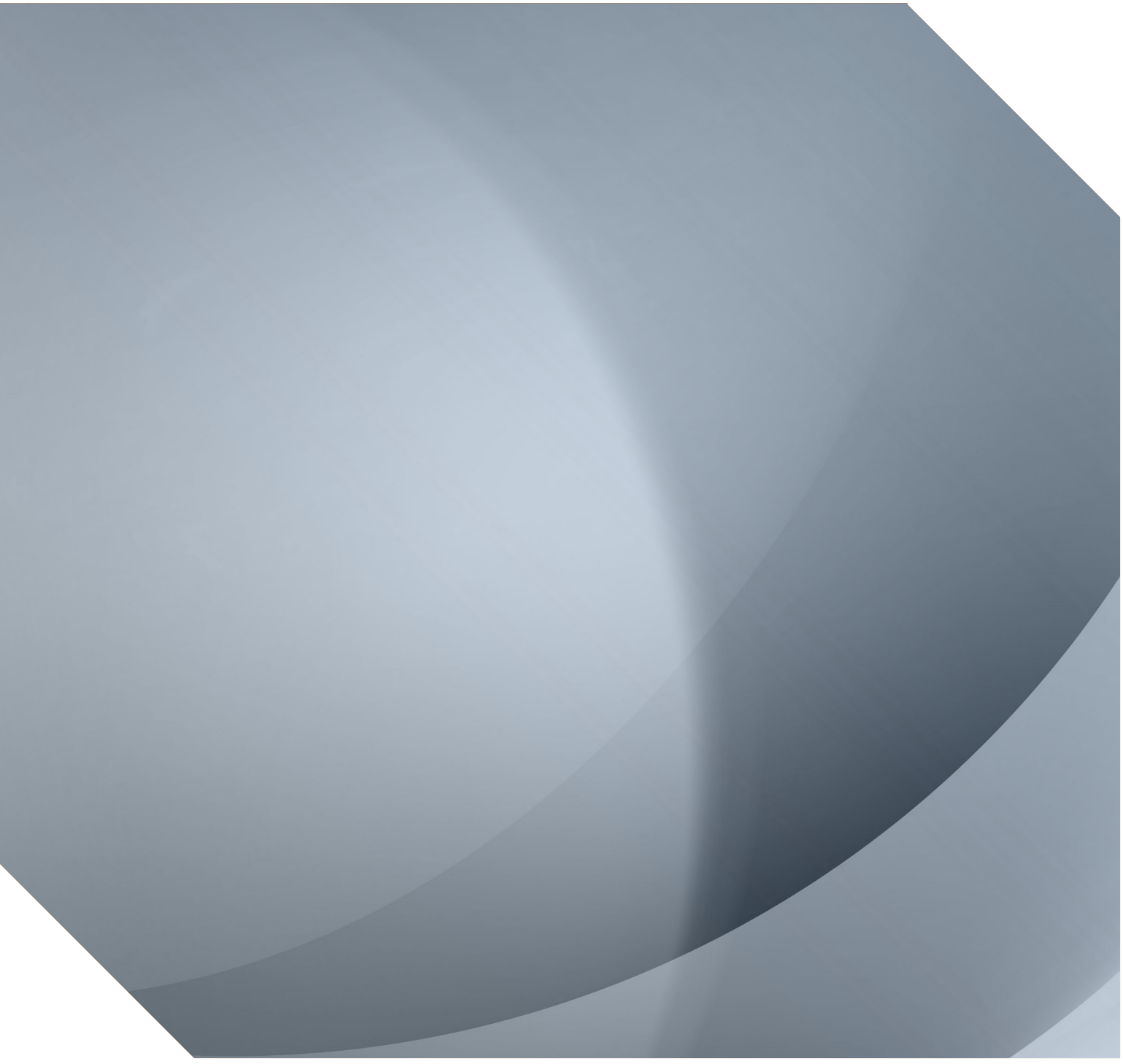
Safety and Airspace Regulation Group

Civil Aviation Authority

ADELT review report

CAP 1144



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Contents

CHAPTER 1

Executive summary

The UK CAA has been aware of issues related to failed and inadvertent deployments of Automatically Deployable Emergency Locator Transmitters (ADELTs) and, as a result, has been actively monitoring issues associated with ADELTs. As a result of this monitoring the UK CAA initiated a further review of ADELT performance, the sole intent of which was to make a number of recommendations related to ADELT performance, based on the knowledge gained over 26 years with the aim of increasing the likelihood of helicopter occupants being located and rescued in the event of an accident or incident.

The review was performed in two phases; a review of Mandatory Occurrence Reports (MORs) related to ADELT incidents (to determine a base set of performance issues) followed by a review of a number of accident reports.

The review of accident reports covered a period of 26 years and included the accidents referenced in the Helicopter Airworthiness Review Panel (HARP) Report – CAP 491[1]. This was supplemented by some accidents that occurred after publication of the HARP report to check whether the data gathered from a review of MORs was consistent with the information contained in accident reports." All the accidents reports that were reviewed related to accidents/incidents that occurred in the North and Irish Seas.

The aim of this review was to address four basic questions:

- What are the main causes of degraded ADELT functionality?
- Is the ability of an ADELT to function correctly significantly affected by the helicopter tail boom becoming detached?
- Is the ability of an ADELT to function correctly significantly affected by helicopter inversion?
- Have recent improvements in ADELT system designs improved ADELT reliability?

Analysis of the MORs and accident investigation reports reviewed during this investigation demonstrates that there are a number of common issues associated with the deployment or non-deployment of an ADELT. The review concluded that ADELT functionality is influenced by:

- The location of the ADELT on the aircraft

1 CAP 491 can be found on the CAA website.

- The location of ADELT related sensors in the aircraft
- The location of the power supplies for ADELTs and their supporting sensors
- Flight deck and maintenance human factors issues
- The level of clarity and completeness of maintenance instructions

The review concluded that there is probably no one "perfect" ADELT installation. Any ADELT installation design is likely to have to be a compromise to achieve the best possible resolution of issues associated with equipment selection, location and maintenance.

Finally, this report concludes that, while some previously identified ADELT issues have been resolved with no further occurrences, some have either recurred despite the system and installation designs being amended, or have only been partly resolved.

These conclusions were re-reviewed in the light of more recent helicopter accidents in the North Sea (G-REDW and G-CHCN). Although no new recommendations are proposed following these accidents, the information gained from a review of publicly available data related to these accidents supports the conclusions of this report.

The review includes a number of recommendations related to location of the ADELT, ADELT related sensors and ADELT sensor power supplies. If adopted, these have the potential to optimise installation designs and maximise the likelihood of the ADELT deploying and transmitting appropriately. Recommendations are also made regarding human factors issues and maintenance issues that have the potential to reduce the number of inadvertent deployments of ADELTs.

In addition to the ADELT related lessons and recommendations, discussions with the AAIB identified that there are some helicopter flight recorder installations that place the flight recorders in parts of the tailboom that are likely to become detached during or after an accident. As a result, this report contains one general flight recommendation that flight recorders are also located away from these areas.

CHAPTER 2

Acknowledgements

The following people and organisations supported this review:

- Bond Helicopters (Aberdeen) and CHC Scotia (Aberdeen) were consulted as part of this review and provided information on the general issues they had experienced relating to poor performance of ADELTs.
- Bristow Helicopters (Aberdeen) were also consulted as part of this review and provided information on the general issues they had experienced. In addition, Bristow kindly gave permission to photograph their aircraft equipped with ADELTs to illustrate possible ADELT locations.
- Caledonian Airborne Systems were also consulted as part of this review and provided information on the general issues they had experienced. In addition, they provided information on ADELT design issues.
- The UK AAIB were also consulted as part of this review, provided access to reports that are publicly available but not on their website and provided information about ADELT issues that are generally encountered during accident/incident investigations.
- The AAIB Denmark provided information on an accident report that was only available in Danish.
- CAA SARG technical staff from the Airworthiness and Flight Operations Capability Teams.

The author is grateful to these people and organisations for their invaluable support during this review.

CHAPTER 3

Introduction

The UK CAA has been aware of issues related to failed and inadvertent deployments of Automatically Deployable Emergency Locator Transmitters (ADELTs) for several years, as the following extract from CAP 641 "Report of the Review of Helicopter Offshore Safety and Survival" [Ref 37] shows:

> "ADELT does not have a good record of satisfactory operation in crashes … Thus, whereas finding a ditched helicopter has never been a problem, it might not always be easy to locate the scene of a crash which has occurred with little warning some distance away from an offshore platform, particularly if the aircraft has not remained on the surface."

This review was performed to identify the most likely causes of ADELT malfunctions and make a number of recommendations solely aimed at increasing the likelihood of helicopter occupants being located and rescued in the event of an accident or incident. It covered a period of 26 years from 1986 to 2012 and used the UK CAA's Mandatory Occurrence Report (MOR) database and publicly available air accident investigation reports as its primary sources of information.

In addition, this review made reference to the HARP (Helicopter Airworthiness Review Panel) report of 1984 (CAP 491 [Ref 35]) to ensure that it was aligned with the other helicopter research reports collated in CAP 491. Specifically, this review addressed the same set of accident reports covered by the HARP report to determine whether any ADELT related lessons could be learned from evaluating them. A number of other accident reports (related to accidents that occurred after the publication of the HARP report) were also investigated with the same intent.

The helicopter operators in Aberdeen (Bristow, Bond and CHC), Caledonian Airborne Systems and the UK AAIB also provided input to this review. The UK AAIB provided copies of publicly available accident reports which were not published on their website and general information about the damage helicopters have been subjected to during an accident. AAIB Denmark also provided information about an accident report that was only available in Danish. Bristow, Bond, CHC and Caledonian Airborne Systems commented on the initial drafts of this report and to provide input on the types of ADELT related issues they have experienced.

The review was performed in two stages; a review of the UK CAA MORs to determine a base set of ADELT issues and a subsequent review of the data related to the accidents listed in the HARP report and other, more recent,

accident reports to determine whether this information confirmed the findings derived from the review of MORs.

The review of the CAA MORs resulted in the identification of five categories of ADELT issues:

- Failure To Deploy
- Inadvertent Deployment
- Performance
- Other
- Unclassified

These categories are defined in section four of this report (Definitions and Acronyms).

The categories of ADELT issues identified by the review of MORs are used in this review as the Primary Classifications (i.e. the initial categories used to sort the MOR data).

Each of the four relevant primary categories (i.e. excluding 'unclassified') were subjected to further analysis, which resulted in the allocation of Secondary Classifications, intended to indicate the most likely cause of the ADELT issue under consideration. The secondary classifications listed below are also defined in section 4 of this report.

- Design
- External Event
- Human Factors
- In-Flight Damage
- Installation
- Maintenance
- Manufacturing
- Performance

Note 1: The issues identified as unclassified have been included in these charts for completeness but have not been subjected to any further analysis.

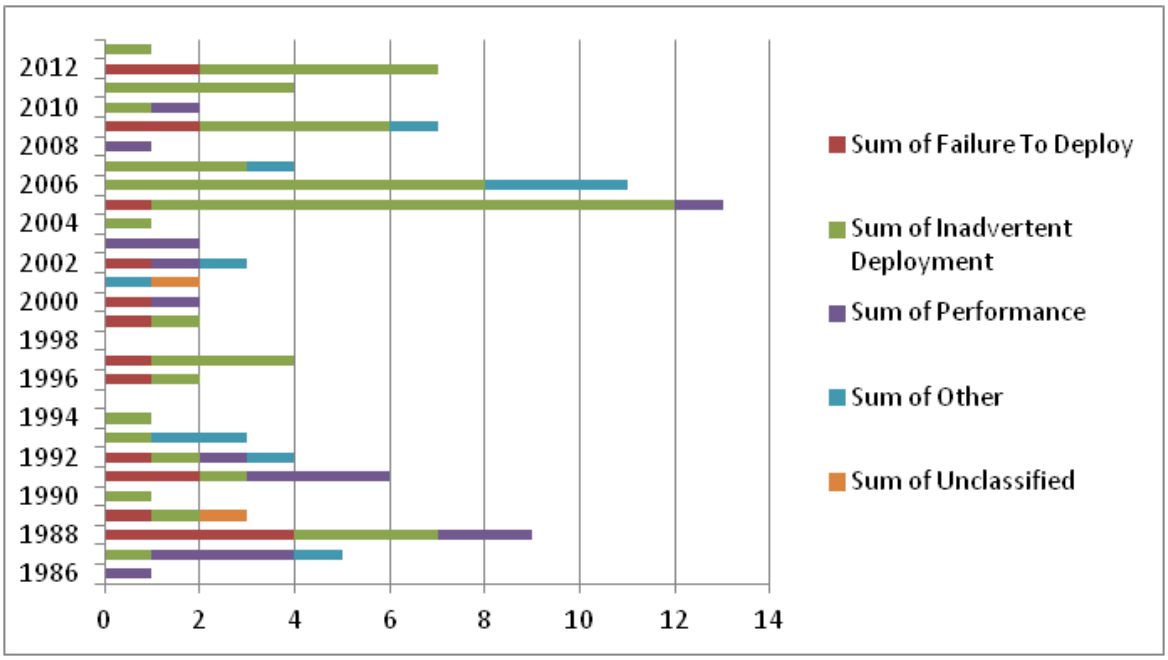
Note 2: Automatically deployable beacons are generally referred to as Automatically Deployable Emergency Locator Transmitters (ADELTs) or Crash

Position Indicators (CPIs). This report has simplified the terminology used such that reference is only made to ADELTs. In all cases, the use of the term ADELT(s) should be interpreted as referring to both ADELTs and CPIs.

Figure 1 below provides an overview of the prevalence of each type of ADELT issue over the 26 year period.

It should be noted that, as a result of the time span this review covers, some of the rotorcraft types that appear in this document have since been retired, along with their ADELT installations. However, as the lessons associated with the ADELT issues raised may still be relevant, they have been addressed in this report.

Figure 1 – Top Level ADELT Distribution



From the data available, it appears that the most common issue related to ADELTs is "inadvertent deployment", closely followed by "systematic" and "other". However, care should be taken when using this set of data to draw conclusions related to the overall distribution of different types of ADELT issues because:

- Although the majority of "failure to deploy" issues relate to aircraft accidents or incidents, this review has classified some events as "failure to deploy" on the basis that the issues identified were likely to result in a failure to deploy, even though an actual failure to deploy had not occurred.

- Although the conclusions related to the distribution of ADELT issues drawn in this review appear to be sound, based on the data available, they are taken from a statistically small dataset and, were a wider dataset available, those conclusions may have been different.

The report will address each type of ADELT issue identified in this review and discuss the most common causes for each.

A number of recommendations have been made as a result of these analyses and these are identified in Section 11 of this report (Recommendations).

As detailed earlier, this review has also covered a number of accident reports. However, only publicly available accident reports or interim bulletins associated with accidents/incidents were reviewed as part of this research. Accidents involving public transport rotorcraft for which an accident report or interim bulletin was not publicly available while this report was in preparation have been specifically excluded from this report.

Some interim bulletins were used to evaluate data associated with accidents still under investigation and, where use of these bulletins was necessary, permission to use the data was obtained from the relevant investigation agencies and operators. Although the review of recent accident investigation bulletins has not changed the conclusions of this report, the data obtained from these reports supports the conclusions drawn.

The list was discussed with CAA specialists, the AAIB, North Sea Operators and an ADELT manufacturer before being finalised and an agreement was reached that the final list was suitably representative.

The list of accidents that has been considered is:

Reg	Year	Pub avail report	Pub transport	UK register	Ditched	ADELT refs	Tail boom separation	Rotorcraft inversion
G-ATSC	8 Mar 1976	Y	Y	Y	Y	N	N	Y
G-BBHN	1 Oct 1977	Y	Y	Y	Y	N	Y	Y
G-BIJF	12 Aug 1981	Y	Y	Y	N	Y	N	Y
G-ASWI	13 Aug 1981	Y	Y	Y		Y	N	N
G-BDIL	14 Sep 1982	Y	Y	Y	N	Y	N	N
G-ASNL	11 Mar 1983	Y	Y	Y	Y	N	Y but N/A[1]	Y but N/A[1]
G-BEON	16 Jul 1983	Y	Y	Y	N	Y	N	Y

Reg	Year	Pub avail report	Pub transport	UK register	Ditched	ADELT refs	Tail boom separation	Rotorcraft inversion
G-BARJ	24 Dec 1983	Y	Y	Y	N	N	N	Y
OY-HMC	2 Jan 1984	Y	Y	N	Y	N	Y	Y
G-BISO	2 May 1984	Y	Y	Y	Y	N	N	Y
G-AZOM	24 Jul 1984	Y	Y	Y	Y	N	N	Y
G-BJJR	20 Nov 1984	Y	Y	Y	N	N	N	N
G-BKFN	15 May 1986	Y	Y	Y	Y	N	N	N
G-BWFC	6 Nov 1986	Y	Y	Y	N	Y	N	N
G-BEID	13 Jul 1988	Y	Y	Y	Y	Y	N	Y but N/A[2]
G-BDII	17 Oct 1988	Y	Y	Y	N	N	N	Y
G-BDES	10 Nov 1988	Y	Y	Y	Y	Y	Y	Y
G-BGKJ	25 Apr 1989	Y	Y	Y	Y	N	N	N
G-BEWL	25 Jul 1990	Y	Y	Y	N	N	N	N
G-TIGH	14 Mar 1992	Y	Y	Y	N	Y	Y	Y
G-TIGK	19 Jan 1995	Y	Y	Y	Y	Y	N	N
G-HAUG	12 Dec 1996	Y	Y	Y	N	Y	N	N
LN-OPG	8 Sept 1997	Y	Y	N	N	Y	Y	N
G-BJVX	16 Jul 2002	Y	Y	Y	N	N	N	N
G-JSAR	21 Nov 2006	Y	Y	Y	Y	Y	N	N
G-BLUN	27 Dec 2006	Y	Y	Y	N	N	Y	N
G-REDU	18 Feb 2009	Y	Y	Y	N	Y	Y	N
G-REDL	1 April 2009	Y	Y	Y	N	N[3]	N[4]	N[4]
G-REDW	10 Oct 2012	Y	Y	Y	Y	Y	N	N
G-CHCN	22 Oct 2012	Y	Y	Y	Y	Y	N	N

Reg	Year	Pub avail report	Pub transport	UK register	Ditched	ADELT refs	Tail boom separation	Rotorcraft inversion
1 This resulted from damage inflicted during the attempt to recover the rotorcraft.								
2 The inversion occurred as a result of a fire that destroyed most of the fuselage.								
3 This full report in to this accident has not been published yet.								
4 The aircraft was destroyed on impact.								

Table 1 List of reviewed accident reports

Note 3: CAP 641 (Report of the Review of Helicopter Offshore Safety and Survival, dated February 1995) draws a distinction between ditching and crashing, where ditching is understood to be a controlled descent into water and crashing is understood to be an uncontrolled descent into water. This review has used the same distinction in order to assess whether ADELT performance or the likelihood of either tail boom separation or rotorcraft inversion are affected by whether the rotorcraft crashes or ditches.

Each accident report has been subject to primary and secondary assessments.

The primary assessment was performed to determine whether the performance of the ADELT was specifically addressed and whether any ADELT related recommendations were made.

The secondary assessment was used to determine whether the rotorcraft tail boom separated from the main fuselage and whether the rotorcraft inverted. This assessment was performed to support the analysis of the effect of tail boom separation and rotorcraft inversion on ADELT performance – see Sections 9 and 10 of this report.

Extracts from the listed accident reports are provided in Appendix B to this report. Although the whole accident report is not provided, the following information is provided for each accident:

- The aircraft type
- The basic accident details (location, date and time)
- The synopsis of the accident
- Any comments on the ADELT plus any associated findings and recommendations
- Any comments on tail boom separation plus finding and recommendations
- Any comments on rotorcraft inversion plus findings and recommendations

- The CAA response to any ADELT recommendations
- An indication of where the full accident report can be found

CHAPTER 4
Definitions and acronyms

Term	Definition
ADELT	Automatically Deployable Emergency Location Transmitter. This is an Emergency Locator Transmitter (ELT) that has been designed to be ejected from an aircraft and to automatically transmit its location to aid Search and Rescue (SAR) activities.
CPI	Crash Position Indicator. This is a marketing term for a specific manufacturer's ADELT.
Crash	An uncontrolled descent into water. Definition taken from CAP 641 [Ref 37].
Design	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to a design issue that either caused the equipment to fail or directly resulted in a human factors event.
Ditching	A controlled descent into water. Definition taken from CAP 641 [Ref 37].
External Event	This term has been used as a secondary classification to indicate either that: ▪ The MOR under consideration is not related to ADELT event but merely refers to an ADELT in the explanatory text (e.g. a spurious PLB transmission – see MOR 200604317), or that ▪ The ADELT event in question resulted from an external event that was not related to the ADELT design, manufacture, installation, maintenance or usage. An example of this is a ship pitching (see MOR 199302109).
Failure to Deploy	This term has been used as a primary classification to refer to either: ▪ Issues that directly resulted in a failure to deploy, or ▪ Issues whose end result was most likely to be a failure to deploy
Hostile Environment	A hostile environment is defined as: (a) an environment in which: (i) a safe forced landing cannot be accomplished because the surface is inadequate; (ii) the helicopter occupants cannot be adequately protected from the elements; (iii) search and rescue response/capability is not provided consistent with anticipated exposure; or (iv) there is an unacceptable risk of endangering persons or property on the ground; (b) in any case, the following areas: (i) for overwater operations, the open sea areas north of 45N and south of 45S designated by the authority of the State concerned; (ii) those parts of a congested area without adequate safe forced landing areas;

Term	Definition
Human Factors	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to a human factors issue that was not directly triggered by a design issue (e.g. a switch being deliberately activated but in the wrong direction).
In-Flight Damage	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to damage that occurs in flight.
Inadvertent Deployment	This term has been used as a primary classification to refer to either: ▪ Issues that directly resulted in an inadvertent deployment, or ▪ Issues whose end result was most likely to be an inadvertent deployment.
Installation	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to an installation issue.
Maintenance	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to a maintenance error.
Manufacturing	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to a manufacturing issue.
Not Applicable	This term has been used as a secondary classification used solely when the primary classification is Unclassified. In this case, the MOR data is not relevant to this review and a secondary classification is not applicable.
Other	This term has been used as a primary classification to refer to MOR records that specifically call out an ADELT or CPI but do not directly relate to failure to deploy, inadvertent activation or systematic issues. This type of event has been investigated to determine if there are lessons to be learnt from these reports that could be used to reduce future occurrences of the other three types of issue.
Performance	This term has been used as a primary classification to refer to issues that affected ADELT/CPI functionality/capability but that did not/were not likely to result in a failure to deploy or an inadvertent deployment.
Personal Locator Beacon (PLB)	Term used to identify a type of personal ELT that, in general, does not hold an aviation equipment approval.
Sensor	A number of different types of sensor can be used in conjunction with an ADELT to activate its deployment mechanism. These are: **Frangible Switches** – These are used to detect that parts of an airframe have become damaged (buckled). **G Switches** – These are acceleration activated sensors used to detect that an aircraft has impacted with either terrain or water. **Hydrostatic Switches** – These are water activated sensors used to detect that an aircraft has landed or crashed on water. **Saline Switches** – These are salt water activated sensors used to detect that an aircraft has crashed or landed on salt water. These are sometimes used in preference to hydrostatic switches to avoid inadvertent deployment of an ADELT whilst an aircraft is being cleaned.

Term	Definition
Unclassified	This term has been used as a primary classification to refer to MOR reports that were identified by the search of the CAA MOR database but which do not actually relate to either ADELTs or CPIs. These records were identified by the search of the MOR database as a result of the term CPI being used in two different senses within the MOR database; 1) Crash Position Indicator (relevant to this research) and 2) Control Position Indicator (not relevant to this review).
Unknown	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event cannot be determined from the available information.
Wear	This term has been used as a secondary classification to indicate that the most likely cause of an ADELT event is related to a part (or parts) wearing.

Acronym	Expansion
AAIB	Air Accident Investigation Branch (UK)
AAIU	Air Accident Investigation Unit (Ireland)
AD	Airworthiness Directive
ADELT	Automatically Deployable Emergency Location Transmitter.
CAA	Civil Aviation Authority (UK)
CAP	Civil Aviation Publication (UK)
CFIT	Controlled Flight Into Terrain
CPI	Crash Position Indicator
MOR	Mandatory Occurrence Report, raised under the auspices of CAP 382
PLB	Personal Locator Beacon

CHAPTER 5

Evaluation of failures to deploy

5.1 Introduction

This chapter provides a detailed analysis of the MORs related to Failure to Deploy. Table 2 provides a tabulated summary of the MORs related to Failure to Deploy and the associated reasons for those failures. The text that follows Table 2 provides the analysis of those MORs and, where applicable, the relevant accident investigation reports.

Classification	No of MORs	Top level identified cause	Detailed cause	Reference to main MOR Table (Annex A).	
				Annex A Ref	MOR number
Design Issues	11	Equipment location	Sensor location	M11 M12 M14 M15	198802141 198803491 198803829 198804052
			Electrical power Location		
			ADELT Location		
		Human factors	N/A	M101	201212866
		Sensor selection	N/A	M37	199605710
		Vibration	N/A	M20 M25 M26	198903806 199102308 199102388
		Water ingress	N/A	M28	199201636
		Wiring issues	N/A	M42 M11 M12 M14 M15	199902037 199802141 198803491 198803829 198804052
Installation issues	1	N/A	N/A	M89	200911410
Manufacturing issues	1	N/A	N/A	M39	199704615
Wear	1	N/A	N/A	M64	200509195
Unknown	4	N/A	N/A	M44 M48 M83 M97	200003812 200200339 200901483 201204951

Table 2 – MORs associated with failure to deploy

The data contained in Table 2 shows that there are 18 MORs related to non-deployment of ADELTs and CPIs which can be split in to five basic types:

- Design issues
- Installation issues
- Manufacturing issues
- Wear
- Unknown

5.2 Design issues

There are five types of design issue related to the 'Failure To Deploy' classification:

- Equipment location
- Sensor selection
- Vibration
- Water ingress
- Wiring issues

5.2.1 Equipment location

MORs 198802141 (M11), 198803491 (M12), 198803829 (M14) and 198804052 (M15) relate to a series of ditchings where the ADELTs failed to deploy as a result of equipment location issues.

These incidents were subject to both AAIB recommendations and a mandatory AD [Ref 30]. As such, the immediate lessons that could be drawn can be seen to have been implemented.

Despite this, discussions with operators and a review of recent accident reports have shown that location of ADELTs, ADELT sensors and ADELT related power supplies is still of concern and has the potential to result in additional non-deployments.

The issues associated with location of ADELTs, ADELT sensors, and electrical power supplies are discussed below.

5.2.2 ADELT location

Analysis of both MORs and accident reports has identified that the location of an ADELT (e.g on the tail boom or close to the passenger cabin) can have a significant effect on whether an ADELT will survive an accident/incident such that it will be able to perform its intended function.

If the ADELT is located on the tail boom of a helicopter it is more susceptible to damage that results from being struck by rotor blades, separation of the tail boom from the rest of the fuselage or the tail rotor drive breaking[2].

Locating the ADELT forward of the tail boom will protect it from this type of damage. However, any alternative location for an ADELT must be carefully considered to avoid:

- Potential conflict with the main rotors,
- Compromising any emergency exits.

The design of the ADELT can also have a bearing on this issue. If an ADELT is shaped in to an aerofoil an inappropriate location may lead to it flying upwards into the main rotors on initial deployment.

As a result of these issues the following recommendations are made:

Recommendation 1a – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with determination of the appropriate location of an ADELT/CPI with respect to the transport joint and the main rotors to maximise the likelihood of deployment and transmission.

Recommendation 1b – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with installations that could compromise emergency exits or any safety related functions or parts of the aircraft to ensure that overall airworthiness is maintained and that the likelihood of passenger survival is not decreased.

5.2.3 Sensor location

Analysis of currently available data indicates that some sensor locations are less likely to result in ADELT deployment than others.

2 Section 9 of this report discusses the likelihood of tail boom separation in more detail.

Some hydrostatic/saline sensors are located near the roof of the passenger cabin which means that the rotorcraft would have to invert (capsize) or substantially submerge before the sensor would be activated.

Currently a significant proportion of rotorcraft do invert after ditching or crashing into water[3] but this does not always happen and the current flotation system technologies are being improved to further reduce the probability of rotorcraft inversion (see reference 35). This implies that future improvements in flotation technology may render roof mounted hydrostatic/saline sensors less effective. As a result, the following is recommended:

Recommendation 1c – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment).

5.2.4 Electrical power location

The evaluation of MORs and accident reports, together with discussions with AAIB, indicate that there have been a number of occasions where an ADELT has failed to deploy as a result of the electrical power supply to the related sensors becoming immersed in water. This has resulted in the sensors failing before they can be triggered.

Investigation of these incidents has shown that the electrical power supply for these sensors is installed towards the base of the main fuselage, resulting in the rapid immersion and consequent failure of the power supply once the rotorcraft enters the water.

It should be noted that, if the power supply is located such that it will be immersed as the rotorcraft settles in the water, failure of the power supply can also occur in the event of a controlled ditching.

Incidents such as this are still occurring and loss of power supplies resulting from immersion in sea water is considered to be an ongoing problem. It is accepted that it isn't likely to be possible to address all types of event with one solution and, as a result, the following recommendation is made:

3 Section 10 of this report discusses the likelihood of rotorcraft inversion in more detail.

Recommendation 1d – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX*:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the location and type of power supplies for all elements of an ADELT/CPI system to maximise the likelihood of ADELT deployment and transmission during an accident or incident.

* XX refers to the set of aviation certification specifications, e.g., CS-23/25

5.2.5 Human factors

MOR 201212866 (M101) relates to deployment failure that resulted from a lack of knowledge of the subtleties of the ADELT system installed in the rotorcraft concerned[4]. In this particular case the flight crew were unaware that manually triggering the ADELT system before ditching would prevent it from being automatically deployed until the system had been reset. This was a subtlety of operation that was not intuitively obvious and which was not documented in the flight manual.

There are a number of obvious human factors issues associated with the interface between a flight crew and an ADELT system (e.g. non-guarded switches which allow inadvertent triggering) and these are being addressed by the ADELT design community. However, it is important to ensure that all aspects associated with the human/ADELT system interface are addressed in the flight manual, particularly those which relate to functionality that is not intuitively obvious. As a result of these issues the following recommendation is made:

Recommendation 1e1 – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address mitigation of any relevant factors issues including flight deck human factors issues (such as inadvertent activation/ arming).

5.2.6 Sensor selection

MOR 199605710 (M37) and AAIU Report 01/98 refer to a fatal CFIT accident. One of the conclusions of the accident report was that the ADELT related sensors were of the wrong type to result in ADELT activation[5]. The automatic activation

4 The extract from the relevant AAIB accident investigation bulletin is provided in Appendix B B29

5 The extract from AAIU accident investigation report AAIU Report 01/98 [Ref 21] is provided in Appendix B22

of the ADELT trigger mechanisms was only supported by hydrostatic sensors. As the aircraft crashed on land the ADELT sensors would not have been triggered.

It is accepted that the most common function of an ADELT is to be deployed over water, but it should be noted that many rotorcraft that operate in the North or Irish Seas fly over a hostile environment prior to reaching the sea. This being the case, it seems advisable to recommend that ADELTs are not solely triggered by hydrostatic or saline sensors. However, the simple addition of a standard 'g' switch is not likely to be acceptable as the data associated with flight recorders shows that standard 'g' switches can be triggered by events other than a crash (e.g. a lightning strike or a ground handling incident). If an ADELT were fitted with a standard 'g' switch, incidents such as lightning strikes could result in the ADELT being inappropriately deployed. Guidance on the required performance of 'g' switches can be found in EUROCAE ED-62.

No additional recommendations are made as a result of the findings associated with MOR 199605710 (M37) and the associated AAIU accident investigation. However, attention is drawn to recommendation 1c, which is reproduced below:

Recommendation 1c – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment).

5.2.7 Vibration

MORs 198903806 (M20), 199102308 (M25) and 199102388 (M26) refer to failures to deploy that resulted from vibration induced burring.

The material used to form the back of the ADELT was not sufficiently robust to withstand the vibration levels associated with a rotorcraft. As a result, burrs formed on the edges of the ADELT locator slots preventing the ADELT deploying even when the deployment mechanism was activated.

A modification was developed to rectify this situation and no further incidents of this type of non-deployment have been seen since that modification was incorporated. This type of incident is not considered relevant to the current ADELT/CPI non-deployment issues and, as such, no recommendations are made.

5.2.8 Water ingress

MOR 199201636 (M28) refers to an incidence of corrosion that could have resulted in a failure to deploy. This appears to have been an isolated incident as no further MORs related to this type of ADELT failure mechanism have been raised during this investigation. However, given the environment that most ADELT systems are operated in (e.g. the North and Irish Seas), it is accepted that corrosion is a problem that could recur. As a result, a number of aircraft maintenance manuals were inspected and it was found that not all maintenance manuals cover the whole ADELT system – several of the manuals inspected focussed on the deployable beacon and provided little or no guidance on the maintenance/inspection requirements for other parts of the system. As a result the following is recommended:

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

5.2.9 Wiring Issues

Evaluation of accident reports[6] indicates that damage to wiring has the potential to result in a failure to deploy. In addition, MOR 199902037 (M42) relates to a wiring issue that rendered a submersion actuator defective. Although this did not actually result in a failure to deploy, had the ADELT been needed whilst this fault was undetected, it would have done.

In addition:

Wiring is discussed as a contributory factor in MORs 198802141 (M11), 198803491 (M12), 198803829 (M14) and 198804052 (M15). These MORs are also discussed above in terms of sensor/electrical power location.

An inspection of available ADELT and CPI Component Maintenance Manuals has identified that checks of the submersion actuator functional integrity are not specified.

No additional recommendations are made; however, attention is drawn to recommendations 1d and 1f, which are reproduced below.

6 See Appendices B1 to B30

Recommendation 1d – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX*:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the location and type of power supplies for all elements of an ADELT/CPI system to maximise the likelihood of ADELT deployment and transmission during an accident or incident.

* XX refers to the set of aviation certification specifications, e.g., CS-23/25

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

ADELTs are located in a manner designed to avoid interactions with the main or tail rotors in the event of inadvertent deployment.

The data reviewed during this review shows that the tail boom of a rotorcraft can become detached during an accident or incident[7] with the result that the wiring between the crash sensors and the ADELT is disrupted or physically broken.

No additional recommendations have been made related to this issue; however, attention is drawn to recommendations 1a and 1d, where recommendation 1a is reproduced below.

Recommendation 1a – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with determination of the appropriate location of an ADELT/CPI with respect to the transport joint and the main rotors to maximise the likelihood of deployment and transmission.

Discussions with AAIB identified that the ADELT issues associated with being located toward the aft end of the tail boom may also apply to flight recorders and so the following recommendation is made:

7 Where the reference to accident or incident includes "tail bumps"

Recommendation 5 – It is recommended that designers of flight recorders and aircraft flight recorder installations consider re-locating rotorcraft flight recorders into a part of the rotorcraft that is not subject to tail break issues.

5.3 Installation issues

Analysis of MOR data (specifically MOR 200911410 (M89)) indicates that chafed wiring has the potential to prevent the deployment of an ADELT.

As noted previously, an inspection of maintenance manuals has identified that not all maintenance manuals address the complete ADELT system installed on an aircraft.

No additional recommendations have been made with respect to this issue; however, attention is drawn to recommendation 1f, which is reproduced below:

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

5.4 Manufacturing

MOR 199704615 (M39) refers to a manufacturing issue that could have resulted in a failure to deploy.

There is only one incidence of this type of report in the list of ADELT MORs and so this is considered to be an isolated event that does not merit a specific recommendation.

5.5 Wear

MOR 200509195 (M64) refers to a failure to deploy that resulted from wearing of the main cases and pistons.

There is only one incidence of this type of report in the list of ADELT MORs and so this is considered to be an isolated event that does not merit a specific recommendation; however, attention is drawn to recommendation 1f.

5.6 Unknown

MORs 200003812, 20020339 and 200901483 have been classified as unknown as it was not possible to determine a probable cause for those events from the information available.

CHAPTER 6

Evaluation of inadvertent deployments

6.1 Introduction

This chapter provides a detailed analysis of the MORs classified as 'Inadvertent Deployment'. Table 3 provides a tabulated summary of the MORs related to inadvertent deployment and the associated reasons for those failures. The text that follows Table 3 provides the analysis of those MORs and, where applicable, the relevant accident investigation reports.

Classification	No of MORs	Top level identified cause	Detailed cause	Reference to main MOR Table (Annex A).	
				Annex A Ref	MOR number
Design issues	15	Design induced human factors	N/A	M38	199704478
				M40	199704980
				M41	199705986
				M43	199902336
				M54	200504249
				M56	200505413
				M59	200506741
				M65	200509296
		Robustness	Vibration, distortion, liners & seals	M13	198803736
				M55	200504764
				M66	200510704
				M78	200700568
			Location & water ingres	M8	198702572
				M75	200608951
				M76	200609183
Human factors	3	N/A	N/A	M71	200602977
				M96	201202777
				M100	201209986

Classification	No of MORs	Top level identified cause	Detailed cause	Reference to main MOR Table (Annex A).	
				Annex A Ref	MOR number
Installation issues	4	N/A	N/A	M33	199301925
				M67	200600119
				M68	200600623
				M84	200904571
Maintenance issues	7	Incorrect assembly	N/A	M23	199101360
		Excess stressing of components	N/A	M19	198902218
		Micro-switch alignment	N/A	M57	200506099
		Waterproofing	N/A	M53	200406853
				M93	201114478
				M94	201115065
				M95	201115066

Classification	No of MORs	Top level identified cause	Detailed cause	Reference to main MOR Table (Annex A).	
				Annex A Ref	MOR number
Unknown	24	N/A	N/A	M9	198801119
				M10	198801871
				M21	199003325
				M29	199204060
				M35	199403142
				M36	199601053
				M58	200506258
				M60	200508162
				M61	200508382
				M63	200509194
				M69	200600712
				M70	200602281
				M77	200611448
				M79	200701969
				M80	200702096
				M85	200907497
				M86	200909638
				M87	200910882
				M91	201012411
				M92	201101188
				M98	201205512
				M99	201206384
				M102	201215354
				M103	201301229

Table 3

The data contained in Table 3 shows that there are 53 MORs related to inadvertent deployment of ADELTs and CPIs which can be split into five basic types:

- Design issues
- Human factors issues
- Installation issues
- Maintenance issues
- Unknown

6.2 Design issues

There are two types of issue related to the 'Design' classification:

- Design induced human factors errors
- Robustness faults

6.2.1 Design induced human factors errors

MORs 199704478 (M38), 199704980 (M40), 199705986 (M41), 199902336 (M43), 200504249 (M54), 200505413 (M56), 200506741 (M59) and 200509296 (M65) relate to inadvertent activation of switches. It is noted that some rotorcraft cockpits and consoles have limited space as a result of the types of operation they are used for. It is also true that some types of rotorcraft operation require specific types of clothing (e.g. gloves) which can make correct manipulation of switches harder. However, this is a human factors issue that could be at least partly addressed by design (e.g. careful consideration of switch location and the design of switch guards).

No additional recommendations are raised. However, attention is drawn to Recommendation 1f, which is reproduced below.

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

6.2.2 Robustness Faults

Robustness can be split into two categories:

- Vibration, distortion, liners & seals
- Location/water ingress

6.2.3 Vibration, distortion, liners & seals

MOR 198803736 (M13) refers to an incidence of damage related to distortion and vibration that could have led to an inadvertent deployment.

MOR 200504764 (M55) refers to an inadvertent deployment that resulted from vibration.

MOR 200510704 refers to a faulty seal that resulted in an inadvertent activation.

MOR 200700568 (M78) refers to an overly compressed ADELT liner that resulted in an inadvertent activation.

Each of these is indicative of an initial equipment design that may not have been sufficiently robust to survive the intended environment.

No additional recommendations are made but attention is drawn to Recommendation 1c, as reproduced below.

> **Recommendation 1c** – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment).

6.2.4 Location & water ingress

MORs 198702572 (M8), 200608951 (M75) and 200609183 (M76) refer to incidents of water/moisture ingress, some of which can be directly attributed to the location of the part in question.

In addition, discussion with operators has identified that there have been numerous occasions when their own internal occurrence monitors have reported sensor location as a contributory cause of inadvertent deployment.

Some of these internal reports relate to inadvertent activation whilst cleaning or taxiing a rotorcraft. These have been triggered by locating a hydrostatic switch (as opposed to a saline switch) in the undercarriage bay of a rotorcraft.

Clearly, when a rotorcraft is parked or taxiing, its undercarriage is down and the undercarriage bay is open. This means that water can be sprayed onto the hydrostatic sensors in sufficient quantities for a sufficient duration to trigger the hydrostatic switch and deploy the ADELT/CPI.

A number of other internal reports refer to ADELTS being inadvertently deployed as a result of saline switches being located in the undercarriage bay of a rotorcraft and being activated by salt spray.

No additional recommendations are made; however, attention is drawn to Recommendation 1c, which is reproduced below.

Recommendation 1c – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment).

6.3 Human factors

MOR 200602977 (M71) refers to an incident where an ADELT was inadvertently deployed as a result of an incorrect switch movement. MOR 201202777 (M96) refers to an incident of an ADELT being deployed as a result of the battery being inadvertently selected on during pre-start checks. MOR 201209986 (M100) refers to an inadvertent deployment of an ADELT as a result of the device being in the incorrect setting whilst being tested.

These MORs all refer to incorrect operation of the ADELT system as a result of human error and, although no additional recommendations are made, attention is drawn to Recommendation 1e, which is reproduced below.

Recommendation 1e – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with Mitigation of any relevant human factors issues including:

1. Flight deck human factors issues (such as inadvertent activation/arming) and
2. Maintenance human factors issues (such as misleading or incomplete maintenance instructions).

6.4 Installation issues

MORs 199301925, 200600119, 200600623 and 200904571 refer to a set of installation issues predominantly related to wiring (incorrect wiring and damaged wiring).

While these are indicative of common wiring issues, they do not appear to be indicative of a specific ADELT issue. However, clear and complete maintenance instructions may assist in the detection and mitigation of these issues.

No additional recommendations are made, however, attention is drawn to Recommendation 1f.

6.5 Maintenance issues

There are four types of maintenance issue related to the 'Inadvertent Deployment' classification:

- Incorrect assembly
- Excess stressing of components
- Micro-switch alignment
- Waterproofing

MOR 199101360 refers to an incidence of incorrect assembly. MOR 198902218 refers to an incidence of excess stressing of components. MOR 200506099 refers to an incidence of micro-switch misalignment.

Each of these MORs appears to relate to recognised types of maintenance errors and omissions and, as they are spread over a sixteen year period, they do not appear to indicate an ADELT specific set of issues. However, clear and complete maintenance instructions could assist in the detection and mitigation of this type of issue.

MOR 200406853 refers to an incidence of water ingress resulting from a required maintenance action (the application of silicone grease) being omitted. Although there is only one MOR that specifically refers to the need to apply silicon grease to assist in waterproofing, omission of tasks is a common human factors issue that could be at least partially mitigated by the use of clear and complete maintenance instructions. As a result, the following recommendation is made:

Recommendation 1e2 – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address mitigation of any relevant factors issues including maintenance human factors issues (such as misleading or incomplete maintenance instructions).

6.6 Unknown

MORs 198801119, 198801871, 199003325, 199204060, 199403142, 199601053, 200509194, 200600712, 200611448, 200701969, 200702096, 200907497, 200506258, 200508162, 200508382, 200602281, 200909638, 200910882, 201012411, 201101188, 201205512, 201206384, 201215354 and 201301229 have been classified as unknown as it was not possible to determine a probable cause for those events from the information available.

CHAPTER 7

Evaluation of performance issues

7.1 Introduction

This chapter provides a detailed analysis of the MORs classified as 'Performance Issues'. Table 4 provides a tabulated summary of the MORs related to performance issues and the associated reasons for those failures. The text that follows Table 4 provides the analysis of those MORs and, where applicable, the relevant accident investigation reports.

Classification	No of MORs	Top level identified cause	Detailed cause	Reference to main MOR Table (Annex A).	
				Annex A Ref	MOR number
Design issues	6	Design induced human factors	N/A	M52	200308245
		Robustness	Switch failures	M4	198700070
				M22	199100076
			Susceptibility to vibration and wear	M17	198804209
				M27	199102551
				M45	200007694
Maintenance issues	8	Antenna issues	N/A	M30	199204092
		Error/omissions	N/A	M5	198701090
				M16	198804208
				M24	199102275
				M62	200509166
				M82	200808505
				M90	201005028
		Excessive loads	N/A	M6	198701136
Manufacturing issues	1	N/A	N/A	M3	198604297
Unknown	2	N/A	N/A	M49	200200339
				M51	200303770

Table 4

The data contained in Table 4 shows that there are 17 MORs related to ADELTs and CPIs performance issues which can be split into four basic types:

- Design Issues
- Maintenance issues
- Manufacturing issues
- Unknown

7.2 Design issues

There are two types of design issue related to the 'Performance' classification:

- Robustness
- Design induced human factors

7.2.1 Robustness

Robustness can be split into two categories:

- Switch failures
- Susceptibility to vibration/wear

Switch failures

MORs 198700070 (M4) and 199100076 (M22) relate to switch failures. Although there is limited information available related to these failures it seems possible that these failures occurred as a result of the design providing an inadequate level of robustness against the environment the switches were installed in.

Susceptibility to vibration/wear

MORs 198804209 (M17), 199102551 (M27) and 200007694 (M45) refer to either vibration damage or wear and are potentially indicative of designs that were inadequately robust against the predictable installed environment.

Switch failures and vibration/wear induced damage can have an impact on ADELT performance. Although no additional recommendations have been made attention is drawn to Recommendation 1c, which is reproduced below.

Recommendation 1c – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment).

7.2.2 Design induced human factors

MOR 200308245 (M52) refers to an incident where an incorrect electrical connector was used. This type of maintenance human factor can be directly addressed by design (e.g. by ensuring that the design of any relevant connectors minimises the possibility of mistakes).

No additional recommendations have been made but attention is drawn to Recommendation 1e2, which is reproduced below.

Recommendation 1e2 – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address mitigation of any relevant factors issues including maintenance human factors issues (such as misleading or incomplete maintenance instructions).

7.3 Maintenance issues

There are three types of maintenance issue related to the MORs classified as 'Performance':

- Antenna issues
- Errors/omissions
- Excessive loads

7.3.1 Antenna issues

MOR 199204092 (M30) refers to unexpected antenna behaviour – cracking noises when the antenna was flexed.

There is only one incident of this type among the ADELT MOR reports and so its occurrence is statistically low. However, poor antenna performance may result in

degraded ADELT performance and appropriate maintenance requirements have the potential to help in the resolution of these issues.

No additional recommendations are made but attention is drawn to Recommendation 1f, which is reproduced below.

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

7.3.2 Errors/omissions

MORs 198701090 (M5), 198804208 (M16), 199102275 (M24), 200509166 (M62), 200808505 (M82) and 2010005208 (M90) all refer to maintenance errors and omissions.

Each of these MORs appears to relate to recognised types of maintenance errors and omissions. They are spread over a twenty three year period, and do not appear to indicate an ADELT specific set of issues. However, analysis of MORs and accident reports and discussions with operators indicated that correct maintenance and storage of ADELT batteries was fundamental to ADELT performance. Battery maintenance and storage issues are not limited to ADELTs but it was noted that there have been problems with some ADELT batteries that resulted in the labels being difficult to read or the storage instructions being difficult to follow. As a result, the following is recommended:

Recommendation 1g – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with labelling on ADELT/CPI component parts (e.g. batteries) to ensure that any necessary labels (e.g. usage instructions or battery shelf life information) are appropriately visible, unambiguous and permanent to minimise the possibility of incorrect usage.

Attention is also drawn to Recommendation 1f.

7.3.3 Excessive loads

MOR 198701136 (M6) refers to an incident of ADELT damage that may have occurred as a result of excessive loads being applied during maintenance.

A fleet alert bulletin was issued to address this incident and no further incidents of this type have been reported since this bulletin was issued.

This type of incident is not considered relevant to the current set of performance issues but attention is drawn to Recommendation 1f, which is reproduced below.

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

7.4 Manufacturing issues

MOR 198604297 (M3) refers to an event where a battery exploded during the installation of an ADELT. The event appears to have occurred as a result of the use of faulty components. Although this infers the presence of some generic production control issues, these issues do not directly relate to ADELT design, installation, maintenance or use and, as such, no ADELT related recommendations have been made as a result of this MOR.

7.5 Unknown

MORs 200200339 (M49) and 200303770 (M51) have been classified as unknown as it was not possible to determine a probable cause for those events from the information available.

CHAPTER 8

Evaluation of other events

8.1 Introduction

This chapter provides a detailed analysis of the MORs classified as 'Other'. Table 5 provides a tabulated summary of the MORs related to other issues and the associated reasons for those failures. The text that follows Table 5 provides the analysis of those MORs and, where applicable, the relevant accident investigation reports.

Classification	No of MORs	Top level identified cause	Reference to main MOR Table (Annex A).	
			Annex A Ref	MOR number
Design	3	Robustness	M7	198702571
			M88	200911082
		Spurious warnings	M32	199301513
External events	5	In-flight damage	M34	199302109
			M50	200207646
		PLB transmissions	M72	200604317
			M73	200606089
		Aircraft events	M81	200708324
Installation issues	1	N/A	M74	200607680
Unknown	2	N/A	M31	199204953
			M47	200108341

Table 5

The data contained in Table 5 shows that there are 11 MORs related to other issues which can be split into four basic types:

- Design Issues
- External events
- Installation issues
- Unknown

8.2 Design issues

There are two types of design issue related to the 'Other' classification:

- Robustness
- Spurious warnings

8.2.1 Robustness

MORs 198702571 (M7) and 200911082 (M88) refer to incidents of damage to the ADELT casing and the ADELT support brackets respectively.

It is possible that the root cause of the ADELT case crack and the cracked support brackets was a maintenance issue but, since this is not referenced in either MOR, it seems reasonable to assume that the root cause was either a design that was not able to withstand the levels of vibration likely to occur on a helicopter or a manufacturing error that resulted in an ADELT that was vulnerable to damage.

No additional ADELT related recommendations have been made as a result of these two MORs but as some cracking issues can be identified via routine maintenance attention is drawn to recommendation 1f, which is reproduced below.

Recommendation 1f – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with the type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained.

8.2.2 Spurious warnings

MOR 199301513 (M32) refers to a spurious illumination of the ADELT DEPLOY light. There is currently only one direct reference to spurious warnings among the ADELT MORs and so this incident is not currently deemed to be statistically

significant. However, a recent accident has identified additional human factors issues that have resulted in an ADELT failing to deploy.

As a result of the continuing presence of human factors issues in ADELT system/installation designs, attention is drawn to recommendation 1e, which is reproduced below.

Recommendation 1e – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with Mitigation of any relevant human factors issues including:

1. Flight deck human factors issues (such as inadvertent activation/arming) and
2. Maintenance human factors issues (such as misleading or incomplete maintenance instructions).

8.3 External events

There are three types of external event associated with the 'Other' classification:

- In-flight damage
- Plb transmissions
- Aircraft events

8.3.1 In-flight damage

MOR 200207646 (M50) refers to a collision with the deck edge netting of an oil rig, resulting in damage to the aircraft's ADELT.

MOR 199302109 (M34) refers to an event where a ship pitched whilst a helicopter was hovering over its helideck, resulting in damage to the helicopter's ADELT.

In each case it might be possible to determine whether that the location of the ADELT could have affected the likelihood of it being damaged if more information was available regarding the location of the ADELT (i.e. was it fitted to the end of the tail boom or was it located close to the passenger cabin). However, in the absence of this information, no ADELT related recommendations can be made.

8.3.2 PLB Transmissions

There are two MORs (200604317 (M72) and 200606089 (M73)) that refer to PLB transmissions. Neither of these MORs refers to an actual ADELT event and no ADELT related recommendations can be made.

8.3.3 Aircraft events

MOR 200708324 (M81) refers to a non-ADELT-related issue. As such this MOR has not resulted in any recommendations.

8.4 Installation issues

MOR 200607680 (M74) refers to an event where the ADELT switch guard was found to be detached. While this could have resulted in a human factors related inadvertent deployment of the ADELT, only one incident of this appears in the available data.

Despite the limited number of reports related damage to switch guards, human factors issues continue to contribute to ADELT failures and, as such, attention is drawn to recommendation 1e, which is reproduced below.

Recommendation 1e – It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with Mitigation of any relevant human factors issues including:

1. Flight deck human factors issues (such as inadvertent activation/arming) and
2. Maintenance human factors issues (such as misleading or incomplete maintenance instructions).

8.5 Unknown

MOR 200108341 (M47) has been classified as unknown as it was not possible to determine a probable cause for the event from the information available.

CHAPTER 9

Tail boom separation issues

Analysis of the accident data considered in this review (see Table 1 for a summary of this data) shows that seven of the accidents resulted in a separation of the helicopter tail boom. Of these seven tail boom separations, four occurred in accidents where reference to the ADELT was also made, indicating that nearly 60% of tail boom separations were linked to accidents where a reference to the ADELT was made. The implication of this is that separation of the tail boom has a high probability of degrading ADELT functionality.

Additional technical discussions were held with operators and accident investigators to validate this result. These discussions identified that, where an ADELT is located aft of the transport joint (see figures 1 and 2), any disruption of the tail rotor drive shaft has the potential to disrupt or disconnect the ADELT wiring (see also the AAIB Reports in to G-REDU, Appendix C27).

A review of accident reports and discussions with accident investigators and operators has also identified that, when a tail boom does become detached, it usually becomes detached at, or just aft of, the transport joint. In these cases, if an ADELT is located aft of the transport joint, it is reasonable to predict that the ADELT has the potential to become detached from its sensors and power supply before it can be deployed.

The analysis of the accident data used for this review also considered whether there was any link between controlled ditching and the incidence of tail boom separation. The data indicates that a controlled ditching is slightly less likely to result in a separation of the tail boom, but when this is viewed against the overall dataset, it does not change any of the recommendations of this report. As a crash can result in loss of the tail boom it is still preferable, where possible, to locate an ADELT forward of the transport joint.

Figure 1

Figure 2

Figures 1 and 2 show an ADELT installation that is aft of the transport joint and more susceptible to the effects of a tail boom separation, e.g. damage to or breaking of wiring.

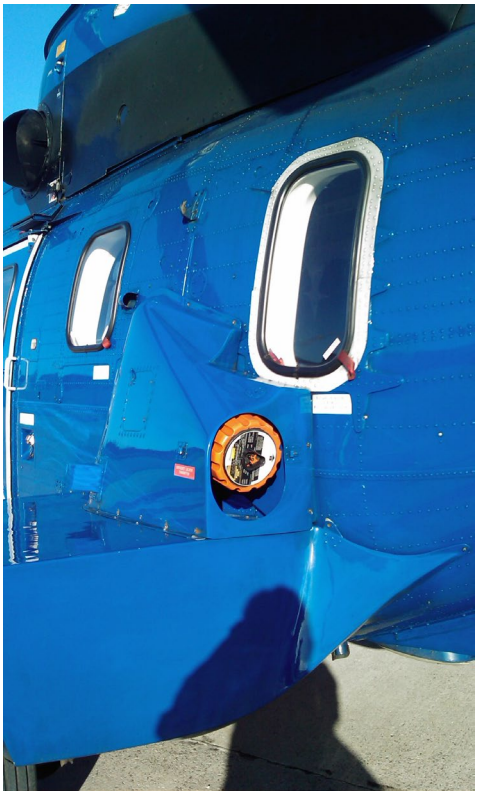


Figure 3

Figure 4

Figures 3 and 4 show an ADELT installation that is forward of the transport joint and, as such, is less likely to be damaged or loss in the event of a tail boom separation.

CHAPTER 10

Rotorcraft inversion considerations

The analysis of accident and MOR data detailed in previous chapters (see Table 1 for a summary of this data) identified that some ADELT installations had been designed such that water/saline switches were located in an area of the cabin that appeared to pre-suppose that the helicopter would become inverted in the event of an accident.

There is compelling data to support this pre-supposition (see below) but, if ADELT performance is to be improved, the continuing validity of this supposition should be questioned.

Analysis of the accident data considered in this review shows that four of the eleven accidents that resulted in inversion of the helicopter also made reference to the ADELT.

This indicates that approximately 36% of the inversions assessed as part of this review were related to an ADELT reference. The analysis of the data also shows that 50% of ditchings result in the helicopter becoming inverted.

A further review of rotorcraft inversion data was performed to validate this conclusion.

CAP 641 (Report of the Review of Helicopter Offshore Safety and Survival – 1994) was reviewed and the following comments were noted:

> "Experience has shown that in the offshore environment, surface conditions are very often such that, despite the correct functioning of flotation gear, the aircraft will very soon capsize."
>
> "...we recognise the extreme difficulty of persuading a helicopter, with its inherently high centre of gravity, to remain upright on anything but the calmest of seas"
>
> "Experience has shown that a severe crash is often followed by rapid inversion and submersion of the aircraft,"
>
> "Improved flotation would make a major contribution to the prospects of safe escape after a crash. Although the scope for such improvement may be extremely limited in the case of aircraft now in service, and the probably catastrophic consequences of inadvertent deployment in flight of a high-

> mounted device would need careful consideration, it remains a possibility which should not be neglected in the current study on flotation and stability."

The United States Federal Aviation Administration commissioned a report on "Rotorcraft Ditchings and Water-Related Impacts" [Ref 39]. This study analysed 77 helicopter impacts with water from 1982 to 1989 in terms of occupant injury and death, and reached a number of conclusions including:

> "Flotation equipment, as is currently deployed and used, does not adequately keep the occupiable area of the rotorcraft upright and afloat."

Most of the accidents included in the FAA commissioned study involved relatively small helicopters (for example, the Jet Ranger) which were not representative of the types in general use for UK offshore operations. However, the authors of CAP 641 found that there was "nothing in the conclusions of this study that conflicted with our own views of the principal hazards in a helicopter crash and the methods of countering them."

CAP 641 made several recommendations including:

> "The CAA should accelerate and/or coordinate current studies into helicopter crashworthiness, flotation and stability parameters and the automatic activation of flotation gear, as indicated in Paragraphs 8.7, 9.6 and 10.3. Particular account should be taken of the need to improve provision for flotation after a severe impact, including the possibility of installing extra flotation devices specifically to cater for a crash, as suggested in Paragraph 10.9."

The data above appears to provide substantial support for the supposition that a helicopter is likely to become inverted in the event of an accident over water, but there are three points which should be considered before reaching a final conclusion.

- Both of these documents were published over a decade ago and may not be representative of rotorcraft that have been designed since their publication.
- CAP 641 specifically recommends that the possibility of "...installing extra flotation devices" be investigated.
- A lot of work has already been put in to developing rotorcraft flotation systems since the publication of CAP 641, and this work continues to be progressed and improved.

When the points listed above are taken into account, it becomes apparent that the validity of any pre-supposition that a rotorcraft will become inverted after descent onto the water may be open to question. As such, when developing ADELT sensor installations, rather than pre-supposing rotorcraft inversion, it would be better to investigate the effectiveness of any installed flotation systems first.

CHAPTER 11
Recommendations

The analysis of ADELT/CPI data documented in this report has resulted in the following recommendations:

No.	Recommendation
1	It is recommended that EASA develop guidance material to assist designers of future ADELTs/CPIs and aircraft ADELT/CPI installations to demonstrate compliance with CS XX:1301, 1309, 1529 and 1581. This guidance material should address the issues associated with: a) Determination of the appropriate location of an ADELT/CPI with respect to the transport joint and the main rotors to maximise the likelihood of ADELT deployment and transmission. b) Installations that could compromise emergency exits or any safety related functions or parts of the aircraft to ensure that overall airworthiness is maintained and that the likelihood of passenger survival is not decreased. c) Appropriate selection and location of activation sensors to take account of the functional capabilities and the intended role of the aircraft (e.g. environments where the aircraft will be operated, especially if hostile, and whether the aircraft has flotation equipment). d) The location and type of power supplies for all elements of an ADELT/CPI system to maximise the likelihood of ADELT deployment and transmission during an accident or incident. e) Mitigation of any relevant human factors issues including: i) Flight deck human factors issues (such as inadvertent activation/arming) and ii) Maintenance human factors issues (such as misleading or incomplete maintenance instructions). f) The type and frequency of required maintenance tasks to ensure that all elements of the ADELT/CPI system are appropriately maintained. g) Labelling on ADELT/CPI component parts (e.g. batteries) to ensure that any necessary labels (e.g. usage instructions or battery shelf life information) are appropriately visible, unambiguous and permanent to minimise the possibility of incorrect usage.
2	In the light of the recent accidents in the North Sea where ADELTs/CPIs failed to deploy, it is recommended that EASA consider the need to re-evaluate current ADELT installations that are being carried by rotorcraft known to be operating in a hostile environment.

No.	Recommendation
3	In the light of the recent accidents in the North Sea where ADELTs/CPIs failed to deploy, it is recommended that, where rotorcraft are being operated in a hostile environment, the operators of those rotorcraft include an evaluation of the suitability of their current ADELT/CPI installations for the intended function and operational environment of their rotorcraft as part of their SMS risk assessment process.
4	It is recommended that EASA develop specific design requirements for ADELTs (e.g. an ETSO) based on the content of CAA Specification 16, ED-62A and the recommendations of this report.
5	It is recommended that designers of flight recorders and aircraft flight recorder installations consider re-locating rotorcraft flight recorders into a part of the rotorcraft that is not subject to tail break issues and/or consider the use of deployable memory.

CHAPTER 12
References

No.	Report	Source
1	Aircraft Accident Report 4/85: Report on the accident to British Airways S-61N in the North Sea 75 NM East of Aberdeen on 11 March 1983	AAIB
2	Aircraft Accident Report 4/83: Report on the accident to Westland Wessex 60 G-ASWI 12 miles ENE of Bacton, Norfolk on 13 August 1981	AAIB
3	Aircraft Accident Report 11/76: Report on the accident in the North Sea, north east of the River Humber estuary on 8 March 1976	AAIB
4	Aircraft Accident Report 3/85 G-AZOM	AAIB
5	Aircraft Accident Report 2/84 G-BARJ	AAIB
6	Aircraft Accident Report 8/78: Report on the accident in the North Sea, North East of Aberdeen on 1 October 1977	AAIB
7	Aircraft Accident Report 1/90: Report on the accident to Sikorsky S61N, G-BDES in the North Sea 90 nm north east of Aberdeen on 10 November 1988	AAIB
8	Aircraft Accident Report 3/89: Report on the accident to the Sikorsky S61N helicopter G-BDII near Handa Island off the north-west coast of Scotland on 17 October 1988	AAIB
9	Aircraft Accident Report 2/84: Report on the accident to Bell 212, G-BDIL 14 miles from the Murchison platform on 14 September 1982	AAIB
10	Aircraft Accident Report 3/90: Report on the accident to Sikorsky S-61N, G-BEID 29 nm north east of Sumburgh, Shetland Isles on 13 July 1988	AAIB
11	Aircraft Accident Report 8/84: Report on the accident to British Airways Sikorsky S-61N, G-BEON in the sea near St Mary's aerodrome, Isles of Scilly on 16 July 1983	AAIB

No.	Report	Source
12	Aircraft Accident Report 2/91: Report on the accident to Sikorsky S-61N, G_BEWL at Brent Spar, East Shetland Basin n 25 July 1990	AAIB
13	Aircraft Accident Report 9/89 No Supporting Title Provided	AAIB
14	Aircraft Accident Report 10/82: Report on the accident to Bell 212 G-BIJF in the North Sea, south east of the Dunlin Alpha platform, on 12 August 1981	AAIB
15	Aircraft Accident Report 5/87: Report on the accident to Boeing Vertol (BV) 234 LR G-BISO in the East Shetland Basin of the North Sea on 2 May 1984	AAIB
16	Aircraft Accident Report 1/87: Report on the accident to Bell 212 G-BJJR, in the North Sea 50 miles east of the Humber on 20 November 1984	AAIB
17	Aircraft Supplemental Accident Report S3/2002.	AAIB
18	Aircraft Accident Report 9/87: Report on the accident to Bell 214 ST G-BKFN in the North Sea 14 miles North East of Fraserburgh, Scotland on 15 May 1986	AAIB
19	AAIB Special Bulletin S1/2007	AAIB
20	Aircraft Accident Report 2/88: Report on the accident to Boeing Vertol 234 LR, G-BWFC 2.5 Miles east of Sumburgh, Shetland Isles on 6 November 1986	AAIB
21	Aircraft Accident Report 01/98: Report on the accident to Sikorsky S-76B G-HAUG at Omeath, Co. Louth 12 December 1996	AAIU
22	Aircraft Accident Report 8/2004	AAIB
23	Aircraft Accident Report 2/97: Report on the accident to Aerospatiale AS332L Super Puma, G-TIGK, in North Sea 6nm south-west of Brae Alpha Oil Production Platform on 19 January 1995	AAIB
24	Air Accident Investigation Board, Norway (AAIB/N) Report 47/2001 Report on the air accident 8 September 1997 in the Norwegian Sea, approx 100 nm west north west of Bronnoysund, involving Eurocopter AS 332L1 Super Puma, LN-OPG, operated by Helicopter Service AS	AAIB/N
25	OY-HMC	AIB (Denmark)
26	AAIB Report 1/2011 G-REDU	AAIB

No.	Report	Source
27	AAIB Special Bulletin 5/2009 G-REDL	AAIB
28	AAIB Special Bulletin S2/2013 G-REDW	AAIB
29	AAIB Special Bulletin S3/2013 G-REDW & CHCN	AAIB
30	AAIB Special Bulletin S7/2013 G-CHCN	AAIB

No	Report	Source	Date
31	EUROCAE ED-62 Minimum Operational Performance Specification For Emergency Locator Transmitters.	EUROCAE	May 1990
32	CAP 476 Amdt 287 Issue 6 Mandatory Aircraft Modifications and Inspections Summary	CAA	January 2003
33	CAA AD 058-12-88	CAA	December 1988
34	CAP 476 Mandatory Aircraft Modifications and Inspections Summary Issue 287	CAA	September 2004
35	CAP 491 Helicopter Airworthiness Review Panel (HARP) Report	CAA	1984
36	CAP 594 Air Accidents Investigation Branch (AAIB) Recommendations: Progress Report 1991	CAA	1991
37	CAP 641 Report of the Review of Helicopter Offshore Safety and Survival	CAA	1995
38	CAS/CPT 600/SB-01	Caledonian Airborne Systems	1988
39	Rotorcraft Ditchings and Water-Related Impacts.	FAA	October 1993

APPENDIX A

List of MORs

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M1	197603439	Occurrence: WHEN 'NAV' SELECTED A C YAWED SHARPLY TO RIGHT	VC10 Super	Unclassified	N/A	OCCURRED WITH NR1 AP ENGAGED. RUDDER APPLICATION COMFIRMED BY RUDDER INDICES YAW DAMPER & CPI NR 1 AUTOPILOT HAD BEEN DEFECTED ON 18.7.76 FOR DISCONNECTING IN TURNS. RUDDER DEFLECTION ON CPI APPROX 1/6 RIGHT. YAW DAMPER INDICATED ALL FULL SCALE RIGHT. NR 1 AUTOPILOT DISCONNECTED ON HANDWHEEL. OPERATION NORMAL WITH NR 2. CAA CLOSURE; 3 AXIS RATE GYRO CHANGED CURED FAULT.NO FURTHER RECURRENCE TO DATE.NO FURTHER ACTION.
M2	198100684	Occurrence: RUDDER TRIM FAULT NOT RECTIFIED ALSO APU FAULT	B747	Unclassified	N/A	THIS A/C HAD AN A.D.D STATING THAT IT REQUIRED 1.5 DIVISIONS OF LH RUDDER TRIM IN CRUISE. SUBSEQUENT DEFECT RAISED SAID A/C DID NOT REQUIRE TRIM BUT CPI SHOWS 2 DEG LEFT DEFLECTION ON LOWER RUDDER.SYSTEM LUBRICATED BUT DEFECT COULD NOT BE CLEARED.A/C HAD BEEN FLYING IN THIS CONDITION SINCE 19TH FEB.ALSO, APU HAD BEEN U/S FOR 1 WEEK CAA CLOSURE-NO CAA ACTION REQUIRED. MAINT MANUAL TRIM LIMITS ARE 2 UNITS. HOWEVER PCU INPUT ROD & LOWER PCU CHANGED.RUDDER TRAVEL WAS WITHIN LIMITS AT ALL TIMES.
M3	198604297	ADELT BEACON DEPLOYMENT BATTERY EXPLODED.	SA365 Dauphin	Performance	Manufacture	DURING INSTALLATION OF ADELT BEACON MOD, BATT EXPLODED. P/N: 00,23,1071; S/N: 8607575. NIL HOURS. ADDNL INFO: EXPLOSION OCCURRED AFTER CONTROL PANEL REMOVED WHEN OPERATION OF TEST SWITCH FAILED TO PRODUCE ANY CURRENT. 7.5AMP C/ BREAKER BETWEEN ADELT TERMINAL FOUND TO HAVE LOW RESISTANCE BUT THIS WAS PROBABLY RESULT OF EXPLOSION. OTHERWISE NO FAULT FOUND. CAA CLOSURE: EXAM OF BATTERY REMAINS INDICATES USE OF FAULTY COMPONENTS AT CONSTRUCTION, POSSIBLY LEADING TO SHORT CIRCUIT DURING INSTALLATION. BATTERIES REMOVED FROM ALL ADELT SYSTEMS PENDING APPROVAL OF REDESIGNED BATTERY. MEANWHILE SYSTEMS CONNECTED TO A/C BATTERY. SAFT ASB 1/87 & VARIOUS LOCAL MODS REFER.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M4	198700070	Occurrence: AUTO DEPLOYABLE LOCATOR TRANSMITTER MALFN ARM/OFF SWITCH FAILED	Sikorsky S61	Performance	Design	NO VOLTAGE PRESENT ON PIN "A" OF THE "ADELT" CARRIER DISCONNECT.(BOTH WITH MANUAL DEPLOY & SHORTING OUT AUTO DEPLOY SWITCHES).SEE ALSO 87/00154C CAA CLOSURE:"ARM" SWITCH RETND TO OHAUL AGENCY WHO REPORT FAILURE DUE JAMMED CONTACT WIPER.LOW FAILURE RATE OF COMPONENT (1.5%) CONSIDERED TO BE ACCEPTABLE.BIH SPECIAL CHECK SC100/S-2001 COMPLETED WITH TOTAL OF TWO SWITCHES FOUND DEFECTIVE.OTHER ABERDEEN -BASED OPRS ADVISED OF DEFECT.
M5	198701090	Occurrence: PART OF ADELT BEACON ANTENNA MISSING DETACHED 6MM FRM ATTACH PT WORN THROUGH	Sikorsky S76	Performance	Maintenance	POSSIBLY WORN THROUGH BY RESTRAINT. P/N 92900000-02 (00-23-1085). CAA CLOSURE: FLEET CHECK CARRIED OUT-NO OTHER A/C AFFECTED. CONSIDERED TO BE A RANDOM OCCURRENCE POSSIBLY AS RESULT OF ANTENNA BEING STRAIGHTENED AFTER AN ACCIDENTAL BENDING THUS CREATING A WEAK POINT.AS A PRECAUTIONARY MEASURE BCAL TELEX 12251/JH ISSUED REQUIRING APPLICATION OF"RAYCHEM"PROTECTIVE HEAT- SHRINK SLEEVING OVER ANTENNA AT THIS POINT.
M6	198701136	Occurrence: ADELT BEACON WITH 2 IN CRACK AROUND ELECTRONIC BOARDS HOUSING	Sikorsky S61	Performance	Maintenance	CAUSE UNKNOWN BUT DAILY AMBIENT TEMPS BETWEEN +28/34DEG C.P/N 92900000-01B. ADDNL INFO:AFTER INVESTGN THE MFR HAS CONCLUDED THAT DAMAGE WAS CAUSED BY THE APPLICATION OF AN EXCESSIVE LOAD POSSIBLY DURING MAINTENANCE.A FLEET ALERT BULLETIN IS TO BE ISSUED REMIND- ING STAFF OF THE CARE NEEDED IN HANDLG THIS EQUIPMENT.
M7	198702571	Occurrence: "ADELT" CASING CRACKED AFT OF TEST SWITCH FLEET CHECK NO OTHER INCIDENTS	SA332 Super Puma	Other	Design	"ADELT" CASING CRACKED AFT OF TEST SWITCH FLEET CHECK NO OTHER INCIDENTS. ACTION WILL BE TAKEN ON OCC 87/02572H
M8	198702572	Occurrence: "ADELT" DEPLOYED AT 40FT AGL SUBMERSN SWITCH MALFUNCTION FLUID INGRESS	Bolkow 105	Inadvertent Deployment	Design	SEE OCC 87/02571X CAA CLOSURE:MOISTURE CONTAMINATION CONFIRMED.LOCAL MOD INTRODUCED TO 'POT' SUBMERSION ACTUATOR CONNECTORS. CREWS ADVISED TO REPORT ANY WARNING LIGHTS IMMEDIATELY.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M9	198801119	Occurrence: ADELT BEACON SEPARATED INFLT DEPLOY SYST INTACT SUSPECT MOUNT SCREWS LOOSE	Sikorsky S76	Inadvertent Deployment	Unknown	Same As Title **Note:** This has been given a secondary classification of unknown as it is not possible to determine whether the screws were loose as a result of vibration or maintenance error.
M10	198801871	Occurrence: ADELT BEACON FIRED WHEN UNDERSLUNG LOAD RELEASED ARM SWITCH IN "OFF" POSN	Bolkow 105	Inadvertent Deployment	Unknown	BEACON RECOVERED & FOUND BROKEN IN TWO. NO FAULT FOUND IN FIRING MECHANISM. UNIT RETURNED TO MFR.SEE ALSO 87/02572. CAA CLOSURE: ADELT SQUIB FIRING LINES CHANGED AS A PRECAUTION. NO FURTHER SIMILAR OCCURRENCES REPORTED TO DATE (31 JULY 91). NO FURTHER CAA ACTION PROPOSED.
M11	198802141	Occurrence: ADELT BEACON FAILED TO DEPLOY IN EMERGENCY SITUATION 3 DITCHINGS	Sikorsky S61	Failure To Deploy	Design	See Text For MOR 198804052 (M15) **Note:** See the text for MOR 198804052 (M15). This has been included as a separate event because it was recorded separately via MOR 198802141
M12	198803491	Occurrence: ADELT BEACON FAILED TO DEPLOY IN EMERGENCY SITUATION 3 DITCHINGS	Sikorsky S61	Failure To Deploy	Design	See Text For MOR 198804052 (M15) **Note:** See the text for MOR 198804052 (M15). This has been included as a separate event because it was recorded separately via MOR 198802141
M13	198803736	Occurrence: ADELT BEACON DEPLOYED IN WORKSHOP FIRING PIN SHEARED BY PISTON MOVEMENT	Bell 214	Inadvertent Deployment	Design	SEE ALSO 87/00154,87/02572 & OPEN OCC 88/01871.SEE DIGEST D/88/45. INVESTGN REVEALED PIN HAD PROBABLY SHEARED AS RESULT OF PROGRESSIVE DISTORTION SUFFERED THROUGH TURNING MOTION DURING LOADING & SUBSEQUENT IN- SERVICE VIBRATION.WITHOUT PIN IN PLACE ONLY VERY SLIGHT DISTURBANCE CAN CAUSE BEACON TO EJECT.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M14	198803829	Occurrence: ADELT BEACON FAILED TO DEPLOY IN EMERGENCY SITUATION 3 DITCHINGS	Sikorsky S61	Failure To Deploy	Design	See Text For MOR 198804052 (M15) **Note:** See the text for MOR 198804052 (M15). This has been included as a separate event because it was recorded separately via MOR 198802141
M15	198804052	Occurrence: ADELT BEACON FAILED TO DEPLOY IN EMERGENCY SITUATION 3 DITCHINGS	Sikorsky S61	Failure To Deploy	Design	OCCS 88/02141, 88/03491 & 88/03829 REFER. CAA CLOSURE:SB CAS/CPT 600/SB-1 HAS BEEN MADE MANDATORY UNDER CAA AD058-12-88.LTO 914 ALSO REFERS. **Note:** Caledonian Airborne Systems Service Bulletin CAS/CPT 600/SB-01. was raised to require the re-wiring of control panel p/n 00-23-1065 and the relocation of the deployment battery and Submersion Actuator. CAP 476 Amdt 287, Issue 6 dated Jan 2003 shows that CAA AD 058-12-88 Mandated Caledonian Airborne Systems Service Bulletin CAS/CPT 600/SB-01 and required implementation not later than 31 March 1989. See Appendix I for more information.
M16	198804208	Occurrence: ADELT BEACON RESTRAINT PLATE LOOSE POSS SHORT CIRCUIT SCREWS UNDONE/LOST	Bell 212	Performance	Maintenance	MISSING SCREW & WASHER FOUND INSIDE BUOY.FLEET CHECK CARRIED OUT-NO OTHER A/C AFFECTED. SEE OCC 88/04052, 88/02141,88/03491 & 88/03819.
M17	198804209	Occurrence: ADELT BEACON CAP CRACKED IN 3 PLACES AT ATTACHMENT THREAD	Bell 212	Performance	Design	RESULTS OF FLEET CHECK SHOWED OTHER A/C TO BE SIMILARLY AFFECTED. BELIEVED THAT HEAT & STRONG UV LIGHT EXPERIENCD DURING OPERATIONS IN ARABIAN GULF MAY BE CONTRIBUTORY FACTORS.MFR INFORMED & DAILY INSPCN INTRODUCED.SEE OCC 88/04052

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M18	198901193	Occurrence: 4 5 DIVS OF LH RUDDER TRIM REQUIRED FOR STRAIGHT & LEVEL YAW TRIM DAMPER MALFN	B747	Unclassified	N/A	CPI INDICATED 3 DEGS UPPER RIGHT RUDDER INPUT WAS PRESENT. WHEN UPPER YAW DAMPER DISCONNECTED,THE RUDDER TRIM COULD BE RETURNED TO ZERO & ALL INDICATIONS NORMAL. ADD RAISED.
M19	198902218	Occurrence: ADELT BEACON DEPLOYED WHILE BEING REMOVED FROM A/C SHEAR PIN BROKEN	Sikorsky S61	Inadvertent Deployment	Maintenance	SEE ALSO 88/03736.INSPN OF DEPLOYMENT PISTON & SHEAR PIN INDICATED THAT ROTATION OF MAIN CASE OF THE ADELT WHILST UNDER SPRING PRESSURE CAUSED SHEAR PIN TO FAIL.IT WAS NOT DETERMINED WHETHER EXCESS STRESS TO SHEAR PIN OCCURRED DURING ASSEMBLY OR DISASSEMBLY. CAA CLOSURE: MAINT MANUAL AMENDED TO HIGHLIGHT THE NEED TO AVOID MAIN CASE ROTATION DURING LOADING/UNLOADING. **Note:** The secondary classification has been set to Maintenance because the MOR details indicate that the final cause may have been determined to be maintenance
M20	198903806	Occurrence: ADELT SQUIB FIRED INADVERTENTLY DURING WIRING CHECK BUT BEACON DID NOT DEPLOY	Sikorsky S76	Failure To Deploy	Design	LOCKING SPHERES OF DEPLOYMENT MECH FOUND TO HAVE DEFORMED THE EDGES OF THEIR LOCATING HOLES FORMING BURRS ON MAIN CASE WHICH BECAME SEIZED WITHIN RETAINING SLEEVE.BIH SPECIAL CHECK 100/S-2015 RAISED TO RECTIFY & MONITOR THE DEFECT.MAINT MANUAL AMENDMENT PLANNED PENDING PROPOSED MODIFICATION BY MANUFACTURER.SEE ALSO 88/04052. CAA CLOSURE: HAZARD NOW ADEQUATELY CONTROLLED BY INTRODUCTION OF MORE FREQUENT INSPNS. MAINT MANUAL AMENDMENT CMM 25-60-02 REFERS. **Note:** This has been classified as failure to deploy rather than a Performance issue as the most probable end result of the chafed wiring would have been a failure to deploy. The secondary classification has been set to Design because the root cause seems to be an insufficiently robust design to deal with a known high vibration environment.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M21	199003325	Other Occurrence: "ADELT DEPLOYED" LIGHT CAME ON IN CRUISE. ON ARRIVAL ADELT WAS MISSING FROM A/C.	Sikorsky S76	Inadvertent Deployment	Unknown	ATC REPORTED THAT NO ADELT BEACON SIGNALS HAD BEEN RECEIVED. ON INVSTGN DEPLOYMENT MECH WAS STILL IN PLACE BUT ITS BATTERY STUD HAD SHEARED ALLOWING INNER & OUTER SPRINGS TO RELEASE THE BEACON WITHOUT ACTIVATING THE SQUIB CIRCUIT. SEE ALSO 87/00154, 87/02572 & 88/01119. CAA CLOSURE: CONSIDERED ISOLATED INCIDENT.
M22	199100076	Other Occurrence: ADELT COMMENCED TRANSMITTING IN CRUISE WITH AUDIO BREAKTHROUGH ON A/C INTERCOMM.	Sikorsky S76	Performance	Design	ADELT BUOY FOUND TO HAVE INTERNAL FAULT. BUOY (CALEDONIAN AIRBORNE PN:00-23-1087) DESPATCHED WITH BATTERY DISCONNECTED TO MFR FOR INVSTGN. INSPN REVEALED BEACON WAS TRANSMITTING A LOW POWER TEST SIGNAL ONLY DUE TO A DEFECTIVE TEST SWITCH WHICH HAD WORN. THE WEAR HAS BEEN ATTRIBUTED TO A/C VIBRATION. CAA CLOSURE: HAZARD CONSIDERED TO BE ACCEPTABLE PROVIDING FREQUENCY OF OCCURRENCE REMAINS LOW.
M23	199101360	Other Occurrence: ADELT BEACON DEPLOYED UNSELECTED.	Sikorsky S76	Inadvertent Deployment	Maintenance	CAA CLOSURE: OCCURRENCE ATTRIBUTED TO INCORRECT ASSY OF BEACON AT INSTALLATION. REVIEW OF MAINT MANUAL SHOWED THAT ASSY INSTRS ARE CLEAR. OPRS FLEET CHECK COMPLETED.
M24	199102275	Other Occurrence: ADELT BEACON DEPLOYMENT MECHANISM FOUND TO CONTAIN ONLY 3 OF ITS 4 LOCKING SPHERES.	Sikorsky S76	Performance	Maintenance	FOUND DURING ANNUAL INSPN. FURTHER DIS-ASSEMBLY OF MECHANISM FAILED TO REVEAL ANY EVIDENCE OF THE MISSING SPHERE AS EITHER DEBRIS OR CORROSION RESIDUE. SEE OPEN OCC 91/02308.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M25	199102308	Other Occurrence: ADELT DEPLOYMENT MECHANISM FAILED TO SEPARATE AFTER PISTON REMOVED. ONE LOCKING SPHERE REMAINED LODGED IN CASE.	Sikorsky S76	Failure To Deploy	Design	SEE ALSO 91/02275 & 91/02388. FAILURE TO DEPLOY ATTRIBUTED TO VIBN INDUCED BURRING OF ADELT MAIN CASE. MFR NOW MAKES CASES FROM A SLIGHTLY HARDER MATERIAL & WILL SUPPLY THESE IN DUE COURSE. OPR HAS INCREASED FREQUENCY OF BEACON REMOVAL TO 3 MONTHLY INTERVALS (PREVIOUSLY 6 MONTHS). MFR HAS INTRODUCED A MAIN CASE OF HARDER MATERIAL. CAA CLOSURE: HAZARD ADEQUATELY CONTROLLED BY MFR & OPR ACTIONS. **Note:** This has been classified as failure to deploy rather than a Performance issue as the most probable end result of vibration induced burring would have been a failure to deploy.
M26	199102388	Other Occurrence: DURING MAINT CHECK ADELT DEPLOYMENT MECH LOCKING SPHERES WOULD NOT DISENGAGE.	Sikorsky S76	Failure To Deploy	Design	ONCE SPHERES WERE FREED ADELT WOULD STILL NOT SEPARATE DUE BURRING OF SPHERE RETENTION HOLES. SEE ALSO 91/02275 & 91/02308. MFR HAS INTRODUCED A MAIN CASE OF HARDER MATERIAL & OPR HAS INCREASED PERIODICY OF INSPECTION. CAA CLOSURE: HAZARD ADEQUATELY CONTROLLED BY MFR & OPR ACTIONS. **Note:** This has been classified as failure to deploy rather than a Performance issue as the most probable end result of vibration induced burring would have been a failure to deploy.
M27	199102551	Other Occurrence: ADELT BEACON CASING CRACKED ABOVE BEACON TEST SWITCHES.	Sikorsky S76	Performance	Design	BEACON CHANGED. **Note:** The secondary classification has been set to Design because, without further information, inadequate robustness to vibration appears to be the most likely cause. Further discussion with the operators is needed to definitively rule out maintenance action as a cause.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M28	199201636	Other Occurrence: SEVERE CORROSION OF ADELT BEACON SUBMERSION ACTUATOR CONNECTOR.	Bolkow 105	Failure To Deploy	Design	FOUND DURING EQUIPMENT REMOVAL FOR A/C MODIFICATIONS. CORROSION IN FORM OF HEAVY GREEN/WHITE DEPOSITS. ONE FIXED RECEPTACLE CONTACT PIN CORRODED COMPLETELY THROUGH & REMAINED IN SOCKET OF THE FREE CONNECTOR ON REMOVAL. EVIDENCE OF ELECTRICAL ARCING BETWEEN THE CONTACTS ALSO FOUND. CAA CLOSURE: FLEET CHECK REVEALED NO OTHER INSTALLATIONS AFFECTED. MAINTENANCE SCHEDULE AMENDED TO REQUIRE ANNUAL INSPECTION **Note:** This has been classified as failure to deploy rather than a Performance issue as the most probable end result of the corrosion would have been a failure to deploy. The secondary classification has been set to Design because the most likely cause of corrosion is water ingress. Further discussion with the operators is necessary to definitively preclude maintenance action as a root cause of the corrosion.
M29	199204060	Other Occurrence: INADVERTENT ACTIVATION OF ADELT BEACON. SEARCH & RESCUE A/C ARRIVED TO ADVISE OF SITUATION.	Bolkow 105	Inadvertent Deployment	Unknown	BEACON CHECKED, GREEN POWER LIGHT FOUND ILLUMINATED. TEST SWITCH DEPRESSED AND RELEASED, BEACON DEACTIVATED. CYCLING SWITCH CLEARED DEFECT. CAUSE NOT DETERMINED. CAA CLOSURE: RANDOM OCCURRENCE. HAZARD IS ACCEPTABLE PROVIDED FREQUENCY REMAINS LOW
M30	199204092	Other Occurrence: CRACKING NOISE HEARD WHEN ADELT ANTENNA FLEXED. ANTENNA BROKEN INTERNALLY, EFFECTIVENESS CONSIDERED DEGRADED.	SA365 Dauphin	Performance	Maintenance	FOUND DURING POST FLT INSPECTION. ANTENNA PN:606-150-001. CAA CLOSURE: MODIFIED ANTENNA ON TRIAL, WILL BE RETROFITTED ON ATTRITION BASIS. HAZARD CONSIDERED ACCEPTABLE PROVIDING FREQUENCY OF OCCURRENCE REMAINS LOW **Note:** The secondary classification has been set to maintenance but further discussions with the operator are necessary to determine the correctness of this classification

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M31	199204953	Other Occurrence: RH AUXILIARY FUEL TANK FILLER ACCESS PANEL FOUND MISSING AFTER SHUTDOWN ON POST FLT INSPN.	SA365 Dauphin	Other	Unknown	ACCESS PANEL HINGE RIVETS HAD PULLED THROUGH KEVLAR FUEL TANK BOX ALLOWING COMPLETE HINGE ASSY TO DETACH WITH ACCESS PANEL. ADELT BEACON LABEL TORN TOGETHER WITH SLIGHT SCRATCHING ON ADELT BODY. ADELT ASSESSED SERVICEABLE. FLEET CHECK CARRIED OUT. MINOR MOD RAISED TO REPLACE UNUSED PANELS WITH BLANKING PLATES. CAA CLOSURE: HAZARD ADEQUATELY CONTROLLED BY REPORTERS ACTIONS.
M32	199301513	Other Occurrence: ADELT DEPLOY LIGHT ILLUMINATED FOR 30 SECONDS. ADELT SWITCHED OFF & FLT CONTINUED. ADELT FOUND TO BE IN POSITION AFTER LANDING.	Sikorsky S61	Other	Design	SPURIOUS WARNING. CAA CLOSURE-HAZARD ACCEPTABLE PROVIDED FREQUENCY OF OCCURRENCE REMAINS LOW.
M33	199301925	Other Occurrence: Adelt beacon missing. Separated at sleeve retaining assy. Squib had not fired.	Sikorsky S76	Inadvertent Deployment	Installation	CAA CLOSURE-Fleet check carried out-satis. Considered isolated failure of release mechanism **Note:** The secondary classification has been set to Installation as this appears to be an isolated event and so cannot be classified as design.
M34	199302109	Other Occurrence: As a/c brought to hover over ship helideck, ship pitched substantially, resulting in ADELT beacon damage.	Sikorsky S76	Other	External Event	**Note:** Raise Question – Was rest of aircraft damaged?

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M35	199403142	Other Occurrence: Adelt beacon deployed onto helideck, during refuel, when master switches selected 'on'.	SA365 Dauphin	Inadvertent Deployment	Unknown	The cockpit control was not armed & deployment switch was still wire locked 'off'
M36	199601053	Other Occurrence: ADELT deployed at approx 200ft on take off following hovering manoeuvres during CofA air test.	SA365 Dauphin	Inadvertent Deployment	Unknown	

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M37	199605710	UK Reportable Accident: A/c crashed on high ground in bad weather. All 3 on board killed.	Sikorsky S76	Failure To Deploy	Design	Investigation by Irish authorities. Having completed a training detail in the vicinity of Aldergrove Airport, the a/c departed for a 20 minute return flight to its home base at Ballyedmond. The approach was executed using a locally produced, GPS-based approach procedure. Having commenced its descent, in preparation for landing at Ballyedmond, the a/c struck the north face of the Carlingford Mountains at 960ft amsl. All 3 occupants suffered fatal injuries. The investigation found that the circumstances of the accident were consistent with controlled flight into terrain. The primary cause of the accident was assessed as being a loss of situational awareness, which prompted a decision to deviate from the programmed route by delaying the turn on to the final segment of the approach to the missed approach point & subsequent failure to monitor the a/c's rate of turn once initiated. The Irish AAIU Aircraft Accident Report 01/98 contains 9 Safety Recommendations, 5 of which are addressed to the CAA & relate to: i) establishment of a special category for corporate operations; ii) regulation of night & IMC operations by non-instrument rated pilots; iii) external vetting of corporate operations; iv) use of GPS; v) ADELT specifications. CAA Closure: CAA responses to the 5 AAIU Safety Recommendations were communicated by letter dated 27 Aug 98. **Note:** This was a fatal accident related to CFIT, which was investigated by the AAIU. One of the conclusions of the investigation was that the ADELT had probably not been armed but, even if it had been armed, the beacon would not have been activated as it relied hydrostatic sensors being immersed in water and the accident occurred inland. See Appendix G for more information.
M38	199704478	Other Occurrence: On selecting 121.25mhz a distress beacon transmission was picked up. It transpired that subject a/cs ADELT had been inadvertently activated. A/c returned.	SA332 Super Puma	Inadvertent Deployment	Design	**Note:** In the absence of any other information the secondary classification has been set to Design as the most likely cause is a design induced human factor.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M39	199704615	Other Occurrence: ADELT submersion actuator inoperative due defective electrical connector.	A/C Equipment	Failure To Deploy	Manufacture	Connector electrode tubes were loose & connector securing screws missing. Defect would prevent beacon deploying automatically in event of water landing. Actuator, Walter Kidde, PN K38215. Second unit found with similar defect. See Digest 97/D/10. Mfr informed. Fleet check carried out & more frequent inspections introduced. CAA Closure: Hazard adequately controlled by reporter's action. **Note:** This has been classified as failure to deploy rather than a Performance issue as the most probable end result of the defective connector would have been a failure to deploy.
M40	199704980	Other Occurrence: ADELT deployed light came on when arm switch selected. Helideck crew confirmed ADELT had deployed – a/c shutdown. ADELT & spring plunger removed & stowed.	Sikorsky S76	Inadvertent Deployment	Design	No defect found when aircraft checked at base. Deployment attributed to possible inadvertent switch operation by pilot's gloved hand when switching to arm. Although deploy switch is guarded, the guard does not extend over switch. Alternative guard which covers switch recommended by operator
M41	199705986	Other Occurrence: Emergency beacon signal heard by crew breaking in on VOR frequency & strong on 121.5mhz. Source not found, but on return Adelt test switch found active.	SA365 Dauphin	Inadvertent Deployment	Design	**Note:** The secondary classification has been set to Design because it seems possible that the test switch had been inadvertently activated making it a design induced human factor.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M42	199902037	Other Occurrence: ADELT submersion actuator inoperative due to defective electrical connection.	SA365 Dauphin	Failure To Deploy	Design	Tests revealed no continuity between pin A & outer tube, although there was continuity between pin B & inner tube. Defect would prevent beacon deploying automatically in event of water landing. Actuator, Walter Kidde, PN K38215. See also 97/04615. Defect addressed by embodiment of mod no 19513. **Note:** This has been classified as failure to deploy rather than a systematic issue as the most probable end result of the defective connector would have been a failure to deploy. The secondary classification has been set to design because a modification has been developed to addressed this, indicating a design issue.
M43	199902336	Other Occurrence: Inadvertent deployment of ADELT.	SA332 Super Puma	Inadvertent Deployment	Design	Whilst extracting pocket computer from flight bag situated above the document box, it fell on the ADELT control panel with a forward movement, deploying the ADELT. ATC advised. It should be noted that when deployed the ADELT must have been damaged on impact as it did not transmit. On inspection of ADELT control panel it was possible to select the guarded 'DEPLOY' switch to 'DEPLOY' without lifting the switch – the DEPLOY switch is proud of the side protection guards & was showing signs of previous impacts. Due to the exposed location of the ADELT panel opr suggests a more robust guarded switch (ie as per the EXIS lights) to prevent any further occurrences. Beacon, beacon battery, system battery & ADELT control panel changed & tested satis. Crews advised of care to be exercised in cockpit. Opr's investigation ongoing. **Note:** The secondary classification has been set to design as this MOR is indicative of a design induced human factor.
M44	200003812	ADELT beacon failed to deploy.	Sikorsky S76	Failure To Deploy	Unknown	A/c returned to base with tech log defect of squib light inoperative. Squib found to have blown but ADELT beacon had not deployed. A/c systems checked, no fault found. Complete ADELT assembly changed. Manufacturer advised.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M45	200007694	ADELT submersion actuator failed continuity test – pin A not connected to outer tube electrode. Tubes also loose.	SA365 Dauphin	Performance	Design	Actuator PN K38215 changed. See also 1999/02037. Failure attributed to effects of fenestron vibration on submersion actuator. Previously introduced measures, including repositioning of actuator and more frequent inspections, do not appear to have resolved the problem. The possibility of introducing an alternate actuator is being considered.
M46	200105325	Maintenance overrun.	DHC8	Unclassified	N/A	During Certificate of Maintenance Review (CMR) task D83-6110/09E1 appeared to have overrun by 1,035hrs. On investigation it would appear that the PCU was not compliant with AD CF 96/2520 – PCU replaced. See also 200102767 and 200105103. The operators investigation concluded that:- 'The ASR was raised on 28 July 2001 as a consequence of a maintenance review, presumably by the CMR signatory. At issue was the evidence in AMICOS that task D83-611/09E1 had overrun its "not to exceed" period by 1,035 flying hours. This task is the performance of Critical Parts Inspection to the Propeller Control Unit that had been mandated by FAA AD 96-25-20 (the ASR refers incorrectly to Canadian AD CF 96/2520 which does not exist)'. The AMICOS system has now been replaced by a maintenance planning system known as OASES. At the time there were a number of Quality issues and NCRs raised on the subject of AD control at that time, which lead ultimately to Quality performing a 100% check of all ADs on the DHC8 fleet. Following this check a complete AD statement was produced for each aircraft. The Quality manager confirms that the aircraft is now fully compliant with AD 96-25-20 and the Surveyor has verified that the quoted task due dates are as follows: Nr1 PCU P/N 782490A47 S/N 960143, TSO 8,935 flying hours, CPI inspection due in1,565 flying hours. Nr2 PCU P/N 782490A47 S/N 950539, TSO 2,553 flying hours, CPI inspection due in 7,947 flying hours. This information is correctly forecast in OASES under task D83-6110/09E1. CAA Closure: The hazard is adequately controlled by the actions stated above.
M47	200108341	ADELT deployed light illuminated shortly after departure. Aircraft returned.	Sikorsky S76	Other	Unknown	

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M48	200200339	Smoke/fumes in cockpit. PAN declared. Aircraft returned.	SA332 Super Puma	Failure To Deploy	Unknown	Shortly after take off a strong "ozone" smell was noticed, accompanied by tendrils of smoke from the rear of the centre console. The smoke stopped after approx 5 seconds and no services were lost. A PAN was declared, the aircraft returned to base and landed safely. The defect was traced to the emergency floatation control panel. A cockpit water leak had deposited drips of water onto the centre console, in the vicinity of this control panel. The water had then contaminated the "Liteflow" lighting plate of the controller. This caused a short circuit of one of the filaments, which subsequently caused the plastic plate to overheat and give off the fumes and smoke experienced by the crew. The floatation control panel was replaced and the emergency floatation system, along with the AFDS system, was fully functioned and found to be satisfactory. During the investigation, the ADELT control unit was also found to be water contaminated. This controller was replaced as a precaution and full functional checks of the ADELT deployment system carried out satisfactorily. Investigation of the cockpit water leak resulted in the structure above the windscreen transparencies being resealed. The ram air vent was also disassembled and then fully resealed on reassembly. **Note:** This has been classified as both Failure To Deploy (as the most probably end result of the water contamination would have been a failure to deploy) and Systemic (as the MOR indicates a maintenance issue was highlighted by a system failure). The secondary classification has been set to Unknown because it is not possible to determine whether this occurred as a result of a design issue, a random failure or a maintenance error.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M49	200200339	Smoke/fumes in cockpit. PAN declared. Aircraft returned.	SA332 Super Puma	Performance	Unknown	Shortly after take off a strong "ozone" smell was noticed, accompanied by tendrils of smoke from the rear of the centre console. The smoke stopped after approx 5 seconds and no services were lost. A PAN was declared, the aircraft returned to base and landed safely. The defect was traced to the emergency floatation control panel. A cockpit water leak had deposited drips of water onto the centre console, in the vicinity of this control panel. The water had then contaminated the "Liteflow" lighting plate of the controller. This caused a short circuit of one of the filaments, which subsequently caused the plastic plate to overheat and give off the fumes and smoke experienced by the crew. The floatation control panel was replaced and the emergency floatation system, along with the AFDS system, was fully functioned and found to be satisfactory. During the investigation, the ADELT control unit was also found to be water contaminated. This controller was replaced as a precaution and full functional checks of the ADELT deployment system carried out satisfactorily. Investigation of the cockpit water leak resulted in the structure above the windscreen transparencies being resealed. The ram air vent was also disassembled and then fully resealed on reassembly. **Note:** This has been classified as both Failure To Deploy (as the most probably end result of the water contamination would have been a failure to deploy) and Systemic (as the MOR indicates a maintenance issue was highlighted by a system failure). The secondary classification has been set to Unknown because it is not possible to determine whether this occurred as a result of a design issue, a random failure or a maintenance error.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M50	200207646	Serious Incident: ADELT found damaged after landing on offshore platform. Possible collision with deck edge netting support. AAIB AARF investigation.	Sikorsky S76	Other	External Event	The helicopter was making a short positioning flight between rigs in the southern North Sea. It was almost dark and intermittent rain showers were affecting the area. The windscreen was clear but the chin windows were partly misted. The wind direction, reported as 190deg/24kt, necessitated the approach being flown by the co-pilot from the LH seat. He aimed for the centre of the marked circle on the helideck, in accordance with company SOPs. The captain lost sight of the landing area in the last 100ft of the descent but was content that the approach was being flown within normal parameters. Touchdown was uneventful but, after landing, the HLO reported that the aircraft's Automatic Deployable Emergency Locator Transmitter (ADELT), fitted to the rear fuselage, was damaged. An operator's investigation established that the ADELT struck the deck-edge safety netting, and then the seaward side of the cable tray, during the landing. It was concluded that the helicopter had crossed the helideck below the safe profile either because it "had been flown on a too shallow approach with a small flare, or flown on a normal sight picture approach with too hard a flare". A contributory factor may have been the helicopter's centre of gravity which was 80% towards the aft limit and would have required a higher than normal nose attitude in the flare. It was recommended that, in future, the non-handling pilot should bring attitudes of 10deg nose-up or more to the attention of the handling pilot when the helicopter is within 30ft of the surface. Further recommendations include a review of the aiming point for the approach (other aircraft in the operator's fleet aim at the far side of the landing circle) and an investigation into possible solutions to the chin window misting problem. Finally, consideration is to be given to the fitting of an approved modification to reposition the ADELT from its present position under the tail to the right side of the fuselage, aft of the baggage bay. See AAIB Bulletin 4/2003, ref: EW/G2002/10/16. CAA Closure: The hazard is adequately controlled by the actions stated above.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M51	200303770	Automatic Deployable Emergency Locator Transmitter (ADELT) aerial found to have broken off and be missing at shut down. Nothing noted during preceding flight.	Sikorsky S76	Performance	Unknown	**Note:** This could have resulted from a number of causes (maintenance, wear, human factors...) and, from the data available it isn't possible, to determine which is most likely

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M52	200308245	ADELT system replacement battery supplied with incorrect connection socket.	SA332 Super Puma	Performance	Design	A scheduled ADELT system battery replacement was being undertaken. The replacement battery was withdrawn from stock and, after a voltage check, was fitted into the beacon carrier. The battery's electrical connector was connected to the carrier receptacle, the beacon was reloaded and the assembly refitted to the airframe. However, when the ADELT system checks were carried out, the green 'Battery' LED on the ADELT control panel would not illuminate when the test button was pressed. The defect was investigated and traced to the replacement system battery electrical connector being a 3-socket type, while the beacon carrier receptacle was a 4-pin type. Although the connectors had different numbers of pins/sockets, because the connector shell sizes and keyway orientation were identical, the connectors would connect together easily. It did not register when the battery voltage was checked that the connector had 3 sockets instead of 4. The correct 4-socket connector is wired A and C for battery power, as is the incorrect 3-socket connector. The result being that the correct voltage was obtained from the detailed connections, so no query was raised in the engineer's mind. The connectors going together easily further masked the problem. The battery that had been withdrawn from bonded stores had the correct part number (00-23-1099). The entire stock holding of this battery was investigated and two others were found to have the incorrect type of connector fitted. These batteries were quarantined pending further investigation. A replacement battery of the correct configuration was installed and system checks established serviceability. The operator has subsequently amended its procedures and no further problems have been reported. CAA Closure: The hazard is acceptable provided the frequency remains low. **Note:** The secondary classification has been set to Design because the design of the connector allowed a maintenance human factors error to occur.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M53	200406853	Inadvertent discharge of Crash Position Indicator (CPI). Water activated switch did not seem to have any silicone grease coating and was permanently "on", therefore developed a fault.	SA332 Super Puma	Inadvertent Deployment	Maintenance	Following a normal landing, while carrying out the landing checklist, the red 'CPI Discharge' caption was observed to be flashing. The crew delayed disembarkation and held the deck crew clear of aircraft while the emergency checklist, MEL and Bond ESE guide were consulted. The co-pilot made visual confirmation of CPI deployment and the passengers were then disembarked. It was reported that a rig worker had sighted a red object detach from the aircraft on finals. This was confirmed as the CPI and collected by the safety boat. ATC were informed that the aircraft was safe and stood down the SAR. The crew confirmed that the CPI switches in the cockpit were still guarded. Extensive investi-gations were conducted by the operator and the manufacturer of the beacon. All aircraft system tests that were carried out concluded that a water activated switch was the cause of the CPI discharge. When the water activated switch was removed and inspected it was noted that there did not seem to be any silicone grease coating, as compared to two other in-service switches on fleet aircraft. Electrical testing of the switch indicated that it was permanently switched "on" and therefore had developed a fault. CAA Closure: No further CAA action required at this time.
M54	200504249	Accidental deployment of ADELT.	Sikorsky S76	Inadvertent Deployment	Design	During the transit between two offshore platforms the Captain dropped an unopened can of drink, which landed on the centre console behind the ADELT panel. In attempting to catch the can, the Captain believes he caught the deploy switch, as the ADELT deploy caption illuminated immediately. The crew informed Anglia Radar and listened out on 121.5 but heard nothing. On landing the Captain checked the ADELT cradle and found that the ADELT had indeed deployed. Clearance was obtained to return to base without passengers. See also 200504764. **Note:** The secondary classification has been set to design because this MOR is indicative of a design induced human factor.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M55	200504764	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT).	Sikorsky S76	Inadvertent Deployment	Design	On approach to the rig, an uncommanded transmission of the ADELT occurred which, following landing, could not be reset from either inside or outside the aircraft. Rescue Co-ordination Centre advised of false transmission and the unit was switched off. Engineering investigation found the beacon had rotated in the carrier and dragged the deploy switch actuating arm, causing the deploy microswitch to operate. Switch arm reset/adjusted and the aircraft returned to service. See also 200505413 and 200506099.
M56	200505413	Inadvertent operation of Automatically Deployed Emergency Locator Transmitter (ADELT). OEM has issued two SBs on this subject and the subject operator has planned embodiment.	Sikorsky S76	Inadvertent Deployment	Design	As soon as the ADELT was armed, whilst the aircraft was parked on the stand, it began transmitting. The ADELT was switched off and reset. The reporter confirms that this has previously occurred with the modified ADELT equipment and suggests that the modification to install guards on the switches should be introduced as a priority. The reporter also suggests that the necessity of having apparently surplus switches on the ADELT should be investigated. The beacon manufacturer has issued two service bulletins which address this issue. The operator has a programme to embody these modifications. See also 200504764, 200506099, 200509296 and 200510704. CAA Closure: The hazard is adequately controlled by the actions stated above. **Note:** The secondary classification has been set to design because the design of the installation allowed a human factors error (inadvertent switching) to occur.
M57	200506099	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT) in flight.	Sikorsky S76	Inadvertent Deployment	Maintenance	Inbound to Norwich at 20 DME the ADELT started to transmit and could not be reset from the cockpit. Anglia Radar and D&D informed. On inspection the deploy/transmit microswitch was found mis-aligned and was adjusted accordingly. The reporter suggests that such inadvertent transmissions be monitored in case of a fault with the model of ADELT (CPT 900) in use. See also 200504764. Investigation being progressed under 200505413.
M58	200506258	Inadvertent deployment of Crash Position Indicator (CPI). Modification programme initiated.	SA332 Super Puma	Inadvertent Deployment	Unknown	During the pre-flight external inspection, after power had been applied to the aircraft, the CPI was found to be deployed at the side of the aircraft. The ground controller was contacted on 121.7 and it was established that the beacon was transmitting. The reset procedure was carried out and the ground controller confirmed that the transmissions had stopped. Modification programme incorporated across the fleet, since when there has been no recurrence. Other operators informed accordingly. See also 200406853, 200508162, 200508382 and 200602281. CAA Closure: The hazard is adequately controlled by the actions stated above.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M59	200506741	Accidental activation of ADELT.	SA332 Super Puma	Inadvertent Deployment	Design	After shutdown the ADELT safety device was given to the ground crew to be fitted. Shortly afterwards the ADELT control box in the cockpit indicated that the beacon had been activated. A message was passed to the ground crew to check the switches on the beacon. The 'on' switch had been accidentally knocked, activating the beacon. A notice was subsequently posted asking for caution to be exercised when fitting or removing the ADELT strap. **Note:** The secondary classification has been set to design because the design of the installation allowed a human factors error (inadvertent switching) to occur.
M60	200508162	Inadvertent deployment of Crash Position Indicator (CPI).	SA332 Super Puma	Inadvertent Deployment	Unknown	After arriving on stand the ground crew informed the crew that the CPI was missing from the aircraft. The CPI controller was checked and all the switches were found in the correct position. At that point the CPI deployed light was observed to be flashing. The light had not been seen before because of the glare of the sun through the window. ATC were informed and, on arrival at engineering, Kinloss informed ops that the beacon was on the airfield. The beacon was then recovered. See also 200406853 and 200506258. **Note:** Need to check other referenced MORs
M61	200508382	Inadvertent in-flight activation of Crash Position Indicator (CPI). Aircraft returned.	SA332 Super Puma	Inadvertent Deployment	Unknown	During cruise a flashing green light was noted on the CPI panel. Activation of the CPI was confirmed from the emergency frequency, Kinloss and other aircraft in the vicinity. The aircraft returned and an uneventful landing carried out. See also 200508162, 200406853. CAA Closure: Investigation being progressed under 200506258. **Note:** Need to check other referenced MORs
M62	200509166	Inadvertent discharge of ADELT deployment squib.	Sikorsky S76	Performance	Maintenance	During scheduled maintenance of the ADELT system, specifically the ohmic resistance check of the ADELT deployment squib, connection of the safety ohm-meter to the firing and ground line connector pins resulted in a small bang and the unexpected deployment of the ADELT transmitter. The transmitter itself was restrained within the carrier by the safety harness. An engineering notice was raised to remind personnel of the relevant safety and maintenance requirements. **Note:** The secondary classification has been set to maintenance because the MOR details indicate that the event was triggered by a maintenance error.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M63	200509194	Uncommanded operation of Automatically Deployed Emergency Locator Transmitter (ADELT) deployed light during flight.	Sikorsky S76	Inadvertent Deployment	Unknown	Enroute the ADELT amber D/XMT light started flashing and was unable to be reset using the control panel. ATC advised. Once the aircraft landed on the offshore installation the beacon was reset using the beacon reset switch. The aircraft returned to base and engineering were informed. Total aircraft hours 19019.
M64	200509195	ADELT activation. Investigation found that the cause was due to wear in the release mechanism. An SB is in press.	SA332 Super Puma	Failure To Deploy	Wear	During the electrical Part 'E' section of an 'A' check, it was noticed the squib light failed to illuminate during the self test of the ADELT panel. Investigation found the squib had detonated although the beacon had not deployed. Investigation found that the cause was wear in the main cases and pistons, which are now in excess of 15 years old. A proposal for an SB has been sent to EASA to form part of a proposed AD. CAA Closure: The hazard is adequately controlled by existing requirements, procedures and documentation. **Note:** The secondary classification has been set to Wear because, with the data available, it isn't possible to determine whether an earlier maintenance check should have spotted the wear or whether the original design was insufficiently robust.
M65	200509296	Uncommanded ADELT activation in flight. Recurring problem.	Sikorsky S76	Inadvertent Deployment	Design	On landing, the engineer was able to cancel the transmission by external manipulation of the ADELT housing. Investigation being progressed under 200505413 **Note:** This MOR refers back to MOR 200505413 which has a secondary classification of Design. In the absence of additional information this MOR has been given the same classification.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M66	200510704	Inadvertent ADELT transmission. Investigation has resulted in an improved method of setting up the switch and a revised manual.	Sikorsky S76	Inadvertent Deployment	Design	ADELT appeared to deploy and transmit on 121.5 during the cruise, causing break through on VHF 2 – 122.95 and 123.62. The flight crew decided against a reset and set the unit to 'Off', although it continued to transmit. ATC were advised and the flight continued to its planned destination. The ADELT on the subject aircraft was fitted with a weatherseal (p/n: BC84-015) which has been found to allow the beacon to rotate, thereby activating the microswitch and causing the beacon to transmit. The weatherseal was replaced with an older part (p/n: C85-015-1) which maintains a better grip. A check to ensure the beacon is firm in its carrier is to be included in pre-flight walk arounds, whilst the introduction of creep marks is also being considered. Investigation has resulted in the design organisation introducing an improved method of setting up the switch. The operators have been issued with a troubleshooting manual. An amendment to the maintenance manual has been raised to improve the continuing airworthiness instructions and incorporate the above information. See also 200505413. CAA Closure: The hazard is adequately controlled by the actions stated above

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M67	200600119	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT) during approach to rig.	SA365 Dauphin	Inadvertent Deployment	Installation	During the approach to land on the Leman 27B rig, a brief squib sound was heard through the headset. On landing, the ADELT deployed light was noted to be illuminated and inspection found the ADELT (p/n 070-0900-001) missing. Aircraft returned to the main platform and shut down. Technical/operations advice was sought. It was noted that the ADELT arm switch was in the armed position and the deploy switch was in the 'OFF' position. ADELT recovered from the sea adjacent to the Leman 27B rig. Investigation revealed that the associated loom was in very poor condition with chafed submersion actuator wiring. In addition, the firing line to the squib wire (ident ELT4EZO) was found to be unscreened efglass cable instead of screened raychem. The deployment battery, submersion actuator and multi-axis G switch were not located in the correct positions as stated in CPT-600/SB-09. There is ongoing investigation under 200509195. CAA Closure: No further CAA action required at this time **Note:** This MOR refers back to MOR 200509195 which has a secondary classification of Wear. However, MOR 200509195 refers to wearing of main cases and pistons whilst this MOR refers to a wiring problem. As a result the secondary classification of this MOR has been set to Installation rather than simply matching it to the referenced MOR.
M68	200600623	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT).	SA365 Dauphin	Inadvertent Deployment	Installation	ADELT deployed during landing, when selected from 'ARM' to 'SAFE'. Investigation under 200600119 **Note:** This MOR refers back to MOR 200600119 which has a secondary classification of Installation. In the absence of additional information this MOR has been given the same secondary classification

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M69	200600712	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT) during cruise. Investigation has resulted in an improved method of setting up the switch and a revised manual.	Sikorsky S76	Inadvertent Deployment	Unknown	At approximately 10nm to run to the Leman field, the ADELT deploy light started flashing, attempt to reset was unsuccessfully so a decision was made to reset the beacon itself once on the deck of the Leman C. On deck it was found that the ADELT had deployed. Anglia radar advised and aircraft returned to base without passengers. Investigation carried out and crew de-briefed with reference procedures for ADELT re-set. The ADELT light was flashing and the crew had attempted to re-set it by moving the deploy 'XMT/RST' switch to 'XMT/RST'. The light then changed to 'Steady On' and on landing it was found that the ADELT had been deployed. During the attempted re-set the P1 stated that he was very careful not to move the switch 'fwd' at all, only aft to the 'XMT/RST' position. It should be noted that the 'DPL/ARM', 'XMT/ARM' switch was left in the 'DPL/ARM' position. The complete system was checked by avionics and a replacement ADELT etc fitted. Discussions have been held with Q and S and Fleet Support and a number of procedures/modifications have been suggested. The operator states that it is extremely probable that the beacon deployed because it was commanded to do so by an inadvertent and microscopic forward selection of the 3 position switch from 'OFF to DEPLOY' (Fwd = Deploy, Centre = Off, Rearward = Reset). It is for this very reason that the operations circular issued approximately a year ago requires a second switch to be selected to a different position (designed to enable the beacon to transmit but remain in the carrier) before the deploy/reset switch is touched. The crew did not remember to do this. Nevertheless this is tertiary to the event; the switch would not have been touched if the beacon had not started to transmit without cause. Inadvertent activation of the CPT900 beacon is a significant problem that is being actively pursued with the OEM Avionics Type Engineer. Investigation has resulted in the design organisation introducing an improved method of setting up the switch. The operators have been issued with a troubleshooting manual. An amendment to the maintenance manual has been raised to improve the continuing airworthiness instructions and incorporate the above information. CAA Closure: The hazard is adequately controlled by the actions stated above

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M70	200602281	Crash Position Indicator (CPI) activated. Beacon found lying on the ground.	SA332 Super Puma	Inadvertent Deployment	Unknown	While parked and awaiting departure, a beacon noise (pinger) was heard through VHF1, which was tuned to 122.375. Investigation found the CPI Green/Test transmit light flashing. The reset button was pressed resulting in the light extinguishing for a moment before illuminating again. The transmit toggle switch was cycled and the reset button pressed, both without success, after which the red 'deployed' light illuminated. The flight was abandoned and the aircraft returned to the stand. On the way back to the stand, the beacon was seen to be lying on the ground, which was retrieved by airport staff. Investigation being progressed under 200506258. See also 200508162. **Note:** Need to check other referenced MORs
M71	200602977	ADELT transmissions traced to aircraft in hangar. During reset procedure, beacon was inadvertently fired in the hangar.	Bell 214	Inadvertent Deployment	Human Factors	It was reported that transmissions were being received from a Bristow 406MHz ADELT beacon. Investigation revealed that the ADELT beacon installed on the subject aircraft, which was parked in the hangar, had initiated transmissions by itself. Whilst carrying out the reset procedure from the cockpit controller, the switch positions were inadvertently made in the wrong sense (forward instead of aft), resulting in the beacon being fired from its carrier on to the floor of the hangar. The safety strap had previously been removed to access the beacon switch although attempts to carry out a reset at the beacon were unsuccessful. No injuries were incurred and there was no damage to the aircraft or ground equipment but the beacon itself was damaged on striking the floor.
M72	200604317	Spurious SARBE transmission due to inadvertent activation of passenger's Personal Locator Beacon (PLB) on lifejacket (LSJ).	SA332 Super Puma	Other	External Event	A 121.5 MHz SARBE (distress) transmission was noticed on 'homer' when the aircraft was on AUK A platform. All passengers' LSJs were checked, together with two crew LSJs and ADELT but no obvious source of transmission was found. The aircraft departed and the SARBE indication remained for the duration of the flight – ATC were informed. Passengers LSJs were checked again on arrival and a PLB transmitter was found activated on one of the lifejackets. See also 200305618. **Note:** This MOR refers to a transmission from a Personal Locator Beacon (PLB) and not a transmission from an ADELT.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M73	200606089	Personal Locator Beacon (PLB) transmitting.	Sikorsky S76	Other	External Event	During pre-start checks, a PLB transmission was heard on 121.5 MHz. Aircraft Automatically Deployable Emergency Locator Beacon (ADELT) and crew beacons were checked and found satisfactory. Passengers were then offloaded and their PLBs checked, with one found to be transmitting. Beacon reset, passengers re-boarded and the flight departed. The reporter notes that the PLBs are low power, but when triggered they render radio reception by the aircraft on 121.5 and close frequencies impossible. See also 200403785. **Note:** This MOR refers to a transmission from a Personal Locator Beacon (PLB) and not a transmission from an ADELT.
M74	200607680	ADELT "switch guard" cover separated from a/c and fell into sea on take off.	Sikorsky S76	Other	Installation	On departure from the Viking PA, the HLO reported something had fallen from the a/c into the sea. On the next landing the HLO inspected the a/c prior to touchdown and crew inspected the a/c on landing. Nothing was found missing. On arrival back at base, it was discovered that the ADELT "switch guard" cover was missing. **Note:** The secondary classification has been set to Installation as it seems likely that the switch guard fixings had failed in some way.
M75	200608951	Crash Position Indicator (CPI) uncommanded deployment.	Eurocopter EC225	Inadvertent Deployment	Design	On arrival, crew noticed a green flashing 'CPI Gone' warning on the CPI panel. On shutdown, CPI found to be no longer attached to the a/c. Operator found evidence of water in the immersion sensors (water-activated switches) on their a/c. EASA have issued AD 2006-0300, which states that immersion sensor p/n 50323, which is declared unfit for flight, is replaced with a new immersion sensor, p/n 503232. See also 200609183 and 200609668. CAA Closure: The hazard is adequately controlled by existing requirements, procedures and documentation.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M76	200609183	After ATC reported that the a/c's emergency beacon was transmitting, it was discovered that an uncommanded in-flight deployment of the Crash Position Indicator (CPI) had occurred.	Eurocopter EC225	Inadvertent Deployment	Design	After ATC reported that the a/c's emergency beacon was transmitting, it was discovered that an uncommanded in-flight deployment of the Crash Position Indicator (CPI) had occurred. See also 200609668. Investigation progressed under 200608951 Note: This MOR refers back to MOR 200608951 which has a secondary classification of Design. In the absence of additional information, this MOR has been given the same secondary classification.
M77	200611448	During cruise, the ADELT light began to flash and the associated aural warning sounded. Attempts to reset the system in flight were unsuccessful.	Sikorsky S76	Inadvertent Deployment	Unknown	After landing the beacon was reset manually, the fault cleared and did not recur. See also 200509296.
M78	200700568	Uncommanded operation of Automatic Deployable Emergency Locator Transmitter (ADELT) during take-off. Aircraft returned. Microswitch activated by flattened foam liner.	Sikorsky S61	Inadvertent Deployment	Design	ADELT started to transmit (heard through headsets) and white deploy/ transmit light illuminated. Investigation revealed that this is the third occurrence of beacon activation caused by the foam liner in neck of beacon carrier becoming flattened over time, subsequently allowing enough play to momentarily activate the microswitch. Reporter comments that some additional support is needed in lower half of carrier neck to prevent foam from flattening. ADELT p/n 070-0900-001, TSN 1098.46hrs, TSO 107.55hrs. The carrier, p/n 00-23-1063, has been replaced and withdrawn from service. CAA Closure: The hazard is acceptable provided the frequency remains low.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M79	200701969	Inadvertent ADELT transmission after landing offshore.	SA332 Super Puma	Inadvertent Deployment	Unknown	Deployed/transmit light on ADELT panel was seen to be flashing and the emergency morse ident heard through the headphones. Reset button on ADELT beacon was operated and indications of transmission stopped. Amsterdam ATC were informed of the incident but had not received an emergency signal, it was revealed later that a signal had been received by Aberdeen ATC. System inspected and reset with no fault apparent. See also 200702096 same aircraft.
M80	200702096	Inadvertent ADELT transmission prior to landing offshore.	SA332 Super Puma	Inadvertent Deployment	Unknown	Deployed/transmit light on ADELT panel was seen to be flashing and the emergency morse ident heard through the headphones. Reset button on ADELT beacon was operated and indications of transmission stopped. System inspected and reset with no fault found. See also 200701969 same aircraft, two days earlier.
M81	200708324	Following standard shutdown, the co-pilot observed smoke and flames from engine bay area when fitting the ADELT safety device. No abnormal flight deck indications.	SA332 Super Puma	Other	External Event	Some evidence of unburned fuel around the engine exhaust area. The airport fire service were notified by the line office. Upon investigation, it was observed that the engine door non slip material in the vicinity of the module 4 was showing signs of overheating and had in fact separated from the actual engine door. It was further observed that the adhesive backing of the non slip had run and dripped onto the module 4 casing and the exhaust pipe. It was suspected that it was the adhesive from this non slip material that had ignited during the engine shut down, therefore the door was stripped of the material and it was discovered not of the 'metallised' type. The non slip for the interior of the engine doors should be of the 'metallised' type, which has tolerance of the engine bay temperature. In operator stock, there was the non 'metallised' type for which use should be restricted to the exterior steps etc. They are difficult to tell apart, and a section was placed on the nr2 engine door to renew a torn one. The heat of the engine bay caused the adhesive to run and come in contact with the exhaust and module 4 casing area which led to the event. The non 'metallised' non slip material is to be removed from stock and disposed of. All non slip material will now be of the 'metallised' type to prevent further recurrence. The aircraft was subjected to extensive ground runs and engine shut downs and no repetition of the shut down incident reoccurred. CAA Closure: The hazard is adequately controlled by the actions stated above.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M82	200808505	During Captain's pre-flight walk round, the ADELT inspection panel was found open and hanging loose with all four fasteners undone.	SA332 Super Puma	Performance	Maintenance	Investigation revealed that, having completed and signed off their pre-flight inspection, the engineers realised that they had overlooked a recently introduced monthly check of the ADELT battery validity date. This date can be viewed by opening the ADELT inspection panel, which the engineer then omitted to close. Appropriate advice given by engineering management.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M83	200901483	UK Reportable Accident: A/c descended into the sea close to offshore platform. All 18 occupants rescued. A/c remained afloat but tail cone separated and sank. Subject to AAIB Field investigation.	Eurocopter EC225	Failure To Deploy	Unknown	Shortly before commencing the approach, the crew were informed that weather conditions had deteriorated, with visibility reducing to 0.5nm and cloud base to 500ft. At a range of approx 13nm, the platform was sighted and the crew agreed to descend to 500ft and conduct a visual approach using weather radar to assist with range information. A further descent was then initiated but on passing 400ft the helicopter entered a bank of fog. The a/c returned to 500ft where the gas flare and platform lights could be seen but not the helideck, which has an elevation of 166ft. At a distance of 0.75nm from the platform, the commander disengaged the autopilot hold modes to fly the helicopter manually. The crew then suspended the 'Check Height' audio warning. The helicopter commenced a turn to the left and began to descend and reduce speed. When it rolled out of the turn visibility appeared to have reduced but the crew could still see the bright glow of the gas flre. The co-pilot was visual with what he believed was the platform's helideck lighting as well as the platform lights and the commander was visual with what he believed were the platform lights but could not identify the helideck. Shortly after that the aircraft landed heavily on the surface of the sea. All the passengers and crew survived the accident with a few minor injuries and were rescued within two hours. The helicopter's tail boom detached from the main structure on impact and subsequently sank. The remainder of the fuselage continued to float but later became inverted before being recovered from the sea. The tail boom, containing the CVFDR and TAWS computer, was located on the seabed and was also recovered along with some other items of wreckage, including the left main door. During the course of the investigation it was established that the aircraft's automatically deployable Crash Position Indicator (CPI) had failed to release/transmit. In addition, the crew had failed to extend the antennae on their lifejacket Personal Locator Beacons (PLBs) or liferaft Emergency Locator Transmitters (ELTs) and that signals from these devices were suppressed by transmissions from the passenger's Wrist Watch Personal Locator Beacons (WWPLBs). Four Safety Recommendations (2009-064 to -067) are made on this subject. See AAIB Special Bulletins S3/2009 and S4/2009. CAA Closure: CAA FACTOR F9/2009, detailing the CAA responses to the four AAIB Safety Recommendations, was issued on 12 August 2009. Any further CAA action required will be progressed via the 'Annual Review of AAIB Recommendations' procedure. **Note:** This MOR relates to an accident that is still under investigation by the AAIB. To date there have been no safety recommendations related to ADELTS made as a result of this recommendation. See Appendix K for more information.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M84	200904571	Inadvertent ADELT deployment.	SA365 Dauphin	Inadvertent Deployment	Installation	The ADELT switch appeared to be in the transmit/reset position, but when the switch was moved to the off position the ADELT deployed. **Note:** The secondary classification has been set to Installation because the MOR details imply that the switch may have been incorrectly wired.
M85	200907497	ADELT beacon transmission in flight.	SA365 Dauphin	Inadvertent Deployment	Unknown	On raising collective to contain Nr during a standard 360deg autorotation from 1500ft 'ADELT D'PLYD/XMT illuminated with associated audio through headset indicating ADELT was transmitting. ATC notified.
M86	200909638	Uncommanded Crash Position Indicator (CPI) deployment as the aircraft was towed into the hangar.	Eurocopter EC225	Inadvertent Deployment	Unknown	Uncommanded Crash Position Indicator (CPI) deployment as the aircraft was towed into the hangar.
M87	200910882	Uncommanded Crash Position Indicator (CPI) deployment in flight.	SA332 Super Puma	Inadvertent Deployment	Unknown	Outbound in the cruise an audio ELT tone sounded together with flashing green 'TX/TEST' light. System successfully reset as per SOPs and flight continued without further incident. Inbound in the cruise warnings recurred and again system initially successfully reset. However fault recurred several times and eventually the red 'Beacon Gone' light illuminated and continued flashing until shut down. Post flight inspection confirmed that CPI had been deployed.
M88	200911082	ADELT support brackets cracked.	SA365 Dauphin	Other	Design	On removal of the tail cone cowling to inspect the nav light wiring, two cracks were noticed on the LH side of the rear doubler skin. On removal of the ADELT carrier from the rear fuselage, the support spacers between the carrier and the support brackets in the tail fell off. The two 'U' channels fitted in the tail to support the carrier had failed allowing the weight of the carrier to be taken by the rear doubler skin causing it to crack. CAA Closure: Due to failure of the ADELT support channels, inspection of this area is to be carried out at 500hrs from repair.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M89	200911410	Crash Position Indicator (CPI) beacon submersion switch wiring chafed.	Agusta AB139	Failure To Deploy	Installation	During landing gear leg replacement, both wires were noticed to be chafed and exposed. Reporter comments that if both wires had totally separated it would have prevented automatic deployment of CPI when in water, or moisture ingress or contact of wires could have caused deployment of beacon. **Note:** This has been classified as Failure To Deploy as the most probable end result of the chafed wiring would have been a failure to deploy
M90	201005028	CPI SIU battery housing and battery found loose.	SA332 Super Puma	Performance	Maintenance	Control unit and beacon lights were flashing slowly. Upon replacing the battery on the SIU, the battery and housing were found rattling around, as one of the bolts was loose inside. SIU battery had become loose causing the control panel to indicate 'Beacon Gone'. Fleet check for battery security initiated.
M91	201012411	During cruise, Crash Position Indicator (CPI) activated. System reset and no further activation occurred.	SA365 Dauphin	Inadvertent Deployment	Unknown	During cruise, Crash Position Indicator (CPI) activated. System reset and no further activation occurred.
M92	201101188	When ADELT switched during post landing checks emergency beacon transmissions heard over intercom. ADELT switched off for return sector. Unit removed for inspection.	SIKORSKY S76	Inadvertent Deployment	Unknown	Fault found with internal mechanism of unit. **Note:** This has been given a secondary classification of unknown as it is not possible to determine whether the fault was a production fault or a design fault.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M93	201114478	Crash position indicator (CPI) beacon self deployed in flight.	AEROSPATIALE AS332	Inadvertent Deployment	Maintenance	During flight the CPI beacon lights flashed. Both switches were in the guarded position. Engineering checks carried out on arrival. Corrosion was found on ADELT unit connector. CPI and deployment systems replaced.
M94	201115065	Uncommanded ELT activation. ADELT connector contaminated.	AEROSPATIALE SA365	Inadvertent Deployment	Maintenance	Shortly after take-off, the CPT900 ADELT began transmitting. 121.5MHz transmissions were received on the VHF radio and the 'deployed/ transmit' light was seen to be flashing. Eight attempts were made to reset the unit using the cockpit controls. It did eventually reset with no further occurrences. Subsequent investigations found moisture ingress in the ADELT unit/airframe electrical plug. Plug cleaned and refitted with satisfactory results.
M95	201115066	Uncommanded ELT activation. ADELT connector contaminated.	AEROSPATIALE SA365	Inadvertent Deployment	Maintenance	Three minutes after take-off, the ELT was heard transmitting on the VHF radio. control unit used to rest system but after 30secs it began transmitting again. Two attempts were required to reset it. A/c returned. ADELT carrier assembly removed and moisture evident on connector which was subsequently dried and refitted. Access panel sealed against further moisture ingress.
M96	201202777	CPI beacon deployed when battery selected on during pre-start checks. Blue 'Deployed' light illuminated and aural warning activated.	SIKORSKY S92 A	Inadvertent Deployment	Human Factors	ATC and engineering informed. Beacon replaced. **Note:** This has been given a secondary classification of human factors because of the reference to the battery being selected on

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M97	201204951	Serious Incident: Pilot reported a gear problem and intention to ditch in the North Sea. Reported as gearbox oil pressure warning. 14 POB, no injuries. Damage to be advised. AAIB Field investigation.	EUROCOPTER EC225	Failure To Deploy	Unknown	The crew of the helicopter carried out a controlled ditching following indications of a failure of the main gearbox (MGB) lubrication system and, subsequently, a warning indicating failure of the emergency lubrication system. All passengers and crew evacuated the helicopter into a life raft and were subsequently rescued. Two passengers sustained minor injuries. A further Special Bulletin details the progress made in identifying the failure mechanism that caused the 360deg circumferential crack, in the bevel gear vertical shaft in the helicopter's main gearbox, which was identified in the early stages of the investigation and published in AAIB Special Bulletin S2/2012. It also details progress on the investigation into the indicated failure of the main gearbox emergency lubrication system published in AAIB Special Bulletin S3/2012. Latest Special Bulletin contains information about the helicopter's main gearbox (MGB) lubrication system and the results of an investigation into the indication of a failure of the emergency lubrication system, after it was activated by the crew. It follows publication of two earlier Special Bulletins on this accident. This was the first occasion that the EC225 LP MGB emergency lubrication system had been operated in-service. One Safety Recommendation, nr 2012-034 addressed to the European Aviation Safety Agency. AAIB Special Bulletin S5/2012. A further Special Bulletin has been published containing information on the progress of the investigation into the emergency lubrication systems and the Crash Position Indicators (CPI). AAIB Special Bulletin: S2/2013, Ref: EW/C2012/05/01. **Note:** This has been given a secondary classification of unknown because the accident investigation was unable to provide a definitive reason for the failure to deploy. See Also Appendix XXXX
M98	201205512	Uncommanded deployment of the Crash Position Indicator (CPI).	AEROSPATIALE SA365	Inadvertent Deployment	Unknown	After the last flight of the day it was noticed that the CPI was missing. No cockpit indications were present. ATC conducted a search of the main runways and taxiways. ARCC were informed and confirmed that they had not, and were not, receiving any transmissions from the device. Local police informed.

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M99	201206384	Uncommanded deployment of Crash Position Indicator.	AEROSPATIALE SA365	Inadvertent Deployment	Unknown	CPI deployment light was recognised on shutting down. CPI confirmed missing. Time and position of deployment not known.
M100	201209986	Inadvertent deployment of crash position indicator (CPI).	EUROCOPTER EC135	Inadvertent Deployment	Human Factors	CPI was not in the correct setting whilst being tested and a signal was transmitted and recorded by MCC Kinloss. **Notes:** This has been given a secondary classification of human factors because of the reference to the CPI being in the incorrect setting during testing
M101	201212866	UK Reportable Accident. MAYDAY declared due to failure of main rotor gearbox emergency lubrication system. A/c ditched in sea but remained upright with flotation devices inflated. 19 POB no injuries. Subject to AAIB Field Investigation.	EUROCOPTER EC225	Failure To Deploy	Design	The crew of the helicopter carried out a controlled ditching following indications of a failure of the main gearbox (MGB) lubrication system and, subsequently, a warning indicating failure of the emergency lubrication system. All passengers and crew evacuated the helicopter and were subsequently rescued without injury. AAIB Special Bulletin S6/2012, Ref: EW/C2012/10/03. A further Special Bulletin contains information on the progress of the investigation into identifying the cause of the 360deg circumferential crack in the bevel gear vertical shaft on the subject a/c. It also compares the findings with those recorded previously on another EC225 LP accident involving a similar failure and provides a further update on the investigation into both accidents. One Safety Recommendation, nr 2012-034 addressed to the European Aviation Safety Agency. AAIB Special Bulletin S7/2012. A further Special Bulletin has been published containing information on the progress of the investigation into the emergency lubrication systems and the Crash Position Indicators (CPI). AAIB Special Bulletin AAIB Bulletin: S2/2013, Ref: EW/C2012/10/03. **Notes:** This has been given a secondary classification of design because the accident investigation identified a design issue that resulted in the system being designed not to deploy in the event of the crew manually selecting transmit. See Also Appendix XXXXX

No	MOR	MOR title	Aircraft	Primary classification	Secondary classification	MOR details
M102	201215354	ADELT transmitting inadvertently.	SIKORSKY S76 C	Inadvertent Deployment	Unknown	The fault occurred initially on power up of a/c with the flashing light in the cockpit indicating the ADELT was transmitting. A reset was performed before departure and all transmission indications ceased. However, on approach to the platform ATC informed that the ADELT was again transmitting. No cockpit indications reflected this. Reset once more on arrival and unit switched off for the return flight. Engineering assistance sought, unable to reproduce the fault but suspected intermittent operation of G-switch so this part was replaced and a/c released to service. **Notes:** This has been given a secondary classification of unknown as it is not clear whether the G-Switch was responsible for the intermittent transmissions and it is also unclear whether this was an installation, maintenance or wear problem
M103	201301229	Crash position indicator (CPI) beacon deployed in hangar.	AEROSPATIALE AS332 L2	Inadvertent Deployment	Unknown	During fault finding into a CPI defect, the beacon deployed. At the time, the a/c power was off and the CPI was selected off. **Notes:** This has been given a secondary classification of unknown because it isn't possible to determine whether the deployment was related to the fault that was being investigated, an inadvertent action on behalf of the investigator or another, unspecified cause.

APPENDIX B

Accident investigation reports

B1 – Extracts From the G-ATSC Investigation

B1.1 Aircraft Type

Wessex 60 Series 1

B1.2 Accident Information

The accident occurred in the North Sea, 35nm north east of the River Humber estuary at 13:17hrs on 8 March 1976.

B1.3 Synopsis – Extracted From AAIB Report 11/76 [Ref 3]

The accident happened with both engines stopped in rapid succession shortly after the helicopter had taken off from a gas rig platform in the North Sea. A successful ditching was carried out and all the occupants of the aircraft were able to escape unhurt and board the life raft. After some 25 minutes they were picked up by a rig support vessel.

The accident was caused by the ingestion of the engine intake cover which the pilot had omitted to remove before take-off.

B1.4 Background To AAIB Recommendation Relating To ADELT

No reference was made to ADELTs and there were no ADELT related recommendations made.

B1.5 Tail Break Information

None as a result of the accident, the aircraft was destroyed by the effects of immersion and movement on the seabed.

B1.6 Rotorcraft Inversion Information

Section 1.1 (History of flight) of the report states that:

" The port wheel flotation bag failed about one hour after the aircraft had entered the water, allowing it to roll over and float with the tail rotor clear of the surface. The aircraft sank later that evening in 90 feet of water whilst an attempt was

being made to tow it ashore. It was successfully salvaged and bought ashore 12 days later."

B1.7 CAA Response to ADELT Recommendations

No ADELT related recommendations were made.

B1.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk.uk

B2 – Extracts From the G-BBHN Investigation

B2.1 Aircraft Type

S61N

B2.2 Accident Information

The accident occurred in the North Sea, 48 nautical miles NE of Aberdeen at 14:18 hrs on 1 October 1977.

B2.3 Synopsis – Extracted From AAIB Report 8/78 [Ref 6]

The accident occurred when the helicopter made an emergency landing in very rough seas and capsized almost immediately after touchdown. The liferaft could not be deployed, however all three occupants were rescued by another helicopter after 53 minutes immersion, uninjured but suffering from the effects of exposure. The floating wreckage was salvaged three days later.

It is concluded that this accident was caused by the helicopter alighting on open water in very rough seas which were beyond the sea keeping capabilities of the aircraft, because the commander believed that a major structural failure was imminent. It is probable that a main rotor blade pocket had become partially raised and disbonded causing very severe vibration.

B2.4 Background To AAIB Recommendation Relating To ADELT

There were no ADELT related recommendations, however, it was noted in the report that none of the aircraft involved in the rescue were fitted with equipment that would have allowed them to home to either 121.5MHz or 243MHz. Finding xv "*Although personal locator beacons were available to the crew, none of the helicopters or surface vessels deployed was equipped to home on to their beacon*

transmissions, had a search operation been necessary" reflects this. As a result, even if ADELTs had been available they would have had no effect.

B2.5 Tail Break Information

The tail boom separated in upward bending at a position immediately aft of the transport joint. As this is not attributed to the salvage operation, it is assumed to have occurred during the accident.

B2.6 Rotorcraft Inversion Information

Section 1.1 of the report notes that *"At the time of the ditching the wind was assessed as being 30 to 40 knots with heavy seas and wave heights of 20 to 30 feet."*

The text continues *"The commander had considered keeping the rotors turning after touchdown but when he saw the "wall of water" ahead he realised that the rotor would not survive."*

The text further continues *"The helicopter climbed the face of the advancing wave, which was very steep, achieving a pitch angle of about 30o and on reaching the crest the bow lifted clear. According to eye witnesses in RJ the wave carried the machine backwards and it yawed about 30o to the left under the influence of wind and wave. As HN rolled to the left the slowly turning rotor blades dug in to the water and it capsized almost immediately."*

B2.7 CAA Response to ADELT Recommendations

No ADELT related recommendations were made.

B2.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk.uk

B3 – Extracts From the G-BIJF Investigation

B3.1 Aircraft Type

Bell 212

B 3.2 Accident Information

The accident occurred in the North Sea, approximately 1.3 miles south east of the Dunlin Alpha Platform at 04:35 hours on 12 August 1981.

B 3.3 Synopsis – Extracted From AAIB Report 10/82 [Ref 14]

The accident occurred during a daytime flight, planned for VMC, between the Brent Field and the Dunlin platform in the North Sea. The helicopter encountered an area of reduced visibility and continued towards the Dunlin at a height of 200 feet until a decision was made to return to the Brent Field. During the turn, control of the helicopter was lost after the aircraft pitched 20o nose up and climbed to 300 feet with zero airspeed. It began yawing rapidly to the right and descending and struck the sea in an essentially level attitude. The single fatality and 13 survivors were retrieved by another helicopter and a rig support vessel after some 44 minutes. The wreckage was salvaged by the rig support vessel the same day.

B3.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.5 of the report states that the emergency board was fitted with a BE369 floating SARBE beacon operating on 121.5MHz and 243MHz. This is not the same thing as an ADELT but it might have been useful in attracting attention except that this section of the report goes on to say that "*Neither the emergency board or any of the equipment attached to it was recovered during salvage*".

Section 2.6 of the report states that:

"*Of the two emergency radio beacons in the accident helicopter the BE369 beacon was lost thus leaving available to the survivors on the SARBE Mk5 in the lifejacket of the commander. If the commander had been incapacitated by the impact there would have been no emergency beacon to guide rescue ships and aircraft to the wreckage. A way to overcome this failing would be to require public transport helicopters of this size to be fitted with an emergency beacon which is automatically deployed on immersion in water, or by impact forces*".

The observation above led to finding ix:

"*Had the aircraft been fitted with an automatically deployed emergency beacon and if all the stand-by vessels had been fitted with the associated homing*

equipment the nearest stand-by vessel should have been able to reach the survivors within 15 minutes".

This, in turn, led to recommendation 4.3:

"Public transport helicopters be fitted with an emergency beacon which is automatically deployed on immersion in water or by impact forces."

B3.5 Tail Break Information

The tail did not become detached during this accident.

B3.6 Rotorcraft Inversion Information

Section 1.1 of the report states that:

"The aircraft hit the water hard and immediately inverted with the cockpit and cabin immediately filling with water".

B3.7 CAA Response to ADELT Recommendations – Extracted From Factor F1 1987

The Air Navigation Order, Schedule 5, has been amended to give effect to this recommendation from 1st November 1986.

B3.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk.uk

B4 – Extracts From the G-ASWI Investigation

B4.1 Aircraft Type

Westland Wessex 60

B4.2 Accident Information

The accident occurred 12 miles ENE of Bacton, Norfolk at 15:42 hrs on 13 August 1981

B4.3 Synopsis – Extracted From AAIB Report 4/83 [Ref 2]

The helicopter was flying from the Leman Bank gas field to Bacton, Norfolk, when it suffered a complete loss of power to the main rotor gearbox. In the late

stages of the ensuing autorotation the helicopter went out of control and crashed into the sea, all thirteen men on board being killed.

There was insufficient evidence to permit the cause of either the loss of power or the loss of control to be established. However, the report discusses possible causes and ten safety recommendations are made.

B4.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.4 (Safety equipment) of the report states that:

"A Burndept Model BE 369 portable electronic flotation distress beacon was mounted inside the cabin on the starboard side immediately aft of the door"

Section 1.15 (Survival aspects) of the report states that:

" The RAF search and rescue Sea King took off from Coltishall at 1547 hrs and was directed by ATC along a vector of 050oM towards the accident area. Shortly before crossing the coast the Sea King detected a crash locator beacon signal on 121.5MHz, homed on to it, and spotted wreckage when 1 1/2 miles distant. The Sea King recovered the bodies of six passengers and the cabin attendant as well as items of floating wreckage. The bodies of the Commander and four passengers were recovered during the next fortnight but that of one passenger was never found. The Sea King also recovered WI's BE369 emergency beacon which had floated away from the aircraft transmitting on 121.5 and 243 MHz."

Section 2.4.3 (Automatic survival radio beacon) of the report states that:

" In different circumstances WI's impact with the water might have been a much less violent one, survived by severely injured occupants unable to operate the survival beacons carried and in need of prompt location and transport to hospital. Fortuitously, the Burndept 369 beacon carried in the cabin cleared the wreckage, floated and transmitted a signal. The rescue Sea King was thus able to quickly locate the accident site.

This raises the question of whether offshore helicopters should be equipped with an automatic survival radio beacon. The main case for the automatic survival radio beacon in aircraft rests on increasing the chances of survivors being rescued before they deteriorate so much that they die. Such a beacon, activated by immersion or by impact forces, would give an increased probability that the electronic distress signals will be transmitted. It would be of especial value where the crew are unable to switch on the manually operated survival beacons now carried, due to injury or other reason. Passengers carried in aircraft over hostile survival environments are especially at risk, and this applies to helicopters operating around the British Isles. The use of automatically operated survival

beacons in helicopters operating offshore can also be invaluable in the location of wreckage for accident investigation, as the underwater sonar location beacon carried by helicopters still entails a surface vessel search at short range. The CAA was therefore recommended to consider requiring helicopters operating offshore to be fitted with an automatic survival radio beacon."

These comments led to recommendation 4.8 which states that:

" Public transport helicopters be fitted with a survival radio beacon which is automatically deployed on immersion in water or by impact forces."

B4.5 Tail Break Information

None – the aircraft was destroyed on impact

B4.6 Rotorcraft Inversion Information

None – the aircraft was destroyed on impact.

B4.7 CAA Response to ADELT Recommendations – Extracted From Factor F4 1984

A draft specification for automatically deployable emergency location transmitters has been prepared. Apart from flight crew activation it is envisaged that the equipment will be deployed by the action of crash sensors (frangible and/or inertia switches) and a hydraulic pressure switch. The industry is being consulted on the proposals.

B4.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk.uk

B5 – Extracts From the G-BARJ Investigation

B5.1 Aircraft Type

Bell 212

B5.2 Accident Information

The accident occurred in the Brent oil field on the 24th December 1983 at 12:00 hrs.

B5.3 Synopsis – Extracted From AAIB Report 2/84 [Ref 5]

The aircraft had been on a winching training flight in the Brent field. It had been necessary to restrict the crew to one pilot and winch operator in order to remain below the maximum single engined hover weight. The wind was less than 10 knots and there was a 4-5 metre irregular swell with the occasional larger wave.

After completing 4 practice drum lifts the aircraft obtained clearance to carry out practise winching over the deck of the HUDDERSFIELD TOWN – the Brent Charlie stand-by vessel. The winching area at the stern of the vessel was a 20 feet diameter yellow circle which was bordered around its aft edge by a fixed guard rail containing nine stanchions 3 1/2 feet high positioned 4 1/1 feet apart with three rails between each. The aircraft winch was located (as usual) in the forward starboard position and the winch operator was sitting in the forward cabin doorway with the door locked open. As the stern of the vessel was approached the winch hook was lowered with a ballast weight attached to it with a piece of flat webbing approximately one foot long. A satisfactory hover was maintained at a height of 20-30 feet for a period of 1-2 minutes with the hook over the centre of the winching area. The stern of the vessel then began to corkscrew in a larger swell and the deck rose allowing two turns of the cable to collect on the deck. The winch operator winched in and as the stern dropped in to a deep trough the cable swung aft allowing the hook to contact the guard rail which was not protected by canvas "dodgers". The ballast weight and cord wrapped around the middle guard rail and immediately pulled taut, causing the aircraft to roll to the right and pitch nose-down until the pilot had full left cyclic applied. The aircraft dived in to the sea alongside the vessel in an attitude approximately 45o down. Both the crew and a witness on the ship estimated that the elapsed time between the cable attaching to the rail and the aircraft hitting the sea was approximately 3-4 seconds.

The helicopter immediately inverted with the emergency flotation equipment partially inflated.

B5.4 Background To AAIB Recommendation Relating To ADELT

There were no ADELT related recommendations.

B5.5 Tail Break Information

The tail boom did not become detached.

B5.6 Rotorcraft Inversion Information

The aircraft was destroyed in impact with the sea.

B5.7 CAA Response to ADELT Recommendations.

No ADELT related recommendations were made.

B5.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B6 – Extracts From the G-ASNL Investigation

B6.1 Aircraft Type

Sikorsky S-61N

B6.2 Accident Information

The accident occurred in the north sea, 75 nm north east of Aberdeen at 14:43 hrs on 11th March 1983

B6.3 Synopsis – Extracted From AAIB Report 4/85 [Ref 1]

The accident occurred during a routine flight from the Piper and Claymore platforms to Aberdeen. Shortly after departure from the Claymore Platform the crew heard a loud bang, and experienced vibration from the main rotor transmission. At the same time the crew observed that the No 1 engine had run down and stopped. The crew transmitted a MAYDAY distress call and announced their intention to make a precautionary landing alighting on the water. A controlled ditching was completed without incident and the helicopter floated in a stable manner with the emergency flotation gear inflated. During deployment, both liferafts carried on board the helicopter were punctured and rendered unusable by sharp projections on the hull of the helicopter. A Royal Air Force Sea King helicopter arrived on the scene one hour after the ditching and the passengers

and crew were winched on board and flown to Aberdeen. An attempt at recovery of the helicopter by an oil company support vessel resulted in the helicopter being damaged and subsequently sinking. It was later recovered from the sea bed and examined at the Accident Investigation Branch, Farnborough.

The report concludes that the accident was caused by a failure, in fatigue, of a spur gear in the main rotor transmission gearbox which resulted in a rupture of the gearbox casing and loss of the transmission lubrication oil.

B6.4 Background To AAIB Recommendation Relating To ADELT

There were no AAIB references to ADELTs or recommendations regarding ADELTs, however, it is notable that it took an hour for a rescue helicopter to arrive and it is possible that a functioning ADELT may have reduced these times.

Although a specification for ADELTs was not available in 1983, it is notable that some aircraft were carrying "portable electronic flotation distress beacons" (see Appendix B2 – extracts from the G-ASWI investigation). This implies that the industry was already of the opinion that location devices would aid search and rescue.

By 1984, a draft specification for ADELTs had been developed. This would appear to indicate that the industry and the UK CAA agreed with the premise that reliable, automatically deployable, emergency location systems had the potential to increase the likelihood of rescue and, therefore, survival.

B6.5 Tail Break Information

The tail boom did eventually become detached from the rotorcraft but this was a result of damage inflicted during the recovery attempt and so the tail boom detachment is not relevant to this report.

B6.6 Rotorcraft Inversion Information

The rotorcraft did eventually sink, although it is not clear whether it became inverted before it sank. Either way, the rotorcraft sank as a result of damage inflicted during the recovery attempt and so sinking event is not relevant to this report.

B6.7 CAA Response to ADELT Recommendations

No ADELT related recommendations were made.

B6.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B7 – Extracts From the G-BEON Investigation

B7.1 Aircraft Type

S61N

B7.2 Accident Information

The accident occurred in the sea near St. Mary's Aerodrome, Isles of Scilly, at about 11:35 hrs on July 16 1983.

B7.3 Synopsis – Extracted From AAIB Report 8/84 [Ref 11]

G-BEON was on a scheduled service from Penzance to the Isles of Scilly, and was being operated in accordance with the Visual Flight Rules (VFR). Whilst it was on the approach to St Mary's aerodrome the helicopter gradually descended from its intended height of 250 feet without either pilot being aware of this, and flew in to the water.

Nineteen of the 23 passengers, and 1 of the 3 crew members lost their lives. St Mary's lifeboat attended the scene and picked up the 6 survivors.

B7.4 Background To AAIB Recommendation Relating To ADELT

Section 2.8.2 of the report states that:

"*Apart from flotation aspects another severe handicap incurred by the survivors in the water was that the helicopter sank together with the dual frequency BE369 beacon and the BE375 PLB's carried in the lifejackets of the three crew members. This accident again illustrates the value of equipping helicopters which operate offshore with a survival radio beacon which is automatically deployed by immersion in water or by impact forces. Recommendations to this effect were made in AAIB reports 10/82* [G-BIJF]*, 4/83* [G-ASWI] *and 2/84* [G-BDIL]".

This assertion led to recommendation 4.5:

"*Public transport helicopters be fitted with a survival radio beacon which is automatically deployed on immersion in water or by impact forces.*"

B7.5 Tail Break Information

The aircraft was destroyed as a result of the impact.

B7.6 Rotorcraft Inversion Information

The final paragraph of section 1.1 of the report states that:

"*During the impact both sponsons broke off together with the inflatable flotation gear, water entered the cockpit forcibly, and the aircraft's hull was disrupted in such a way as to cause water to burst open the two freight-bay hatches in the floor. The fuselage rolled over, filled with water, and quickly sank*".

B7.7 CAA Response to ADELT Recommendations – Extracted From Factor F3 1986

This recommendation has been accepted. All helicopters engaged on public transport flights beyond 10 Minutes flying time from land will be required to be equipped with an automatically deployable emergency locator transmitter.

This will be implemented by 1 October 1986. The transmitters will be dual frequency (121.5 and 243 MHz), and as an option may also be fitted with a radar transponder.

B7.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B8 – Extracts From the G-BDIL Investigation

B8.1 Aircraft Type

Bell 212

B8.2 Accident Information

The accident occurred in the North Sea, 030o (T) 14 miles from the Murchison platform at 0242 hrs on September 14 1982.

B8.3 Synopsis – Extracted From AAIB Report 2/84 [Ref 9]

The accident occurred during a night Search and Rescue (SAR) flight and was reported to the Accidents Investigation Branch on 14 September. The investigation commenced the same day.

The Baffin Seal seismic survey vessel, operating 5 to 10 miles north of the Murchison platform, had reported that a man had been injured in an accident on board. At approximately 0200 hrs the Brent Field helicopter unit was alerted to take a doctor and medical attendant to the Baffin Sea and, because the helideck of the vessel was obstructed, a winch was fitted to the aircraft and a full SAR crew was carried. The aircraft took off at 0225 hrs and some minutes later was seen to pass close to the Murchison platform at low level and disappear on a north easterly heading in driving rain and poor visibility. The aircraft was in radio contact with the Baffin Seal on marine VHF and had given its position as 'FIVE MILES NORTH OF THE MURCHISON PLATFORM LETTING DOWN TO SURFACE CONTACT'. Soon after this at approximately 0242 hrs contact with the helicopter was lost on all frequencies. Small items of wreckage and two bodies were recovered later that day in an area 17 to 22 miles north east of the Murchison. The bulk of the wreckage was eventually recovered from the sea bed at a depth of 1,120 feet in a position of 030o (T) 14 miles from the Murchison. All six occupants died.

B8.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.4(iv) of the report states that:

"The aircraft was carrying in the cabin a BE 369 floating SARBE beacon for operation on 121.5 MHz and 243MHz. The beacon was recovered from the sea bed with the main bulk of the wreckage".

Section 1.6.4(vi) of the report states that:

"An automatically deployable survival radio beacon was not required by United Kingdom regulations and neither was one fitted."

Although the aircraft was not equipped with an ADELT, it should be noted that section 1.15.1 of the report states that "The accident was not survivable" and so the absence of an ADELT would have had no material impact on the likelihood of victims surviving this specific accident.

Section 2.13 of the report states that:

"It is obviously an advantage if those engaged in a search can be directed at an early stage to the correct area. Quite apart from greatly aiding the rescue of potential survivors, this would make it possible to reduce the resources required, time involved and therefore the cost of the search operation. One problem is that helicopters engaged in offshore operations are frequently out of range of ATC radar coverage. If a data link system is developed whereby the aircraft's position is periodically transmitted to ATC, this could be used to provide accurate information on a missing aircraft's last known position. An alternative solution

would be to fit to helicopters an automatically deployed survival radio beacon which could be homed on by the searching forces."

The result of these comments was recommendation 4.4 which states that:

"Public transport helicopters to be fitted with a survival radio beacon which is automatically deployed on immersion in water or by impact forces".

B8.5 Tail Break Information

The aircraft was destroyed on impact with the sea.

B8.6 Rotorcraft Inversion Information

The aircraft was destroyed on impact with the sea.

B8.7 CAA Response to ADELT Recommendations – Extracted from Factor F8 1984

A draft specification for automatically deployable emergency location transmitters has been prepared. Apart from the flight crew activation it is envisaged that the equipment will be deployed by the action of crash sensors (frangible and/or inertia switches) and a hydraulic pressure switch. The industry is being consulted on the proposals.

B8.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk.uk

B9 – Extracts From the OY-HMC Investigation

B9.1 Aircraft Type

Aerospatiale AS332L Super Puma

B9.2 Accident Information

The helicopter was ditched at night 22nm east of the Dan-B Platform, in the North Sea on the 2nd of January 1984.

B9.3 Synopsis – Extracted From AIB Denmark Report HCL1/84-0-001 [Ref 25]

None available – original report in Danish.

B9.4 Background To AAIB/N Recommendation Relating To ADELT

There were no ADELT related recommendations.

B9.5 Tail Break Information

The helicopter was ditched at night in adverse weather conditions and the tail boom became separated either during or after ditching.

B9.6 Rotorcraft Inversion Information

The helicopter ditched with a high nose attitude and both the tail boom and the left hand float separated. As a result the helicopter capsized and floated, partially submerged for approximately 10 nm before it sank.

B9.7 CAA Response to ADELT Recommendations

No ADELT related recommendations were made.

B9.8 Location of the Accident Report

There is only a Danish copy of this report; the information above was provided as a courtesy by AIB Denmark. The basic information related to this accident was provided in bulletin form in the AIB Denmark annual report of 1984.

B10 – Extracts From the G-BISO Investigation

B10.1 Aircraft Type

Boeing Vertol (BV) 234 LR

B10.2 Accident Information

The accident occurred in the East Shetland Basin of the North Sea, 8 miles west north west of the Cormorant Alpha rig at 1241 hours on 2 May 1984.

B10.3 Synopsis – Extracted From AAIB Report 5/87 [Ref 15]

The aircraft was engaged on a flight from the Polycastle Rig in the Magnus Field to Aberdeen carrying a full load of 44 passengers, one cabin attendant and two flight deck crew. Shortly after establishing in the cruise at 120 knots (kt) a violent disturbance was experienced. There then followed a series of disturbances, with changes in aircraft altitude, normal acceleration('g') and rotor speed, associated with fluctuations in the No 2 flight control hydraulic boost system pressure.

After implementing the "Emergency Check List Drill, Flight Boost Hydraulic Pressure Low" and attempting to regain control of the aircraft by changes in speed and height, the crew elected to ditch, fearing all control might be lost. A successful ditching was achieved 8 miles west north west of the Cormorant Alpha Rig. With the aircraft on a north easterly heading, into wind and swell, an attempt was made to water taxi towards the North Cormorant Rig. However, when the aircraft was found to be taking on water and sinking, an evacuation of the passengers commenced. After all the passengers and the cabin attendant were clear, the engines and rotors were stopped, following which the two pilots evacuated the aircraft. Shortly afterwards the aircraft capsized. It remained floating inverted until its recovery. All crew and passengers were rescued by other helicopters or surface vessels.

B10.4 Background To AAIB Recommendation Relating To ADELT

The report contains no ADELT references and no ADELT related recommendations were made.

B10.5 Tail Break Information

The tail boom did not break during this accident.

B10.6 Rotorcraft Inversion Information

The report synopsis states that:

"*After all the passengers and the cabin attendance were clear, the engines and rotors were stopped, following which the two pilots evacuated the aircraft. Shortly afterwards the aircraft capsized*".

In addition, finding 17 of the report states that:

"*The aircraft ditched undamaged on an almost calm sea, but capsized 82 minutes after touchdown...*".

B10.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for the CAA to respond to.

B10.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B11 – Extracts From the G-AZOM Investigation

B11.1 Aircraft Type

Bolkow B105D

B11.2 Accident Information

The accident occurred 5.5 nms due east of Skegness on July 24 1984 at approximately 12:02 hours.

B11.3 Synopsis – Extracted From AAIB Report 3/85 [Ref 4]

The purpose of the 30 minute flight was to ferry two passengers from Strubby heliport, in Lincolnshire, to Bacton gas terminal in Norfolk. The weather was good and the Commander decided to conduct the flight at 1000 feet amsl, flying visually on a direct track from Strubby to Bacton. At approximately 1155hrs, with one of the passengers in the front left (P2) seat, the aircraft lifted off for Bacton. The departure was normal and the commander levelled the aircraft at 1000 feet amsl and established a cruise speed of 110 kts.

When the aircraft was about 5nm off the coast of Skegness the Commander heard a "dull bang" from the back and the yaw pedals gave a "twitch". His immediate impression was that something was wrong with the tail rotor and he decided to descend so as to be closer to the surface and also to turn right towards Skegness. At this juncture there was no apparent loss of yaw control so the Commander established the aircraft in a 70kt powered descent, turning to the right. During this descent he felt further vibrations and so decided to alight on the sea. Accordingly, he inflated the helicopter floats and called Strubby to announce he was going to ditch but did not transmit a full distress message. He also told passengers to don their lifejackets. By this time it was apparent that the yaw pedals, although still effective, were losing sensitivity. Nevertheless, the Commander flared successfully but, as power was applied in order to reduce the descent rate, all yaw control was lost and the helicopter performed 2 or 3 (360o) turns to the right, before hitting the water.

As a result of rotating in to the surface of the sea one of the four floats detached and the aircraft immediately rolled on to its right side. It stabilised for sufficient time to allow the front seat passenger to jettison his door, through which all three occupants escaped. Very shortly after that the aircraft rolled upside down.

B11.4 Background To AAIB Recommendation Relating To ADELT

There are no references to ADELTS in this report.

B11.5 Tail Break Information

The tail boom did not become detached.

B11.6 Rotorcraft Inversion Information

The helicopter did invert as a result of one of the floats becoming detached.

B11.7 CAA Response to ADELT Recommendations

There were no ADELT recommendations for the CAA to respond to.

B11.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B12 – Extracts From the G-BJJR Investigation

B12.1 Aircraft Type

Bell 212

B12.2 Accident Information

The accident occurred 50 miles NE of the Humber at 19:19 hrs on 20 November 1984.

B12.3 Synopsis – Extracted From AAIB Report 1/87 [Ref 16]

The helicopter departed from its base at North Denes near Great Yarmouth at 1757 hrs to carry out various transport tasks on several rigs in the southern North Sea. Its final task was to collect 7 passengers from the rig Cecile Provine and transport them back to Great Yarmouth. During the night approach to this rig, in reasonable weather conditions, the helicopter crashed in to the sea 200 metres north of the rig and both crew members perished. Most of the wreckage was recovered from the sea bed in two diving operations during the next few weeks.

B12.4 Background To AAIB Recommendation Relating To ADELT

The report contains no ADELT references.

B12.5 Tail Break Information

Not applicable the aircraft was destroyed by the impact with the sea.

B12.6 Rotorcraft Inversion Information

Not applicable the aircraft was destroyed by the impact with the sea and sank.

B12.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for the CAA to respond to.

B12.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B13 – Extracts From the G-BKFN Investigation

B13.1 Aircraft Type

Bell 214 ST

B13.2 Accident Information

The accident occurred 14 miles NE of Fraserburgh at 11:00 hrs on 15 May 1986.

B13.3 Synopsis – Extracted From AAIB Report 9/87 [Ref 18]

The accident occurred during a flight from Sumburgh in the Shetland Isles to Aberdeen. A partial loss of collective control resulted in the crew being unable to maintain height and the helicopter was forced to ditch 14 miles north east of Fraserburgh, Scotland. The crew and passengers were able to evacuate safely and were picked up by a fishing vessel that was in the area. The helicopter was subsequently recovered and taken to the operator's base in Aberdeen.

B13.4 Background To AAIB Recommendation Relating To ADELT

The report contains no ADELT references.

B13.5 Tail Break Information

None – The aircraft floated after a successful ditching.

B13.6 Rotorcraft Inversion Information

None – The aircraft floated after a successful ditching.

B13.7 CAA Response to ADELT Recommendations

There were no ADELT recommendations for the CAA to respond to.

B13.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B14 – Extracts From the G-BWFC Investigation

B14.1 Aircraft Type

Boeing Vertol (BV) 234 LR

B14.2 Accident Information

The accident occurred approximately 2.5 miles east of Sumburgh, Shetland Isles (Latitude: 59o 53.5' North, Longitude 001o 12' West) at approximately 11:31 hrs on November 6 1986.

B14.3 Synopsis – Extracted From AAIB Report 2/88 [Ref 20]

The accident happened when the helicopter was approaching to land at Sumburgh Airport, Shetland Isles on returning from the Brent oilfield in the East Shetland Basin. Whilst descending from a height of 1,000 feet and at a range of about 2.5 miles from the helicopter runway at Sumburgh, the helicopter suffered a catastrophic failure of the forward transmission which in turn led to de-synchronisation of the twin rotors such that the forward and aft rotor blades collided. As a result the aft pylon, complete with the aft transmission and rotor system, detached from the fuselage. The aircraft struck the sea in a tail down attitude with considerable force, broke up and sank.

B14.4 Background To AAIB Recommendation Relating To ADELT

Section 1.15.3 of the report states that:

" The aircraft was fitted with an automatically deployable emergency location transmitter (ADELT) mounted externally in the left rear side of the fuselage and incorporating a VHF/UHF emergency transmitter and an X band radar transponder. Release could be initiated by pilot selection or automatically either by frangible or water sensing switches. Impact damage to the aft part of the aircraft was particularly severe and the ADELT was found broken up and rendered inoperative."

Section 2.2 of the report states that:

"*Fortunately, the Coastguard helicopter was able to rescue them after about 10 minutes in the sea, albeit suffering from hypothermia. Has this aircraft not sighted the wreckage, the chances of rescue arriving in time could have been crucially dependent on the functioning of the ADELT, but this was destroyed by the impact. Since the accident, it has been proposed to modify ADELT installations to include an independent power supply within the fuselage mounted housing so that deployment is not jeopardised by an interruption of the aircraft's power supply. However, in this case the ADELT was located in a position which happened to take the brunt of the impact and it was not considered that any sensible redesign could ensure that the ADELT would survive such an impact.*"

These statements led to safety recommendation 4.3 which states that:

"It has been recommended that r*equirements relating to the ADELT equipment, including location, crashworthiness, protection and power supplies, be reviewed in the light of this accident.*"

B14.5 Tail Break Information

There is no specific tail break information because the rotorcraft disintegrated on impact with the water. However, section 1.12.3 of this report notes that:

"There were marks which indicated that rotor blade contact with the cockpit section had occurred, but with relatively little velocity. No other evidence was found that any rotor blades had struck the fuselage, but structural disintegration of the cabin was such that this possibility could not be dismissed."

B14.6 Rotorcraft Inversion Information

There is no rotorcraft inversion information, the rotorcraft disintegrated on impact with the water.

B14.7 CAA Response to ADELT Recommendations – Extracted From "Annual Progress Report on Responses to AAIB Safety Recommendations 1990"

"*The Authority accepts this Recommendation. The requirements relating to the ADELT equipment have been reviewed and amendments have been drafted: these will shortly be circulated for Industry comment. Action has also been taken, in conjunction with the operators and the ADELT system manufacturer, to modify the installations already in service so as to improve the ability of the system to survive an accident. This includes the repositioning, within the equipment*

housing, of the independent power source which ejects the transmitter on activation.

Status – September 1990 – Closed

Technical consultation with industry on the content of Issue 2 of CAA Specification No 16 "Automatically Deployable Emergency Locator Transmitters for Helicopters" is complete and all appropriate ADELT installations have been modified. The formal publication of the specification is proceeding."

NOTE: Issue 2 of CAA Specification was published on December 1 1991.

B14.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B15 – Extracts From the G-BEID Investigation

B15.1 Aircraft Type

Sikorsky S61N

B15.2 Accident Information

The accident occurred in the North Sea, 11nm from the Shetland Island coast at 1431 hrs on 13 July 1988.

B15.3 Synopsis – Extracted From AAIB Report 3/90

Whilst operating a passenger flight from a North Sea rig to Sumburgh, the crew heard an unusual noise which was almost immediately followed by a fire warning on No 2 engine, and shortly thereafter by a fire warning on No 1 engine. Three minutes after the initial noise a controlled ditching was carried out 11 nm from the Shetland Island coast onto an almost calm sea. By this time the cabin had filled with smoke. All twenty one occupants evacuated successfully into liferafts and were winched into a Search and Rescue helicopter. After a fierce fire had consumed much of the floating aircraft, the remains broke up and sank.

B15.4 Background To AAIB Recommendation Relating To ADELT

The following text has been extracted from Section 1.6.2.9 of the AAIB report:

"A modification was incorporated in BIH S-61N Helicopters in 1987 to provide an Automatically Deployable Emergency Location Transmitter (ADELT)...The ADELT

was mounted in an external plinth located about midway up the right/rear sidewall of the fuselage and deployed by springs when released from a mechanical latch by an electrically fired explosive cartridge. The electrical source for the cartridge was originally a dedicated 12 volt lithium battery, but this had been removed from S-61Ns and the supply taken from an aircraft essential busbar. Cartridge activation could initiated by any of three frangible switches, triggered by impact forces in a heavy touchdown situation; or by manual operation of a guarded Deploy Switch in the cockpit, with the ADELT Arm Switch in its normal in-flight 'Arm' position."

Section 1.12.7 of the AAIB report states that: *"The remains of the ADELT, which was severely fire damaged, were found in the ADELT housing. Examination showed that the deployment cartridge had not fired, but under test it operated at an electrical current that was within limts."*

Section 1.15.4 of the AAIB report states that: *"The ADELT did not deploy and the crew reported that they had not operated the Deploy Switch. The operator's Operations Manual contained a description of the ADELT, which stated that in the event of a controlled ditching a manual release of the ADELT would be carried out, but there was no reference to this in the Emergency Drills in the Operations Manual or the Emergency/Abnormal Checklist."*

Section 2.2 of the AAIB report states that *"The crew omission of ADELT manual deployment selection before leaving the aircraft was possibly related to a general climate of feeling that deployment would be automatic in case of a ditching, in line with the title of the equipment. Infact, in a gentle ditching where the frangible switches remained intact the ADELT would not automatically deploy unless the aircraft capsized or took on large quantities of water, sufficient to cover the immersion switch in the plinth, well above the cabin floor level. A major contributory factor may well also have been the lack of any mention of the ADELT in the emergency drills. Had ID's ditching circumstances been somewhat less favourable, the occupant's survival could have depended on the ADELT. It is considered unsatisfactory that, two years after its incorporation throughout the operators fleet, a simple revision of a Checklist card had not been made. The CAA, in the course of their flight standards monitoring function, had drawn the operator's attention to this omission, but the operator had failed to take action to rectify this. "*

The issues listed above led to the following finding (number 10):

"The Automatically Deployable Emergency Location Transmitter did not deploy. Manual deployment selection by the crew was not required by drills, and conditions for automatic deployment were not met until after the ADELT had been disabled by fire damage."

This led to the following Recommendation (number 4.10):

"Conduct a review of S-61N emergency procedures for crews to ensure that the procedure for deployment of the ADELT, by manual selection from the cockpit, are included in crew checklists and carried out in simulated training."

B15.5 Tail Break Information

This was an aircraft fire that did not result in a tail break.

B15.6 Rotorcraft Inversion Information

Section 1.3 of the report states that "Approximately one hour after the ditching, when the fire had destroyed most of the fuselage structure above floor level, the remnants of the aircraft capsized and floated with only the tail boom above the sea surface" Although the aircraft did eventually capsize, this would appear to be the result of the fire and is not deemed applicable to this review.

B15.7 CAA Response to ADELT Recommendation – Extracted From CAP 594 [Ref 37]

The Authority accepts this Recommendation. The operator has reviewed its emergency procedures and manual deployment of the ADELT is now included on the emergency checklist.

Simulator training procedures have been revised in respect of ADELT operation following emergency landing. These actions are being reviewed for the other S-61 operator as part of the Authority's normal monitoring function.

Action has been taken to review S61 operators' Check-lists and emergency drills, and these have been amended to include manual selection of the ADELT and these procedures are included in simulator training.

B15.8 Location of Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B16 – Extracts From the G-BDII Investigation

B16.1 Aircraft Type

S61N

B16.2 Accident Information

The accident occurred near Handa island, of the NW coast of Scotland at 20:40 hrs on 17 October 1988.

B16.3 Synopsis – Extracted From AAIB Report 3/89 [Ref 8]

The accident occurred during a Search and Rescue (SAR) mission, centred off the northwest coast of Scotland … The duty SAR crew were called out from their base at Stornoway to conduct a Search and Rescue flight for the two occupants of a small fishing boat, which had capsized somewhere in the area of Handa island. Towards the end of the search, whilst performing a hover manoeuvre, a crew member commented that the helicopter was travelling backwards very fast.

The commander's attempted recovery from this manoeuvre resulted in the aircraft striking the sea and immediately rolling over. All four crew members eventually boarded the liferaft and were later rescued by a Sea King SAR helicopter from RAF Lossiemouth which returned them to Stornoway.

B16.4 Background To AAIB Recommendation Relating To ADELT

There were no ADELT related recommendations.

B16.5 Tail Break Information

The tail boom did not separate from the helicopter.

B16.6 Rotorcraft Inversion Information

The report states that "*The helicopter immediately rolled inverted and settled into a nose-down attitude, sinking slowly.*"

B16.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for the CAA to respond to.

B16.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B17 – Extracts From the G-BDES Investigation

B17.1 Aircraft Type

Sikorsky S61N

B17.2 Accident Information

The accident occurred in the North Sea 90 nm north east of Aberdeen at 08:50 hours on 10 November 1988.

B17.3 Synopsis – Extracted From AAIB Report 1/90 [Ref 7]

The Sikorsky S61N, G-BDES, was tasked on a non scheduled public transport service from Aberdeen to three oil installations in the North Sea 100 nm north east of Aberdeen and return. The outbound and two short inter-rig sectors were completed without incident and, after refuelling, the aircraft was prepared for the return to Aberdeen.

With a crew of two and eleven passengers on board G-BDES was lifted to a low hover and the engines and controls checked before commencing the climb. Whilst established in the cruise the crew and passengers became aware of an unusual, initially slight, buzzing noise. This noise increased in volume and the commander decided to land as soon as possible and turned towards a suitably equipped platform. The noise continued to get louder associated with increasing vibration. Following loss of the main transmission oil pressure, restored by use of the Emergency Lubrication Pump, a sudden change in the level of both noise and vibration associated with rapidly fluctuating engine indications forced the commander to execute an immediate ditching. Shortly afterwards G-BDES inverted.

The crew and the passengers evacuated the aircraft and were rescued without serious injury.

B17.4 Background To AAIB Recommendation Relating To ADELT

The following text has been extracted from Section 1.17.1 of the AAIB report:

"The ADELT installation was examined at the AAIB facility at Farnborough. Most of the system wiring, the control panel, the two forward frangible switches, the saline switch and the lithium battery were not recovered and could not therefore be examined. The ADELT unit was badly disrupted; examination revealed that the pyrotechnic squib had not fired. An acceptance and firing check carried out on the squib proved it to be serviceable. The rear frangible switch was found to be serviceable but had not operated. The crew did not attempt to deploy the

ADELT using the flight deck ADELT DEPLOY switch. A Service Bulletin (CAS/CPT 600/SB-01)had been issued by the ADELT manufacturer to provide alternative deployment activation means in the event of a failure of the aircraft power supply or system wiring. This was made mandatory by CAA Airworthiness Directive 058-12-88 for compliance not later than 31 March 1989 but had not been implemented on G-BDES."

The issues listed in section 1.17.1 led to the following finding (number xvi):

"The Automatically Deployable Emergency Locator Transmitter failed to operate but it was not possible to establish a reason".

This led to the following Recommendation (number 4.5):

"The Civil Aviation Authority review the design and installation of the Automatically Deployed Emergency Locator Transmitter system on helicopters in order to ensure reliable operation."

B17.5 Tail Break Information

Section 1.12.1 of the AAIB report states that:

"At 1616 hrs a report was received from MSV Tharos that the aircraft's tail had broken off and had sunk at a position 58o27.4'N and 000o9.2'W".

There were no findings or recommendations associated with this.

B17.6 Rotorcraft Inversion Information

Section 1.1 of the AAIB report states that:

"The commander announced his intention to ditch the aircraft and the co-pilot transmitted an abbreviated MAYDAY. There was insufficient height to turn into wind. Speed was reduced to below 20 kt IAS at which point the commander felt that her was losing yaw control. The ditching was cushioned by use of collective control and the aircraft contacted the water in a slightly nose-up attitude with no bank. On impact the commander lowered the collective lever; the co-pilot shut down engines and attempted to deploy the flotation system. The ditching had occurred in a trough between two very large waves. The front of the aircraft was immediately engulfed by a wave and shortly afterwards G-BDES rolled to the right and inverted. A summary of pre-impact timing is at Appendix 1."

The predicted weather conditions were reported as:

1.7 **Meteorological information**

1.7.1 Synoptic situation

A strong to gale south-westerly airstream covered the area with frontal troughs lying north-south over western Scotland and moving east at about 25 kt.

1.7.2 Forecast weather

Surface wind: 200oC/35 kt.

The actual weather conditions were reported as:

1.7.3 Actual weather conditions

An aftercast by the Meteorological Office gave the following conditions for the ditching area:-

Surface wind: 190oC/25-30 kt with gusts to 40 kt.

The inversion of the rotorcraft led to the following finding:

"On ditching, the front of the aircraft was immediately engulfed by a wave, it rolled to the right and inverted."

This finding led to the following recommendation:

"The Civil Aviation Authority give further consideration to the problems of escape from inverted helicopters, given the likelihood of rapid capsize following ditching, when approving helicopters for offshore operations."

B17.7 CAA Response To ADELT Recommendation – Extracted From CAP 594

The CAA accepts this Recommendation. Wiring errors are known to have prevented the deployment of an ADELT of the type installed on G-BDES (Caledonian Airborne Systems CPT 600 system) in another accident involving an S61N. However, because of the disruption to the ADELT system on G-BDES it has not been possible to establish whether similar wiring errors existed.

CAA issued Airworthiness Directive 058-12-88 in December 1988 which required the modification of all CAS CPT 600 ADELT Systems, in accordance with Caledonian Airborne Systems Service Bulletin CAS/CPT 600/SB-01 by 31 March 1989. The modifications included replacement of the deployment battery with a

different type, relocation of the deployment battery and submersion actuator, and changes to the control panel and airframe wiring.

CAA also issued a Letter to Owners/Operators No. 914 dated 10 February 1989 which recommended that the ADELT activation circuit wiring should also be checked during the embodiment of CAA AD -58-12-88 and periodically thereafter. A number of other detail changes, including the clarification in the CPT 600 Maintenance Manual of accept/reject criteria for airframe vibration induced wear in the deployment mechanism, have since been introduced to improve the reliability of the ADELT system.

B17.8 Location of Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B18 – Extracts From the G-BGKJ Investigation

B18.1 Aircraft Type

Bolkow 105D

B18.2 Accident Information

The accident occurred near Scatsta Aerodrome, Shetland Isles at 1432 hrs on April 25.

B18.3 Synopsis – Extracted From AAIB Report 9/89 [Ref 13]

The helicopter departed at about 1345 hrs and carried out an oil pollution reconnaissance flight to the northwest. At 1415 hrs the commander called Scatsta Tower and was passed the weather, which was surface wind 030o/15 kt, visibility 5000 metres in rain, cloud base 1000 feet and temperature 3o. As there appeared to be extensive low cloud between his position, north of Esha Ness lighthouse and his base at Sella Ness he elected to carry out an NDB approach to runway 24 at Scatsta, intending to break right for the helicopter pad, which was about half a mile to the northeast of the runway threshold. At 1422 hrs the controller advised that it had started to snow and decided to monitor the approach on radar.

Shortly after 1422 hrs and just prior to entering cloud at 2500 feet, 7nm on a bearing of 300o from the "SS" NDB, the commander carried out the initial approach checks and switched on the engine anti-ice system. He noted an

increase in the turbine outlet temperature on both engines. On entering the cloud he encountered sleet which appeared to turn to water as it made contact with the windscreen. A visual check of the airframe showed no signs of ice accretion and the outside air temperature (OAT) gauge was reported to have read 1oC. Although he could not see the OAT gauge, the observer's report of the inflight conditions was similar to that of the commander. At 1425 hrs the controller advised that the heaviest weather returns, on the radar, were on the 24 approach at 2.5 to 3 nm. The aircraft passed the beacon at 1426 hrs, descended to 2000 feet, carried out a righthand positioning turn and overflew the beacon at 1429 hrs to commence the outbound leg. Once established outbound it descended to 1700 feet. The commander noted that the inflight conditions were the same as previously reported. After 1 minute 40 seconds he turned right and established on the inbound track of 243o.

At 1431 hrs the controller advised that the range from touchdown was 5.5 nm. Shortly after this transmission, the commander heard a dull thud and the aircraft yawed to the left. He noticed the number one engine N2 decrease, heard the associated audio warning and saw the central panel RPM warning light. As N2 passed 60% the aircraft again yawed to the left and the number two engine N2 decreased. The collective lever was lowered immediately. The call "Mayday, Mayday, Mayday. Golf Kilo Juliet double engine failure" was recorded at 1431:47.3hrs.

Autorotation was established at 75 kt, and the aircraft was turned on to a heading of 020o, the last known surface wind direction. The commanded glanced away from his instruments, momentarily, to select the float inflation switch. When he did not hear the floats inflate he looked down and saw that he had inadvertently selected fuel jettison. Both guarded switches were on the same centre panel, separated only by the windscreen wiper switch. Leaving the fuel jettison selected, he then successfully inflated the floats. At 150 feet the surface of the sea was visible but there was no forward vision. The flare was started at 50 feet on the radar altimeter, and the landing was cushioned by the use of collective pitch. Although the landing did not feel heavy, the commander noted that there was some forward speed and the right front and both rear float bags became partially detached. Shortly after 1432 hrs the commander informed Scatsta Air Traffic Control that they were on the water and were vacating the aircraft. He then carried out shutdown checks, deselected the fuel jettison, and initiated the evacuation. The aircraft had taken up a marked list to the rear right.

B18.4 Background To AAIB Recommendation Relating To ADELT

The accident synopsis notes that "the ADELT beacon had been automatically activated".

B18.5 Tail Break Information

The tail boom did not become detached from the rest of the aircraft but the synopsis states that:

"...the rear of the main fuselage had buckled around the tail boom attachment in a way that indicated that the boom had been strained downwards."

B18.6 Rotorcraft Inversion Information

The aircraft did not become inverted as a result of the accident.

B18.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for CAA to respond to.

B18.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B19 – Extracts From the G-BEWL Investigation

B19.1 Aircraft Type

S61N

B19.2 Accident Information

The accident occurred at Brent Spar, East Shetland Basin at 0944 hrs on 25 July 1990.

B19.3 Synopsis – Extracted From AAIB Report 2/91 [Ref 12]

The accident occurred whilst the helicopter was manoeuvring to land on the Brent Spar, a permanently moored semi-submersible offshore storage and tanker loading unit. After the helicopter had approached to a hovering position adjacent to the helideck, several witnesses realised that it was positioned dangerously close to a part of the installation's crane structure. The tail rotor blade tips contacted a handrail surrounding the anemometer mast which was attached to the crane 'A' frame after which the helicopter crashed onto the helideck and almost immediately fell over the side of the deck and into the sea. Seven survivors were rescued from the sea having made their escape from the sinking helicopter. Six occupants including the crew perished.

B19.4 Background To AAIB Recommendation Relating To ADELT

Section 2.7 of the report states that:

" The ADELT beacon appears to have deployed normally under the initiation of the saline switch, however, given the circumstances of the accident, in which the ditched helicopter was located immediately, the ADELT had little or no part to play in the SAR phase. When the beacon was examined by the manufacturer it was found to operate correctly, both in respect of the radio homing signals and in response to radar interrogation. Battery power was found to be lower than expected and this would have affected the radio signal strength. The radar response was at full strength, due to lower voltage requirements. Examination of the battery revealed no defect and it was unclear why its capacity was low. At the time of the accident, the battery had consumed some 70% of its service life and, depending on the frequency and duration of in service checks, may have been approaching replacement. Also, even when not activated, storage in the vertical or near vertical position would cause some current drain due to latching of the attitude sensing circuitry. This may have been the case before installation or in the period following recovery."

Although the ADELT was operational, it is worth taking note of the issues related to storage which may have led to transmissions of limited time – see the main report. This fact led to conclusion number xiv which stated that:

" The ADELT beacon, if it had been required by rescue agencies, was unlikely to have provided assistance for any length of time or over any great distance due to its depleted internal batteries."

Although potential degradation of ADELT performance was specifically mentioned, no recommendations were made related to ADELTs. Despite this, Recommendation Systematic 03, related to maintenance and storage of ADELTs and ADELT batteries, should be considered.

B19.5 Tail Break Information

The helicopter was destroyed as a result of the accident.

B19.6 Rotorcraft Inversion Information

The helicopter was destroyed as a result of the accident.

B19.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for the CAA to respond to.

B19.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B20 – Extracts From the G-TIGH Investigation

B20.1 Aircraft Type

AS 332L Super Puma

B20.2 Accident Information

The accident occurred in the northern North Sea, approximately 500m east of the Cormorant 'A' Oil Production Platform in the East Shetland Basin at 19:50 hours on 14 March 1992.

B20.3 Synopsis – Extracted From AAIB Report 2/93

The accident occurred at night during a shuttle of personnel from an oil production platform to a nearby accommodation 'Flotel'. The crew had been similarly engaged with other shuttle tasks since leaving Sumburgh nearly four hours earlier. Weather conditions were severe with winds gusting up to 55 kts, snow showers and very rough seas. However, the helicopter was being operated within its specified wind limits. Having embarked 15 passengers, the helicopter lifted from the platform helideck, transitioned forwards and almost immediately began a right turn towards the 'Flotel'. Climbing to a height of 250 feet and whilst turning downwind, the handling pilot, who was also the aircraft commander, reduced power and raised the nose of the helicopter such that the airspeed reduced to zero and a rate of descent built up. Once he was aware of the descent, which was also advised by his co-pilot and the Automatic Voice Alerting Device (AVAD), he applied full power but the descent could not be arrested before the helicopter struck the sea. Down draughts and incipient Vortex Ring state may have exacerbated the situation.

The helicopter rolled on to its right side before inverting and sinking within a minute or two. All but five of the occupants managed to escape from the helicopter before it sank. Of the twelve survivors in the sea, only six were recovered alive; the others perished in the hostile sea environment, some of them having survived for a considerable time. The rescue operation, using ships and helicopters, began almost at once but was severely hampered by the conditions. The wreckage of the helicopter and its Combined Voice and Flight Data Recorder (CVFDR) were recovered some 30 hours later.

B20.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.1.4 of the report states that:

" The ADELT system fitted on GH consisted of the beacon itself, a launching spring, a pyrotechnic squib and a lithium battery, all in a carrier mounted on the left-hand side of the rear fuselage. The launching system could be initiated by any one of three signals; a cockpit switch, a saline switch in the carrier or any one of three frangible 'crash' switches mounted in the airframe, close to the skin."

Section 1.12.7 of the report states that:

" The ADELT beacon had been successfully deployed in the accident. The pyrotechnic deployment squib in the fuselage-mounted ADELT carrier had fired, the aircraft ADELT wiring was intact and the saline switch was functional. The glass bowls of the two forward 'frangible' switches were intact, despite deformation around the right-hand switch but the rear 'frangible' switch had been fractured in the impact by displacement of the aircraft skin. Thus it appeared the rear 'frangible' switch had initiated the deployment of the beacon and that, if this had not occurred, the saline switch would have done so shortly afterwards.

Examination of the ELT beacon itself showed the unit to be fully serviceable and, when activated, still to give a satisfactory signal".

B20.5 Tail Break Information

Section 1.12.2 of the report states that:

" The damage to the helicopter's tail boom indicates that it also failed structurally at impact, pivoting forward and to the right."

B20.6 Rotorcraft Inversion Information

The report synopsis states that:

" The helicopter rolled on to its right side before inverting and sinking within a minute or two".

B20.7 CAA Response to ADELT Recommendations.

There were not ADELT related recommendations for CAA to respond to.

B20.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B21 – Extracts From the G-TIGK Investigation

B21.1 Aircraft Type

Aerospatiale AS332L Super Puma (Tiger).

B21.2 Accident Information

The accident occurred in the North Sea, 6nm south-west of the Brae Alpha Oil Production Platform at about 12:40 hours on 19 January 1995.

B21.3 Synopsis – Extracted From AAIB Report 2/97 [Ref 23]

The helicopter was conducting a charter flight, ferrying 16 maintenance engineers from Aberdeen to the Brae oilfield. Having just passed a position 120 nm on the 062o radial from the Aberdeen VHF omnirange (VOR) radio beacon, and whilst beginning its descent from 3,000 feet above mean sea level (amsl), the helicopter was struck by lightning. This resulted in severe vibration which, a few minutes later, developed into a loss of tail rotor control, necessitating an immediate ditching in heavy seas. The ditching was executed successfully and the helicopter remained upright enabling the passengers and crew to board a heliraft, from which they were subsequently rescued. There were no injuries sustained and the passengers and crew were later returned to Aberdeen by helicopter and ship.

B21.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.6.2 of the report states:

"*The ADELT system fitted to G-TIGK consisted of the beacon, a launching spring, a pyrotechnic 'squib' and a lithium battery; all were in a carrier mounted externally on the left-hand side of the rear fuselage (Appendix B, Figure 4). The launching system could be initiated by any one of three signals from: a cockpit switch, a saline switch in the carrier, or from any one of three frangible 'crash switches' mounted in the airframe, close to the skin. Although the ADELT eventually radiated successfully, it is not known whether it deployed on ditching, during the subsequent period of floating, or from the sea bed.*"

Section 1.18.10 of the report states:

"*Two external plats which acted as load spreaders for pairs of bolts securing an internal bracket (which supported the shroud mounted ADELT unit) were curled up at their edges*" and

"*A number of avionic units appeared to have been damaged, or rendered inoperative, by the strike. These included one starter-generator and/or the generator control unit, the automatic direction finding (ADF) loop aerial and*

receiver, the P1 station box, the anti –collision beacon power supply unit, a further power supply unit, the ADELT unit and elements of its deployment system, together with the FDR acquisition unit. It appeared that high voltage currents had passed through a large number of avionic units and although the remained generally operative, their future life may have been greatly reduced.

The ADELT unit was mounted at the extreme rear of the aircraft with its antenna pointing aft. The latter component had completely disappeared. This suggested that the discharge had travelled between the outboard trailing edge of the damaged main rotor and the ADELT antenna".

Although the report text identifies a lack of certainty regarding when the ADELT started to transmit there were no ADELT related safety recommendations. This may be because of the potential system damage identified by subsequent sections of the report. Although there were no ADELT related recommendations, it should be noted that the location of the ADELT and its antenna are identified as a possible cause of damage to the ADELT. This is another example of an ADELT system becoming damaged as a result of the location of its various parts.

B21.5 Tail Break Information

The tail boom did not become detached.

B21.6 Rotorcraft Inversion Information

The helicopter did not invert as a result of the accident, but it did sink as a result of the flotation bags being punctured during the salvage activities. This has not been counted as a helicopter inversion for the purposes of this paper because the inversion was not a direct result of the accident.

B21.7 CAA Response to ADELT Recommendations.

There were no ADELT related Recommendations for the CAA to respond to.

B21.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B22 – Extracts From the G-HAUG Investigation

B22.1 Aircraft Type

Sikorsky S-76B

B22.2 Accident Information

The accident occurred in the Carlingford Mountains, approximately 2 miles SE of Omeath at 18:16hrs on 12 December 1996.

B22.3 Synopsis – Extracted From AAIU Report 01/98 [Ref 21]

G-HAUG departed Belfast International – Aldergrove Airport on 12 December at 18:03 hrs to return to its home base at Ballyedmond, Co. Down, Northern Ireland. This would normally be a flight of some 20 minutes duration. The approach to the home base was executed using a locally produced GPS based approach procedure. Having commenced its descent, in preparation for landing at Ballyendmond, the helicopter struck the north face of the Carlingford Mountains at 960 feet above sea level, approximately 2 miles SE of the village of Omeath, Co. Louth, at 18:16 hrs. All three occupants suffered fatal injuries.

The investigation found that the circumstances of the accident were consistent with controlled flight into terrain.

B22.4 Background To AAIB Recommendation Relating To ADELT

The following text has been extracted from Section 1.6.9 of the AAIU report:

"The ADELT system is a distress beacon that can be either manually or automatically ejected from the aircraft. Automatic ejection is accomplished by impact sensitive switches mounted in the aircraft. The ADELT fitted to G-HAUG was a Series CPT-600 manufactured by Caledonian Airborne Systems. This item of equipment was fitted as an option on G-HAUG; there was no regulatory requirement to fit this item to the aircraft.

When ejected, the beacon is only automatically activated when it is immersed in water. The buoyant beacon then transmits on 121.50 MHz and 243 MHz, which are international distress frequencies. The beacon is also equipped with a transponder, which transmits an encoded signal between 9.3 and 9.5 GHz.

On G-HAUG, the ADELT beacon was housed in a special fairing underneath the tail boom, and was configured to be ejected rearward on receipt of a signal from the crew or from the crash switches"

Section 1.6.12 of the AAIU report notes that the aircraft was serviced on 22 October and that *"A 3-month inspection of the ADELT was carried out, the ADELT beacon was tested and its battery was replaced."*

Section 1.15.3 of the AAIU report states that: *"G-HAUG was equipped with an ADELT Emergency Location Transmitter as described in para 1.6.9. This unit did not eject from the aircraft in the accident. The aerial of the beacon had become*

detached from the beacon during the impact. After the accident, the beacon assembly was returned to the UK for testing and was found to function correctly."

Section 2.19.1 of the AAIU report states that: *"It is probable that the ADELT was not armed, and for this reason did not deploy. However even if it had been armed and had deployed, it would not have transmitted, as the beacon must be immersed in water to activate the beacon battery. If the accident had been survivable, and ELT beacon which could have functioned without immersion in water may have facilitated the location of the aircraft. Some countries required ELT beacons to function in such on-land situations."*

The issues listed in section 1.17.1above led to the following finding (number 3.1.26):

"In the case of this accident, because of the severity of the impact, the non-functioning of the ADELT had no effect on the survivability of those on board. However it did fail in its function to assist the SAR teams in their efforts to locate the accident site. If the impact had been less severe, the fact that the ADELT would not have functioned as it was not immersed in water, could have adversely affected the prospects for survival of those on board".

This led to the following Recommendation (number 4.9):

"The UK CAA should consider amending the certification specification for ADELTs to ensure that these devices are capable of functioning following overland accidents."

B22.5 Tail Break Information

None – this was a CFIT related accident in which the whole aircraft was destroyed.

B22.6 Rotorcraft Inversion Information

None – this was a CFIT accident.

B22.7 CAA Response to ADELT Recommendations – Extracted From Response to Irish AAIU

When the provision of ADELTs is required by the UK operating rules, they must be approved to the requirements of EUROCAE Minimum Operating Performance Specification ED62, which superceded CAA Specification 16. Both these specifications already require that ADELTS are activated automatically by the deployment means when the automatic deployment occurs, whether on land or water. The Authority therefore considers that the existing specifications already satisfy this Recommendation.

B22.8 Location of the Accident Report

This accident report can be found on the website of the Air Accident Investigation Unit, Ireland website using the following link:

www.aaiu.ie

B23 – Extracts From the LN-OPG Investigation

B23.1 Aircraft Type

Aerospatiale AS332L Super Puma

B23.2 Accident Information

The accident occurred in the Nowegian Sea, approximately 100 nm west of Bronnoysund on 8 September 1997 at approximately 06:56 hours

B23.3 Synopsis – Extracted From AAIB/N Report 47/2001 [Ref 24]

On 8 September 1997 at 0600 hours, the helicopter took off from Bronnoysund Airport on course for the oil production vessel "Norne". On board were a crew of two pilots and 10 passengers. The flight proceeded as normal on a standard IFR flight plan at an altitude of 2,000 ft until 0650 hours when the crew observed a short illumination of the overspeed (OVSP) light. The crew had no reason to assume that this was a serious warning signal. The helicopter approached the Norne, and the crew made contact with the Transocean Prospect oil rig, which was operating the radio station for the area. Communications with the Bodo Air Traffic Control Centre (ATCC) were then terminated. A short time after this, the crew observed what they assumed to be further abnormal indicators in the cockpit. The ongoing fault in the axle between the right motor adn the mean gearbox now became critical. This led to the R/H and the L/H power turbines burst (were torn apart). This meant that vital flight control rods were cut and the helicopter went completely out of control. Everyone onboard was killed when the helicopter hit the surface of the sea.

B23.4 Background To AAIB/N Recommendation Relating To ADELT

Section 1.9.6 of the report states that:

"The aircraft was equipped with an externally mounted Emergency Locator Transmitter of the ADELT type. No signal from this transmitter was ever received."

Sections 1.15.1.3 and 1.15.1.4 of the report state:

"The helicopter had an Emergency Locator Transmitter of the Automatical Deployable Emergency Locator Transmitter (ADELT) type, model CPT 600. This was mounted the L/H sponson on the helicopter and could be actuated either manually or automatically. On actuation, it is released by a spring so that it is discharged upward and backward. During the impact with the surface of the sea, the Emergency Location Transmitter was so damaged that it neither was ejected not did it begin to transmit.

On the basis of experience from the British sector of the North Sea, HS advised against type approval and use of this Emergency Locator Transmitter when the type came on to the Norwegian market. However, the type was approved and installed into helicopters belonging to AS Morefly. On its takeover of this fleet of helicopters, HS also became a user of the type."

Section 2.14.3 of the report states that:

" The Emergency Locator Transmitter that was installed in LN-OPG did not contribute to locating the helicopter wreckage. This was due to it being destroyed when the helicopter hit the surface of the sea. In the opinon of the AAIB/N, the Emergency Locator Transmitter in question is vulnerable to loadings in conjunction with accidents and is positioned in a confined area that means even minor damage might prevent it from releasing. An assessment should therefore be made as to whether it is suitable for its purpose.

Section 3.1.6.c of the report states that:

" The helicopter's Emergency Locator Transmitter (type ADELT) was smashed in the impact with the surface of the sea and consequently did not transmit any emergency signals. The Emergency Locator Transmitter was therefore of no assistance in warning of the accident or determining the site of the accident."

These statements led to the following recommendation (number 42/2001) to *the Norwegian Civil Aviation Authority (Luftfartstilsynet)*

" In collaboration with the Norwegian Post and Telecommunications Authority [Post-og Teletilsynet], the Norwegian Civil Aviation Authority [Luftfartstilsynet] should assess whether Emergency Locator Transmitters of the ADELT type, model CPT 600, should be approved for use in Norwegian aircraft. (Recommendation nr. 42/2001)

B23.5 Tail Break Information

Section 1.12.2.1 of the report states that:

" The helicopters tail was raised as the first section."

Section 1.12.2.4 of the report states that:

"The helicopter's tail, including the tail rotor, had separated at main frame 9000, but were found right next to the cabin. The tail boom was bent to the right in middle...".

B23.6 Rotorcraft Inversion Information

Section 2.2.11 of the report states that:

"In the opinion of the AAIB/N, the helicopter fell almost vertically after breaking up in the air. The impact with the surface of the sea caused such great damage to the helicopter that it sank after a very short time. This may explain why all the parts were found within a relatively limited area on the seabed.

B23.7 CAA Response to ADELT Recommendations

No ADELT related recommendations were made to the UK CAA.

B23.8 Location of the Accident Report

This accident report can be found on the Air Accident Investigation Branch Norway website using the following link:

www.aaib.no

B24 – Extracts From the G-BJVX Investigation

B24.1 Aircraft Type

Sikorsky S76A (Modified)

B24.2 Accident Information

The accident occurred approximately 0.8nm north west of the Leman 49/26 Foxtrot platform in the Leman Offshore Gas Field of the North Sea at approximately 18:44 hrs on 16 July 2002.

B24.3 Synopsis – Extracted From AAIBSupplemental Report S3/2002 [Ref 17]

On the evening of the accident the aircraft departed Norwich to complete a scheduled flight consisting of six sectors in the southern North Sea offshore gas fields. The first four sectors were completed without incident but whilst en-route between the Clipper, an offshore platform, and the Global Santa Fe Monarch, a drilling rig, the aircraft suffered a catastrophic structural failure. The helicopter's

main rotor assembly separated almost immediately and the fuselage fell to the surface about 0.8nm north-west of the Global Santa Fe Monarch which at the time was attached to the Leman 49/26 Foxtrot platform, a normally unmanned installation. Witnesses reported hearing a single or double muffled bang or boom, and seeing the aircraft fall in to the sea. The fuselage disintegrated on impact and the majority of the structure sank. Fast rescue craft launched from Putford Achilles, a multipurpose standby vessel, arrived at the scene of the accident within a few minutes. There were no survivors amongst the nine passengers and two crew.

B24.4 Background To AAIB Recommendation Relating To ADELT

Section 1.6.13 of the report states that:

" The ADELT beacon fitted to G-BJVX was mounted in a carrier located externally at the lower rear section of the tail boom. The ADELT could be deployed by any one of three methods: a cockpit switch; a saline switch in the carrier; and by either of two frangible 'crash switches' mounted in the airframe. The radio transmitter beacon was a conical shaped sealed self-buoyant unit with an antenna system mounted in the upper portion.

The current requirements for an ADELT are specified in EUROCAE document ED-62 dated May 1990. This document supersedes MPS 1/WG4/65,, "Minimum Performance for Radio Survival Beacons functioning on VHF" dated July 1965. In respect of current requirements for crash shock resistance, an ADELT should survive a 500g impulse lasting 4 +/- 1 milliseconds and a 100g impulse lasting 23 +/- 2 milliseconds. Regarding impact shock developed by contact with a hard surface (eg rock, concrete, steel) the ADELT must survive an impact velocity of 25 metres/sec (80 feet/sec) under laboratory conditions. Calculations indicated that the speed of water impact was in the order of 140kt (72 metres/sec or 236 feet/sec) with the fuselage in a 37o dive."

Section 1.12.3.3 states that:

" When recovered the ADELT (Automatically Deployed Emergency Location Transmitter) beacon did not appear to have deployed when the helicopter struck the sea surface. It was recovered from the main wreckage site together with its carrier into which it appeared to be loosely fitted. The beacon launcher had been torn away from its mounting position at the lower rear part of the tailboom. The beacon deployment springs mounted within the launcher unit were extended. The electrically initiated explosive squib was not recovered. The radio transmitter beacon had been severely damaged during the impact rendering it unserviceable electrically and non-buoyant.

The launcher unit and the beacon were physically examined and there were no obvious defects that would have prevented deployment of the beacon.

The mechanical firing mechanism was dismantled and no fault was found with any of the mechanical parts. The lithium battery was tested and found to be well below its minimum charge which was consistent with its submersion in water for a period of time. The electric charge within the battery indicated that there had not been a defect and that it had not suffered a short circuit. The battery was found to be well within its service calendar life.

The examination of the launcher mechanism, which did not include the explosive squib, concluded that there was no evidence of a pre-impact defect or failure that would have prevented deployment of the beacon.

The launcher and the aircraft mounting bracket were taken to an explosives laboratory for chemical analysis. The results of this analysis detected traces of the explosive used in the electrically initiated squib, which indicated that the squib had fired."

Section 2.18.1 of the report states:

" The ADELT beacon, a variant of the more generic ELT (Emergency Locater Transmitter) did not perform its intended functions of automatically marking the crash position of the helicopter and transmitting on international distress frequencies. When found, it was on the sea bed still loosely within its carrier. The launcher squib had fired but the spring ejection mechanism was completely overpowered by the speed and force of the impact. Calculations indicated that the speed of water impact was in the order of 140kt with the fuselage in a 37o dive.

The beacon itself and its ejector mechanism were probably serviceable before water impact but the equipment specification was probably exceeded by the unforeseen brutality of the water impact."

These statements led to finding number 35:

" The ADELT beacon and its ejector mechanism were probably serviceable before water impact but the equipment's specification was probably exceeded at water impact."

There were no safety recommendations related to the ADELT, presumably because the cause of its failure to deploy was likely to have been the fact that its survival specifications were exceeded by the force of the impact.

B24.5 Tail Break Information

None, the aircraft was destroyed on impact.

B24.6 Rotorcraft Inversion Information

None, the aircraft was destroyed on impact.

B24.7 CAA Response to ADELT Recommendations

There were no ADELT related recommendations for the CAA to respond to.

B24.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B25 – Extracts From the G-JSAR Investigation

B25.1 Aircraft Type

Eurocopter AS332L2 "Super Puma"

B25.2 Accident Information

The helicopter was forced to make an emergency landing in the North Sea, approximately 10 nm North West of Den-Helder at 11:28pm on the 21st November 2006.

B25.3 Synopsis – Extracted From Dutch Safety Board Report "Emergency landing Bristow AS332L2 search and rescue helicopter". [Ref 26]

On the evening of Tuesday 21 November 2006 at 11.28 p.m. a helicopter of the Eurocopter AS332L2 "Super Puma" type, registration number G-JSAR, was forced to make an emergency landing in the North Sea, approximately ten nautical miles to the north-west of Den Helder. The four crew members and thirteen passengers were rescued from the sea after approximately 1 hour and carried to Den Helder using different means of transportation. One passenger was admitted to hospital with mild hypothermia symptoms but discharged after a few hours; the remaining occupants were uninjured.

The passengers came from production platform K15B belonging to the Nederlandse Aardolie Maatschappij (NAM). Because of a prolonged power outage

("black out") – which had started at 08.00 p.m. that day – they had transferred to the drilling platform adjacent to the K15B, the Noble George Sauvageau (hereinafter referred to as the Noble George). After the power outage on the K15B the work on the Noble George had been halted for some time, but was resumed when it became clear that no fire had broken out on the K15B – all the safety provisions on the Noble George were functioning properly. It was decided to take anyone not needed to work on fixing the power outage to the mainland, for which the Search and Rescue (SAR) helicopter G-JSAR was deployed. On the return flight the crew reported fluctuations in the engine revolutions, and there were also problems with the steering, following which the crew decided to make an emergency landing. The Coast Guard organised and coordinated the successful rescue operation.

B25.4 Background To AAIB Recommendation Relating To ADELT

Section 1.15 of the report states that:

"The G-JSAR is equipped with an Automatically Deployable Emergency Locator Transmitter (ADELT). After the helicopter ditched, the ADELT deployed automatically and started transmitting."

Section 2.2.5 of the report states that:

"...the emergency locator transmitter (ADELT) deployed automatically and started transmitting."

Section 7.6 states that:

"The 'responder radar' element of the ADELT beacon on the G-JSAR assisted the rescue ship(s) in locating the area of the ditched aircraft due to returns from this transponder on their radar screens."

The ADELT performed as expected and, as a result, no ADELT related recommendations were made.

B25.5 Tail Break Information

The tail boom did not become detached.

B25.6 Rotorcraft Inversion Information

The helicopter did not invert.

B25.7 CAA Response to ADELT Recommendations.

There were no ADELT related Recommendations for the CAA to respond to.

B25.8 Location of the Accident Report

This accident report can be found on the Dutch Safety Board website using the following link:

www.safetyboard.nl

B26 – Extracts From the G-BLUN Investigation

B26.1 Aircraft Type

Aerospatiale SA365N, Dauphin 2

B26.2 Accident Information

The accident occurred in the Irish Sea, approximately 0.25nm south of the North Morecambe platform (located within the Morcambe Bay gas field) at approximately 18:33 hours on 27 December 2006.

B26.3 Synopsis – Extracted From AAIB Special Bulletin S1/2007 [Ref 19]

The helicopter departed Blackpool at 1800 hrs on a scheduled flight consisting of eight sectors within the Morecambe Bay gas field. The first two sectors were completed without incident but, when preparing to land on the North Morecambe platform, in the dark, the helicopter flew past the platform and struck the surface of the sea. The fuselage disintegrated on impact and the majority of the structure sank. Two fast response craft from a multipurpose standby vessel, which was on position close to the platform, arrived at the scene of the accident 16 minutes later. There were no survivors amongst the five passengers or two crew.

B26.4 Background To AAIB Recommendation Relating To ADELT

Section 1.15.1 of the report states that "*At 1834 hrs, the North Morecambe Platform 'Man Overboard' alarm was activated and reports of a helicopter ditching were received on a marine radio channel. The Highland Sprite, stationed approximately one mile to the southwest of the platform, launched two FRCs towards the reported area. The Liverpool Coastguard Maritime Rescue Co-ordination Centre (MRCC) initiated full Search and Rescue (SAR) action in liaison with the Aeronautical Rescue Co-ordination Centre (ARCC) at RAF Kinloss, initially deploying two rescue helicopters and two allweather lifeboats. The MRCC incident log records that the transmission from the Automatically Deployable Emergency Locator Transmitter (ADELT) was first detected, by satellite, at 1835 hrs. This signal, which included a doppler derived position of the beacon, was*

updated 30 minutes later when the satellite next passed overhead and at routine intervals thereafter."

As the ADELT functioned as intended in this accident, the AAIB made no recommendations related to ADELTS.

B26.5 Tail Break Information

Section 1.12.1 of the report states that "*The first items of wreckage to be recovered were found floating on the surface by the two FRCs launched from the Highland Sprite, stationed approximately one mile to the south-west of the platform. Much of the floating debris included engine and transmission cowlings, fuselage panels, passenger seats and an inflated life raft. The most significant item recovered at this stage was the tailboom, complete with the fenestron tail rotor and gearbox. The condition of this wreckage suggested that the helicopter had impacted the sea at high speed, and that the remainder would be scattered on the sea bed. This wreckage was recovered to shore on the morning of 29 December 2006.*"

"*As noted in paragraph 1.12.1, the fenestron tail rotor and its gearbox were still attached to the tailboom and empennage structure, which had been recovered floating on the surface by rescue vessels on the night of the accident. A long section of the tail rotor centre driveshaft had pulled out of its sliding spline connection with the rear shaft (which was still in-situ) and was later recovered from the sea bed. The forward end had failed in bending at the same location where the tailboom had fractured. The remaining section of the centre driveshaft was found still connected to the forward shaft, which had also broken into two pieces in bending. Both flexible couplings in the system were intact.*"

The rotorcraft was destroyed on impact during this incident so there were no recommendations related to the failure of the tail boom.

B26.6 Rotorcraft Inversion Information

The rotorcraft was destroyed on impact so it did not have chance to invert.

B26.7 CAA Response to ADELT Recommendations

There were no ADELT recommendations for the CAA to respond to.

B26.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B27 – Extracts From the G-REDU Investigation

B27.1 Aircraft Type

Eurocopter EC225 LP Super Puma

B27.2 Accident Information

The accident occurred approximately 300m southwest of the ETAP Central Production Facility Platform helideck in the North Sea at 18:37hrs on 18 February 2009.

B27.3 Synopsis – Extracted From AAIB Report 1/2011 [Ref 27]

"The helicopter departed Aberdeen Airport at 1742hrs on a scheduled flight to the Eastern Trough Area Project (ETAP). The flight consisted of three sectors, with the first landing being made, at night, on the ETAP Central Production Facility Platform. Weather conditions at the platform deteriorated after the aircraft left Aberdeen; the visibility and cloud base were estimated as being 0.5 nm and 500ft respectively. At 1835 hrs the flight crew made a visual approach to the platform during which the helicopter descended and impacted the surface of the sea. The helicopter remained upright, supported by its flotation equipment which had inflated automatically. All those on board were able to evacuate the helicopter in to its liferafts and they were successfully rescue by air and maritime Search and Rescue (SAR) assets."

B27.4 Background To AAIB Recommendation Relating To ADELT

Section 1.15.4.1 of the report states that:

"The helicopter was equipped with an externally mounted, deployable crashposition indicator (CPI). The CPI was mounted on a panel forming the lower left side of the aft extension of the baggage hold at the rear of the main cabin. Deployment could be achieved as a result of any one of the following three actions:

1. *Operation of a g-switch registering more than 6g acceleration in any direction.*
2. *Manual operation by a crew member from the flight deck.*
3. *Automatic operation by immersion in water of a water switch, positioned just above cabin floor level behind the cabin trim and slightly aft of the left main cabin door aperture.*

Regardless of the deployment method, automatic transmission commences once it has separated from the helicopter. The release system uses a very small

explosive charge and a light spring to project the CPI away from the helicopter. The CPI subsequently floats and transmits on 406.0 MHz as well as on 121.5 and 243.0 MHz.

The CPI may be switched to a transmit function by the crew whilst the helicopter is in flight."

Section 2.5.9 states that:

" The circumstances of this accident, ie the combination of forward speed and rate of descent, with associated nose-up attitude, resulted in both linear vertical and nose-down angular pitching accelerations at impact. These, in combination, created sufficient bending moment at the tail-boom attachment to cause downward structural failure. This, in turn, led to downward displacement of the rotating tail-rotor drive shaft. Entanglement with wiring looms and consequent damage to those incorporating part of the CPI release system, then occurred.

The resulting nose-down attitude of the floating aircraft, following the separation of the tail-boom, appears to have resulted in the water switch remaining above the waterline following automatic deployment of the flotation equipment.

The reason for the failure of the CPI to deploy on G-REDU was not fully determined. It was, however, judged to have been influenced by one or more of the following factors:

1. *The crew release was not utilised – the crew did not report using it and the release switch was found positioned and gated in the normal flight setting after salvage.*
2. *The relatively low linear acceleration imparted to the 'G' switch in any direction during the impact, resulting in the switch failing to trigger.*
3. *The low position of the CPI unit mounting, both in relation to the floating waterline and to the initial point of impact of the fuselage with the water, resulting in water immersion of that unit and associated wiring."*

This extract from the report supports the conclusions indicated by other data regarding the potential effect of tail boom separation and sensor selection and location to compromise the functionality of an ADELT.

These observations resulted in the following recommendation:

"Safety Recommendation 2011-071

It is recommended that the European Aviation Safety Agency reviews the location and design of the components and installation features of Automatically Deployable Emergency Locator

Transmitters and Crash Position Indicator units, when required to be fitted to offshore helicopters, to ensure the reliability of operation of such units during and after water impacts."

B27.5 Tail Break Information

Section 2.5.9 states that:

" The circumstances of this accident, ie the combination of forward speed and rate of descent, with associated nose-up attitude, resulted in both linear vertical and nose-down angular pitching accelerations at impact. These, in combination, created sufficient bending moment at the tail-boom attachment to cause downward structural failure. This, in turn, led to downward displacement of the rotating tail-rotor drive shaft. Entanglement with wiring looms and consequent damage to those incorporating part of the CPI release system, then occurred."

This clearly demonstrates that damage to the tailboom and/or tail rotor drive shaft can damage the release system of an ADELT.

B27.6 Rotorcraft Inversion Information

The report synopsis states that:

" The helicopter remained upright, supported by its flotation equipment which had inflated automatically."

B27.7 CAA Response to ADELT Recommendations

The recommendations from this report were aimed at EASA rather than CAA and so the CAA had no recommendations to respond to.

B27.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B28 – Extracts From the G-REDL Investigation

B28.1 Aircraft Type

Eurocopter AS332L2 Super Puma

B28.2 Accident Information

The accident occurred in the sea approximately 11nm north-east of Peterhead Scotland at 12:55hrs on 1 April 2009.

B28.3 Synopsis – Extracted From AAIB Special Bulletin 5/2009 [Ref 28]

" Recorded radar information showed the helicopter flying inbound towards Aberdeen at 2,000 ft and then turning right and descending rapidly. Surface visibility was good and an eye witness, working on a supply vessel approximately 2 nm from the accident site, heard a helicopter and saw it descend rapidly before it hit the surface of the sea. Immediately after impact he saw the four main rotor blades, still connected at their hub, strike the water."

B28.4 Background To AAIB Recommendation Relating To ADELT

There were no references to the ADELT in the AAIB Special Bulletins for G-REDL.

B28.5 Tail Break Information

None available –the aircraft was destroyed on impact.

B28.6 Rotorcraft Inversion Information

None available –the aircraft was destroyed on impact.

B28.7 CAA Response to ADELT Recommendations

No ADELT related recommendations had been made related to G-REDL at the time when this report was published.

B28.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B29 – Extracts From the G-REDW Investigation

B29.1 Aircraft Type

EC225 LP Super Puma

B29.2 Accident Information

The accident occurred 20nm east of Aberdeen at 11:14hrs on 10 May 2012.

B29.3 Synopsis – Extracted From AAIB Special Bulletin S3/2013 [Ref 29]

" The helicopter was on a scheduled flight from Aberdeen Airport to the Maersk Resilient platform, in the North Sea, 150 nm east of Aberdeen. On board were two flight crew and twelve passengers. The helicopter was in the cruise at 3,000 ft with the autopilot engaged and at an approximate speed of 143 KIAS. Thirtyfour nm east of Aberdeen Airport, the crew were presented with indications of low pressure in both the main gearbox (MGB) main and standby oil lubrication systems. This was followed by a chip indication on the Vehicle Monitoring System (VMS), and the MGB oil temperature starting to increase.

The commander assumed control of the helicopter, reduced speed towards 80 KIAS, turned back towards the coast and initiated a descent. The crew activated the emergency lubrication system and during the descent the mgbemlub1 caption illuminated on the Central Warning Panel (CWP), for which the associated procedure is to land immediately. The commander briefed the passengers and carried out a controlled ditching. The total flight time was 27 minutes."

B29.4 Background To AAIB Recommendation Relating To ADELT Extracted From AAIB Special Bulletin S2/2013 [Ref 30]

Note – the Special Bulletin referenced here applies to both G-REDW and G-CHCN. Unless specifically stated, any quotations from the report apply to both aircraft.

The description of the ADELT system states that:

" Both helicopters were equipped with an externallymounted, deployable Type 15-503 crash position indicator (CPI). On G-REDW, the CPI was mounted on the lower left side of baggage hold at the rear of the main cabin. On G-CHCN the CPI was mounted on the left side of the tail boom, just aft of the main cabin.

The CPI system consists of the CPI beacon, a beacon release unit, a system interface unit, a cockpit control panel, a water activated switch and an aircraft identification unit (Figure 3). These components are located in various positions around the helicopter, and are connected by wiring which is integrated with the rest of the helicopter's wiring looms, and is therefore not specifically protected against water ingress. The electrical connectors in the CPI system however conform to an industry standard specification1 which ensures good performance when submerged in water at shallow depths.

Deployment of the CPI is achieved by any one of the following:

1. *A g-switch detecting an acceleration of more than 6 g in any direction*
2. *Manual operation of the DEPLOY switch on the cockpit control panel*
3. *Immersion of the water activated switch"*

the cockpit control panel. Once selected to TRANSMIT, the CPI will not automatically deploy either by means of the g-switch or the water activated switch, unless a system reset, by pressing the TEST/RESET button on the cockpit control panel, has first been performed. The helicopter manufacturer was unaware of this feature of the CPI operation and as such no relevant information was included in the EC225 LP Flight Manual. Nor was this information included in the Type 15-503 CPI Operating Manual published by the CPI manufacturer."

The text related specifically to G-REDW states that:

" The CPI on G-REDW did not deploy and remained attached to the helicopter. Photographic evidence shows that the water level in the cabin whilst the helicopter was floating was above the level at which the water activated switch was mounted. The crew did not activate the CPI beacon, either by selecting TRANSMIT or DEPLOY on the cockpit control panel, prior to the emergency evacuation. As such, no distress signal was detected from the helicopter during the accident."

The discussion section of the report makes the following statement with relation to G-REDW:

" The CPI on G-REDW did not release automatically; photographs show the water level in the cabin was above the level of the water activated switch. Whilst further work is required to support any final conclusions, issues relating to the continuity of the helicopter wiring when submerged, the design of the water activated switch and the location of the water activated switch relative to the water level following the ditching are being investigated as possible causes for the non-deployment of the CPI".

No final conclusions in to the causes for the non-deployment of the G-REDW ADELT were reached during the time that this investigation was being performed, however, the current investigation in to wiring continuity and location of switches would indicate that the recommendations contained in this report regarding maintenance instructions and sensor selection and location have the potential to improve the reliability of ADELT systems.

B29.5 Tail Break Information

None – the tailboom is not reported as becoming detached.

B29.6 Rotorcraft Inversion Information

The synopsis of special bulletin S3/2012 states that:

" The helicopter remained upright, supported by the emergency flotation gear".

B29.7 CAA Response to ADELT Recommendations

No ADELT recommendations have been made at this point, however, any recommendations that are made will be made to EASA and so there will be no CAA response to reference.

B29.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk

B30 – Extracts From the G-CHCN Investigation

B30.1 Aircraft Type

EC225 LP Super Puma

B30.2 Accident Information

The accident occurred in the North Sea approximately 32nm south-west of Sumburgh, Shetland Islands at approximately 14:25hrs on 22 October 2012.

B30.3 Synopsis – Extracted From AAIB Special Bulletin S7/2013 [Ref 31]

" The helicopter was on a planned flight from Aberdeen International Airport to the West Phoenix drilling rig, approximately 226 nm to the north.

The crew reported that, whilst in the cruise at about 140 kt and 3,000 ft amsl with approximately 81% total torque applied, the XMSN (transmission) caption illuminated on the Central Warning Panel (CWP). They added that the CHIP, M.P (main pressure), and the S/B.P (standby oil pump pressure) captions on the Vehicle Management System (VMS) also illuminated and the main gearbox oil pressure indicated zero. The MGB.P (main gear box oil pressure) caption then illuminated on the CWP. The crew actioned the 'Total Loss of MGB (Main Gear

Box) Oil Pressure' checklist, which required the activation of the MGB emergency lubrication system (EMLUB). However, within a minute the MGB EMLUB caption illuminated on the CWP indicating that the emergency lubrication system had failed. The crew carried out the 'Emergency Landing – Power ON' checklist and successfully ditched the helicopter in the sea, close to a ship. There were no reported injuries."

B30.4 Background To AAIB Recommendation Relating To ADELT Extracted From AAIB Special Bulletin S2/2013 [Ref 30]

Note – the Special Bulletin referenced here applies to both G-REDW and G-CHCN. Unless specifically stated, any quotations from the report apply to both aircraft.

The description of the ADELT system states that:

" Both helicopters were equipped with an externallymounted, deployable Type 15-503 crash position indicator (CPI). On G-REDW, the CPI was mounted on the lower left side of baggage hold at the rear of the main cabin. On G-CHCN the CPI was mounted on the left side of the tail boom, just aft of the main cabin.

The CPI system consists of the CPI beacon, a beacon release unit, a system interface unit, a cockpit control panel, a water activated switch and an aircraft identification unit (Figure 3). These components are located in various positions around the helicopter, and are connected by wiring which is integrated with the rest of the helicopter's wiring looms, and is therefore not specifically protected against water ingress. The electrical connectors in the CPI system however conform to an industry standard specification1 which ensures good performance when submerged in water at shallow depths.

Deployment of the CPI is achieved by any one of the following:

1. *A g-switch detecting an acceleration of more than 6 g in any direction*
2. *Manual operation of the DEPLOY switch on the cockpit control panel*
3. *Immersion of the water activated switch"*

A further part of this report states that:

" The CPI may be manually switched to a TRANSMIT function (without deployment) by the crew, via the cockpit control panel. Once selected to TRANSMIT, the CPI will not automatically deploy either by means of the g-switch or the water activated switch, unless a system reset, by pressing the TEST/RESET button on the cockpit control panel, has first been performed. The helicopter manufacturer was unaware of this feature of the CPI operation and as such no

relevant information was included in the EC225 LP Flight Manual. Nor was this information included in the Type 15-503 CPI Operating Manual published by the CPI manufacturer."

The text related specifically to G-CHCN states that:

" The CPI on G-CHCN was manually selected to TRANSMIT by the flight crew during the final preparations for the ditching. At 1424 hrs a 'Detect-only' alert was received by the Aeronautical Rescue Coordination Centre (ARCC) at Kinloss, from a GEO satellite signal. This alert did not provide any positional information, but did contain the 15-digit hexadecimal code unique to G-CHCN. At 1432 hrs an unresolved position alert was then received, and at 1453 hrs a further LEO satellite alert was received, which confirmed the position of G-CHCN. The CPI beacon remained attached to the helicopter and continued to transmit until it was recovered to land. Photographic evidence and water damage within the cabin indicated that the water level was above that of the water activated switch, while the helicopter was floating."

Testing of the various system components of the ADELT system installed on G-CHCN concluded that there were *" no defects with these components that would have prevented the automatic deployment of the CPI beacon, had a manual TRANSMIT not been selected."*

This conclusion demonstrates that there are still human factors issues associated with ADELT design which have yet to be resolved and that clearer and more complete instructions for use of the ADELT system could have prevented the non-deployment of the ADELT system on CHCN.

The report notes that subsequent to the G-REDU incident, the manufacturer modified the design of their ADELT system such that it would deploy automatically, whether or not TRANSMIT had been selected.

B30.5 Tail Break Information

None – the tailboom is not reported as becoming detached.

B30.6 Rotorcraft Inversion Information

None – the aircraft is not reported as becoming inverted.

B30.7 CAA Response to ADELT Recommendations

No ADELT recommendations have been made at this point, however, any recommendations that are made will be made to EASA and so there will be no CAA response to reference.

B30.8 Location of the Accident Report

This accident report can be found on the United Kingdom Air Accident Investigation Branch website using the following link:

www.aaib.gov.uk