

**6th Meeting of the Technical Advisory Panel on Accidental Aircraft Crash Risk
29 October 2014 – Redgrave Court**

Attendees

Panel members	
Tim Allmark (TA)	Technical Lead – ONR
Matt Lloyd Davies (MLD)	Technical Secretary – ONR
Malcolm Goodwin (MG)	ABS Consulting
Sid Hawkins (SH)	Air Accident Investigation Branch
Roger Jackson (RJ)	AMEC – Representing DNSR
David Pitfield (DP)	Loughborough University
Matt Greaves (MGr)	Cranfield University

Apologies

Malcolm Spaven (MS)	Aviatica
Michael Johnston (MJ)	EDF Energy, representing Safety Director's Forum

1. Introduction

TA welcomed the TAP members to the meeting and thanked them for their continued participation and contributions.

2. Previous minutes and actions

RJ highlighted a number of typos in the previous minutes. No other comments were received

ACTION 06/01: MLD to correct minutes of meeting 5.

Ref	Assigned to	Action description	Status
05/01	MLD	MLD to forward copy of model summary table to DG and DP	Closed
05/02	DP/DG	Complete model summary table and incorporate into report	Closed
05/03	DP/DG	Tabulate the mapping between 'requirements' identified during meeting 4 and the models reviewed in the report	DP to confirm that this has been done ¹
05/04	MJ	MJ to investigate EDF's appetite for trialling a flight monitoring system on site	On going
05/05	ALL	Provide comments on the LU and HSL technical reports to MLD	Closed
05/06	MLD	Collate and discuss comments from the Panel on technical reports with LU and HSL	Closed
05/07	NW/DP/DG	Act on comments, incorporate changes and combine their reports into a single report.	Closed

¹ Closed out post-meeting TRIM reference 2014/405693

3. Messages from Chief Nuclear Inspector

TA reported on a recent meeting with the CNI who expressed his apologies for being unable to address the TAP in person. The CNI asked TA to convey a number of messages to the TAP on his behalf:

1. The CNI continues to appreciate the TAP's on-going work. He recognises that the matter is not a trivial one and that the TAP is doing an admirable job of elucidating the key issues.
2. It is important that the TAP reaches definitive recommendations as a result of its deliberations and the supporting research, and the fact that a TAP is transient in nature, not perpetual, should be borne in mind.
3. ONR's principles of enforcement should be considered when the TAP forms its conclusions and recommendations. TA gave a short overview of the Principles of Enforcement and noted that in allocating resource, ONR should have regard to these principles.
4. ONR's strategy for undertaking research has undergone change since the transition to statutory corporation. Research is now targeted at those areas where the greatest benefit, in terms of risk reduction, can be achieved.

ACTION 06/02: MLD to circulate a copy of the Enforcement Policy Statement, highlighting the relevant sections on Principles of Enforcement.

4. Consultation outcome

MLD presented a series of slides summarising the outcome of the recent consultation exercise, the aim of which was to seek the views and opinions of panel members on the TAP's progress. TAP members were invited to comment on ONR's summary of the response. The following table summarises the discussion.

Q1 To what extent has the TAP met the Chief Nuclear inspector's aims?	
ONR summary of response	TAP comments
Panel agrees that the CNI's aims have been met. However: - Input from MoD could have enhanced discussions. - Consideration of military aircraft flying patterns may have provided added insight . - End-user involvement should have come sooner.	This is not necessarily a shortfall of the TAP but may have a bearing on future updating of modelling and data. This is particularly important as this data is more time sensitive than that for commercial aircraft.
Q2 To what extent has the TAP met its objectives?	
ONR summary of response	TAP comments
Panel agrees that the CNI's aims have been met. However: - Input from MoD could have enhanced discussions. - Consideration of military aircraft flying patterns may have provided added insight . - End-user involvement should have come sooner.	Objectives have been met when considering the principle of proportionality

Q3 To what extent has the TAP addressed the technical areas it set out to address?	
ONR summary of response	TAP comments
<p>General agreement that the TAP has addressed these areas. However:</p> <ul style="list-style-type: none"> - Further comments on the lack of consideration of MCA data and flying patterns - Local factors could have been discussed in more detail 	<p>Agreement that there was no need for the TAP to pursue local factors any further, but recognition that it is important for end-users to consider local factors in their assessment of aircraft crash risk. This led to Recommendations 1 & 2 (below).</p>
Q4 What other technical areas do you consider should be investigated?	
ONR summary of response	TAP comments
<ul style="list-style-type: none"> - Look ahead to future aviation trends - Greater consideration of local factors - Formal definitions of aircraft and airspace categories - Analysis of military aircraft data - data screening methods/ decision making 	<p>Agreement that there was no need for the TAP to consider these areas any further, but recognition that it is important for end-users to consider them in their assessment of aircraft crash risk. This contributed to discussions on Recommendations 1 & 2 (below).</p>
Q5 To what extent has the LU/HSL research report met your expectations?	
ONR summary of response	TAP comments
<p>The panel agrees the report(s) has met their expectations Particular comments that the inclusion of a measure of confidence enhances the existing methodology</p>	<p>The TAP felt the report had missed the opportunity to state if Byrne was the most appropriate methodology.</p>
Q6 To what extent do you support the report's conclusions and recommendations?	
ONR summary of response	TAP comments
<p>The panel supports the conclusions and recommendations to varying degrees. However:</p> <ul style="list-style-type: none"> - The report focuses on reliability and airfield crashes - The relevance to nuclear sites was questioned 	<p>A separate discussion was held to consider each recommendation. (See below)</p>
Q7 Do you believe there is a need for further research or deliberations?	
ONR summary of response	TAP comments
<p>A number of areas identified, including:</p> <ul style="list-style-type: none"> - Consideration of local factors including meteorological effects - Flight density around nuclear sites - Lateral distribution of crashes 	<p>It was felt that it would not be appropriate for the TAP to consider these matters any further, but this, and the issues identified in Q3 and Q4 should be brought to the attention of Licensees through the Safety Directors Forum. This led to TAP Recommendation 3 (below).</p>

5. HSL/LU research report recommendations

Recommendation	TAP comments
1 All operators of licensed nuclear sites should undertake a site-specific hazard identification exercise in relation to the aviation-specific external threats to ensure that their safety arguments were complete and had not omitted any hazardous scenarios from consideration.	This is considered routine business for ONR as it forms part of the licensing regime. However, ONR should review TAG 013 to reflect TAP output and recommendations. ONR should provide a copy of the TAP's report to the CNI.
2 The geographic spread and time space of aircraft accident data should be expanded because of the sparse nature of accident data for crashes onto GB.	Caution should be exercised when considering use of historical data. The relevance of data should be considered alongside the quantity, and it should be relevant to UK aviation. ONR TAG/013 should be updated to include guidance on data selection.
3 The operators of licensed nuclear sites, and other government agencies, should consider special measures to protect against "beyond design case" events from aviation-related activities.	This is beyond the scope of the TAP and is captured under other ONR and regulatory requirements e.g. extendibility of emergency plans.
4 The operators of licensed nuclear sites should be responsible for conducting local flight surveys to ensure that the number and type of flights operating in the vicinity of the licensed nuclear site is compatible with the assumptions used in the calculation of aircraft accident frequency.	The TAP considered this to be prescriptive and onerous. The focus should be to ensure licensees use appropriate data and that they can justify their data selection.
5 The operators of licensed nuclear sites should ensure that local operating conditions that may modify the probability of a flight suffering an accident significantly are taken into account.	The TAP fully supported this recommendation.
6 The significant number of general aviation accidents away from the aerodrome of departure and intended arrival may allow for a more site-specific model to be derived rather than the current generalised Byrne distribution.	The TAP questioned whether the benefit was sufficient to justify the burden of generating a site specific model. It was recommended that Licensees should use site specific data and if practicable a site specific model, but normal regulatory judgement should be applied to ensure compliance with the principles of enforcement.
7 The significant number of general aviation accidents in the vicinity of the aerodrome of departure or intended arrival may allow for a more site-specific model to be derived rather than the Philips model in current use. The use of the DOE standard as an improved method prior to the development of a new model should be considered.	The TAP questioned whether the benefit was sufficient to justify the burden of generating a site specific model. It was recommended that Licensees should use site specific data and if practicable a site specific model, but normal regulatory judgement should be applied to ensure compliance with the principles of enforcement.

Recommendation	TAP comments
8 The Byrne model should be improved for the calculation of crash frequency distributions in the vicinity of an aerodrome. The use of a third generation model, such as NLR, should be considered as a short term replacement until a model that is available includes normalisation, use of normal operations data, consideration of aerodrome design factors and consideration of aircraft performance factors.	The TAP recognised that the Byrne model contains deficiencies and could be improved. However, it also recognised that only one site would be affected by local aerodrome operations and then only for a relatively short period of time. The TAP also noted that results reported in the HSL/LU report, comparing 3 different methodologies, concluded that Byrne was the more conservative estimate of crash risk. The TAP concluded that development of the Byrne model was not warranted. However, the TAP recommended that Licensees take account of local factors to ensure the methodology remains relevant to the site.
9 The cross-track lateral accident location for all phases of flight would benefit from additional research to validate, or otherwise, the current assumptions within crash location models.	The TAP questioned the benefit of additional research into cross-track lateral accident location modelling. It noted that it was aware of the issues around this but the scarcity of data would hinder development of a model. However, it recommended that TAG 013 should be updated to highlight the issue.
10 The grouping of aircraft into different mass and kinetic energy groups should be reconsidered with the objective of removing the inconsistencies present within the Byrne model. Operations by ex-military aircraft could be considered for grouping with current military aircraft. Operation of civilian aircraft but on military and state activities could be considered for grouping with current military aircraft.	The TAP noted that neither it nor ONR would be able to influence categorisation of aircraft as this is the responsibility of other National and International bodies. It commented that end-users should be aware of differences in categorisations, thereby addressing the inconsistency in Byrne. The TAP disagreed with the statement that "Operation of civilian aircraft but on military and state activities could be considered for grouping with current military aircraft.". In any case, this would be a very minor contribution to the overall data set.
11 The modelling of military aircraft accidents could be improved and associated with actual flight paths intended to be flown as well as forecast loss rates for new aircraft types.	The TAP reiterated its earlier recommendation that relevant stakeholders e.g. MoD, CAA etc., should be consulted when establishing the data sources and other inputs to calculation of aircraft crash risk.
12 The Byrne model could be improved through the local application of a hazard analysis to consider the licensed nuclear site acting as an obstacle to an otherwise safe flight.	There was some question over the intent of this recommendation. However, the TAP felt it would be captured as a local factor when assessing aircraft crash risk.
13 The Byrne model could be improved by updating the assumptions relating to aircraft impact models, skidding friction factors, projectile bounce factors and projectiles dropping from aircraft.	The TAP recognised that these factors contribute to the overall event, but it was judged that no real benefit would be seen by undertaking further work. However, the TAP recommended that TAG 013 should be updated to provide regulatory guidance on these supplementary contributors to aircraft crash risk.

Recommendation	TAP comments
14 The Byrne model should be extended, if required to comply with consequence analyses implications, to include the hovering phase of helicopter operations, the operation of gyrocopters, gliders, airships, gas-lifting balloons and hot-air balloons. The use of the DOE standard as a substitute would be an acceptable intermediate step until a more specific GB model could be developed.	The TAP considered that there was no benefit in doing this as the consequences from these aircraft types are negligible.
15 Operations by unmanned aerial vehicles should be considered in greater detail in time.	This issue is being addressed by cross-government programme of work. In any case it is unlikely to have a significant effect on nuclear sites.
16 Any future model developed for use in the vicinity of an aerodrome should consider the correlation between lateral and longitudinal crash distances; the use of a gamma distribution; the normalisation of the data including aircraft performance factors and flight performance factors and the use of normal operations data. The significance of the variation in weather conditions experienced across GB could be tested in a sample analysis in order to determine if such factors had to be considered at all locations of licensed nuclear sites.	This recommendation is linked to recommendation 8. The TAP noted that it affected one site for a limited period of time.
17 If any model is to be developed beyond the Byrne model for use in GB then the usability could be improved by changing to look-up tables such as published in the DOE standard model or through a risk map being published for the whole of GB.	The TAP considered that this was a matter of usability and was not within the scope of the TAP's deliberations. However, the TAP noted that any improvement in the usability of modelling should be encouraged provided there was no loss in model/data integrity, and that there was still visibility to the underlying methodology.
18 Any modelling of aircraft accident frequencies at a specific location should include the consideration of confidence intervals and the 95% confidence interval upper bound should be used in safety arguments to demonstrate that a licensed nuclear site does not suffer from excessive risk associated with aviation-related hazards.	Regulatory expectation is that Licensees should use a 95% confidence interval for design basis events and a 50% confidence interval for beyond design basis events. A 95% confidence interval for beyond design basis events is considered to be unnecessarily conservative. The TAP supported inclusion of a measure of confidence in risk quantification. TAG 013 should be updated to reflect this position.

6. Recommendations

From the discussions held under sections 5 and 6 above, the TAP reached the following recommendations:

Recommendation 1: A forum should be established between the CAA, ONR, MoD and Licensees to allow the effective sharing of information on changes in flight patterns, operational activities, crash data, and other relevant topics, such that licensees are able to ensure they have taken account of current and emerging trends in aviation risk.

Recommendation 2: The ONR Technical Assessment Guide (TAG) should be updated to reflect knowledge gained during the course of the TAP's deliberations.

Recommendation 3: The outcome of the TAP should be shared with industry through the Safety Director's Forum.

The following areas were identified as initial topics for discussion by the group identified in Recommendation 1:

1. Military aviation training activity and crash data
2. Effect of local factors on crashes
3. Data sources and screening methodologies

7. Correspondence from [REDACTED]

On 28 October 2014, [REDACTED] emailed a letter to the panel asking them to consider the views expressed in [REDACTED] letter during their deliberations at the meeting. TA invited members to consider if the letter had raised any matters not already addressed by the TAP. The TAP considered that there was no new information for it to consider.

However, TA recognised that the letter had been sent at short notice and that the TAP may not have had sufficient time to fully consider its contents. TA therefore invited TAP members to consider the letter in greater detail and provide comments to ONR post-meeting if any new information was identified.

ACTION 06/03: ALL to consider correspondence from [REDACTED] and provide comments if any new information is identified, by 14 November 2014.

8. Future meetings

The TAP concluded that it had reached the end of its deliberations and that it was content for the recommendations made during this meeting to be presented to the Chief Nuclear Inspector as the output of its work. No further meetings were considered necessary; however, the TAP will have the opportunity to review and comment on the draft report to the CNI, prior to formal closure of the TAP.

TA thanked all panel members for their professional and diligent contribution to the work of the TAP, and reiterated the CNI's praise for their work in what is a sensitive and technically challenging area.

9. Actions

Ref	Assigned to	Action description
05/03	DP/DG	Tabulate the mapping between 'requirements' identified during meeting 4 and the models reviewed in the report
05/04	MJ	MJ to investigate EDF's appetite for trialling a flight monitoring system on site
06/01	MLD	Correct minutes of meeting 5.
06/02	MLD	Circulate a copy of the Enforcement Policy Statement, highlighting the relevant sections on Principles of Enforcement.
06/03	ALL	Consider correspondence from [REDACTED] and provide comments if any new information is identified, by 14 November 2014.