

SHERIFFDOM of TAYSIDE CENTRAL and FIFE at PERTH

DETERMINATION

by

LINDSAY DAVID ROBERTSON FOULIS, Esquire, Sheriff of the Sheriffdom of Tayside Central and Fife at Perth following an INQUIRY held at Perth on 29th, 30th and 31st May, 2nd and 4th October 2007, and 28th April 2008 into the deaths of EDWARD LAPSLEY, formerly of 31, Strowthers Terrace, High Spenn, Rowlands Gill, Tyne and Wear and ROBERT PHILIP GLOVER WARD, formerly of 2242, Great Western Road, Glasgow.

PERTH, 2nd October 2008. The Sheriff, having considered all the evidence adduced, Determines :-

1. In terms of Section 6(1)(a) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that the said Edward Lapsley and Robert Philip Glover Ward died at around 10.15am on 21st December 2005 in the crash of the Bell 206B Jet Ranger II helicopter G-WLLY. The said helicopter crashed into a field near to Viewbank Farm, by Coupar Angus situated next to the A94 Perth to Forfar road.
2. In terms of Section 6(1)(b) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that the cause of the deaths of both Edward Lapsley and Robert Philip Glover Ward was multiple injuries caused by blunt force trauma sustained by them in the said helicopter crash.
3. In terms of section 6(1)(b) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that the cause of the accident which caused the deaths of Messrs Ward and Lapsley was the loss of torque in the stiff nuts attaching the vertical tail fin to the supports. This loss of torque was initially caused by the presence of paint on the surfaces of the supports which were attached to the

vertical tail fin. Thereafter fatigue developed in these surfaces causing cracks in them. This in turn caused a further loss of torque. The upper supports failed resulting in the vertical tail fin swinging out from the tail with the bottom of the fin swinging in and coming into contact with the tail rotor. This contact between the rotor and the fin caused the fin, tail rotor assembly and gear box, and the stinger to detach from the tail boom rendering the crash unavoidable.

4. In terms of section 6(1)(c) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that a reasonable precaution whereby the accident resulting in the deaths might have been avoided was the removal of the paint from the relevant surfaces of the supports for the vertical tail fin followed by the application of a primer to seal the exposed metal.
5. In terms of section 6(1)(c) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that a reasonable precaution whereby the accident resulting in the deaths might have been avoided was the careful movement of the vertical tail fin by the pilot during pre flight inspection. Such movement might have detected undue instability in the vertical tail fin caused by loss of torque in the stiff nuts attaching the said fin to the supports.
6. In terms of section 6(1)(e) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 that the aircraft manufacturer has taken steps since the accident to ensure that those factors which, in the opinion of the AAIB, might have contributed to the accident, have been satisfactorily addressed.

NOTE

May I begin by offering my sincere condolences to the families and friends of Mr Lapsley and Mr Ward. It is most unfortunate that the inquiry took almost a year to conclude. I further regret the time it has taken me to issue my determination. This is in

part due to the intervention of my summer leave but further is caused by the requirements of other business which has to be dealt with within strict time limits. Such business often intrudes on time which could be spent on matters such as this determination.

The evidence in this Fatal Accident Inquiry was led over a number of days in Perth Sheriff Court, namely 29th, 30th and 31st May, 2nd and 4th October 2007. I further took the evidence of Mr George Fell on commission in Bristol on 4th March 2008. The Crown and those representing HJS Helicopters Ltd provided me with submissions in writing. Those representing Total Air Management Services Ltd made oral submissions on 28th April 2008 and at the stage the Crown and the representatives of HJS Helicopters took the opportunity to expand their written submissions to a minimal extent. For ease of reference the submissions from all parties are appended to this note.

Mr Brown, Procurator Fiscal depute, Perth represented the Crown in this inquiry. Mr Morrison, solicitor, Glasgow represented Total Air Management Services Ltd, and Mrs Gilmore, advocate, represented HJS Helicopters Ltd. For a time the interests of G and N Aviation, the owners of the helicopter, were represented by Mr Burnside, solicitor, Aberdeen, but after the evidence led in May 2007, he considered that it was no longer necessary for that concern's interests to be represented in the inquiry. Accordingly he took no further active part in it.

The Crown led evidence in affidavit form from the following witnesses:-
Andrew Gill, Graham Sighe, George Cormack, M/s Odina Lapsley, Mrs Josephine Lapsley, Mrs Frances Tickner, Roderick Ritchie, Hugh Tyrer, M/s Geraldine Bruce, Detective Constable David Rankine, Detective Sergeant Charles Robb, and Doctor David Saddler. The Crown led evidence in court from Detective Constable Rosemary Mann, Andrew Brown, M/s Linda McKenna, Craig Penney, Ralph Bissett, Keith Conardi, John McGeough, Andrew Wilson, Steven Findlay, Michael Cooper, Sydney Simpson, Bryan Dermidy, Adrian Jones, George Laidlaw, Malcolm Rhind, Detective Sergeant Charles Robb, and Allan Robinson. In addition George Fell gave evidence on commission. The other parties represented at the inquiry did not call any further witnesses to give evidence.

I now propose to deal separately with each of the subsections of section 6 of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976. I shall refer to the relevant evidence and my conclusions thereon as appropriate under each heading.

Section 6(1)(a) – Where and when the deaths and any accident resulting in the deaths took place.

There was no dispute in this regard. Both men were killed in the helicopter crash involving the Bell 206B Jet Ranger II Helicopter G-WLLY. The helicopter crashed into a field near to Viewpark Farm by Coupar Angus next to the A94 Perth to Forfar road. The helicopter crash occurred about 10.15am on 21st December 2005.

Section 6(1)(b) – The cause or causes of such deaths and any accident resulting in the death.

There is no issue as to the cause of the deaths of both men. The cause of their deaths was set out in the affidavit of Doctor David Saddler and the accompanying post mortem reports on both men. Likewise I agree with Mrs Gilmore's observation that there is no issue as to the immediate mechanism of the accident. It is clear that the vertical tail fin, the tail root assembly and gearbox fell from the helicopter first. This had occurred as a result of the fin detaching from the tail boom with the bottom of the fin swinging in towards the tail and coming into contact with the tail rotor.

The four bolts which held the vertical tail fin in position on the two tail fin supports were secured by stiff nuts. The torque applied to each nut and bolt should have been between 50 and 70 lbf.in. When measured after the crash, the torque on each assembly varied between 30 lbf.in, in the case of the top aft assembly, and 15lbf.in, in the case of the bottom forward assembly. The bolt in this last assembly was noted to be bent and accordingly this last measurement was not considered to be reliable. The area around the bolt holes on each support was found to be fractured.

The vertical tail fin and supports were subjected to a metallurgical examination by an organisation called Qinetiq. Their examination revealed that there was fatigue at the sites of the bolt holes on the supports. Qinetiq concluded that the upper attachments holding the fin to the boom failed first (top aft followed by top forward) followed by

the lower attachments (bottom aft followed by bottom forward). This resulted in the top of the fin swinging out from the boom with the lower part swinging in and coming into contact with the arc of the tail rotor. As a consequence, the fin, the stinger and the tail rotor assembly and gearbox, weighing in total about 20 kilograms, detached from the tail boom. The loss of this weight moved the centre of gravity in the helicopter to the front of the craft. Further the loss of the tail rotor resulted in the body of the helicopter rotating in the opposite direction to the main rotor. With the movement of the centre of gravity to the front of the craft, Mr Ward might have attempted to counter the nose down/tail up pitch by adjusting the main rotor disc. Marks on the boom indicated that the rotor had touched it then flexed forward. The rotor disc then separated and sliced through the cabin.

The underlying cause of the accident requires a closer examination of the evidence. It was accepted that this focused on the torque readings for the bolt assemblies in relation to the vertical tail fin. The fin was attached by the supports to the tail of the helicopter. The fin was attached to the supports themselves by stiff nuts. These are nuts which lock into position once they are applied. They, accordingly, are not anticipated to slacken whilst in service. Considerable force requires to be applied when they are being tightened. After the crash, they were found to be in good condition. The conclusion reached by the authors of the AAIB report relating to the crash was that these nuts had not slackened whilst in position.

After the crash the supports themselves were the subject of a metallurgical examination. This discovered that there were fatigue cracks on the surfaces of the supports which were attached to the vertical tail fin. These had started at the holes in the surfaces through which the stiff nuts were inserted and thereafter progressed outwards from the holes and also through the supports themselves.

The loss of torque can contribute to the creation of metal fatigue in a component. The greater compression that exists between two components, the greater resistance there is to metal fatigue. In the case of the helicopter, during flight, force operates on the vertical tail fin pulling it away from the tail of the helicopter with the possibility of resultant reduction in compression.

In the words of the AAIB report, there was no evidence of defects which would explain the fatigue cracks. Accordingly, there were two possible explanations for these torque readings being substantially below those specified in the maintenance manual, namely between 50 and 70 lbf.in. Firstly, at the time of the reassembly of the helicopter in September 2005, the incorrect torque was applied. Alternatively, the presence of paint on the outboard surfaces of the fin attachments resulted in the gradual loss of torque. If the incorrect, lower torque had been applied in September 2005, then clearly the compression force exerted on the relevant components would have been less. The tail fin would have been less securely attached with potentially less resistance to metal fatigue. The presence of paint would likewise have the effect of there being less resistance to fatigue as the deterioration or disintegration of a paint surface would result in loss of torque.

I wish to consider these in turn. The first is that the torque which was applied at the time of reassembly was incorrect, the torque applied being lower than that required in the maintenance manual.

The person who was responsible for reassembling the relevant parts was Mr George Fell. He was described by various witnesses as being a very methodical and meticulous engineer, experienced with this particular aircraft. He was licensed to work with this aircraft. He gave evidence at a commission held in Bristol and was clear in his evidence that the torque which was applied at the time of reassembly was in accordance with the maintenance manual. He did not keep the torque to be applied to various components in his head. He relied on the manual and the torque applied was in accordance with the manual.

The only other person present at the time was Malcolm Rhind. He was working for HJS Helicopters Ltd in a self employed capacity in September 2005. At that time, he was an aircraft maintenance engineer with a Civil Aviation Authority licence to work on the Bell 206 helicopter. He was asked by Mr Fell to carry out a duplicate inspection of the reassembly of the tail section, and in particular the refitting of the vertical tail fin. He recalled a torque stripe over the bolts. He did not physically check the torque applied to the nuts. He, however, described going through the maintenance manual and confirming that the vertical tail fin had been fitted in accordance with the

relevant section of the manual. In particular, Mr Fell confirmed that the torque values applied conformed to those required in the manual. No engineer would torque stripe a bolt without being completely sure that the appropriate value had been applied. On the inspection, however, he did not see the outward surfaces of the fin attachments.

The other explanation for the low torque readings was the presence of paint on the supports attaching the vertical tail fin to the tail of the helicopter. It was not disputed that the fin was resprayed in December 2000. In 2005 as a result of the discovery of corrosion, the 'bathtub' section of the helicopter had to be replaced. This required the removal of *inter alia* vertical tail fin. When the helicopter was reassembled by Mr Fell in September 2005, no paint was applied. When the supports were examined after the crash, it was discovered that there was paint covering some parts of the outward surfaces of the supports, the part of the supports which were attached to the vertical tail fin prior to the crash. It goes without saying that at the time of reattachment of the fin in September 2005, the amount of paint on these faces would certainly be no less than was noted on the surfaces of the supports on examination after the crash. Whilst the helicopter had flown from December 2000 until April 2005 with paint on these surfaces without incident, with the removal of the fin in April 2005, it was likely that the integrity of the paint would be broken resulting in some of the paint coming off the surfaces at that point. The paint on these surfaces would accordingly be in that condition when reassembly occurred in September 2005. The paint would be in a different condition to that in December 2000, the time of the respray.

In considering whether I can make a determination regarding either of these it seems to me that the logical starting off point is that as a matter of fact there was paint on the surfaces of the supports. In comparison, I am not satisfied that Mr Fell did not apply the correct torque when attaching the vertical tail fin to the supports during reassembly in September 2005. I come to this conclusion for a number of reasons.

Firstly, I found Mr Fell to be an impressive witness. He gave his evidence in a straightforward manner and did not seek to minimise any potential criticism which might come his way by seeking the assistance of factors which were undoubtedly available to him to excuse or avoid any culpability on his part. Whilst he could not guarantee that he had not applied the wrong torque, he could not accept that he could

have made such a fundamental mistake. Turning to the presence of paint, however, he had to and did accept that paint had been present on the surfaces of the supports at the time he reassembled the helicopter. He accepted that he had seen the surfaces upon which there was paint. Whilst he agreed that the relevant section of the manual was silent regarding paint being present on the surfaces of the supports, he did not seek to use this as an excuse for his reassembling the vertical tail fin to the tail by means of the supports which had paint on the surfaces. Instead, he observed 'I would hope that I would take paint off. I obviously missed it.' He also remarked that the silence in the relevant section in the manual was 'more of an excuse than a reason.' He is to be commended for his approach.

Secondly, Mr Fell was an experienced engineer. He was described as methodical and very meticulous. No one who knew him professionally who gave evidence had any reservations as to his abilities. The reassembly of the fin to the tail was described by Mr Fell as quite straightforward. As Mr Robinson remarked, in light of his experience, he believed that it was unlikely that Mr Fell would make a basic error of that sort, namely applying the incorrect torque. The requisite torque values to be used were specified in the relevant section of the maintenance manual. Mr Fell explained that he would go by the values in the manual as these can change. Mr Fell was well aware of the consequences of the wrong torque values being used for the relevant components. Further, with his experience, he had an instinct concerning the correct torque to be applied – the three white knuckles he described it. In short, if the wrong torque had been applied, he would have known it.

Thirdly, there was the conduct of the reassembly itself by Mr Fell. The evidence suggested that he was looking at page 12 of the maintenance manual at the time he was reassembling the vertical tail fin to the tail. This evidence was not challenged. The relevant entry in the workpacks/work sheets dealing with this reassembly was in Mr Fell's handwriting. It records 'vertical fin refitted in accordance with 530000 page 12.' Page 12 has the diagram of the relevant section of the helicopter and sets out the torque values to be applied and where the components go. It seems to me that Mr Fell had regard to this section of the maintenance manual when reattaching the vertical tail fin to the tail. The section specified the correct torque values to be applied. In addition, a duplicate inspection of the attachment of the fin to the tail was undertaken

by Mr Malcolm Rhind. This was not required in terms of the manual. Further, Mr Fell applied a torque stripe across the stiff nuts attaching the vertical tail fin to the supports. This again was not required by the manual. There was no dispute as to these matters. The lack of evidence of a torque stripe during examination after the crash was explained by such a stripe being able to be wiped off during cleaning. In my opinion, these matters did not support a conclusion that Mr Fell would make a basic error. His work was characterised as taking more care rather than being slipshod. In addition, the application of the torque stripe would not be carried out unless the engineer was satisfied as to the torque applied.

Further, there was no evidence that the tools which Mr Fell used, and in particular the torque wrench, were anything other than fit for the job. He said that he maintained his own tools. Accordingly, if he had used his own torque wrench it would have been fit for the job. He calibrated his torque wrench every two to three months and it had been calibrated a matter of weeks prior to the reassembly. This evidence was not challenged. If he had used a torque wrench supplied by HJS Helicopters Ltd, Mr George Laidlaw indicated that the reassembly was within the period of the calibration certificate for the tool. Mr Fell also said that if he had used the wrench belonging to them, he would have checked that it was properly calibrated. In any event, it was clear from Mr Robinson that some sort of spanner was used to tighten the relevant stiff nuts. In his opinion, if such a spanner was used, even if it was not accurately measuring the torque applied, the torque applied would have been pretty close to the levels required in the manual. In fairness, it seems to me that this might have the same effect as the presence of paint. If the correct torque was applied but paint was present resulting in the loss of torque during flying, it seems to me that the application of torque slightly below that required in terms of the manual might also result in loss of torque during flight. Torque after all is a method to ensure an adequate clamping force. The greater the clamping force, the greater is the resistance to fatigue.

Fifthly, the content of the manual itself relating to installation of the vertical tail fin was silent regarding paint on the material surface. The section dealing with installation makes no observation regarding paint. At the relevant time, Mr Fell was, in effect, installing the fin. Mr Fell, in evidence, did not say that he was using that page in the manual when reattaching the fin to the tail of the helicopter. As already

noted, the only evidence as to which part of the manual he was looking at when carrying out the material operation is found in the relevant entry in the workpacks/work sheets dealing with the reassembly of the vertical tail fin. This entry in Mr Fell's handwriting records 'vertical fin refitted in accordance with 530000 page 12.' I have already referred to the content of that page. However, there is no reference to the presence of paint on that page. Accordingly, in doing work in accordance with page 12, his attention would not necessarily be drawn to dealing with the presence of paint. Of course, when it was suggested to him in cross examination by Mrs Gilmore that as he was installing the fin, there were no specific instructions about paint, Mr Fell responded that that was more of an excuse than a reason. In addition, under the heading 'Inspection and Repair' on page 11 of the manual, reference is made to removal of paint in the area of the fin attachment nutplates. Accordingly, I do not think that the lack of specific reference to the presence of paint at certain sections of the manual can be relied on too heavily. However, it is a factor that cannot be ignored. In addition, it has to be observed that firstly, it makes sense for any paint to be removed if something is going to be inspected. Paint could hide small defects. Further, the fact that reference is made to paint possibly being present in the area of the fin attachment nutplates suggests that this was at very least not an unknown occurrence notwithstanding the indication earlier in the manual that the relevant area should have a primer coating only.

In addition, Mr Adrian Jones, a fifty two year old aircraft engineer, observed that if he had discovered paint on the supports he would have consulted the manual, albeit he identified a problem might arise if mating surfaces were painted. Mr Laidlaw did not think paint should be present but qualified this by saying that avionics were not his field. Mr Malcolm Rhind expected a light primer to avoid corrosion. He would have checked the manual to ascertain what was permissible although he considered that he would not have attached the supports with paint on the relevant surfaces. The suggestion from engineers that they would consult the manual when combined with the relevant section of the manual being silent on the point could explain why Mr Fell did not remove paint from the relevant surfaces of the supports when reassembling the helicopter.

Further, the helicopter had flown for five years completing just over six hundred flying hours during that period. It had done so with paint on the relevant surfaces of the supports. Perhaps, as Mr Morrison suggested, Mr Fell considered at the crucial point that as the helicopter had flown in that condition for that period, he could put it back in the same condition. As Mr Fell conceded, there might be an element of truth in that suggestion.

Finally, there is the number of hours which the helicopter flew between the reassembly in September 2005 and the crash on 21st December 2005 when combined with the characteristics of helicopter flight. After the reassembly the helicopter flew approximately one hundred and eighty five hours up to the time of the crash. All the evidence pointed to a helicopter being susceptible to vibration during flight. A number of witnesses described a helicopter as a vibration machine. Mr Andrew Wilson said that Mr Ward remarked that the helicopter was 'a bit of a rattling old bugger.' Whilst nothing was read into the remark which was described as off hand and said almost out of fondness for the helicopter, it nonetheless gives a clear indication of the forces at work during a flight. It was not disputed that the commencement and extension of the cracks in the supports caused by fatigue would come from vibration and the buffeting received by the vertical tail fin as a result of the aerodynamics at work during flight. Mr Findlay from Qinetiq analysed the relevant supports and considered that the corrosion had been present for a while. Accordingly, whilst he could give no real timescale because there was insufficient evidence, he considered that the cracking occurred over a period of days or weeks. Mr Robinson considered that the problem had arisen since the reassembly.

It seems to me more likely that if the correct torque had been applied at the time of reassembly, then this is consistent with the number of hours which were flown from then until the crash. This represents a gradual path to failure. Mr Fell remarked that if the torque which had been applied at reassembly was the same as the breakout torque on the three stiff nuts after the crash, he was amazed that they stayed on for one hundred hours. It is also worthwhile observing that it was accepted that the sequence of failure began with the top rear support. The relevant stiff nut attaching this support to the fin had the greatest breakout torque of all the four nuts when examined by the AAIB, namely 30 lbf.in. Accordingly, the nut, which required the most force to

remove it after the crash, was the point at which the failure first occurred. There may be many reasons for this, or perhaps more correctly, why the break out torque in the stiff nuts attaching the top forward and bottom rear supports to the fin were lower. It does, however, seem slightly strange if the wrong torque was applied at the time of reassembly. Mr Robinson considered that it was likely that the top aft support failed sometime before the crash. Although he could give no precise time, he thought days or weeks. If this was the case, the other supports would have been more exposed to the forces which operated on the fin. I suppose that might explain the difference in torque values. Once the top aft support failed, with the other supports more exposed, their torque values might reduce. It has to be borne in mind that the reason for the torque value on the bottom forward attachment being much lower than the others was considered to be the prior failures of the other attachments. Again the fatigue was greater in the top supports when compared to the bottom.

Turning now to the issue of whether the presence of paint on the surface of the supports was a cause of the accident, I accept that the presence of paint on mating surfaces is not advisable. Further, whilst some were not that certain, there was general consensus on the matter between those with greater expertise regarding the maintenance of the helicopter. Mr Allan Robinson explained why this was the case. When the vertical tail fin was removed the film of gloss paint was broken. With the flaking of the paint, on reassembly the flaking surface would result in an environment in which any torque value applied could be reduced over time. Mr Fell was aware of this. Mr Rhind likewise was aware of this.

In light of my rejection of the possibility of Mr Fell applying the incorrect torque to the relevant components, the issue then turns on whether in the circumstances I can conclude that the presence of paint was a cause of the crash. In submission, Mrs Gilmore suggested that in light of the evidence I could not come to such a conclusion.

It is true that Mr Robinson would not commit himself in evidence. He concluded his examination in chief by indicating that he thought that the presence of paint may have contributed. He considered that to contribute the crash to the presence of paint was conjecture. Further, in making these comments, he did remark that he considered that it was highly unlikely that Mr Fell would make such a basic error as applying the

wrong torque. Accordingly, he seems to have largely discounted the ‘wrong torque application’ explanation. However, having considered the evidence, I am satisfied in all the circumstances that Mr Fell did not apply the wrong torque for the reasons to which I have already referred. Mrs Gilmore submitted that there were other possible causes but the evidence does not point, in my opinion, in any other direction. Whilst I appreciate that there is no evidence as to the condition of the paint on the relevant surfaces at the time of reassembly, it seems to me perfectly logical that with the removal of the vertical tail fin from the tail the surface of the paint would be broken resulting in the presence of an uneven paint surface on reassembly, some of the paint having been removed during that operation. That was the condition of the paint on the relevant surfaces after the crash. There is an explanation as to why the condition of the paint could have caused the crash and the evidence is consistent with that explanation. In all the circumstances I have come to the conclusion that the presence of paint on the relevant surfaces was a cause of the crash.

Section 6(1)(c) – The reasonable precautions, if any, whereby the deaths and any accident resulting in the deaths might have been avoided.

In light of the conclusion reached in the preceding section regarding the underlying cause of the crash, there can be little doubt that a reasonable precaution which might have avoided the crash was the removal of the paint from the relevant surfaces of the supports for the vertical tail fin. Thereafter a primer would be applied to seal the exposed metal. The time required for such a task was not great.

In addition, Mrs Gilmore submitted that the pre flight inspection carried out by the pilot might have discovered the problem regarding the low torque in the relevant attachments prior to the fatal flight.

I would firstly observe that the productions which deal with such an inspection give no real details as to what is expected regarding the vertical tail fin. Crown production number 64 relates to the pre flight/walk round inspection and was prepared by HJS Helicopters Ltd. It simply refers to ‘a walk round type inspection of the helicopter....for condition including any obvious signs of wear, damage, or leakage.’ Crown production number 211 is the document dealing with the pre flight inspection

prepared by Bell. At the relevant section it simply refers to the condition of the vertical tail fin. There is no detail in either document as to what is or should be involved in such a walk round inspection.

It was not disputed that Mr Ward was a very experienced and capable pilot. Mr Andrew Wilson described him as being very knowledgeable and professional regarding issues of safety. There was unchallenged evidence from Mr McGeough that Mr Ward carried out the pre flight inspection and I have no doubt that in the course of that he looked at the vertical tail fin. Accordingly, I consider that the first issue is what could reasonably have been involved in Mr Ward's pre flight inspection insofar as relating to that fin. The further issue is whether the performance of such an inspection could have detected the problem relating to the loss of torque?

There were differing opinions as to what should have been done regarding the vertical tail fin during such an inspection. Mr Keith Conradi, one of the AAIB inspectors, who had been a pilot of both civil and military aircraft, including helicopters, for many years, considered that such a check was a visible one. There was no need to touch the fin. Only if the defect could be seen was it likely to be noticed. Mr Andrew Wilson, an engineer and standby observer, talked of a visual inspection and touching screws to see if they moved. Mr Fell suggested that there was no universal practice regarding touching the rear fin. Messrs Sydney Simpson and Malcolm Rhind felt that, when regard was had to the breakout torque values for the supports, a pilot would feel that the vertical tail fin was loose. Mr Simpson was a flying instructor for sixteen years. Mr Rhind, who was also a pilot although rarely flying Bell Ranger helicopters, talked of the inspection requiring pressure to be applied in order to feel or hear if anything was amiss. Once the cracking in the support surfaces had occurred, he was of the view that the pilot would hear or feel something amiss. Messrs Dermidy and Jones, who were both engineers, considered that it would have been difficult to assess the torque by touching the relevant component.

In assessing the evidence given by all these witnesses, I have to say that I could not come to any conclusion as to whose account I preferred. No witness was challenged as to their respective views and I got the distinct impression that what was involved in such an inspection was very much down to the individual. I have to say that I would

be inclined to place more weight on the evidence given by Messrs Conradi, Simpson, and Rhind as they were pilots. Further, I would tend to place more weight on the evidence of Mr Conradi as he had greatest experience, albeit I considered Mr Rhind a very good witness and Mr Simpson a satisfactory one.

However, having regard to the passage referred to in the submission by Mrs Gilmore, namely that the relevant issue is whether the relevant reasonable precaution might have avoided the accident, I consider that I can make a determination in relation to this matter. Before giving my reasons for this conclusion, I would make the following observations.

Firstly, there was no direct evidence as to what Mr Ward actually did on the day of the crash. Although Mr McGeough believed Mr Ward looked at the vertical fin, he had no recollection of him touching parts of the aircraft. Accordingly, Mr Ward may or may not have touched the fin. The evidence from Mr Andrew Wilson certainly suggested that he might have done so. He talked of Mr Ward touching the bolts to see if they moved, checking for damage, and using a cloth to remove dirt.

Further, in light of the evidence, I do not consider that I can conclude that touching the fin would have, as opposed to, might have avoided the accident. Whilst some were of the opinion that applying pressure to the vertical fin would have disclosed a potential problem, others were of the view that it was difficult to assess torque by touching the fin.

Turning to the reasons for my determination on this point, it firstly appears to me that there was a reasonable body of opinion that the pre flight inspection of the vertical tail fin should involve the pilot touching it. At no point was such a practice challenged as being ill advised or the like. In addition, it appears to me that to touch or move the fin in a careful manner would not be onerous either in what it required either by physical effort or time.

If the vertical fin had been touched, could this have given an indication that all was not well? I accept that by the date of the accident, the surfaces of the supports were cracked as spoken to by Mr Findlay. These cracks had taken some time to develop.

Mr Findlay spoke of these having developed over days or weeks. Mr Robinson likewise was of the view that they had developed over a period. Accordingly, it seems to me that if the fin was touched, the fact that something was not as it should have been, might have been picked up having regard to the evidence of Messrs Rhind and Simpson.

Section 6(1)(d) – The defects, if any, in any system of working which contributed to the deaths or any accident resulting in the deaths.

I have no observations to make. I do not consider in light of the evidence that I can say that there were defects in any system of working. There were no specific instructions regarding the presence of paint which covered the reassembly. Likewise there were no specific directions regarding what was involved in the pre flight inspection of the vertical tail fin.

Section 6(1)(e) – Any other facts which are relevant to the circumstances of the deaths.

Since the crash, a number of bulletins and directives issued by the appropriate authorities have dealt with the issues of the torque to be applied, the provision for checking torque values, and the existence of paint on the relevant surfaces. I have nothing to add in that regard.

There remains one further matter which I wish to cover at this stage. This relates to the pre flight inspection carried out by the pilot of the helicopter. As I have already recorded, there was a considerable divergence of opinion as to what that should involve insofar as relating to the vertical tail fin of this helicopter. The productions which specified that such an inspection be carried out said little as to what should actually be involved. It may be that it is impossible to give any particular specification as to what such an inspection should entail. It may simply be that it is properly left to the individual. It does seem that too much pressure applied to that section of the aircraft could have a detrimental effect. I wonder, however, if persons with the appropriate expertise should not look at this. I have determined that an inspection involving physical contact with the vertical tail fin might have avoided this crash.

Finally, as a postscript, I wish to make the following observation which has nothing to do with the determination itself. The representatives and I wished certain passages of evidence transcribed. This was carried out by Mendip Media Group Ltd of Tiverton in Devon. I do not know whether it is the standard of the recording equipment used or the fact that perhaps employees of that concern have difficult deciphering accents, but I do not recall ever having had transcripts of evidence in court with so many answers having the word 'inaudible' appearing. At no time did I have difficulty hearing either the witnesses concerned or the representatives putting the questions. It defeats the purpose of asking for evidence to be transcribed if there are so many such gaps in the evidence. Both questions and answers become incomprehensible. If my experience is commonplace, I would hope a solution will be found as a matter of some urgency.

SUBMISSIONS FROM THE CROWN

I express my sympathy to the families and thank witness who have attended

I would be entitled to or it may be suggested I should restrict myself to the bare requirements of section 6 of the Fatal Accidents & Inquiries Act. I do not intend to do so. The Inquiry has dragged on for various reasons for almost year and has been attended assiduously by members of the deceased family.

The sequence of events except for the most detailed of matters seems to me to be fairly clear and not substantially in dispute.

Ownership and operation

At the time of the accident the aircraft was owned by G & N Aviation, it was operated by Total Air Management Services Ltd and was being used to carry out pipeline inspections for British Gas all maintenance was the responsibility of H.J.S. Helicopters Ltd. The aircraft had been modified in line with all documentation from the relevant authorities.

The Bell 206B Jet Ranger II Helicopter, G-WLLY took off from Cumbernauld at 9.22 on 21 December 2005 piloted by Mr Ward with Mr Lapsley as observer to carry out pipeline inspection and also ironically for an earlier than required 100 hour inspection which although it is speculation would likely have picked up the fault.

Mr Ward had all the necessary licences and flying hours to fly that particular type of helicopter. There is documentary evidence that the normal pre-flight checks as required by the maintenance manual at the time were carried out and the evidence suggests that Mr Ward was a highly experienced and conscientious pilot to whom such a check would have been second nature.

There is no evidence that the defect which caused the crash should have been noticed at any such check. Indeed it cannot be said that the defect was present or if present was so advanced that it should have been noticed at the time of any Inspection between September 2005 and the accident.

At about 10.15 a.m. over the crash site near Coupar Angus the aircraft was seen by various witnesses to be in difficulty and fall to the ground. The eye witness accounts do not raise any doubt as to the validity of the AAIB Report and its conclusions.

There was no evidence of pilot error being a direct cause of the plane falling to the ground. The weather conditions were windy with good visibility and did not materially contribute to the accident. Any high winds and turbulence might have exacerbated any vibration present but the degree if any to which this contributed could not be quantified.

Police and subsequently the AAIB attended and secured and mapped out the crash site and located the wreckage. From investigation of the crash scene, the damage trail and the nature of the damage the sequence of events was as follows.

Due to a failure of the structures attaching the rear vertical stabiliser the bottom of the Rear Vertical Stabiliser came into the path of the rear rotor. The rear rotor was damaged and in particular tip weights were detached. As a result of this damage and the out of balance forces caused by it the rear rotor detached from the aircraft. The

Rear Vertical Stabiliser detached from the aircraft. The loss of these two parts made the aircraft uncontrollable because the loss of weight adversely affected the centre of gravity and the loss of these two components adversely affected the aircraft's directional stability. Once this had occurred there was nothing the pilot could have done. The nose of the aircraft would have dropped very likely resulting in the pilot applying force to the cyclic stick to correct this. The violence of these movements led the main rotor to detach and to slice through the cockpit. The aircraft and crew fell to the ground. The crew died as a result of the crash.

Initially it was considered that the initiating factor in the sequence of events that lead to the crash may have been detachment of the rear rotor. As a consequence this was soon after sent for analysis and this was carried out by Mr Tyrer. The conclusion of the report was that the detachment was due to bending overload in the bolts. This is consistent with the sequence of events described in the AAIB report.

The aircraft was removed for examination. On examination it was found that the break out torques for the 4 nut and bolt assemblies securing the fin supports/attachment to the inboard surface of the Rear Vertical stabiliser were considerably less than those required by the manufacturers maintenance manual.

The bolts and the attachment were subjected to metallurgical analysis which indicates that three bolts top aft and forward and bottom aft all had evidence of fatigue and that there was evidence of dirt. One bolt the bottom forward was found to have deformed due to overload.

From this, the sequence of failure of the structures attaching the Rear Vertical Stabiliser to the aircraft was:-

- 1 top aft,
- 2 top forward,
- 3 bottom aft,
- 4 bottom forward.

There has been clear evidence that the nuts were highly unlikely to back off during the use of the aircraft, notwithstanding the large amount of vibration present in any

helicopter. From the above it was concluded that the reason for the failure of the attachment was insufficient “Assembly Torque” ie the torque present in the assembly at or about the time of the failure of the parts involved.

The history of the aircraft was described as chequered, however as the history was fully documented from the respray in December 2000 this is not thought to be a problem. In December 2000 the blue metallic paint was applied according to the records. This is the latest record of any respray. Since a respray is a large job and would only be paid for if the job was recorded it is assumed that this is truly the time when the blue metallic paint was applied.

In May 2005 the aircraft was dismantled to be transported for repair to the bath tub section (cabin). This repair was completed and the aircraft returned and then put back together by Mr Fell a highly experienced engineer. He was responsible for replacing the Rear Vertical Stabiliser. There is no record or other evidence of any paint work/primer or other substance being applied or removed during this procedure.

The plane was subjected to 50 hour inspections in October and December 2005 and a 100 hour inspection in November 2005 none of which called for any procedure which would necessarily have revealed the defect even if it was present at the time of inspection.

There is no challenge to or other evidence to suggest that the failure of the Rear Vertical Stabiliser attachment was due to anything other than loss of assembly torque. Accordingly the crucial issue is what caused that loss of torque.

Possibilities Raised.

Human Error and Loss of Paint on Mating Surfaces

One of the most significant factors in deciding which if either option might be the reason for the crash would have been to know how long the fault had been present or for how long it had been developing. That is denied us, the witnesses who might have

been able to tell us Mr Robinson and Mr Findlay are unable to give any time frame that assists the court in reaching any conclusion, that is not a criticism simply a statement of fact.

Human error

Namely that Mr Fell at the time of the rebuild failed to apply the required torque to the assembly. Only Mr Fell could know this. He could not completely discount the possibility but was as clear as he could be that it was unlikely.

It is a matter for the court as to whether he is credible and reliable in this point and the rest of his evidence. These are matters for the court however on the question of credibility I will admit to developing a degree of scepticism from the toing and froing over his apparent inability to appear or to give evidence by live link. However the manner in which he gave his evidence during the commission gave no grounds to attack his credibility in particular his response to a leading question from his own Counsel that the explanation she presented for him to use was “more of a excuse than a reason” was unless he is a superlative actor redolent of some one trying to tell the truth. The question of his reliability is for the court.

All the other witnesses who expressed an opinion doubted that a man of his experience would make such a mistake. The possibility of interruption was raised, Mr Robinson suggested that this was unlikely because all the bolts had torques in excess of that which could be applied by hand.

The theory of the “calibrated elbow” was raised in evidence and while it is speculation it does have some force, how much is a matter for the court

The possibility of a fault in the torque wrench used was raised. It was not clear from his evidence in chief, his prior statement and Mr Rhind’s evidence whether he used his own tool or HJS’s. As the wrench used was not even identified the possibility that it was faulty can never be excluded. However the torque wrench is a fairly uncomplicated tool and there is little that can go wrong. It was Mr Fell’s evidence that he had never known one to go wrong except if damaged such as by dropping. None of

the other witnesses suggested that there was a real likelihood that the wrench was faulty. There is a possibility that the wrong setting was applied but there is no evidence in that respect.

A vital point inspection was recorded as being carried out. This was not required by the maintenance manual but it would not be an unusual additional thing to do. This is simply Mr Fell telling Mr Rhind what he had done. The vital point inspection cannot confirm that the correct torque was applied. It does however give some credence to the assertion that Mr Fell was a conscientious mechanic who was not cutting corners.

In his statement Mr Fell and Mr Rhind speak to a torque strip being applied. Mr Robinson saw no evidence of this. The application or otherwise of a torque strip would not have affected the accident as it is only an indication if bolts have moved not of the initial torque applied at the time of assembly. It did appear that there was a clear conflict of evidence between Mr Rhind and Mr Fell's statement and the evidence of Mr Robinson. However that conflict may have been resolved by Mr Fell's evidence that he was not surprised that Mr Robinson saw no evidence of a torque strip as it may have been removed by persons cleaning the area in question. This was not raised with other witnesses because the possibility of this happening only became an issue in Mr Fell's evidence.

Additionally while it was not a point that was raised in evidence I believe it is significant that ALL the bolts had low torque readings. While one mistake or interruption is possible, though according to some of the evidence unlikely three or four are even less likely.

Loss of Paint

This may have been a cause of the low assembly torque since if paint were lost from the mating surfaces there would have been gaps created between the surfaces leading to a diminution of assembly torque.

As said earlier, in 2000 the blue metallic paint was applied according to the records. This is the latest record of any respray. Since a respray is a large job and would only be paid for if the job was recorded it is assumed that this is truly the time when the

blue metallic paint was applied. There is no record of any later paint work or of the removal of the Rear Vertical Stabiliser. There is no documentary evidence of paint being applied at the rebuild. Neither Mr Fell nor Mr Rhind make any reference to paint primer or other substance being applied or removed neither can recall the condition of the mating surfaces.

It is impossible to say what the state of the paint work on the mating surfaces was at the time of the rebuild in September 2005, and indeed because of the real possibility of paint being lost during the crash, what the state of the paintwork was at the time the structure began to fail. In my own view it would be likely that if the paint work was in something like the state seen in court and in the photographs then Mr Fell would be more likely to notice it and if he had noticed it.

A point was made however that why if the paint had been present since the respray in December 2000, did it only start to disintegrate after the rebuild in September 2005. A possible answer to that was I recall given by Mr Robinson that the removal of the part in May 2005 may have started a break up process (p 148).

There was no indication in the Maintenance manual in use prior to the accident that mating surfaces should not be painted. A number of witnesses were clear that having gloss paint on mating surfaces was a “bad thing” and that it was known to be a bad thing. Mr Fell himself said he hoped he would have taken the paint off if he had noticed it. (p31) From his evidence it is clear that Mr Fell accepts that he should have noticed the fact that there was gloss paint on the mating surfaces and further that if he had he would have removed it. (pp 31 & 40) He did make reference to Jointing Compound but accepted that there was no evidence it had been applied and indeed had no recollection of applying it.

Which of either human error at time of assembly or loss of paint is more likely?

None of the witnesses were able to give a definitive answer.

Mr Robinson “conjectured” that loss of paint was the more likely cause (pp 147-149) because while the court would clearly not be bound by such conjecture it could found

a basis for choosing a particular explanation or at least expressing an opinion as to which was the more likely.

In my own view the evidence is such that the court would not be able to make a definite choice and could only express a view which of the only two explanations put forward for the cause of the loss of assembly torque, namely human error at the time of the rebuild or loss of paint from the mating surfaces was the more likely. Whether lordship feels the evidence justifies that is entirely a matter for you.

It is a matter for the court whether it feels that Mr Fell should have noticed that there was paint (whatever the condition of the paint work) and remedied the situation.

Could/Should the Defect have been Discovered

Obviously if the defect had been discovered it would have been rectified. I am of no doubt that all concerned with the maintenance of the plane including, indeed particularly, Mr Ward would have taken immediate action if they had been aware of the defect. At the risk of or indeed at the cost of contradicting myself, on one view this question does not arise because it is not known when the defect arose or when it would have been capable of being discovered by any check.

However if it is assumed that the defect was present or developing from the time of the rebuild in September 2005 there was no check carried out at any of the inspections which would have necessarily revealed the defect. One check would have been a simple torque check. This was not required by the maintenance manual in use at the time. It was included in a version issued after the accident.

It is a matter for the court whether those who carried out the maintenance should have carried out this check when it was not required by the maintenance manual. There was no evidence from any witness and in particular from Mr Robinson or Mr Conradi that they would expect this to be done. . Mr Robinson indicates he would not criticise anybody for failing to carry out a torque check (p145).

It was raised with Mr Robinson whether the manufacturers should have included this requirement in the earlier versions of the maintenance manual he did not consider they could be blamed for that. (p145).

Reference was made in the evidence to a dye penetrant test. This was not a test that had any application to routine maintenance.

Ground Handling

Before I deal with the specific submissions in terms of section 6 there is one matter that arose in various witnesses' evidence.

In the AAIB report the question of inappropriate ground handling in particular the use of the stinger was mentioned. However the evidence of Mr Robinson was clear that the use of the stinger would apply a force which would place more pressure on the lower bolts. This is not consistent with what is thought to be the sequence of failure namely upper bolts then lower bolts.

There was contradictory evidence and as to whether this practice occurred at HJS premises. It is a matter for the court as to whether it did occur. Even if the practice did occur and had been applied to the aircraft in question it would not have been the cause of the loss of torque. Additionally there was, in fact, as I recall, no specific evidence that the aircraft in this case was subjected to such inappropriate handling.

During the commission when objection was taken by Mrs Gilmore to my asking Mr Fell about this your Lordship mentioned it as a matter that could be raised in the determination, in my view it is not. It is a practice that does occur but it is a practice that it is well known should not occur and being raised as a side issue in Your Lordship's determination is not likely to have any effect. The only value is to show evidence that on occasion procedures at HJS were not always quite as they should be and to demonstrate that people can deviate from what they know they should do.

Formal submissions

The first 2 submissions are largely formal the latter 2 are possibly more contentious, they do not necessarily reflect my views or the views, if any, that I have previously expressed but are determinations which your Lordship would be entitled to come to depending upon what view you took of the evidence. Whether your Lordship would consider making any of the determinations I suggest or mention will depend on your Lordship's view of the evidence.

In terms of section 6(1)(a) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976:-

That on land adjacent to the A94 Coupar Angus to Meikle Road near to Viewpark Farm, Coupar Angus, Perthshire at about 10.15 a.m. on 21 December 2008 Edward Newcomb Lapsley date of birth 27 November 1949 and Robert Phillip Glover Ward date of birth 30 September 1957 died as a result of an accident whereby the Bell 206B Jet Ranger II Helicopter, G-WLLY fell to the ground. At that time they were acting in the course of their respective employments as Observer and Pilot.

In terms of section 6(1)(b)

That the cause of death for Edward Newcomb Lapsley was 1(a) Multiple Injuries, 1(b) Blunt Force Trauma and 1(c) Civilian helicopter Crash (Observer) and the cause of death for Robert Phillip Glover Ward was 1(a) Multiple Injuries, 1(b) Blunt Force Trauma and 1(c) Civilian helicopter Crash (Pilot). The cause of the accident was the failure of the rear vertical stabiliser of the said helicopter which caused the detachment of the rear rotor both of which lead to the helicopter becoming so unstable that it sustained further damage and crashed.

In terms of section 6(1)(c)

The cause of the crash as stated above was the failure of the rear stabiliser. The only explanation given for that is insufficient assembly torque. That two possible causes have been identified, insufficient torque being applied at the time of reconstruction or in service loss of torque occurring due to paint on mating surfaces coming off from the time of reconstruction. The determination if any made will depend on your lordship's views on the evidence.

If you took a view that the accident was caused by insufficient torque being applied at the time of reconstruction then the reasonable precautions that could be suggested would be:-

- (i) Ensuring that sufficient torque was applied.
- (ii) Ensuring any torque wrench was properly calibrated, only if you take the view this was possibly a cause.
- (iii) Carrying out a torque check at either or both the 50 and 100 hour inspections, if you take the view notwithstanding my own comments that it the defect was present or in a state that it could have been noticed and it was reasonable to expect either those involved in the maintenance to have done it notwithstanding it was not required by the maintenance manual or for the manufacturers to have specified it in their maintenance manual.

If you take the view that the lack of torque was due to loss of paint then the reasonable precautions that could be suggested would be:-

- (i) Ensuring that any mating surfaces were free of paint and that only primer was applied. This is now the practice required by the maintenance manual
- (ii) Carrying out a torque check at either or both the 50 and 100 hour inspections with the same comments as (iii) above.

In terms of section 6(1)(d)

If you took a view that the accident was caused by insufficient torque being applied at the time of reconstruction then a defect in any system of working which contributed to the death or accident was :-

- (i) Failing to ensure that sufficient torque was applied. Although you would be entitled to treat this as simple human error case it could be said that as there was no system to properly check that the correct torque was applied to that extent there was a defect in the system of work.
- (ii) Failing to ensure any torque wrench was properly calibrated, only if you take the view this was possibly a cause.
- (iii) Failing to out a torque check at either or both the 50 and 100 hour inspections, if you take the view notwithstanding my own comments that it the defect was present or in a state that it could have been noticed and it was reasonable to expect either those

involved in the maintenance to have done it notwithstanding it was not required by the maintenance manual or for the manufacturers to have specified it in their maintenance manual.

If you take the view that the lack of torque was due to loss of paint:-

(i) Failing to have a system to ensure that any mating surfaces were free of paint and that only primer was applied. This is now the practice required by the maintenance manual. Your Lordship would of course have to take the view that it is a failure not to have a system to ensure that people did not do something it appears everyone knew should not be done i.e. have paint on mating surfaces.

(ii) Failing to have a system of checks at either or both the 50 and 100 hour inspections with the same comments as (iii) above.

In terms of section 6(1)(e)

I have no suggested determination. All that could have reasonably have been done to avoid this accident beyond the avoidance of human error i.e. torque checks and removal of paint from mating surfaces has been included in documentation published since the accident.

SUBMISSIONS FOR TOTAL AIR MANAGEMENT SERVICES LTD.

No issue was taken with the great majority of the submission for the Crown. The facts founded on by the Crown were accepted. There was no difficulty with the Crown's submissions as to the content of findings in terms of section 6(1)(a) and (b) of the 1976 Act. In terms of section 6(1)(c) it was submitted that reasonable precautions which may have avoided the accident were if paint had been removed from mating surfaces at the time of the helicopter's reassembly and that it was reasonable for this to have been done.

Turning firstly to the removal of paint, the AAIB inspection revealed that the supports at the tail were attached by four nuts and bolts. After the accident, the break out torque had been measured and was found to be well below the required torque. Further examination revealed fatigue and cracking through and around all the bolt

holes. The AAIB found that the upper fractures exhibited a considerable degree of corrosion and surface deposits. The conclusion in the inspection that this was caused by a loss of torque was accepted.

There were two possible explanations for the loss of torque. Firstly, the incorrect torque had been applied or alternatively, loss of torque had taken place in service. It was submitted that the more likely of these explanations was in service loss of torque. The AAIB inspection highlighted the fatigue cracks had progressed resulting in the failure of all the attachments. That was the result of loss of torque which had existed for a considerable time. The presence of gloss paint on the faces of the supports was more likely to result in loss of torque. This had been accepted by Mr Robinson. Mr Rhind had said that the presence of paint could cause a loss of torque. Messrs Rhind, Robinson, and Fell had agreed that it was not good for paint to be present, particularly if it was flaking. Whilst the maintenance manual was silent as to the presence of paint, all witnesses agreed that it was good engineering practice for no paint to be present.

How did the paint get there? When the helicopter was disassembled in 2005, it was the first time that the paint had been disturbed since 2000. Once the parts were moved, flaking could occur. It was consistent that deterioration would occur over time rather than instantaneously. The reassembly of the helicopter followed by the crash was a reasonably consistent chain of events albeit there was no evidence of the condition of the paint or the rate of deterioration. The court could draw this inference. Between 2000 and 2005 the integrity of the paint had not been broken. It was possible that the presence of paint could cause loss of torque and in this case it did. Messrs Rhind and Robinson had been present when the parts were examined and the evidence was clear – paint had been present when the helicopter was reassembled.

Mr Fell had reassembled the helicopter. In his original statement he had said that he had no recollection of the paint at the time of reassembly. If he had seen it, he would have removed it. That was best practice. In his evidence (page 31) he said that he could not recall the presence of paint. He hoped that he would have removed it. Obviously, he missed it. He conceded that paint must have been present but he had not acted on it. During cross examination (page 56) he accepted that it was more likely than not that he saw the paint. This was also supported by the evidence of Mr

Robinson when asked about the loss of torque. He had accepted that loss of torque was more likely than the incorrect torque being applied (page 165). Mr Robinson was undertaking a fact finding mission. Mr Fell accepted that it was better to remove paint and primer. There was accordingly sufficient evidence to conclude that the presence of paint caused the accident.

It was reasonable to remove the paint. It was a very easy job to do at the time of reassembly. It was quick and simple. It was of minimal cost. Mr Fell accepted this. It was well known that paint should not be present. The paint was noticeable. Albeit the manual was silent, it was an easy precaution to take.

Accordingly insofar as section 6(1)(c) was concerned, if this precaution had been taken, no accident would have occurred. It was submitted that there was nothing to be added in relation to section 6(1)(d) and (e).

SUBMISSIONS on behalf of HJS HELICOPTERS LTD.

1. Introduction

The evidence at this Inquiry has been led over 6 days (29th -31 May and 2nd and 4th October 2007, and 4th March 2008).

This submission is made on behalf of HJS Helicopters Ltd., the maintenance organisation for the Bell 206 Jet Ranger helicopter in which the two deceased were travelling at the time of death. This submission does not seek to rehearse all the evidence led. The Procurator Fiscal has helpfully summarised much of that evidence, and otherwise the submissions will be directed towards the findings that the Court is enabled to make in terms of the relevant statute.

2. Legal Framework

The relevant statute is the Fatal Accident and Sudden Deaths Inquiry (Scotland) Act 1976.

The purposes of the Inquiry is defined in section 6(1) of the Act which is in the following terms:

“At the conclusion of the evidence and any submissions thereon or as soon as possible thereafter, the Sheriff shall make a determination setting out the following circumstances of the death so far as they have been established to his satisfaction –

- (a) where and when the death and any accident resulting in the death took place;
- (b) the cause or causes of such death and any accident resulting in the death;
- (c) the reasonable precautions, if any, whereby the death and any accident resulting in the death might have been avoided;
- (d) the defects, if any, in any system of working which contributed to the death or any accident resulting in the death; and
- (e) any other facts which are relevant to the circumstances of the death.

It is well settled that it is not the purpose of a Fatal Accident Inquiry to determine any question of civil or criminal fault or liability.

Black v. Scott Lithgow Ltd. SLT 612, LP Hope at page 615G-H:

“There is no power in this section [s.6(1)] to make a finding as to fault or to apportion blame between any persons who might have contributed to the accident...It is plain that the function of the Sheriff at a Fatal Accident Inquiry is different from that which he is required to perform at a proof in a civil action to recover damages. His examination and analysis of the evidence is conducted with a view only to setting out in his determination the circumstances to which the subsection refers, in so far as this can be done to his satisfaction. He has before him no Record or other written pleading, there is no claim of damages by anyone and there are no grounds of fault upon which his decision is required. The inquiry is normally held within a relatively short time after the accident...”

FAI into the death of **Steven Alexander Dekker** 2000 SCLR 1087, Sheriff Dickson at page 1093B-E:

“For the reasons expressed by the Sheriff Principal Mowat in the determination following the Lockerbie air disaster and in accordance with the judgment given by

Lrd President Hope in *Black v. Scott Lithgow Ltd.*, it is not appropriate that a Sheriff should make findings of fault after an FAI. As Sheriff Principal Mowat pointed out: “In a criminal case, or in a civil case based on delict, the accused or the defender is given full notice of the allegations made against him either in the form of a complaint or an indictment or by written pleadings. He is entitled to hear all the evidence against him before putting forward his defence. He is under no obligation to give evidence and may choose not to do so.”

In a FAI no such notice is given and, subject to the provisions of section 5(2) of the Act , a potential defender or accused is not entitled to decline to give evidence. The circumstances between a criminal case or a civil action on the one hand and a Fatal Accident Inquiry on the other are totally different. In terms of section 6(3) of the Act, a Sheriff’s determination may not be founded upon in any other judicial proceedings arising out of the death, and by this method Parliament has indicated that the finding of fault is not intended to be a purpose of the inquiry.”

The commentary to the above report is provided by Sheriff CN Stoddart:

“Even a finding under s. 6(1)(e) relates to matters of fact, provided that these are relevant to the circumstances of the death.”

Carmichael on “Sudden Deaths and Fatal Accident Inquiries” (3rd. Ed. 2005) page 174 states:

“If the cause of an accident is known then it may well be possible, even with what is said to be the wisdom of hindsight, to point to something which, if done, might have avoided or even prevented the death or even the accident resulting in death. Questions of reasonable foreseeability may not be easily dealt with in any Inquiry and will be better left to any action of reparation which may ensue. The precise wording of section 6(1)(c) must be kept in mind. What is required is not a finding as to a reasonable precaution whereby the death or accident resulting in death “would” have been avoided, but whereby the death or accident resulting in the death “might” have been avoided...Certainty that the accident would have been avoided by the reasonable precaution is not what is required. What is envisaged is not a “probability” but a real

or lively possibility that the death might have been avoided by the reasonable precaution.”

3. Where and when Robert Philip Glover Ward and Edward Lapsley died (section 6(1)(a))

On 21st. December 2005 the deceased were travelling in a Bell 206B Jet Ranger II helicopter, registration G-WLLY. The aircraft was owned by G & N Aviation and operated by Total Air Management Services Ltd. At the material time, Mr. Ward (the pilot) and Mr. Lapsley (the observer) were employed by TAMS Ltd. to perform aerial inspections of British Gas pipelines. The aircraft took off for that purpose from Cumbernauld at 9.22a.m.

Witnesses Andrew Brown, Linda McKenna, Craig Penney and Ralph Bisset gave evidence that they saw the aircraft nose-dive into the ground in a field adjacent to Viewbank Farm north of the A94 Meigle to Coupar Angus road. The precise area was further pinpointed by the evidence of DC Mann who gave a CD Rom presentation showing the location of the two deceased in the field. Mr. Penney’s evidence was that the accident occurred at approximately 10.10 to 10.20a.m. The affidavit of David Sadler, pathologist at the University of Dundee, attested to the post mortem reports (Productions 221 and 222) relating to the two deceased. According to those reports, loss of consciousness and death would have been immediate and both men were pronounced dead at 10.24a.m. on 21st. December 2005. Based upon this evidence the deaths of Mr. Ward and Mr. Lapsley may be said to have occurred at or about 10.20a.m. on 21st. December 2005.

4. Cause of death (section 6(1)(b))

The cause of death of both Mr. Ward and Mr. Lapsley as offered by the pathologist David Sadler in Productions 221 and 222 is multiple blunt force injuries following a civilian helicopter crash. In particular, the pathologist concluded that the leg injuries reflected impact from the spinning main rotor blade.

5. The cause of any accident resulting in the death (section 6(1)(b))

The evidence at the Inquiry was that whilst the cause of death is evident from the post mortem report, and whilst the immediate mechanism of the accident seems tolerably clear, the underlying cause of the accident remains more problematic.

A. The immediate cause of the accident

Three of the witnesses to the accident, who were driving at the time, gave evidence that the aircraft broke up in the air. Andrew Brown considered that the rear rotor detached first and that the vertical fin (or stabiliser) departed separately from the rest of the fuselage. Craig Penney recalled the aircraft becoming stationary in the air, the tail seemed to swing to the left and the nose to the right. Then he noticed a “cascade of parts” starting with a large square object which seemed to come from the rear of the main body. He was unable to identify it precisely, but thought it could have been a door. Ralph Bissett was alerted to the presence of the aircraft by noticing debris through his side window. Mr. Bissett, who had some aircraft experience, could see no tail rotor or fin on the helicopter on its dive into the ground.

DC Mann’s CD Rom presentation showed the aircraft’s flight path to the crash site and the eventual location of the wreckage. The report (Production No. 201) compiled by the AAIB explained the significance of the wreckage trail in reconstructing the sequence of events. The report was spoken to by first by Keith Conradi of the AAIB investigation team. His expertise related to flying aspects of the accident. The first items to detach were found earliest in the wreckage trail and were the vertical fin and stinger. The rear rotor was found at some considerable distance. This caused suspicion to crystallise around the rear of the aircraft. The rear rotor and associated gearbox were the subject of examination and report (Production 203) by Mr. Tyrer, a consultant engineer. He concluded that separation was due to bending in the attachment bolts. In the opinion of the AAIB investigators, the likely sequence of events was that the vertical fin had detached first, swinging into the arc of the tail rotor. This sufficiently damaged the tail rotor to cause it (and the associated gearbox) to detach from the aircraft. According to Mr. Conradi, this would have 2 significant effects from the handling point of view. First, the loss of lateral thrust provided by the tail rotor would cause the aircraft to swing to the opposite side (i.e. tail left, nose

right). This would accord with what Mr. Penney had observed. Second, the loss of the rear components created a loss of 20kg. of mass from that area. This would shift the aircraft's centre of gravity to a point forward of the centre of gravity limit, resulting in a nose down/tail up pitch. The pilot might have been able to control the right rotation, but not the nose down attitude. In an attempt to counter the pitch problem, Mr. Conradi considered that the pilot would have applied full aft cyclic control, thus adjusting the main rotor disc. Marks on the tail boom indicated that the main rotor had touched it and then flexed forward. The rotor disc then separated and sliced off the nose of the aircraft. The cyclic would have been severed, and there would have been no way of controlling the aircraft. In Mr. Conradi's view, once this particular sequence of events occurred, the pilot could do nothing to prevent the accident.

The other member of the AAIB investigation team, Andrew Robinson, also spoke to the immediate cause of the accident and to the report (Production No. 201), with particular reference to the engineering aspects. He confirmed Mr. Conradi's conclusions. He explained that the contact of the main rotor blades on the tail boom had led to the tilting of the disc and consequent overload failure of the mast in the air. He was (p. 185) "100% confident" that the failure of the main rotor was a consequence of the other failures. Mr. Robinson observed that this was not a situation that a pilot would normally encounter.

Mr. Conradi and Mr. Robinson both considered that the eye witness accounts of falling objects could be consistent with the loss of the fin, although Mr. Conradi agreed that eye witness accounts did not amount to much. Mr Conradi also observed that weather conditions were another factor.

B. The underlying cause of the accident

Once the AAIB investigation had concluded that the vertical fin was the first component to become detached, attention focussed on the possible reasons. Examination of the four nut and bolt assemblies securing the fin to the fin supports and thence to the tail boom included measurement of the "breakout" torque. In each case this was significantly less than the 50-70 lbf.in specified in the manufacturer's Maintenance Manual. The fin and the fin supports were subjected to metallurgical

analysis by Qinetiq and the resultant report (Production 202) described fatigue in the fractures through and around all the bolt holes. It was possible to determine that the sequence of failure was that the top attachments failed, allowing the fin to move outboard, pivoting about the lower supports and deforming the bottom forward bolt.

The report's author, Steven Findlay, gave evidence that the pattern of corrosion suggested that the timeframe over which the failure had occurred was likely to be "days or weeks" rather than "minutes or hours". Similarly, Mr. Robinson was unable to be any more precise on that point, confirming (pp. 51, 79) that it had probably been since the rebuild in September 2005. Mr. Robinson also explained that the presence of the stinger on this particular model of aircraft added another possible dimension to the disaster: as the cracking in the nut and bolt assembly developed, so the stinger might increase vibration amplitude. Thus the failure could be hastened.

As a result of the above examinations of parts, the crash investigators concluded that loss of torque in the relevant attachments may have been to blame. This could have been insufficient torque in the total assembly at the material time or in-service torque loss.

The main possibilities for the critical torque loss were evident from the AAIB Report and were as follows.

(i) Application of torque

During the summer of 2005, a substantial rebuild of the aircraft was required. HJS Helicopters Ltd. engaged the services of George Fell, an ex-naval engineer with some 45 years overall experience of helicopter maintenance, and about 25 years experience of Bell helicopters. This task involved re-installation of the vertical fin, during which he required to apply torque to the fin attachments. The Maintenance Manual specified torque values of 50-70lbf.in. Mr. Fell's evidence was that he could not remember whether he had used his own torque wrench or the HLS wrench. If the former, he would have applied the lower value and if the latter, closer to the higher. He stated that he calibrated his wrench far more frequently than the recommended one year and that it had never been found inaccurate in its twenty year life. He had last calibrated it

about three weeks before the rebuild. If he had used the HJS wrench, he would have checked it against the calibration machine before the job. There was evidence from George Laidlaw (pp. 41-43) that the HJS wrench was new at the time of the rebuild. When it was next sent for certification in about February 2006, the organisation concerned would have advised HJS had it been inaccurate. In Mr. Fell's March 2006 statement to the AAIB (Production 226), he appeared to recall using the HJS wrench.

Mr. Fell testified that he obtained a print-out of the relevant pages from the Maintenance Manual before attaching the fin. Although he had a general idea of what the appropriate torque would be, he did not rely on this as manufacturers sometimes changed the values. Thus, he would always check. About fifteen minutes elapsed between checking the torque values in the Manual and applying the torque. He was not aware of any interruptions during the job. Mr. Robinson also concluded that interruption was unlikely, given that the degree of breakout torque made it clear that an instrument had been used on all the attachments. Mr. Fell and Macolm Rhind both confirmed that, following fin attachment, they performed a vital points inspection. As regards the torque values, Mr. Rhind's evidence (p. 61) was "We confirmed that the torque value in the book had been used." A vital points inspection was not required by the Manual, but demonstrated Mr. Fell's awareness that failure of the fin would be catastrophic. It was described as "belt-and-braces" and, in my submission, was typical of Mr. Fell's careful approach to his work. The same may be said of the application of torque seal to the relevant bolts for the purpose of identifying subsequent movement. Both Mr. Fell and Mr. Rhind (p. 56-57) stated that this was applied. Mr. Robinson's evidence was that he found no trace of it post-accident. In my submission, this does not constitute a conflict and should not affect the credibility and reliability of Mr. Fell and Mr. Rhind. Mr. Fell observed that torque seal is easily removed by cleaning. In fact, Mr. Rhind (p. 77-78) testified to the fact that cleaning had taken place at the 100 hours inspection on 14th. November 2005.

In relation to the application of torque to the fin attachments, Mr. Fell had no specific recollection of this particular instance. However, he considered that he would have noticed if he had applied the wrong torque. He referred to the "three white knuckles" phenomenon. He was not aware of any occasions during his career when he had applied the wrong torque. Mr. Rhind (p. 117) confirmed that an engineer, dealing with

torque values day in and day out, would recognise an incorrect value. He also observed that the breakout torque values were very low, to the point where the aircraft would stall. Mr. Laidlaw (p.41) observed that an engineer “just knows by experience” when he has reached approximately the right torque. The same point was made by Mr. Robinson, who referred to the engineer’s “feel for the correct torque” or “calibrated elbow”. As regards a possible mistake by Mr. Fell on this occasion, Mr. Robinson was emphatic. He observed (p.153): “I believe it is highly unlikely that he would commit a basic error of that sort.”

(ii) Presence of paint on mating surfaces

Following the accident, examination of the fin supports revealed the presence of the remains of dark blue gloss paint on the outboard surfaces of the supports. There is documentary evidence (Production 207) to the effect that, in December 2000, the aircraft was resprayed. This was approximately 800 flying hours before the accident. There was also evidence from Mr. Fell and others that no painting had occurred since.

Mr. Fell’s evidence was that, at the time of the subsequent rebuild, he did not recall seeing any paint on the parts in question. It is not usual practice to apply paint to mating surfaces of structural joints, and he agreed that he would not be expecting to see paint there. If he had seen paint, he hoped that he would have removed it (p. 31). An alternative was that he might have applied jointing compound to remedy an uneven surface. However, no trace of jointing compound was visible. He also stated that he needed to use glasses for close work and that the lighting conditions were “not great”. Furthermore, the background metal was dark. In the circumstances, he considered that it was more likely than not that he just did not see the paint (p. 57-58). Mr. Jones, another engineer at HJS Helicopters Ltd., expressed the view that if paint **had** been seen on mating surfaces during this task, the Maintenance Manual should be consulted. The Maintenance Manual in use by Mr. Fell at the time (Production 209, section 53.15) contained no instructions regarding the presence of paint on installation. The manufacturer subsequently rectified this omission. It is perhaps significant that, in his evidence, Mr. Robinson revealed (p. 168) that initially the AAIB team did not conclude that the paint should not be there. He also considered

that the presence of paint was perhaps not something that Mr. Fell would encounter every day either.

The significance of the paint on these surfaces was explained in the AAIB Report and by Mr. Robinson (p.148-149). The integrity of the paint surface would be preserved by compression initially, but following the rebuild, a break-up process could begin. Degradation of the paint in service, it was suggested, could result in an uneven surface and consequent loss of torque. The minute tolerances with which we are dealing was emphasised by Mr. Robinson's comments (p. 168 onwards) that standard torque could be lost if a layer four thousandths of an inch were removed. The AAIB Report (Production 201) makes it clear (p. 63) that because there is no way of knowing whether the paint surface was any different at the time of re-attachment from its post-accident state "As a consequence, it was impossible to assess how much of a contribution, if any, the presence of the paint made to the cause of the lack of torque." In evidence, Mr. Robinson admitted that he considered that it was more likely that paint made a contribution to the accident than that insufficient torque was applied. However he volunteered the view (p.149) that the paint degradation "theory" was a difficult one to back up: "It is pure conjecture, personal opinion and I didn't think it was sufficiently strong to write about it." He also went so far as to describe the hypothesis (p. 166) as "admittedly very woolly." This was the reason why the AAIB Report stated (p. 63), a propos loss of torque, "Regardless of the cause..."

The question of torque loss, possible paint loss and the overall circumstances of this accident must also be seen in the context of the helicopter environment generally. Mr. Findlay (Qinetiq) confirmed that the low breakout torque in the attachments does not have an obvious explanation. His evidence was that torque can be lost for a variety of reasons (including, for example, that nuts work themselves loose during flight) or because there was insufficient torque at the outset. Mr. Rhind and Mr. Fell also stated that they had known bolts to come loose and stiff-nuts to back off in service. Such events were not common, but they did occur. A number of witnesses, including Mr. Conradi and Mr. Robinson, stressed the constant presence of vibration in a helicopter (Mr. Conradi characterised it as a "vibration machine"). Mr. Robinson also confirmed that minute differences in manufactured components and environmental factors such as grease, dust, vibration etc could all contribute to torque loss (p. 195-197). He did

not consider (p. 233) that it was possible to say that the accident had one single cause but that it was “a combination of factors”.

6. Possibility of detection (section 6(1)(c) and 6(1)(d))

The possible existence of any opportunity prior to the accident of discovering the developing cracks was considered. Mr. Fell’s evidence was that the parts were in good condition at the time of the rebuild. He had also tested the fin for security in his usual manner by “shaking” it. The investigators concluded that the cracks had probably initiated at some point after the rebuild but, as indicated above, it was not possible to pinpoint when the process might have begun. The aircraft’s maintenance documents (Production 205) and the evidence of the HJS Ltd. employees concerned revealed that all mandatory inspections since the rebuild had been satisfactorily performed, namely, 50 hour inspections in October and December 2005 and a 100 hour inspection in November 2005. At the material time, the manufacturer’s Maintenance Manual required that the 100 hour inspection, which is the more exhaustive check, include inspection of the vertical fin for “condition and security” (Production 205). Mr. Rhind testified to performing this. However, no torque check was specified at such inspections. Following the accident, the manufacturer amended the Maintenance Manual to specify a torque check of the fin attachments at each 100 hour inspection, and torque values were increased from 50-70 to 75-95lbf.in. Mr. Robinson concluded (p. 82) that, even if a torque check had been specified at the 100 hour inspection, it was just not possible to say that there was an increased chance of picking up the low torque in November 2005. Mr. Robinson had visited HJS Helicopters Ltd. to gauge whether they had conformed to the various requirements of the manufacturer’s maintenance schedule and the CAA regulations. He concluded (p. 197) that “everything had been done that was required to be done” and he commented that, by arranging for the upcoming 100 hour check to be performed early, they were showing “quite a responsible approach”. Mr. Robinson was clear (p. 145) that HJS Helicopters Ltd. could not be criticised for not carrying out a torque check at 100 hours when the manufacturer did not so advise. Nor would he criticise the manufacturer for not including such a requirement in the Maintenance Manual in use at the time.

In view of the difficulty experienced by the experts in estimating the inception and progress of the failure in terms more precise than “days or weeks”, in my submission it is not possible to conclude that a torque check at the 100 hours inspection in November (had such a check been mandated) would have resulted in detection of the defect.

There was, however, evidence to the effect that it is mandatory for the pilot to perform a “walk-round” inspection of the aircraft before flight (Productions 64 and 211). This includes checking the fin, and raises the possibility that, at least immediately prior to the accident, some instability might have been detectable. On the day of the accident, John McGeough, Cumbernauld Airport manager, saw Mr. Ward perform this inspection, but could not recall whether he touched the fin. Andrew Wilson, who had often flown with Mr. Ward as observer, described Mr. Ward’s usual check in some considerable detail. It included handling the fin to check for condition and security and, in particular, “to see if it was loose in any way.” Sydney Simpson, as a pilot and flying instructor, was certain that, with such low torque values as were present on breakout, the pilot should have heard, seen and felt that the fin was not as it should be. Mr. Simpson had personally experienced this phenomenon twice on other aircraft. Bryan Dermidy, an experienced aircraft engineer, took the view that there might be noticeable movement (as opposed to normal flexing) if the nuts were loose enough. Adrian Jones, another experienced aircraft engineer, stated that a loose fin would display shakiness which should be manifest during the walk-round inspection. Mr. Rhind was able to speak as both an engineer and a pilot. His evidence was that, once the cracking in the attachments was well developed, he thought that a pilot should be able to both hear and feel some abnormality. Mr. Conradi considered that it was not a requirement to touch the fin. However, if a pilot did touch it when the low breakout torque values were present, he thought that it was “unlikely” that he would detect that it was flexing more than usual. Mr. Robinson was reluctant to express a view, remarking that such a test could, in his view, produce widely differing results. This evidence should also be considered in the context of a conversation between Mr. Ward and Mr. Wilson on 12th. December 2005, nine days before the accident. This involved mention of some element of shakiness, but Mr. Wilson discounted it because Mr. Ward did not see fit to ground the aircraft, or mention it to the maintenance organisation. Mr. Robinson (p. 213) observed that the incident might have provided

some clue that “things were starting to come adrift.” In those circumstances, I would submit that there is evidence upon which it is open to the Court to find that, immediately prior to the accident, there was a “lively possibility” that the defect could have been detected during the performance of the pilot’s walk-round inspection.

7. Submission in respect of Mr. Fell

I submit that the Court should accept Mr. Fell as a credible and reliable witness. His general demeanour was dignified. He gave evidence in a thoughtful and helpful manner. He did not shrink from answering difficult questions, and he did not seek to avail himself of excuses. The general overall impression was of an experienced professional, who approached his work in a conscientious fashion, and who displayed honesty in his dealings with the Court.

In those circumstances, and against the background of the evidence to which I have already referred, I submit that there is no evidence before the Court which could lead to a conclusion of human error on the part of Mr. Fell. In relation to the torque values applied to the attachments, I would submit that, in addition to his own testimony, the evidence of three other experienced engineers - Mr. Robinson, Mr. Rhind and Mr. Laidlaw - points very firmly in the opposite direction. Indeed, Mr. Rhind (p. 52) described him as “...very thoughtful, experienced and his background in aviation is extensive” and (p. 122) “very methodical and very meticulous”. Mr. Laidlaw (p. 45-46) considered him a very good engineer: “...a steady engineer. He got the job done and did it by the book. He did a lot of things which weren’t in the book, but which were to the benefit of safety.” I would go so far as to say that, reading Mr. Robinson’s evidence as a whole, his observations regarding Mr. Fell’s experience, caution and methodical approach to his work are a recurrent theme. It was Mr. Robinson who characterised the suggestion of a basic error by Mr. Fell as “highly unlikely”.

Similarly, turning to the matter of the paint, there is, in my submission, no evidence to suggest that Mr. Fell was remiss in not removing the paint. It was clear from his evidence that he was aware that, if paint was present on mating surfaces, some remedial action was required, either removal or the use of jointing compound. We had evidence from a number of sources that he was an experienced and extremely meticulous worker. He had no recollection of seeing any paint. Furthermore, there

were a number of reasons why even a man of such expertise as Mr. Fell exercising his usual level of diligence, would not have identified the paint as a problem that should be addressed. In my submission, Mr. Robinson's evidence is particularly telling.

8. Suggested determinations

1. I have had the benefit of reading the Crown's suggestions. In relation to suggested determinations in respect of sections 6(1)(a) and 6(1)(b) of the Act, I would adopt the Crown's submissions.

2. In relation to section 6(1)(c) I would make the following submission:

That the cause of the accident was the failure of the vertical fin or stabiliser. Investigation revealed that the most likely cause was the loss of torque in the fin attachments. It is not possible to determine the precise cause of such torque loss or the precise stage at which it developed. Detection of instability in the vertical fin during the pilot's walk-round inspection immediately prior to the accident might have averted the accident.

3. In relation to section 6(1)(d), I refer to my earlier comments regarding the system of work in force at HJS Helicopters Ltd. and the system of work employed by Mr. Fell and, in particular, the conclusions of the AAIB experts regarding such systems. Against that background, I would make the following submission:

That a defect in a system of working which contributed to the death or accident was failure to detect instability in the vertical fin during the pilot's walk-round inspection.

4. In relation to section 6(1)(e) I would make the following submission:

That the aircraft manufacturer has taken steps since the accident to ensure that those factors which, in the opinion of the AAIB, might have contributed to the accident, have been satisfactorily addressed.

There was evidence regarding the movement of the helicopter by the use of the stinger. One employee of HJS said that the stinger was used to guide the helicopter. Mr Robinson had not implicated the stinger as a cause of the accident. It had played no part in the sequence of failure of the bolts. It was permissible to use the stinger as a guide. Pilots used the stinger to move the helicopter and it was inevitable that persons at Cumbernauld had used it to move the helicopter. Further manufacture should have a 'Hands Off' warning.