

Dive Report

K Class Submarine



Firth of Forth
June 2007



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September 2007

Index

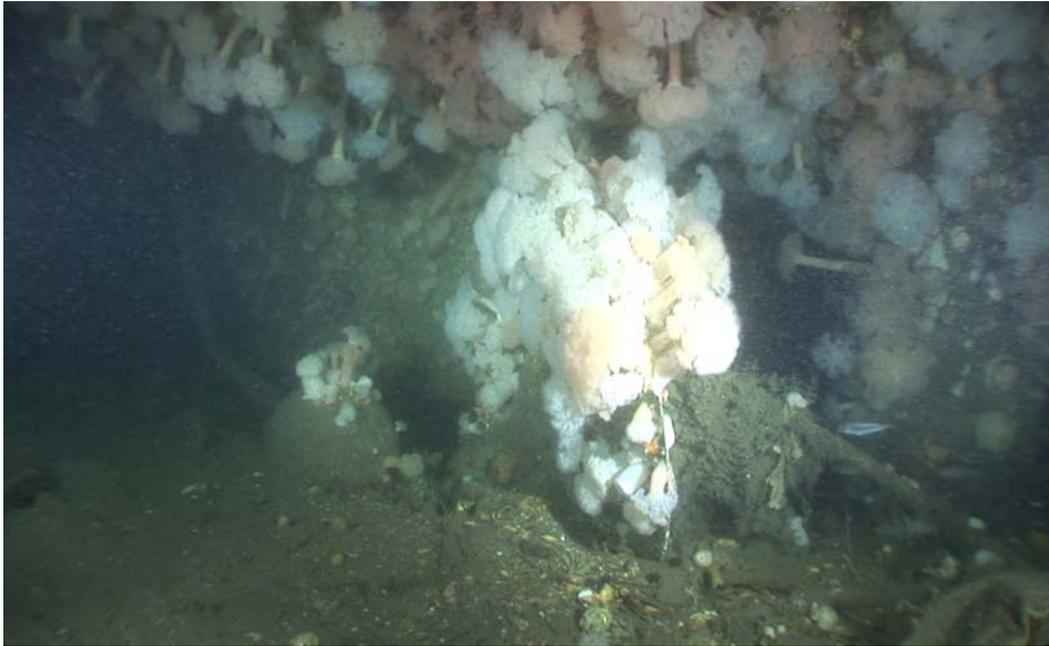
1. Introduction.....	Page 3
2. Stern section.....	Page 5
3. Aft End of Engine room.....	Page 7
4. Deck Gun.....	Page 10
5. Funnel Hatches.....	Page 11
6. Control Room.....	Page 13
7. Deck House and Conning Tower.....	Page 15
8. Forward Hull Section.....	Page 20
9. Conclusions.....	Page 23
10. Further Work.....	Page 26

1. Introduction

- 1.1. A diving expedition was undertaken in the Firth of Forth in the period June 6th to June 10th 2007. The aim of the expedition was to dive and film the wrecks of HMS K4 and HMS K17. Permission to undertake this was not strictly necessary but was sought anyway and granted by the MOD in October 2003. Two expedition attempts were made in 2004 and 2005 but these proved fruitless due to strong wind conditions. The wrecks were designated by the MOD in November 2006 under the Protection of Military Remains Act 1986.
- 1.2. A nine metre RIB with inboard diesel engine was taken to Anstruther by road and berthed in the harbour for the week. There were 5 divers who were all members of Scarborough Sub-Aqua club that dived the site, these were Andrew Jackson, Colin Bell, Malcolm Jenkinson, Tim Lamplough and Andrew Oliver. Three other club members joined the expedition but they restricted themselves to diving in less than 40m and undertook a supporting role, these were David, Jill and Richard Pennock.
- 1.3. Assistance in organising this expedition was given by Don Lees NDC SSAC who put us in touch with Philip Robertson of Historic Scotland, he also advised on tides and locations etc. We are also indebted to Nelson McEachan of the Naval Hydrographic Office in Taunton for his help with wreck positions and backup sites in the Firth of Forth.
- 1.4. The sites are in approximately 54m of water and sixteen miles from Anstruther. We dived on open circuit with 20/20 Trimix to ensure that everyone maintained a clear head. All filming was undertaken by Andrew Jackson using an Amphibico housing and Sony FX1 HD video camera aided by HID lights working at daylight colour temperature. Approximately 45 minutes of footage was taken of one of the sites over 4 dives. This is high definition footage 1080i shot in widescreen which at this time has to be downgraded in quality due to the data handling problems currently experienced with HD footage.
- 1.5. Weather conditions were mostly settled with high pressure and misty conditions, winds peaked at force 4 NE on the Wednesday causing challenging conditions, however no attempts to reach the sites had to be cancelled. Visibility underwater was disappointing, at May Island the water was clear and free of sediment and was in the order of 20 metres. Out on the wreck site visibility was down to 10 metres with significant sediment and loss of sunlight causing backscatter with the video lights. This was minimised as far as possible by having two lights approximately four feet apart placed either side of the camera lens. The vast quantities of Anemones on the site suggest conditions are often poor.

1.6. It was decided to focus all our effort on one wreck site, the position of this site using WGS84 datum is 56°15.512N 02°11.538W, this position was acquired whilst being tied onto the wreck with a rope pulled as tight as possible at slack water. The following report details the significant parts of the wreck that were filmed and presents the facts along with supporting video stills. Hopefully this will help clarify some of the previously conflicting information gathered by divers. Video evidence is much more reliable than diver reports that may have been distorted by nitrogen narcosis. Lastly I have concluded with my personal interpretation of the facts.

2. Stern Section



2.1. The view above is of the Starboard propeller with the forward section of the hull to the right. The propeller appears to be pitched the wrong way. Only one blade is visible and the thin vertical line just right of photo centre is the edge of the propeller. Above this the blade is obscured by anemones. The propeller is buried to a point just above the shaft which gives a good indication of silt level at this point on the wreck. The port propeller was not visited.



2.2. The view above shows the overhang of the stern and gives a good impression of how the wreck is sitting on the seabed with the starboard side lowest and the deck leaning over to starboard at approximately 20 degrees. The seabed can be seen to be rising up locally around the lower aft end of the wreck around the rudder position which is obscured.

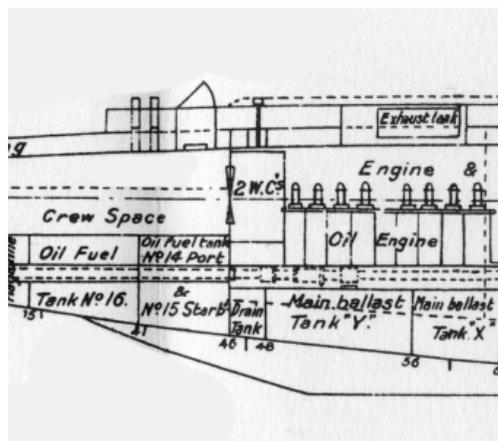


2.3. The view above is of the starboard aft hydroplane which is shown in a level position. The hydroplane is clear of the seabed.

3. Aft End of Engine Room.



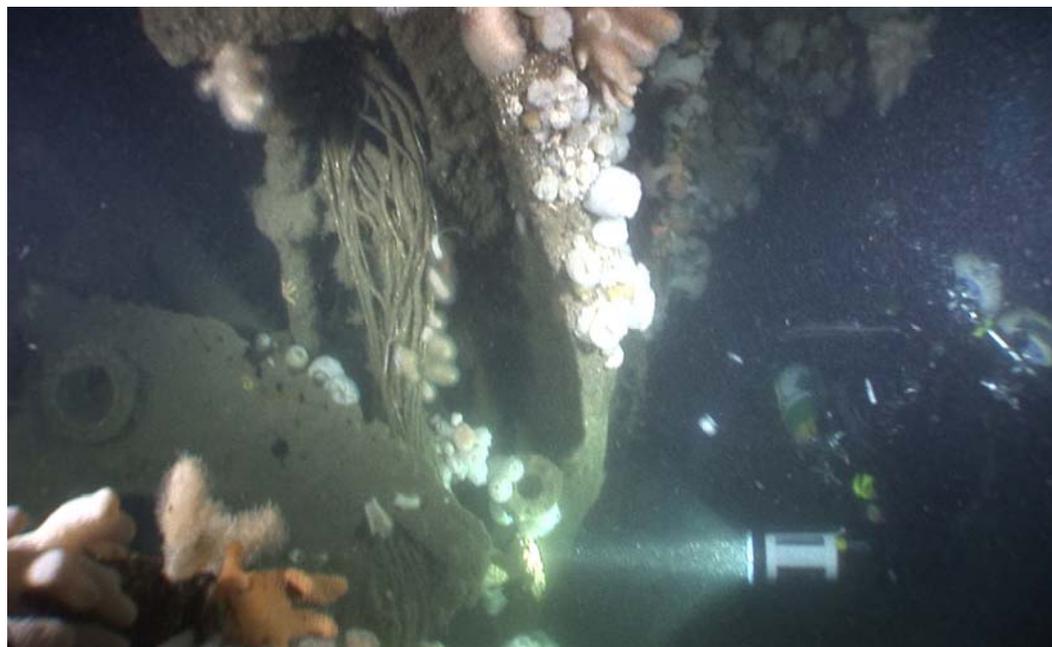
3.1. There is a split in the pressure hull and double skin above at a point on the starboard side just forward of the aft hydroplane. The location of this can be precisely given by reference to the machinery that can be seen within. Above you can see the aft end of the oil engine along with its pressure gauges. Also in the bottom left hand corner it is possible to make out one of the ships toilet. It was reported by other team members that a second toilet was positioned next to this one.



3.2. From the sectional elevation drawing it is possible to see that there are two toilets adjacent to the aft end of the Oil Engine.



- 3.3. The still above shows the split in the hull viewed from above the deck. The closed hatch is the aft escape hatch which was positioned along the centre line of the hull. This indicates that the “V” shaped split extends to a point well beyond the centre of the hull. The split comes in from the starboard side (i.e. bottom right of picture)

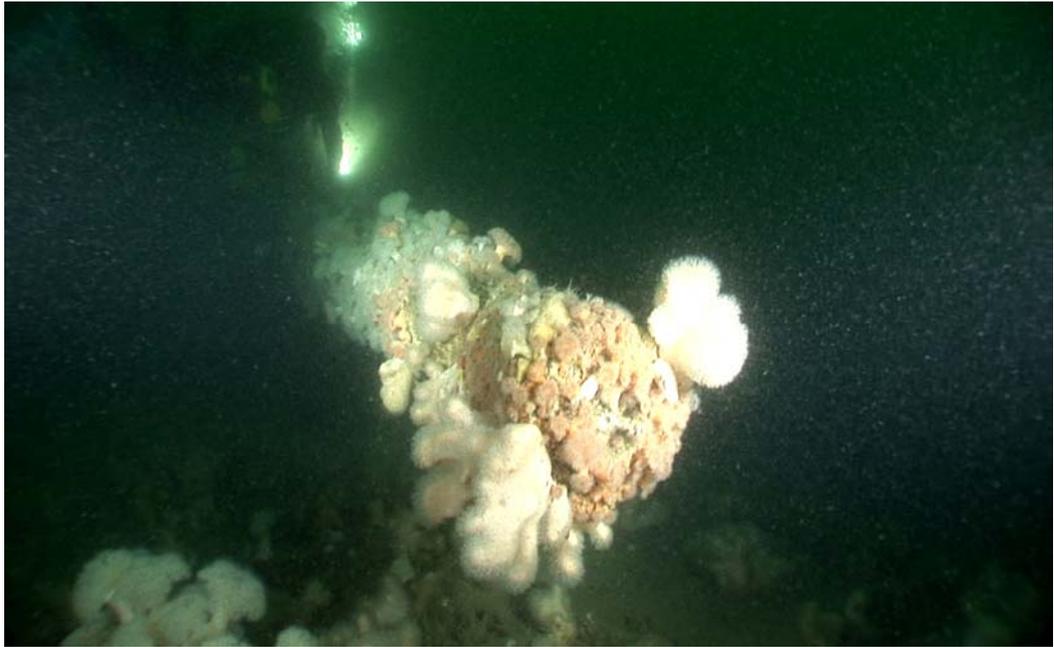


- 3.4. The still above shows the starboard side of the hull at the position of the split. The split is widest at deck level and tapers down to a point below.



- 3.5. The view above shows the lowest point of the hull and the “V” shaped split. The split extends to a point almost level with bottom of the pressure hull. The hull at this point is clear of the seabed.

4. Deck gun

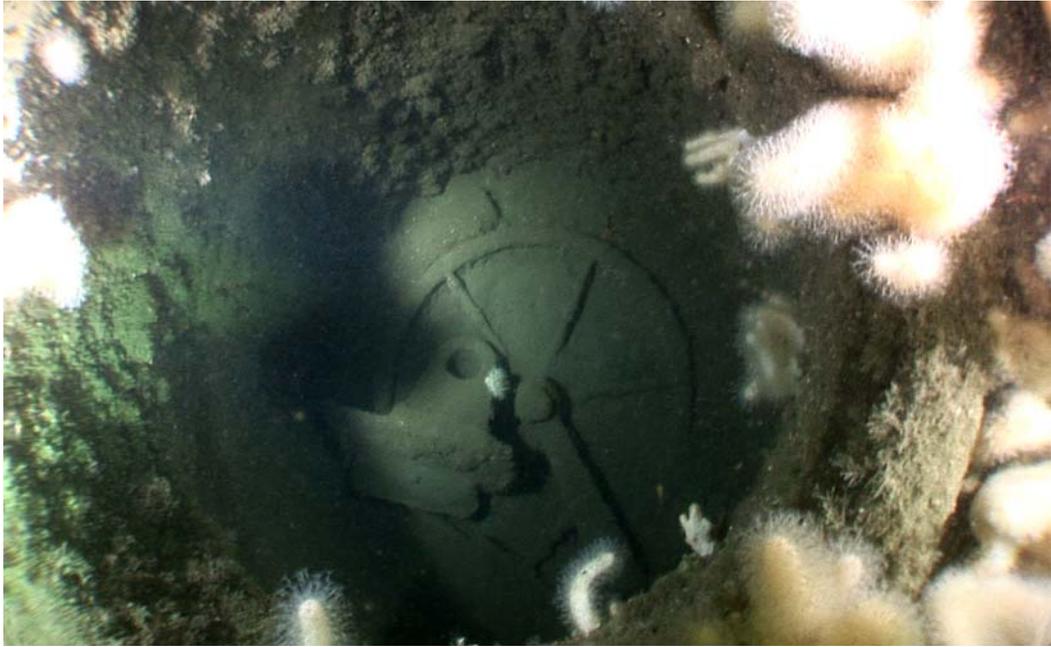


4.1. The deck gun is sat with its barrel parallel to the deck and in line with the centre line of the hull. The gun barrel is pointing forwards and has an end cap in the barrel.



4.2. The breech end of the gun is completely obscured by anemones and it is very difficult to make out any detail.

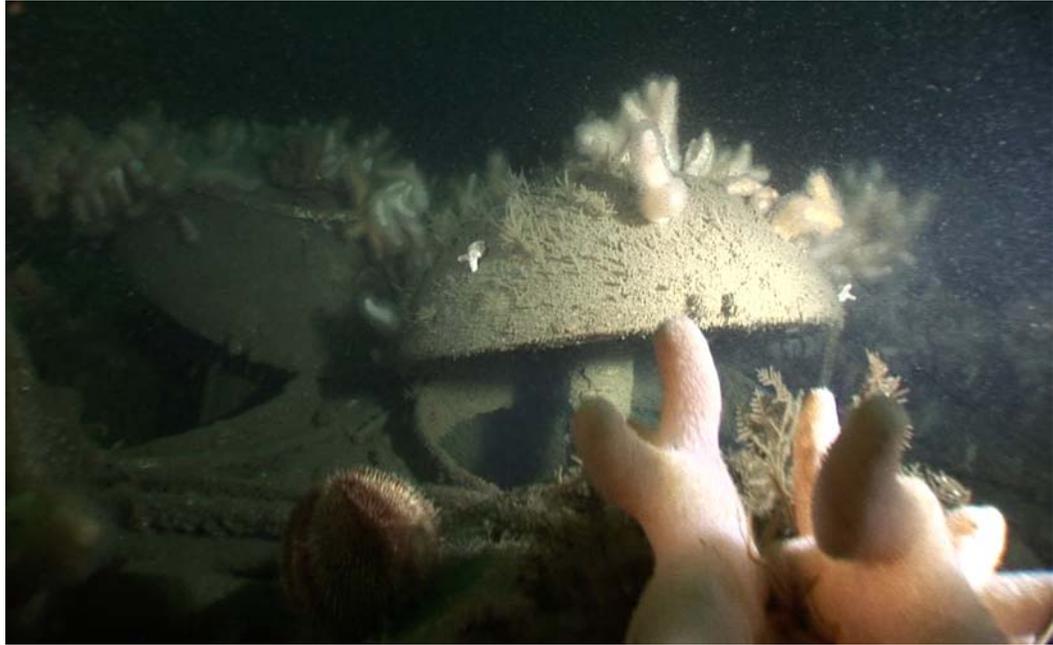
5. Funnel Hatches



- 5.1. The image above is of the inside of the aft funnel casing. The outer hatch is fully open and laid back hinged on the forward edge of the opening. The bottom right hand corner of the photo is the forward side of the casing. The hatch seen at the bottom of the casing is thought to be an inner hatch and a piece of debris has fallen in on top of it.



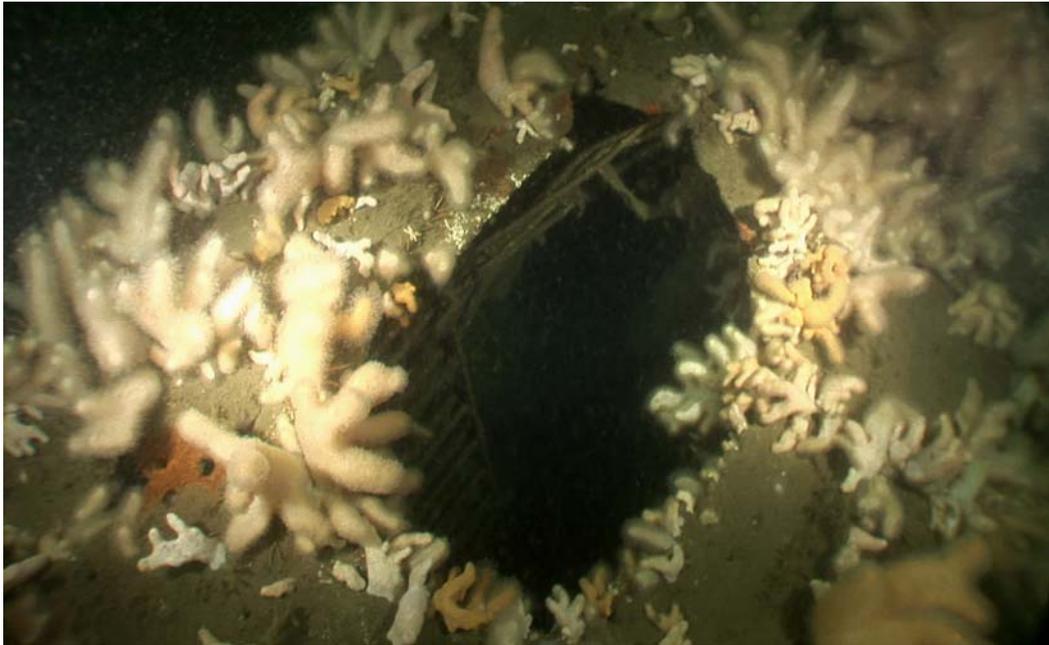
- 5.2. The view above shows the forward funnel hatch, this hatch is hinged on its aft edge and is nearly closed. No indication of the funnel was seen.



5.3. Between the two funnel casings there are a group of six air vents with semi spherical bronze hatches. They are all open to some degree. The aft end of the wreck is to the right of the picture and the vents shown are the two most aft on the port side. Below the picture shows the forward vent on the port side. Its bottom edge is in a vertical alignment and is therefore either fully open or broken off.



6. Control Room



- 6.1. The conning tower and deck house are not in position on the hull. There is a large hole where the conning tower should be and through this it is possible to view the control room beneath. The pressure hull casing around where the conning tower was positioned shows no sign of explosion or impact damage, removal of the conning tower has caused only slight bending and buckling of the main hull.



- 6.2. Both the forward and aft periscopes can be seen in the control room, seen here at 10 O'clock and 4 O'clock but they do not project above the hull casing. The ladder is on the port side of the opening.



6.3. Silt levels in the control room are very low as debris can be seen on the floor of the control room. The size of the hole into the control room is large enough for divers to enter the wreck. This would clearly be extremely dangerous but if anyone was so minded it would be possible.

7. Deck House and Conning Tower



- 7.1. The deck house is laid on the seabed to the starboard side of the control room opening. The deckhouse is laid on its port side with the top of the deck house closest to the main hull. The base of the deck house shows signs of damage but without significant distortion and the rear end of the deck house, where the last window and door would be, is missing.



- 7.2. The aft periscope top is still in position through the deckhouse roof. The forward periscope top is laid on the seabed unattached.



7.3. The steam whistle is still in position on the front of the deckhouse roof.



7.4. The inside of the conning tower can be seen from the underside of the deckhouse.



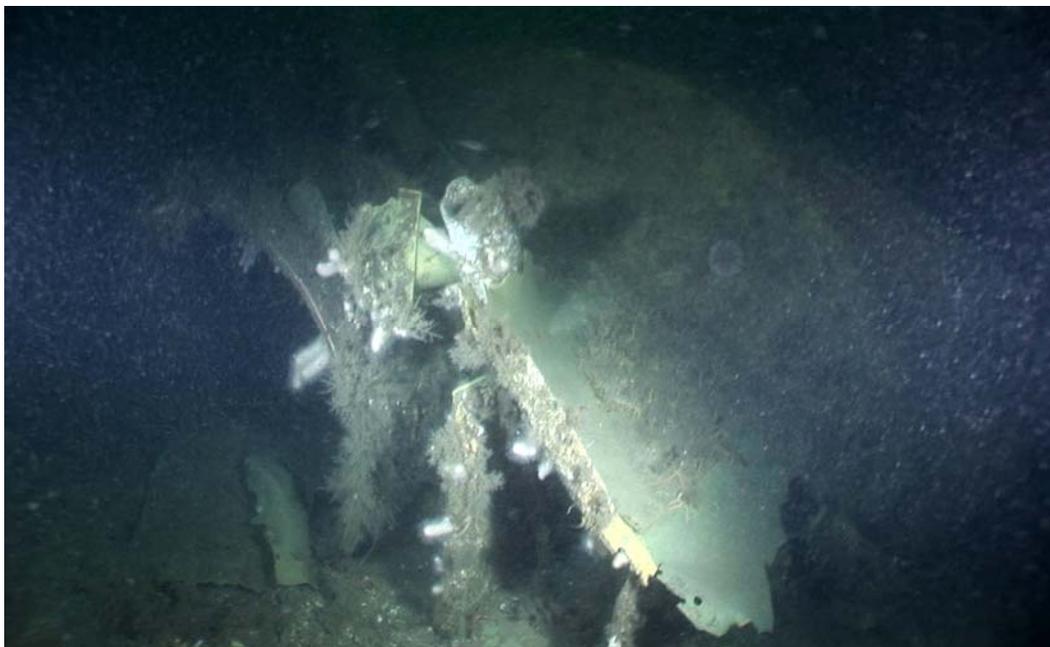
7.5. The outside of the conning tower can be seen behind the ladder, through the damaged area at the rear of the deck house. The ladder gives access from the deckhouse to the deckhouse roof.



7.6. The deck house roof is within 2 metres of the main wreck, the main hull at this point is not sunk into the seabed.



7.7. This view shows the front of the deck house and the streamlined fairing at deck level.



7.8. This view shows the same fairing as 7.7 but the clean lines of the base of the conning tower are also visible.



7.9. This view shows the damage at the back of the deckhouse. The aft periscope can be seen still fixed into the deck house at floor and roof level. The rear end of the deck house where the door was positioned is entirely removed (see elevation in 8.3) however the deck house shape is largely retained and is not distorted. The deckhouse and conning tower are made of brass and bronze respectively.



7.10. This picture shows artefacts in the deckhouse.

8. Forward Hull Section



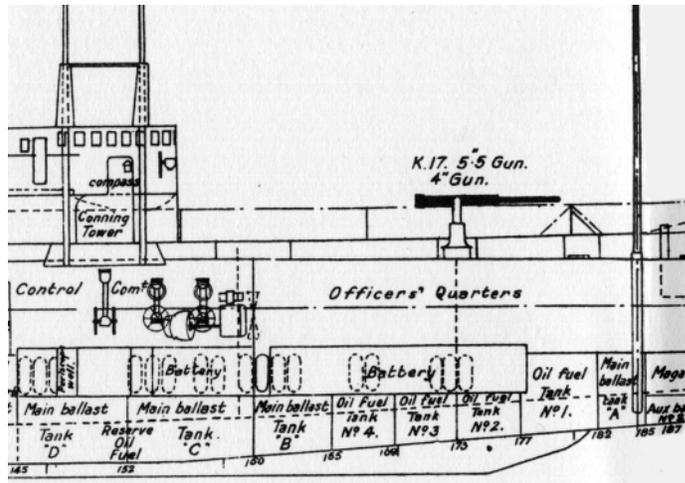
- 8.1. The forward section of the hull is missing. The break has taken place somewhere close to the forward end of the keel. This view shows the break from deck level, there were no signs of the forward deck gun or mast.



- 8.2. The hull at this point is sat above the seabed and is most likely supported on the keel. A below floor bulkhead is visible in the centre of the picture, it is set back from the split by about a metre.



8.3. This is a closer view of the bulkhead and structural frame in foreground. The break in the hull is coincidental with this frame. The break is quite clean on the port side but more uneven and ragged on the starboard side.



8.4. The sectional side elevation above shows the relative positions of Oil fuel tank No1, Main ballast tank A, the mast, the keel and the Magazine.



8.5. This view shows a section of plating on the port side level with the break.



8.6. This view is showing a white curved object which resembles a human rib bone. The timber planks are the remains of the flooring of the officers quarters. At this level it was possible to shine a powerful pencil beam torch aft from the break in the hull and see the hydroplane and steering pedestals in the far distance in the control room.

9. Conclusions

- 9.1. The wreck is generally sitting above a hard seabed that has a shallow covering of softer material. The only exception to this is at the stern where there appears to be a mound of material pushed back behind the stern. This would strongly suggest that the stern hit the seabed first and the wreckage was not only falling downwards but was also travelling slightly backwards. This also explains the reason for the unusual orientation of the starboard propeller blade.
- 9.2. For this to have occurred it is likely that the aft end flooded first which suggests that the split in the hull at the rear of the engine room was the reason for the sinking and the first area of damage.
- 9.3. The split at the stern is wide at the deck and comes to a point at the bottom of the hull. The damage is clearly consistent with a collision from the starboard side and furthermore it is consistent with a collision from a vessel of a similar draught. Had a vessel with a deeper keel been responsible for this damage I would have expected to see less of a vertical "V" shape to the split and more damage to the underside of the pressure hull. In my opinion this makes it much more likely that this is the wreck of K4 and that the damage sustained was caused by K6, a vessel of a similar draught.
- 9.4. The damage at the bow follows the line of a frame and most likely occurred on the surface. If the hull had parted anywhere else the two parts would be very close together on the seabed. A search for the missing bow was made during the dives but it was not found within visible range of the main hull.
- 9.5. The photograph on the cover shows HMS K4 aground and it is possible that the bow section could have been weakened in previous accidents that were apparently common. Such a failure would have started with tension forces on the upper most part of the hull caused by the stern section tilting backwards whilst the bow was lifting.
- 9.6. It is possible that the bow failure was aided by a collision. Any damage caused on the uppermost part of the sinking hull would have weakened the hull's ability to withstand the tension forces that would occur in this area during a stern first sinking. Again this is consistent with the loss of K4 as it was reported that K7 was following K6 and ran over the bow of K4 lightly striking her.
- 9.7. The damage to the conning tower and deckhouse is the most intriguing of all that has been sustained. The brass deckhouse and bronze conning tower have parted company with the pressure hull without a great deal of

buckling or bending of the deck, and without significant distortion of the bottom edge of the conning tower or deck house. The periscopes seem to have sheared off cleanly at deck level. The aft part of the deckhouse is missing but it has parted company along a frame and this is also a relatively neat severance from the whole (there is some brass sheet torn along the starboard edge and bent backwards in 7.9).

- 9.8. The orientation of the deck house, i.e. the roof facing the main wreck, suggests that the two parted company before they hit the seabed as the deckhouse would need some time to flip over into this orientation. Had the deck house just fallen off the wreck or had it been trawled off the wreck it would still have retained some attachments along its bottom edge and would have had the roof furthest away from the main hull. This would have been more typical of conning tower damage and positioning.
- 9.9. The missing aft section of the deckhouse may well be due to a lighter form of construction that did not stand up well to the sinking process. The door area would have introduced a weakness in this area.
- 9.10. In a stern first sinking the internal air pressure at the forward end of the hull may have exerted sufficient forces to cause the conning tower to “pop” off the hull. The loss of the weaker deck house is less surprising and may have followed naturally with escaping air. Submarines were of course designed to withstand pressure from the outside in and not the reverse of this.
- 9.11. The conning tower is made of bronze and is flanged along its base and was riveted to the main hull. In order for this joint to seal the construction relied on rivet tension and compression forces between the brass conning tower and the main hull. External water pressure would have aided the seal. However this construction would not have worked well with a reversal of pressure. Even a slight build up of internal pressure would have tended to open up the joint between the brass and the steel which would have put excessive tension on the rivets leading to total failure.
- 9.12. It is also likely that the tension forces at deck level would have put excessive shearing forces on the rivets securing the conning tower. This in conjunction with building tensile forces may well have contributed to their failure.
- 9.13. The deckhouse and conning tower are not distorted significantly from their original shape and so the likelihood of collision contributing to their removal is low.

- 9.14. The white curved object seen in 8.6 appears to be a rib bone. The object close to it was described by one of the team as part of a shoe. Other members of the team reported that there were several rib like objects close together. The presence of human remains is also consistent with the loss of K4 as K4 went down with all hands whilst the crew of K17 managed to abandon their vessel.
- 9.15. In summary, in my opinion the sinking followed the following order of events;
- 9.15.1. K6 Strikes the starboard side of K4 at the aft end of the engine room.
 - 9.15.2. The stern section takes in water rapidly and begins to settle below the surface.
 - 9.15.3. As the stern settles deeper in the water the bow rises and a combination of structural stresses in the hull and increasing internal air pressure causes the conning tower to “pop” off the hull which is closely followed by the deck house. The deckhouse remains partially attached and retains the conning tower close to its original position.
 - 9.15.4. K7 strikes the bow section of K4 lightly running over the deck, this causes the hull to fracture in an area that is already highly stressed and the bow section severs completely.
 - 9.15.5. The main hull section sinks stern first and takes on a backward trajectory. When it hits the seabed the area around the propellers digs in and causes a mound to form around that area.
 - 9.15.6. Meanwhile the bow section quickly empties of air and takes on a bow first decent with a slightly forward motion. With the bow section travelling forwards and the stern section travelling backwards the two parts of the hull end up some distance apart on the seabed.
 - 9.15.7. As the main hull sinks, at some point close to the end of the decent, the deckhouse breaks free completely along with the conning tower and they flip over and land alongside the main hull.

10. Further Work

- 10.1. We are intending to re-visit the wreck site in May / June 2008 in order to gather further evidence and complete this report. It is also our intention to undertake a similar exercise with the second wreck site as soon as we are able to organise this. This is likely to be in October 2008.
- 10.2. I would like to film the port propeller and take a closer look at how the stern section is sitting on the seabed. It would also be useful to clean off some of the growth around the starboard side propeller and take a closer look at its orientation.
- 10.3. We would like to conduct a swim line search for the bow section of the wreck and I would like to film this for completeness.
- 10.4. I intend to take some close up footage of the flange at the base of the conning tower and the corresponding hull above the control room. It would also be very useful to find a rivet from this joint for inspection.
- 10.5. There is further debris on the starboard side aft of the deckhouse and this maybe the missing part of the deck house. I would like to film this area.
- 10.6. I would like to take a closer look at the starboard side of the forward end of the main hull in order to understand why this break is not as clean as the break in the hull on the port side.