being taken.

- ONR does not specify that the licensee's must use the Byrne Method however attendees are not aware of any licensee using a different methodology than this.

- [redacted] flagged that it is important for the TAP to understand the general criteria against which any assessment of probability is judged. [redacted] provided JC with a copy of two documents for circulation.

-Precautionary Approach, Consequence Based Decisions and Inherent Safety- [redacted] *– May 2011*

-Nuclear Assessment Criteria (extracts from relevant guidelines and letters) – [redacted] *– May 2011*

[redacted] asked TA to confirm that the information in them is correct and to agree that these are the relevant principles and criteria which set the context of the TAP's deliberations.

TA agreed to ask a suitably qualified colleague.

Action 15/11 – 03: TA to ask a colleague specialising in ALARP to confirm that the information is correct or identify any specific errors. A future meeting will include a presentation on Target 9 and ALARP.

Scope of TAP

- TA detailed inclusions and exclusions to the scope. Full details can be found in the appended PowerPoint presentation, along with a list of anticipated deliverables for the TAP.

- TA advised that comments would be welcome on whether TAP members believe that the anticipated deliverables of the TAP are accurate.

- The outline plan for the current meeting and for future meetings was discussed. [redacted] raised the importance of providing an explanation during this initial meeting, of the ways in which the Byrne Model is used.

Byrne Methodology – History

- TA provided a background on the history of the Byrne Model (1997) explaining that it had its roots in SRD reports R55 (1976) and R435 (1987). The 1997 AEAT report included data on crash rates to 1991. In 2002, HSE commissioned AEAT to provide an update to include crash rates from 1991-2000. In 2008, HSE commissioned a further update from ESR Technology to provide rates to 2006.

- [redacted] queried why the 2009 report by ESR, which looked at different types of modelling was not included in the pre-reading for this meeting. TA responded that the intention was to focus on the Byrne Method at this stage.

- MG asked whether TA was aware that the copy of the Sandia report provided was incomplete. TA said this was intended. He felt the last pages were not relevant since they focus on a specific case.

Byrne Methodology – Application

- TA explained the Byrne methodology was used in estimating the probability of an aircraft crash when a licensee conducts its Periodic Safety Review (PSR) which occurs every 10 years. It was also used broadly in the new site selection process.

- SH commented that if the model only looks at historical crash rate data then that presents a problem when it comes to predicting the probability of future events. He pointed out that trends can develop quickly. For example in two years time it is likely all military aviation training will return from the Gulf to the UK. This could result in a considerable increase in activity as military flying training produces a comparatively high level of losses (although it was also noted that military training areas are typically some distances from licensed sites). There was a concern that the 10 yearly PSR may be too infrequent to capture such trends.

- MGR asked what happens if there is a change in the situation within the 10 year period (e.g. CAA relaxed airport fees resulting in a dramatic increase in flight activity) – is there any mechanism for the licensee to pick this up.

- [redacted] noted there is not, this being one of the problems raised in the MSP. [redacted] gave the example of ONR's consultant, ESR, stating that an increase in offset approach angle beyond 5 degrees would make a material difference to the probability calculations for Lydd Airport/Dungeness case. Two years later the CAA approved a 14 degree offset approach without recourse to the licensee or ONR. The fact there is no mechanism to flag these changes was one of the reasons [redacted] and [redacted] recommend an MSP as the only robust way of managing the problem.

- It was agreed that at present there does not appear to be a mechanism for identifying changes. The TAP agreed that there needs to be a route which allows for feedback into the model.

- [redacted] pointed out that the Byrne model is also used when the ONR makes a recommendation in a planning situation. TA agreed that the Byrne model has been used as part of the ONR decision making process.

- [redacted] pointed out that the application is different when applied to a planning situation.

- TA stated that from ONR's perspective the same criteria are applied from the SAPs. TA stated that both the delta and absolute values are examined by ONR to inform its response to planning authorities.

- [redacted] noted that in a planning situation ONR places emphasis on the comparison between different development scenarios. This becomes important when considering any biases in the modelling and the magnitude of the potential change versus the uncertainties involved.

Probability and Consequences

- It was agreed by all that there was a tendency in all the papers to use the word 'risk' and 'probability' interchangeably and the TAP should be careful to distinguish between the two in its deliberations.

- SH flagged up that it is difficult to discuss probabilities without first relating these to consequences. He raised the importance of definitions. Are we looking at any powered aircraft? What do we classify as an aircraft? What scale and nature of event will be considered.

- This led to discussion on the definition of the probability that the TAP is trying to assess. Concluded it is the probability of an aircraft which is capable of inducing a radiological release , crashing onto an area over which the crash could set up a chain of events that results in a radiological release

- TA commented that there is a requirement for all new build reactors in the UK to be built with consideration for malicious aircraft impact from large commercial aircraft.

- SH asked what assumptions are applied in terms of the type of aircraft that might induce a radiological release. He advised that the CAA categorise aircraft by looking at maximum weight, how much damage they are likely to cause and what area they are likely to spread over. He noted a microlight might have the impact of a small car and damage to infrastructure would be relatively small. Impact at around 2.5 tonnes is significant and could cause structural damage. When a Boeing 747 crashed two miles beyond the runway at Stanstead – 80 degree approach angle, 300 miles per hour – the energy imparted was tremendous.

- RJ flagged up that even light aircraft could not be ruled out in certain nuclear installations given the potential to crash into a glovebox and liberate material.

- It was agreed the decision on which category of aircraft to include in any assessment would be case specific. For nuclear power stations it is assumed aircraft 2.3 tonnes or over have the potential to cause a significant radiological release and light aircraft would not have sufficient impact to cause a problem.

- It was then noted that different terminology exists for the definition of light aircraft. Byrne model states 2.3 tonnes. CAA has the definition below 5.7 tonnes. MGR noted that the European data base has a range 2.2 to 5.7 tonnes. There was

discussion about whether it is possible to normalise. SH noted that it would be more meaningful, if possible, to categorise in terms of impact energy (taking account of weight and speed) as this is what will drive the consequence. For example a 2.6 tonne aircraft at high speed could potentially cause similar damage to a considerably heavier aircraft at a low speed.

- SH mentioned that the CAA are happy to provide data for specific requests where possible.

- It was also noted that there are different standards of maintenance and regulation between different categories of aircraft – Should we consider re-banding data in a way which more effectively deals with categories?

RELEVANCE OF BACKGROUND CRASH RATE DATA

- MS raised a concern about the concept of background crash rates. He pointed out that they are hypothetical rates developed on a broad national scale but then applied at site specific level. There is a necessity to design a model which delivers the best end result for licensees in terms of the risk for them. Can we come up with something which delivers a point specific model?

- TA confirmed that the background crash rate is derived by taking the number of background crashes in the country per year and dividing it by the area to get a uniform distribution measured per square kilometre per year. He queried whether the TAP consider this to be a suitable methodology? There was some discussion on background vs airways rates.

- The TAP discussed the possibility of regionalising background crash data to increase relevance or localising data as a small distance such as 3 miles can produce wide variation.

Paucity Of Relevant Data

- TA raised the issue of the lack of relevant data noting that there are only four crashes in the large aircraft background crash rate data base. It was agreed that at least three of these are wrongly assigned (Viscount, Benbecula and Blair Atholl). There was a debate about whether Lockerbie should be included. This will be considered in a future meeting;

Action 15/11 – 04 – Consider inclusion of Lockerbie

- The TAP agreed the lack of relevant data is an overall problem.

- The model only looks at actual accidents where fatalities have occurred. It also screens out all crashes where the pilot had some choice in landing i.e. it assumes that the pilot will always be able to take diversionary action. It was noted that this might be reasonable when considering background crashes where the initiating action will have occurred some distance away. It breaks down the

closer the aircraft is to the nuclear site since there is less chance the diversionary action will be successful.

- SH suggested more information could be gained by giving consideration to near miss events. SD and MG agreed. MG noted this approach is commonly used in the analysis of seismic information (looking at low level seismic events helps build a picture for improving the prediction of future large earthquakes)

- In discussing how to obtain more data MGR suggested that considering crash rates for Europe would be beneficial.

Action 15/11 – 05: MGR to forward link to European background crash rate data to the group.

Fitness For Purpose Of The Model

- [redacted] questioned whether this kind of crash rate modelling is able to adequately represent the interactive variables associate with aircraft take off and landing. The fundamental question is what is the probability of an aircraft and a nuclear power station being in the same place at the same time i.e. what is the probability of an aircraft accidently deviating from its intended flight path and crashing onto the nuclear site - bearing in mind that accidents happen when things go wrong. There are a number of factors which will influence this. Does the model represent them?

- [redacted] cautioned this cannot be dealt with by just looking at the uncertainties in the number which the model generates – this is meaningless if the model does not account for the accident scenarios associated with the case under consideration. MGR agreed and gave the illustration that if you are trying to count the number of leaves on the tree outside then quoting the variation in the number of people sitting in the room is not relevant**.**

- [redacted] noted that the ONR states the need to look at integrated risk – the way in which risk factors can interact within a single chain of events such that the total risk is greater than the sum of the parts. [redacted] pointed out that overlaying the crash rates from various different airports is <u>not</u> integrating the risk. In fact it masks any directional tendencies that might be associated with a particular airport (e.g. airport A might have a propensity for crashes to occur at particular position relative to the runway, airport B another**).** It does not represent the interactive suite of operating constraints and risks at a given airport**.**

- SH noted that he thought places like Heathrow, Gatwick and Stanstead should all be about the same.

- MGR suggested that if the TAP is going to consider the case of a Magnolia coloured (i.e. generic) airport then it should exclude the weird ones with complicated constraints from the data set – then look at how individual airports vary from the generic case.

- [redacted] pointed out ESR[1] states the need to move away from the generic model when considering site specific, non standard airports and confine the comparison to those airports which have the same combination of constraints as the one. under consideration - a problem if there is not a statistically meaningful equivalent.

  Secretary's note - The ESR report states;

  In principle, the additional risk associated with these constraints might be assessed quantitatively on the basis of the operational and accident experience at an appropriate subset of airports. In practice is has been concluded that this sort of assessment approach is not currently viable due to the considerable amount of effort that it is expected would be required to gather reliable statistics

  Taking account of these difficulties, no attempt has been made to quantify these risk factors and the assessment of them has been based on qualitative considerations.

- SD pointed out that the situation is complicated. Spending time and effort developing a magnolia coloured/generic crash rate model is not useful if it does not apply to the situations which are relevant in this country. The TAP should concentrate on the specific cases where the model will be used within the UK and determine whether it is relevant in those situations - the most obvious being Lydd, which it the only airport that is within 5 miles of a nuclear power station.

- There was general agreement that fitness for purpose will be site specific and we should concentrate on what is relevant for the UK.

- RJ raised the question of whether the restricted flying zones around nuclear sites would provide a simpler and adequate solution

- MS and [redacted] pointed out that the principle is fine but the restricted flying zones are not set at a distance that would prevent an accidental aircraft crash rate – they are not intended for that use. MS noted that, as far as he is aware, in every case where a dispensation to fly inside the restricted flying zone has been requested it has been granted. This decision does not appear to be based on any nuclear risk assessment.

[redacted] agreed with the principle of RJ's comments and pointed out this is why a Minimum Separation Policy had been recommended by [redacted] and [redacted] In light of the discussions, [redacted] questioned, why wouldn't you put in place such an obvious preventative measure?

[redacted] notes, based on [redacted] experience, applying an obvious preventative measure that cuts out a vast majority of the risk is a solution which would, at minimum, have to be evaluated in other industries - with pressure for it to be adopted, especially in

situations where the potential outcome is extreme and the penalty for implementing it is low. Product liability and corporate manslaughter legislation would dictate this.

([redacted] points out that this is based on [redacted] 25 years experience of integrating material's processing equipment into the automotive, aerospace, nuclear, electronics, and a range of other industries - having been on the receiving end of HSE's or its equivalent's demands in this regard).

- TA closed down the discussion at this point saying that government planning policy was outside the scope of the TAP.

Other Topics

- Towards the close of the meeting there was brief discussion on other models. TA posed the question that, if none of them were any better at dealing with these issues, then is that is an argument for staying with the existing Byrne model? [redacted] suggested that 'near enough is not good enough' in the nuclear industry. The fundamental question is whether or not the modelling is fit for purpose otherwise one needs to develop other forms of modelling or other ways of managing the problem.

- There was a brief discussion about birdstrike which raised the following points; While the frequency of birdstrike is quite high, the frequency of crashes occurring as a result of it is low. As you cannot mathematically model the likelihood of birdstrike, how can you account for it? MS commented that figures on birdstrike are site specific.

Problems With Byrne Model - Agenda For Next Meeting

- Prior to summing up TA said that the next meeting would consider problems and limitations associated with the Byrne Model. He put up a slide with a list of factors to consider and asked the group to come back with any additions to the list prior to the next meeting.

Action 15/11- 06 TA to circulate slide which had the list of factors.
TAP members to add to the list of factors and limitations for discussion at next meeting .

- TA also asked members whether they knew of any other models that might be relevant

Action 15/11 – 07: All TAP members to see if they can identify any other extant Models for modelling of Accidental Aircraft Crash Rates.

Membership Update

- David Pitfield (Loughborough University) has now accepted an invitation to join the TAP and will attend the next meeting.

- SD will contact Alan Brandwood to check the route through the Safety Directors Forum which resulted in his nomination to the panel as he does not feel he is the most appropriate industry representative.

  Action 15/11 – 08: SD to check route through the Safety Directors Forum which resulted in his nomination to the panel.

- No response was received from the Military Aviation Authority. SH offered to approach Military Aviation Authority via his contacts on behalf on ONR.
  Action 15/11 – 09: SH will contact Military Air Accident Investigation Branch to try to identify a contact/potential TAP member

- ICE nomination was not appropriate and a further nominee is being sought.

- SH offered to assist in identifying a nominee from the CAA through his contacts there.
  Action 15/11 – 10: SH will contact Civil Aviation Authority to try to identify a contact/potential TAP member

- There is currently a lack of practitioner expertise. The TAP requires somebody who applies the methodologies on a day to day basis.

- SH will speak to the Airprox board about regarding near miss data and the potential for a representative to attend the next meeting.
  Action 15/11 – 11: SH to contact the Airprox Board and forward any relevant data held on near misses/discuss the potential for an attendee at the next meeting.

Next Meeting

- The next meeting will be held in January or February 2013 and JC will co-ordinate diaries to establish a date/make arrangements.
  Action 15/11 – 12: JC to co-ordinate diaries for the next meeting of the TAP

  Action 15/11 – 13: TA will develop and circulate a draft topic list for the next meeting.

Actions Table

Action No.	Details	Responsible
15/11 - 01	ONR to advise forum in which the cross departmental issues can be dealt with	ONR
15/11 – 02	Review TOR's and provide feedback to TA.	All
15/11 – 03	TA to ask a colleague specialising in ALARP to confirm that the information is correct or identify any specific errors.	TA
15/11 - 04	Consider inclusion of Lockerbie at meeting 3	All

15/11 – 05	MGR to forward link to European background crash rate data to the group.	MGR
15/11 – 06	TA to circulate slide which had the list of factors. TAP members to add to the list of factors and limitations for discussion at next meeting .	TA/All
15/11 – 07	All TAP members to see if they can identify any other extant Models for modelling of Accidental Aircraft Crash Rates.	All
15/11 – 08	SD to check route through the Safety Directors Forum which resulted in his nomination to the panel**.**	SD
15/11 – 09	SH will contact Military Air Accident Investigation Branch to try to identify a contact/potential TAP member	SH
15/11 – 10	SH will contact Civil Aviation Authority to try to identify a contact/potential TAP member	SH
15/11 – 11	SH to contact the Airprox Board and forward any relevant data held on near misses/discuss the potential for an attendee at the next meeting.	SH
15/11 – 12	JC to co-ordinate diaries for the next meeting of the TAP	JC
15/11 – 13	TA will develop and circulate a draft topic list for the next meeting	T Allmark