ABSTRACT

On Friday, 13th June 1952, a Swedish military airplane, the TP 79 a DC-3, disappeared over the Baltic Sea. The Swedish Air Force and Navy began a search for the plane immediately. For three weeks the only sign of the plane was its rubber life raft found floating in the water. It was later established that the DC-3 had been attacked and shot down by the Soviet Air Force.

The DC-3 was said to be on a navigation training mission. However, many years later the truth was revealed, the real purpose of the flight was signals intelligence. There was no sign of the eight crew members who had been onboard the plane and their families had to wait over fifty years for the plane to be found in 2003. Some of the crew members were still in the wreck, but sadly not all of them.

After the Royal Institute of Technology (KTH) found the Swedish passenger vessel, the S/S Hansa shipwrecked at 108 metres deep, seven kilometres from its originally calculated position, KTH decided to begin a search for the missing DC-3. Nothing had been done to find the plane since July 1952.

The research vessel the Altair, under the flag of KTH, then went to sea on several different occasions trying to locate the plane. The Swedish media, individual unpaid volunteers and the owners of the vessel were all involved in the search. The question is; why did it take such a long time to find the DC-3? Internationally it has been shown that with the necessary, up-to-date equipment it was in fact possible to find crashed planes and wrecked submarines in the 1950s. The R/V Altair was at the right place in 1989, but the cable of the side scan sonar was too short in relationship to depth to register the plane. Documents from the Soviet concerning the shooting down were first released after 1990 when the Soviet Union fell.

Bengt Grisell, with radar expert Gunno Gunnvall and the engineering and science journalist Roger Bengtsson, will further recount the events that occurred in this their report entitled “The DC-3 – a KTH Project”.

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On Friday, 13 June 1952 a military marked DC-3 (TP 79) takes off from Bromma Airport at 09.05 with a crew of eight onboard. Central Flight Control (CEFYL) checks on the plane at twenty minute intervals. The last radio message from the DC-3 comes at 11.08 “All’s well onboard”. The plane is then 47 kilometres east of the eastern tip of the island Fårö, flying at a height of 4 000 meters. It is expected to land at Bromma Airport at 12.00. Instead there is a call to F 2, Hägernäs Wing radio at 11.25 which is answered but is followed by radio silence. The DC-3 does not land at Bromma and they fear the worst. At 18.30 hours a press release is issued by Defence Staff: “A plane on a navigation and radiotelegraphy mission is missing over the Baltic Sea”.

Extensive search and rescue operations are started including ten planes, a destroyer and several smaller naval units. At midnight there are still no results. Some small oil slicks are observed but fog prevents further search. A news plane from the daily newspaper Dagens Nyheter (DN) releases the news that a large oil slick had been observed east of Gotska Sandön. The Air Force is alerted but the oil slick proves to be a rip tide. Due to the thick fog, a Catalina seaplane happens to stray into Russian territory. As with the incident on 17 July 1951 when a Swedish military plane violated Soviet airspace, Sweden tenders its apologies.

Meanwhile several people on the island Gotska Sandön witness that, on the Friday, they had seen a plane flying a figure of eight over the island between 11.15 and 11.30. A yellow object is found at the island Huvudskär which may have come from the DC-3 as a south-easterly is blowing. The same day extensive Russian manoeuvres are underway outside Gotska Sandön, according to the newspapers one hundred MiG planes participate.

On the Sunday a rubber life raft is found 60 kilometres northeast of Gotska Sandön. It is taken to Stockholm for closer examination. There is a continuously expanding oil slick between Gotska Sandön and the island Fårö, almost ten kilometres south of Gotska Sandön. Twenty of the Air Force’s Saab planes (S18) also fly over the area (DN 16th June 1952). Two light bulbs and broken wood pieces are found at the site. The Navy’s echo sound gives a result under the oil slick, dragging and hydrophone searching also respond. In the evening divers are sent down but it is too dark and nothing can be found.

On the Monday after, a Soviet MiG plane shoots down one of the Catalina seaplanes that is searching for the DC-3 over international waters. The crew of the Catalina are rescued by the German vessel the Münsterland, whose crew witness the entire event. The second Catalina seaplane breaks off its search mission. Thousands of angry Swedes demonstrate outside the Soviet Embassy in Stockholm. The Swedish Government is called in and sends a note of protest to the Soviet Union who maintain that the Catalina shot at them and protest against the Swedish note. They send up 250 MiGs into the airspace north of Gotland (DN 18th June 1952). Their assertion that the DC-3 was fitted with radar analysis equipment was denied by Defence Staff.
One group of experts presents a theory that the DC-3 was probably attacked and the radio destroyed. They thought that the plane had then turned left in an attempt to make an emergency landing by pancaking onto the water and then had crashed between Gotska Sandön and Gotland. This theory was backed up by the fact that, at the same time as the radio went dead, a plane was seen circling twice over Gotska Sandön.

The search continues south of Gotska Sandön. Sweeps in the 20 metre deep area at 2 x 3 distance minutes give a positive reading but when divers go down they find nothing. The Navy continues the sweeps however even as they now hold out less hope of finding the DC-3. Meanwhile Navy command considers whether to borrow a specially constructed television camera from England. There is nothing like it in Sweden, however they feel that the time is not yet right, the search must move into another phase first. The assessment is that echo sounding and sweeping are sufficient just now. Echo sounding is not used at first as sweeps are considered to be enough, but now this method is applied as well.

On the Saturday, eight days after the disappearance of the DC-3, it is confirmed that the plane was shot down. The rubber life raft has been examined and it is established that it has been shot at and contains shell splinters. On the Sunday hope again grows about finding the DC-3. The echo sounder registers what is probably a metal object and grey-green paint scrapings are brought up. However the next day it is proved that the echo was produced by a rubble block and that the paint came from a buoy previously laid out by the Navy. On the Wednesday a decision is made to use galvanised sweepers.

On the Wednesday evening the search is resumed in the area and the galvanised sweepers give indications, however the divers find nothing. On the Saturday a decision is made to cease sweeping until further notice.

The Swedish Accident Investigation Board publishes its report which states that the plane crashed 50 kilometres east of Gotska Sandön. This area is too deep to sweep and hope is placed in echo sounding although the unevenness of the seabed means that results could be meagre. On 2nd July, nineteen days after the disappearance of the DC-3, a decision is taken to resume the search the following week. Some days later this is confirmed by the Defence Staff. However nothing happens.

All eight crew members who disappeared with the DC-3 were married and several were fathers of young children. It would be 51 years before the plane is found. Today four crew members have been found and identified, the others are still missing.

The question is whether the mystery would have been easier to solve if the plane had been found earlier? And if it would have been possible to locate the plane if they had used contemporary international underwater technology?

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2. UNDERWATER TECHNOLOGY – A REVIEW OF SWEDISH AND INTERNATIONAL DEVELOPMENTS
Bengt Grisell

My curiosity concerning the sea and all the secrets it kept was awoken early in life. My historical interest was triggered by a wreck found in the sixties by the island of Viksten, northeast of Landsort. But the underwater challenge was the one that appealed most.

Historical research showed that the wreck at Viksten was the remains of the man-o-war Riksnyckeln. This vessel went down in 1628, three weeks after the accidental sinking of the Vasa just outside Stockholm.

The few remains found on the seabed and the exposed situation of the wreck awoke suspicions that there was probably more to find under the loose murrain on the seabed. What forces had this wreck been exposed to over the more than three hundred years it had laid there? The largest part of the wreck had certainly been forced down to the seabed by wind, ice and high seas. During our three years at Viksten, my colleague Sten Ahlberg and I developed various types of techniques, including several different metal detectors, for use under water. We also developed airlifting technology to make it more efficient and possible to use at the depth of the recovery site. It must be said that Swedish underwater technology at that point in time left something to be desired in spite of the successful location (1956) and recovery (1961) of the Vasa. Major inventions in underwater technology were primarily found abroad. The development of sonar, the echo sounder and underwater television during the 1900s made it possible to locate and examine objects on the seabed.

Sonar

Light is suppressed by seawater, mostly due to the presence of particles, and visibility may vary from one hundred metres in the clearest water to a few centimetres in harbour water. Sound, in contrast, is affected by other mechanisms, some extremely complicated, which have only been given a partial explanation in recent years. With sound as a picture provider there is no dependency on light or clear visibility and the muddiest water can be searched through, even to the extent of several metres down into a soft seabed.

Sound under water has interested humans since the beginning of time, however nowadays underwater sound as a science is considered to have been born in September 1826 at Lake Genova. It was there that the Swiss physician and engineer Jean-Daniel Colladon and his colleague Charles Sturm, a mathematician, competed for a prize that had been advertised by the Académie Royal des Science in Paris. The competition concerned the compressibility of liquids. Colladon was very familiar with the theoretical relationships between the speed of sound and density. In order to prove this in practice, a bell was struck underwater which fired a gunpowder shot above water at the same time. This light flash could then be observed from 15 kilometres away by Colladon who also heard the sound through a cone that had been lowered into the water. By measuring the time interval between the two events, the speed of sound through the lake water at 8 degrees Celsius was measured at 1 435 metres per second. Now we know that this was incredibly close to the actual speed, it was only three metres per second out!

After this discovery research was mostly carried out in laboratories. Tito Enrico Martino in 1886 experimentally demonstrated that the speed of sound through water increased with temperature and salinity. Two circumstances then stimulated research into how sound acts in
water; the sinking of the Titanic on its maiden voyage on 15th April 1912 and the successes of German submarines during WWI.

As early as 1901 the Submarine Signal Company was formed in the USA with the aim of developing an underwater signalling device for navigation. This device could show the location of signalling buoys, wrecks, shallows etc. Signals could be received from 15 kilometres away. The different buoys could be identified by the number of pulses, their direction could be determined by placing receivers on each side of the vessel and when the signal was identical on both sides, the direction was determined. In 1913 Professor R.A.Fessenden developed the first transducer (a device that could both transmit and receive sound under water) for the same purpose. It was used for Morse signals.

On 27th April 1914, Fessenden constructed an electromagnetic moving-coil – a transducer (the previous one had actually been mechanical) – that could detect an echo from an iceberg under water at a distance of 3 kilometres. The fate of the Titanic in 1912 had stimulated this particular area of research.

The success of German submarines during WWI had forced the British to establish several different departments aimed at countering their efforts. Various proposals were made – the detection of electrical fields from their electrical equipment, anomalies in the earth magnetic field, heat variations in water, optical detection in water, detection of submarine sound. Even divining rods were suggested - which were probably never tested – however birds trained to spot submarine periscopes were! Serious trials were carried out with seals – in Sweden too – which were not a total disaster.

As early as 1915 British researchers developed various transducers, including piezoelectric types. The hydrophone was, consequently, in full action by 1916, also in the form of a sweep hydrophone that could determine direction. In the same year Britain developed an antisubmarine system whose technological principles are still in use. It consisted of arrays - magnetic field sensory loops on the seabed and passive hydrophones. This leading edge within electronics was maintained by the British all the way up to the 1960s when the USA overtook them.

Even if the hydrophone was improved extensively during its first, pioneer year, production of excellent results was hampered by the lack of a suitable electronic amplifier. It was not until 1917 that a comparatively efficient French amplifier became available. Different experiments and devices for measuring the speed of sound in water were developed and basic theory on sound travel under water was mapped out during this period. Many problems still remained however, problems such as measuring very small time intervals i.e. short distances and the technology needed to register and follow tendencies, i.e. plotting. The first printer arrived in 1934.

The fact that frequency was important for range had been recognised for some time. Consequently the frequency of around 20 kilohertz (kHz) was chosen which gave a range of approximately 4 500 metres for submarine detection at a transducer effect of 50 watts. Quadrupling the effect only increased range by 10 percent as background noise was a limiting factor. Doubling its range to 9 kilometres would have require an effect increase by a factor of 1 000.
Frequency is decisive to range – the lower the frequency the longer the range.

For example:
100 Hz reaches thousands of km
1000 Hz reaches hundreds of km
10 000 Hz (10 kHz) reaches tens of km
100 000 Hz (100 kHz) reaches approximately one km
1 000 000 Hz (1 MHz) reaches tens of metres

From having been a machine weighing several tons, today the sonar is extremely well
developed and is manufactured in various sizes ranging from 80x100 mm to large scale units
permanently attached to vessels’ hulls. Small sonars are currently attached to underwater robots
(ROV - Remotely Operated Vehicle) in order to be able to scan horizontally over 180 degrees or
360 degrees with a radius of approximately 100 metres and with a frequency of approximately
600 kHz.

Since the 1960s there have also been side scan sonars, i.e. sonars that view outwards and
downwards in two directions, starboard and port with the help of an electronic device towed
underwater, known as a “fish”. The “fish” is dragged after the vessel or mounted on a ROV or
the hull of a vessel. This produces a sound picture of the seabed. The width of the search area
can be adjusted from normally 50 to 600 metres, partially dependent on frequency and the
distance between the “fish” and the seabed. For the narrower search patterns - 50 to 100 metres
- 400-500 kHz are used. For the wider search patterns 100 kHz. The side scan sonar is currently
the most useful instrument when searching for objects on the seabed.

The echo sounder
The echo sounder arrived later than the sonar, which may appear strange, although the echo
sounder could be said to be the peacetime, civilian application of the sonar. Producing an echo
from the seabed was actually fairly simple; the problem consisted of translating the echo into
a depth during the brief interval between transmitting the signal and receiving the echo. The
earliest usable system was patented in 1912 by a German named Alexander Behm. A rifle
was shot just above the water surface, the sound was captured by the port hydrophone that
immediately started up the rotation of a mirror on the bridge. The same echo was then captured
by the starboard hydrophone and stopped the mirror’s rotation. A beam of light reflected by
the mirror showed the depth on a scale. For greater depths a charge in the water was used plus
a photographic registration as the mirror could not be used for longer time intervals. Behm
carried out depth measurements in Lake Ploen in 1912 using this prototype which came onto
the market in 1920 when he formed Behm Echelot Gesellschaft in Kiel. It was installed onto a
Swedish marine survey vessel, the Svalan, as early as 1925 however the device did not come
up to expectations. Five years later a French echo sounder was installed on the Swedish marine
survey vessels Svalan and Falken with much more success.

Similar experiments were carried out by P.A.D. Marti in France in August of 1919. Marti
measured a depth of four thousand metres from a cable laying ship the Charente in the Bay of
Biscay. In April 1922, he carried out a continuous echo sound between Marseille and Philippeville
in the Mediterranean. These measurements naturally facilitated the laying of the telegraph
cables. France was also first with the piezoelectrical transducer (Langevin/Florisson) that both
transmitted and received in the same unit. Their echo sounder from 1920 also used a point of
light to indicate depth.
All during the 1920s most countries were working to develop an echo sounder with the help of research that had taken place during the war. In 1922 Langevin and Marti constructed the first, continuously-registering echo sounder. Sooty paper was scratched with small needles and then passed through a bath of varnish (gum arabic) dissolved in alcohol in order to fix the record. The first commercial apparatus was installed on the Ville d’Ys which carried out an echo sound survey between Norway and Iceland in April 1922.

During the 1930s several other models were put into service for civilian purposes, mainly of the magnetostriction type with transducers made of nickel, one for transmitting and one for receiving. Included was a three tube amplifier and chemical paper registration. The paper was moistened with potassium iodine and starch and was fed through by an electric motor. Two lines were registered, the first on the transmission of the sound pulse and the second when the echo returned. Range was approximately 1800 metres (15 kHz).

This echo sounder became extremely popular and successful on the market after the wreck of the Lusitania had been located with its help outside Ireland in June 1935. The manufacturer was Henry Hughes & Sons. As a curiosity it can be mentioned that the Swedish Navy’s first side scan sonar was also manufactured by this company and entitled the Hydrophone 105. It was introduced into the Swedish Navy in 1972. I and my colleague, Sten Ahlberg, borrowed this instrument in 1973 and it provided us with our first experience of a side scan sonar. This hydrophone, with its four registering needles, could only register wrecks whose position was already known and who were 50-100 metres long. It would never have been able to detect the man-of-war Kronan or the passenger ship Hansa (see chapter 4), not to mention the DC-3. As a comparison it could be mentioned that the Vasa – on the seabed outside Stockholm – could be located with modern equipment in less than one hour. In 1956 its discoverer Anders Franzén had to work for several, back-breaking months in a small open boat with his home made, special core sampler.

Modern echo sounders are extremely sophisticated with colour screens, several frequencies in the same instrument, 30 kHz, 50 kHz and 200 kHz. Effects are high, 2000 watts, and it is possible to run them parallel with other special instruments and information banks.

**Underwater television**

Television, or the transmission of electronic pictures, has a long, complex history. Briefly it begins with Abbe Cassellis’ broadcast of pictures via electrical conductors in 1862, the invention of Paul Nipkow’s scanning disc and work with light-sensitive selen cells. During his success with the development of radio telephony, John Logie Baird (Britain) came to connect these two technologies. In 1926 he demonstrated television in London for the first time. Later in 1936 he developed the technology from its original 30 horizontal lines to 240. The system was purely mechanical and was not used again.

The first electronic television for use in homes was created in January 1928 in USA. Development activities were led by the Swedish-born radio pioneer Ernst F. W. Alexandersson in cooperation with the General Electric Company and Radio Corporation of America. Pictures were transmitted via shortwave at 37.77 metres. The sound was transmitted via WGY’s normal transmission frequency of 379.9 metres and received via a standard radio receiver.

1 Ernst Fredrik Werner Alexandersson graduated from KTH in 1900 and was awarded an honorary doctoral degree in 1949. He received many awards and honours during his long life and died in 1975.
Television for industry and science began development in 1940 in connection with the first remote controlled bombs. The aim was to receive images from these bombs which had cameras in their noses and this would enable them to be steered towards their targets from the plane. TV technology was also used in remote controlled planes called Drones. The system had the code name Block and Ring and was tested from Catalina seaplanes as early as 1942. Range was 300 kilometres.

In 1946 the US military tested electronic equipment in its nuclear trials on Bikini Atoll during Operation Crossroad. Vessels and submarines taken as spoils of war from Germany were also included in these tests. The experiments were christened Test Able and Test Baker. Test Able was an atmospheric explosion and Test Baker was an underwater explosion. In both experiments 7 364 different pieces of electronic equipment were tested on 148 target vessels. In order to study the effect of these tests, television technology was used under water.

The following year a television camera (2P21 Orthicon, RCA) was mounted in an underwater housing and the equipment was used down to 55 metres in depth. The underwater housing weighed more than 100 kilos on land and 30 kilos in water. The window consisted of a 19 millimetre thick pane of glass. The camera required a considerable number of remote controls through a 19 leader cable. Cables for picture and synchronisation were separate. A Woolensak vellastigmatic lens f/3.5 was used. The picture angle was only 24 degrees which rapidly proved to be too narrow. The technical development work for this experiment was carried out by Cornell Aeronautical Laboratory.

Jacques-Yves Cousteau began experimenting with underwater television in 1948 but found the results so poor in comparison to normal film that the trial was abandoned. In 1953 Cousteau used underwater television – manufactured by British Thompson-Houston Company – as a surveillance camera at the excavation of a wreck at Grand Conglouë. It was not until the 1960s that television made its breakthrough in underwater technology when the video recorder began its development (Ampex), as it now became possible to save recordings for future documentation.

In Sweden underwater television – made by PYE – was used for the first time in October 1956 on the wreck of the Vasa that had sunk outside Stockholm in 1628. In Sweden, experimental transmissions of conventional TV began in 1953 by which date there were already 26 million TVs in the USA, one in every other home.

It is very probable that the DC-3 could have been found as early as 1952. The technology was in place in other countries. Below some successful searches are described, searches that used contemporary technology.

**The search for the submarine Affray**

In April 1951, the British submarine Affray disappeared during an exercise in collaboration with NATO (Subsmash). It left Portsmouth and disappeared without a trace. When the search was initiated the search area was estimated at approximately two thousand square miles (5 177 square kilometres) an enormous area. The depth of the search area outside the Thames estuary varied between 55 and 65 metres. The search instruments used included an advanced type of echo sounder, ASDIC (Anti-Submarine Detection Investigation Committee).
Locating the submarine was hindered by tidewater and by the large number of wrecks already littering the seabed. Thousands of objects were located with the aid of the ASDICs and many were examined more closely by divers. After several weeks of searching it was suggested that an underwater television camera should be used in order to streamline the search and, not least, to speed up the identification of the objects that were found. After two months of searching the sub was found at a depth of 84 metres. At that time it was not possible to send down divers to the wreck but the underwater television made it possible to determine the cause of the accident. It could be observed that the snorkel had broken off the submarine and that a valve to it was open.

**The search for the passenger plane Yoke Peter**

Another successful search operation, in which stamina and television played a decisive role, was when one of the first passenger jet planes in the world, Yoke Peter, exploded in January 1954 outside Malta in the stratosphere and 35 people were killed. The plane disintegrated into pieces at a height of 7 800 metres.

Many people on land saw it happen. Fishing boats in the area picked up 15 bodies. Parts of the plane were spread over a large area of the sea and had sunk to the seabed at a depth of 210 metres. Rumours of sabotage were soon circulating in British newspapers. The task of finding the parts of the plane was given to Admiral Earl Mountbatten, Commander-in-Chief of NATO’s Mediterranean Fleet.

After all eye witness accounts had been collated - including photographs from other planes in the air - the search area was limited to 518 square kilometres. At that time Britain had established a special group for underwater television within the Royal Naval Scientific Service.
Three different methods were used for the search; vessels that dragged 250 metres of chains and cables between them along the seabed, an observation chamber (Galeazzi’s) and naturally the sonar (ASDIC). PYE and Marconi companies provided their latest equipment for underwater television.

The Marconi camera had a rotating periscope lens and the PYE camera could be dragged along the seabed. Part of the body of the plane was found after one month of searching at a depth of 129 metres. It was lifted using mechanical grip claws. After another month the major part of the front cabin was recovered which included part of a skeleton. The entire operation was a major triumph for underwater television. After eight months’ of searching and after 90 percent of the plane had been recovered, the decisive part that could explain why it crashed was found. It was discovered that a crack in the cockpit of less than six millimetres had caused this disaster!

At another recovery of a Swiss Dakota plane from Lake Boden (a DC-3) three years later, the efficiency of underwater television could once again be demonstrated. After twelve weeks 80 percent of the plane had been recovered from a depth of 204 metres.

**Locating the Swedish DC-3**

The total search area for the DC-3, which was examined by KTH and the Swedish Navy between 1989 and 2001 is the equivalent of 1 550 square kilometres which took more than 100 search days. This area can be compared to the surface area of Öland of 1 342 square kilometres or a total of 180 000 football pitches.

Starting from the 1952 estimated point of impact of the DC-3 which was based on the position of the life raft when it was found 45 hours after the crash, the plane was located approximately eleven nautical miles from that point and consequently well within the search area that had been necessary to locate the Yoke Peter or the Affray.

Consequently it can be observed that there was existing technology internationally that could have located the DC-3 in 1952. Two years later the technology was very well developed, however it was not available in Sweden.
At this point in time Sweden had, in an international context, very little experience of underwater technology and, consequently, search technology. It can be said, with good evidence to support it, that Britain and a number of other larger nations would, in all probability, have succeeded in finding the DC-3 under equivalent conditions.

3. A DC-3 length 19.6 metres, wingspan 28.9 metres.

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I remember Friday, 13th June 1952 fairly well. I was almost 16. It was school summer holiday and I was at home when the radio news came on to say that a Swedish Air Force plane had disappeared over the Baltic Sea. The plane had eight men onboard, five of them telegraphers. The plane’s mission, said the press release from the Defence Staff, was a “navigation flight over the Baltic in connection with the training of radio telegrapher services”.

I was already very interested in defence and I followed developments closely. On the afternoon of Monday, 16th June it was announced that a Catalina seaplane had been shot down by a Soviet MiG-15s. The Catalina was out searching for the DC-3 and had been shot down early in the morning. The Swedish plane managed to carry out an emergency landing on the water and the crew of seven were able to make it to the German cargo ship the Münsterland by life raft. The cargo ship took them to Finland.

The shooting down of the Catalina led to demonstrations outside the Soviet Embassy in Stockholm. An extended exchange of protest notes between Sweden and the Soviet Union followed. Information was released that on 13th June two planes violated Soviet airspace and were driven off by Soviet planes. As concerns the Catalina, I remember that from the Soviet side it had been stated that this plane (maximum speed 200 km/h) had attacked the Soviet jet fighters!

Five years later, in June 1957, I began my military service training as data processing technician at the National Defence Radio Institute (FRA). We started by plotting flight routes that Soviet air surveillance reported via short wave telegraphy. They stated the position of different planes generally speaking every minute, together with a target number and height and time. Times stated were always a little too high – often around two minutes. It had taken a certain amount of time to receive the information from several levels. Positions were given in a square network system whose numbering was changed from time to time. However it was easy for us to reconstruct the new numbering. We knew where different flights usually went. Especially as concerns US and British signals intelligence planes who entered the Baltic Sea south of Skåne and then continued in loops east of Gotland. Often they also swung round Gotland.

They were very careful to report these flights from the Soviet side. One aim was certainly to warn their own units so that they could maintain radio silence on missions that they wanted to protect. They also reported on their own fighter planes that took off from different bases in the Baltic States. Anyone working in this job could probably answer questions about the DC-3 that disappeared. Yes the “telegraphers” belonged to FRA and were carrying out signals intelligence. The young men doing their military service were taught very thoroughly to always consider confidentiality of information. At that time in 1957, the fact that Sweden carried out signals intelligence and that FRA was the organisation doing it was still a secret. Whatever your opinion on this matter, this background probably explains a lot of the peculiar behaviour demonstrated by the Swedish side over the next years.

After completing my compulsory military service I worked for a few years as a civilian employee at FRA. Activities still mainly concerned flights over the Baltic as reported by Soviet air surveillance. I left FRA in 1964 and took up a position at the Air Force Staff Intelligence Department (FS/Und.). Initially this concerned studies of foreign professional press within the flying field. After one year
I took over responsibility for what was to become the radar intelligence service. This included the registration and processing of information from Swedish radar stations with the aim of developing intelligence on the behaviour of other nations’ flights. One prioritised task was to develop sketch maps to record when foreign planes violated Swedish air space. In order to be able to carefully study and plot these planes’ movements in peace and quiet, 16 millimetre film cameras were set up around the country.

From the autumn of 1981, I and my colleagues were transferred from the Air Force Staff to the Defence Staff. Eventually the unit was named HKV/MUST (HQ/Military Intelligence and Security Services). I retained this area of responsibility until I retired in 2001.

In March 1991 a General Sjinkarenko appeared in the media. In 1952 he had been a colonel and was in command of the Baltic air defence area. Sjinkarenko said that he had ordered the shooting down of the Swedish DC-3 and stated that it had violated Soviet air space. Based on this statement, on 12th March 1991, the Swedish Ministry for Foreign Affairs made a request to the Embassy of the Soviet Union to be able to examine any material on the incident held by Soviet authorities. On 21st March a decision was taken by the then Minister of Foreign Affairs to set up a Government Commission to study the DC-3 incident. On 25th March, the Commander-in-Chief of the Swedish forces appointed a special military commissioner – Colonel Rolf Gustafsson – to assist this Government Commission. The work of reviewing archive material and interviewing a great number of people began.

In the autumn of 1991 there was a change of government in Sweden. On 30th October the Prime Minister, Carl Bildt, received a visit from a Soviet emissary, Ambassador Fokin. Fokin informed the PM that the Soviet Union was now prepared to officially admit to shooting down the Swedish DC-3 over international waters and that this action was a serious violation of generally accepted international law.

In November the Commission travelled to Moscow and received copies of Soviet documents from 1952, including a sketch map of how the Soviet air surveillance perceived the flight patterns of the DC-3 and the Soviet fighter plane. The visitors were also afforded the opportunity to meet and talk with the pilot of the Soviet fighter who had shot down the DC-3, Captain G.I. Osinskij.

Colonel Gustafsson had office space at MUST and I helped him to establish sketch maps on the flight paths of the previous (1951 and 1952) DC-3 flights. The Commission presented its report “Rapport från DC-3-utredningen Ds 1992:5”, in February 1992.

The main thrust of the report was two recommendations:
1. That if possible the plane should be located and recovered.
2. That all documents of importance to the issue should be released to the public.

Between 1992 and 1995, the Navy searched a total of eight times without finding the DC-3. Owe Wiktorin, the Commander-in-Chief, stated in a letter dated 25th January 1996 to the families of the lost crew members that he considered that the Defence Force had consequently done all it could and that he had taken a decision not to mount any more search missions.

The next time I came into contact with the DC-3 incident was in December 1999. The Acting Commander of MUST asked in a meeting if anyone had been working with this issue as the
Cabinet Secretary of the Ministry for Foreign Affairs, Jan Eliasson, had requested background information for an interview he was intending to give the media. I said that I had helped Colonel Gustafsson some years earlier and was then assigned the task of gathering the necessary information. Mr Eliasson wanted to know where the Navy had searched and how much financial compensation the families of the crew had received in total.

In order to complete this task I had to collect a number of documents from various places within HQ. I gathered the facts, not only to obtain the information required but also to still my own curiosity about where the plane could possibly be positioned.

The background information included:
Information on time of final, incomplete radio call on short wave telegraphy that was received by the telegrapher at F2 (Hägernäs) and that he felt showed signs of being from the signaller on the DC-3, Gösta Blad. The time noted was 11.25, but as this note was made after the event it is probable that the actual time was around 11.23.

Another Swedish representative submitted a copy of a sketch map of the flight paths of the DC-3 (called “Target No. 303) and the MiG-15 as they were perceived by the Soviet Air Surveillance Centre. This sketch was dated 13th June 1952. What is striking is the zig-zag flight path stated for “Target No. 303” as is the short distance between positions labelled with the times 13.08 and 13.14 (Swedish time 11.08 and 11.14). On the sketch map the position of the attack was stated at approximately N 5805 E 2012.

According to the Soviet documents, surveillance was carried out using two radar stations of the P-3 type at Radio Post No.15 at Ventspils (see sketch map). We know that the beam width of this type of radar is around 30 degrees. When a target shows sufficient radar target area and the distance is not too great, an indicator (called a PPI) is shown as a bow-shaped line taking up approximately 30 degrees. It is estimated that the target is then at the middle of this bow shaped line and a position, with a satisfactory degree of accuracy, can be determined. However planes show different radar target area depending on their aspect angle i.e. the angle between the plane’s length axel and the direction of the radar. A plane that turns broadside to the direction of the radar shows a radar target area of perhaps 100 m² while another aspect angle may produce a radar target area of less than 1 m². As the aspect angle is changed somewhat while the radar sweeps over the target, pulse hits may only be achieved at the beginning or at the end of the 30 degree sector. This may easily lead to a bearing inaccuracy of as much as ten degrees. As concerns the accuracy in distance of this type of radar I have estimated it as better than one kilometre.

Less than two days after the incident, the destroyer Sundsvall found an uninflated life raft at position N 5834 E 2015. This was determined to have come from the DC-3 and was examined by the Swedish National Laboratory of Forensic Science and found to contain shell splinters of Soviet manufacture. Taking currents and winds into account, the life raft’s starting point was calculated at N 5821 E 2011. In 1991 the Swedish Meteorological and Hydrological Institute (SMHI) made new calculations and arrived at the coordinates N 5824 E 2026 with a margin (radius from stated position) of 10 km.

The Soviet fighter pilot’s description of the event was that the DC-3’s left engine was on fire and that the plane, after a left turn dived steeply and disappeared into cloud cover.

A sketch map established by the Navy showed all the areas that had been searched.
4. Copy of Russian sketch map of the flight paths of the DC-3 and the MiG-15 on 13th June 1952.
There was also information that led searchers to the proximity of Gotska Sandön, and especially to the area south of this island. There were reports from fishermen on net finds etc. There were also observations from three individuals on a Coast Artillery transport boat called the Gråtruten that was transporting staff and materiel to the island. They saw a twin-engined plane circle in over the island, disappear out to sea but return for another crossing. They saw no smoke coming from the plane and could not agree on whether the plane’s wings were positioned high or low. I decided that this plane was not the DC-3, primarily due to the distance from the point where the attack took place (approximately 15 minutes flying time) and because the plane did not appear to be damaged. I felt that this had been a Soviet reconnaissance plane with the task of photographing the buildings on Gotska Sandön.

In December 1999 I summarised the most important information for the calculation of the crash point of the DC-3 in a sketch map. From the Soviet information (in which their radar was relatively accurate at distance) the DC-3 had flown farther east in comparison to the estimates made by the Swedish Accident Investigation Board. Its final position at 11.14 hours according to the sketch (see Page 17) must have been farther northeast if probable bearings errors (towards a target that was becoming difficult to see) are taken into consideration. If, in addition, we assume that times stated were two minutes too high (11.14 must be read as 11.12) the position of the attack is moved a further few kilometres northwards.

With this as background material I submitted a written recommendation to C MUST (Lieutenant-General Håkan Syrén) that if further searches were to be carried out then they should occur within the red areas marked on the sketch and primarily in the western half of this area. However no further searches were carried out by the defence forces. Only when a civil search expedition located the wreck in June 2003 was the Navy commissioned to begin recovery.

At the beginning of 2000, Bengt Grisell of KTH made a written request to the Defence Force to be supplied with information on where the Navy had searched for the DC-3. Grisell intended to take the research vessel, the Altair, out in the summer of 2000 to once again look for the DC-3, a project that was financed by Dagens Nyheter and TV 4. I was tasked to submit the Navy’s information which I did. I also advised Mr. Grisell in the same way as I had advised C MUST, namely to search within SMHI’s red circle starting from the west.

Grisell’s searched, however, relatively close to Gotska Sandön in the summer of 2000. The Altair found an object that could have been the wing of a plane located on the edge of Swedish territorial waters. I did not believe that this could be the DC-3 but petitioned Operative Command (of which I was a member) to be able to examine the object with the assistance of a ROV. According to information received an order had been issued concerning such an examination but the occasion never arose. I insisted and reminded them of this right up until my retirement on 1st August 2001.

In the summer of 2002 a ceremony in remembrance of the incident – 50 years on – was held. The media paid this a great deal of attention. In connection with this the national security reporter of the Svenska Dagbladet (a Swedish daily newspaper) - Mikael Holmström - had clearly been researching Foreign Office documents and had come across the sketch map I had submitted in December 1999. He rang me up and I told him what I believed. This led to an article entitled “Sweden searched for the DC-3 in the wrong place”.

In the winter of 2002 – 2003, Bengt Grisell planned to make a request to Government for funds to mount a new search in the summer of 2003. I advised KTH to make a written request to the Prime
Minister’s Office so that the issue could be processed at the highest possible level. The document, with a request for SEK 200 000, was sent off in February and included appeals from several crew family members.

The request was submitted to the Ministry of Education. It was refused. The refusal came in the form of a Government Decision dated 16th April 2003 signed by Thomas Östros, Minister of Education. Consequently on 22nd May I wrote a letter to the Prime Minister Göran Persson and appealed to him to take a personal position on this issue. On 10th June I received an e-mail from an employee of the Prime Minister’s Office. She informed me that the PM had read my letter and had asked her to send it to the Ministry for Foreign Affairs for further processing and reassessment.

What I did not know then was that very same day (10th June) an expedition initiated by Anders Jallai with Carl Douglas as financier had found the DC-3! On 16th June a remote camera could be sent down to take pictures of the wreck. I did not know that they had searched regularly since 2000 but when I rang Carl Douglas to congratulate him on his success (he had previously worked at MUST so we were acquainted) he said he would like to interview me.

Now we know that the DC-3 has been lifted and that the remains of three Air Force men and the FRA commander were recovered. On 27th March 2004 I was given the opportunity of seeing the plane as they began to examine it in one of the tunnels on Muskö. It was clear that the left engine itself and the area around it had been on fire. What I had not expected was that so much of the plane’s left side would be ripped off. The only thing found during the 1952 searches was the life raft. Christer Magnusson, who is leading the project, has promised me a copy of the report when it is completed. The plane’s position is no longer a secret – it was N 5823.522 E 2017.400 – in the western part of SMHI’s red circle.

Now it is probable that the DC-3 will be moved to the Airforce Museum at Malmslätt and become a part of the history of the Cold War. Surely much more will be written about this plane and its fate.

In 2007, the Government granted extra funding to the Swedish Air Force Museum to finance a new building at Malmslätt to house an exhibition of the DC-3, a MiG-15 and other objects from the Cold War. It is estimated that this building will be open to the public in 2010.

The official report on the DC-3 was submitted to the Swedish Armed Forces on 25th May 2007. There is still no evidence as to what happened to the four FRA operators. If they landed in the water with life jackets inflated they may have drifted towards the northeast. Requests to Estonian authorities for help have elicited no response to date. Perhaps there is an answer in the Russian archives somewhere?
5. Gunno Gunnvall's sketch map with the calculated crash point of the DC-3 (the red circle).
Nya spaningar efter DC 3:an i sommar

En artikel i Svenska Dagbladet hittar starten för nya efterspaningar efter den svenska DC 3:an som sköt ner av Sovjet 1952. Forskningsinsamlare Bengt Grissell planerar nästa sommar att med sitt fartyg Altair lotta efter flygplanet i ett nytt "hot" område.


Han har med fartyget Altair gjort flera uppmanade flytt på Östersjön. 1980 funna han Gotlandshulagnet passagerarläsa Hana, torparet av ryssarna 1944.


- I området är vattendjupet 70-130 meter, men botten är slät. Altair har en mycket avancerad undervattensrad (sådana sam- mar) som kapabiliteter av Wallenbergsstiftelsen och kan söka av området på ungefär en vecka.


Roger Almeberg som är son till DC 3:ans pilot Alvar Almeberg och talesman för de allmänna villkommernas planerna.


MIKAEL HOLMSTROM
08 135 63 36, mikael.holmstrom@svd.se
Sökningar efter den 1952 nedskutna DC-3:an - Sammanställning av genomgångna rapporter

<table>
<thead>
<tr>
<th>Datum</th>
<th>Fartyg</th>
<th>Rapport</th>
<th>Område</th>
<th>Funna objekt</th>
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<tbody>
<tr>
<td>91-01-23–25</td>
<td>Altair</td>
<td>OB HPM 92-03-13 Axberg utlåtande 92-01-27 och 92-02-05</td>
<td>Kring GS</td>
<td>4 pos bör undersökas vidare</td>
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<tr>
<td>92-04-13—14</td>
<td>Kullen Vinga</td>
<td>A + 5.mirkavd rapport 92-04-21 end missiv HMS Kullen Rapp 92-04-16x</td>
<td>10 NM E o W GS</td>
<td>22 objekt varav 1 trävark</td>
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<td>92-05-25—29</td>
<td>Altair</td>
<td>Altrgp rapp 92-06-14</td>
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<tr>
<td>92-08-24—28</td>
<td>Altair</td>
<td>Altrgp rapp 92-09-01</td>
<td>Intill GS</td>
<td>Vrak</td>
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<tr>
<td>92-12-06—07</td>
<td>Ven</td>
<td>A,B 5.min dikavd rapp 92-12-09 HMS Ven rapp 92-12-07x</td>
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<tr>
<td>93-02-08—13</td>
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<tr>
<td>93-09-13—14</td>
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<td>A 521.minrjödiv rapp 93-09-15x</td>
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<td>Prio 1-5 genomfört Veckan blaste bort</td>
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<td>Landsort</td>
<td>A,B 521.minrjödiv rapp 93-10-30x</td>
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<td>A,B 521.mrjödiv rapp 94-03-28y</td>
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<td>96</td>
<td>HKV ML</td>
<td>96-02-12y</td>
<td>5820,4/1927,8</td>
<td>Uppdrag t FMB undersöka ev vinge resp närfalla</td>
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7. Gunno Gunnvall's summary of reports showing the vessels that searched for the DC-3 from 1991 to 1995.
4. INTRODUCTION
Bengt Grisell

In 1970 I and my colleague Sten Ahlberg purchased an ex-lifeboat/pilot boat called the Oskarshamn 1 from the Swedish Maritime Administration. This vessel was renamed the Mare Balticum and was then operated as a research vessel for KTH. She was used for three years for many activities particularly for the partial excavation of the wreck of the Riksnyckeln. This site in the archipelago outside Stockholm had been of interest as early as 1967 (see Forum Navale no 28, 1973).

Its rediscovery and uncovering led to cooperation with Anders Franzén², a researcher who concentrated on marine history and is best known as the man who found the Vasa. In 1979 he was appointed to a special, government-funded position at KTH in order to be able to return to his research within marine history. Our cooperation then intensified.

After archival research concerning the vessel the Resande Man that went down in 1660 in the archipelago outside Stockholm, a decision was taken to search for the wreck using previously untried technology. In addition to KTH a company called Undervattensfoto took part led by Bengt Börjesson who provided the underwater equipment free of charge, as well as the other partner in Mare Balticum, Sten Ahlberg of Swedish Television. For a period of four years underwater television searches were carried out of an area as big as most of Stockholm without making any real finds. In spite of the advanced (for that time) search equipment we had no success in locating the wreck. During a group meeting concerning this project I suggested that we should take the now well-developed searching equipment down to Öland and try to locate the man-of-war Stora Kronan³ on the east coast of the island. Franzén had searched for this wreck several times previously without success. Ahlberg and I had also tried to find it in the early 1970s, however underwater technology had developed so much since then that the odds of finding the wreck were now extremely high.

At Easter of 1979, a number of fishermen and other individuals from Öland were interviewed in order to develop an interesting search area based on their observations. However not much useful knowledge was gained from this so I established a search programme based on previous information and constructed according to “Decca Laner”.

The search of this area was initiated in the summer of 1979 using a Klein Side Scan Sonar without finding anything. The following year we decided to us an Elsec magnetometer and selected an area where Bo Cassel, of the Navy’s diving vessel Belos, had previously observed rough timber on the sea bed. The search was initiated with the magnetometer and, in the area around “sand 28” on the sea chart, there were indications that were assessed as interesting and requiring closer examination. When we let down the TV equipment we could see that the Stora Kronan had been located! (See Trita Hot Report KTH, 1980). With hindsight we realised that we had actually passed over the wreck with the sonar without it registering on the fragile, wet paper that was used by the Klein during that period.

In 1983 I became a part-time employee of the Department of Shipbuilding at KTH to work with Anders Franzén. The Head of Department was Professor Erik Steenroth. In 1985 we were

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² Anders Franzén became an Honorary Doctor of Engineering at KTH in 1983 and was awarded KTH’s Great Prize in 1988 and the title of Professor. He died in 1993.
³ The Kronan exploded and sank in a battle with the Danish and Dutch fleets in 1676.
cooperating with Deutsches Hydrographisches Institut in Hamburg (DHI), BBC in London and
the National Geographical Society in Washington. We produced underwater material that was used
for various TV programmes in cooperation with Swedish Television’s Växjö office. The technology
for this was developed at KTH with the help of engineers from Swedish television in Stockholm
and Växjö.

DHI visited Öland on their research vessel Atair that participated in various searches around Öland
in the summer of 1985. In 1987 KTH received a very fair offer from the German state to buy the
Atair. As KTH was not willing to take on the responsibilities and costs of being a ship owner to a
vessel of this size it was purchased by a small group of individuals, some of whom were employed
at KTH.

The ship was re-christened the R/V Altair, the Anglo-Saxon name for the star Atair. The then
President of KTH Janne Carlsson gave his permission for the ship to be used for KTH research.
A prominent businessman Eric Malmsten of Djursholm donated SEK 150 000 for the operation
of the ship over three years.

On 15th June 1988, the R/V Altair located the wreck of the passenger ship the S/S Hansa that
had been torpedoed by a Russian submarine in 1944 on its way to Visby with 84 people on board,
there were only two survivors (see “Den torpederade gotlandsbåten Hansa” Roger Bengtsson,
Höganäs1992). On this occasion a more modern sonar made by EG & G and borrowed from
Uppsala University was used as well as the vessel’s own Decca navigation equipment. The S/S
Hansa was located seven kilometres from its official position at 108 metres depth, split in two
halves.

After the successful location of the S/S Hansa we were considering what the next project for the R/V Altair could be. At this point in time certain amount of public interest had been generated concerning the fate of the DC-3. A book had been published by Kenth Ohlson (“Catalinaaffären – Nytt ljus över svenskarnas försvinnande” Lund 1987). An article in a local newspaper stated that a plane had been found in a bog in Latvia which could be it and the national newspaper Expressen printed blazing headlines “DC-3 found!” The Raoul Wallenberg Affair (a Swedish diplomat “disappeared” by the Russians) was also a constantly recurring subject in the press at that time.

One opinion often expressed was that the DC-3 had been forced down in the Soviet Union. Witnesses who maintained that they had seen Wallenberg alive also appeared in the DC-3 affair as they said that they had spoken to, or heard of, Swedish flyers in Soviet prison camps. If the DC-3’s location at the bottom of the Baltic could be found, these witnesses would also be discredited as concerns Raoul Wallenberg. Everyone in our group was convinced that the DC-3 was at the bottom of the Baltic as radio traffic had been broken off suddenly during transmission. We felt the plane would be relatively easy to locate – which turned out not to be the case!

Roger Bengtsson at Swedish Radio’s Science Section had been involved in the Hansa project and now showed great interest in searching for the DC-3 and was also able to organise some financing. Lars Porne from the national newspaper Svenska Dagbladet also shared our interest and arranged the rest of the funding through his paper. These contributions made it possible for the R/V Altair to initiate the first search for the DC-3 after 37 years of silence.

5. THE SEARCH

Bengt Grisell

When KTH initiated its search for the DC-3, the Soviet Union had not yet admitted shooting it down. There was no further information available except for the Swedish Accident Investigation Board’s report from 1953. The DC-3 incident was entitled “The Catalina Incident” after the sea plane that had been shot down during the search operations for the DC-3. The Swedish authorities had not yet officially admitted what the DC-3 was really doing which was signals intelligence. Sometimes it was inaccurately referred to as a “spy plane” which was an insult to the families of the lost crew. Signals intelligence is a legal activity according to international law, which spying is not. It was not until February 1992 that the Swedish Ministry for Foreign Affair’s report was published including some new material.

First search – in the right place

The point of departure for the search tactics for the summer of 1989 was the point where the life raft had been found by the destroyer Sundsvall on 15th June 1952 at 08.27 a.m. At that point in time the life raft had been drifting for approximately 45 hours. The position of the life raft that was stated by the Sundsvall was considered to be inaccurate. The investigators in 1953 estimated this inaccuracy to 0.5 nautical miles. Today we can state that, on the 29th June 1952, Flight Engineer Gösta Zetterquist had calculated the life rafts drift to a position that is extremely close to the location of the wreck (see Annex 1).

At the request of Roger Bengtsson of Swedish Radio, SMHI made new calculations of the data concerning the life raft’s drift path using modern calculation models. These models had primarily been developed for oil slick drift forecasts and require information on the depth of the floating object, i.e. the size of the oil slick. The question is, did the raft float like a “package” on the surface? Or did it move as it was found; opened but not inflated and riding deep in the water? The answer is probably both. We will never know. The uncertainty of the drift path of the life raft is consequently great as almost two days passed between the crash and the pick up.

Roger Bengtsson calculated the drift path – and consequently the primary search area – based on wind information from several sources including search operation vessels in 1952, the Gotska Sandön lighthouse station, SMHI and statistical information on currents (see Chapter 6).

We felt that it would be possible to locate the plane but it would take time. Our optimism proved to be ill founded. The search began on 21st May 1989 at 5.20 p.m. and was concluded at 10.10 a.m. on 25th May 1989, a total of approximately 72 hours not including when we were forced to break off due to bad weather and seek shelter by Gotska Sandön. Approximately 308 square kilometres had been searched. According to the sea chart the depth in the area should be between 69 and 123 metres. However we found sites that were 140 metres deep. Today we know that the plane was actually within this primary search area.

Alternative theories

As previously mentioned, the Soviet Union had still made no admissions concerning the actual incident. It was not until much later in the 1990s that a partial description of the shooting down was received from the Russian side. As we saw it then there were several, equally plausible, scenarios concerning the plane’s position.
The life raft
The main alternatives were that the life raft was ripped from the plane when it hit the water. This meant that the search area was determined using “backwards calculations” of the drift path from its find position. However, it was not 100 percent certain that the raft was separated from the plane at the crash point. It could have left the plane before it hit the water. The door could have been shot off in the attack at four thousand metres up and the raft could have broken free then. One of the plane’s two life rafts was stored just inside the door. Someone could even have thrown the life raft out perhaps with the intention of using a parachute to jump. Or the raft was thrown out because it caught fire and was giving off smoke - examination had shown that shell splinters had hit the raft. If this last alternative were true then the plane could be literally anywhere.

Gotska Sandön
One possible crash location was close to Gotska Sandön. Several oil slicks had been reported from around the island in the 24-hour period after the crash. Dives and sea bed searches were carried out in 1952 because of these sightings. At least five independent witnesses on Gotska Sandön had, on the same day as the incident - in fact at the actual time of the incident - observed a plane that could have been the DC-3 circling the island. In addition a Finnish seaman had observed a plane flying low by the island on the same day and reported this to the ship’s captain on arrival at Helsinki. Fishermen had also reported net finds of aluminium parts of a plane from the area around Gotska Sandön. Taking this information all together we could not exclude the scenario that the wounded plane first found Gotska Sandön in an attempt to make it home to Bromma Airport. Alternatively the plane could also have continued towards Fårö where Bungefältet was an identified emergency landing field.

After the wreck was located in 2003 it became clear that the “Sandön plane” cannot have been the DC-3. The investigator appointed by the Commander in Chief, Colonel Rolf Gustafsson, feels that this was a similar Soviet reconnaissance plane. Russia has not yet confirmed this information.

Why did the plane not register?
The EG & G 260 sonar equipment was borrowed from the Dept. of Physical Geography at Uppsala University or the Marine Geology Department at Stockholm University, whichever was available. On this occasion we were allowed to borrow the equipment from Stockholm University. Unfortunately whether it registered anything around the location of the wreck, and if so what, is impossible to say today as the printout from this expedition (which amounted to several large boxes’ full) has been lost, probably thrown out. We have moved premised five times within KTH since then.

One of the main reasons why we failed to register the wreck could have been that the cable to the sonar’s “fish” was too short. As we had borrowed the sonar we only had a standard cable, 50 metres long. Stockholm University had a longer cable (150 metres) which was not available to us as it was permanently attached to a winch on their research vessel the Strombus. Consequently we had purchased an eleven millimetre, 150 metre long steel wire cable for SEK 30 000, which was a considerable sum to us, and mounted it on the Altair’s aft cable drum. Our strategy was to plan for a broad search area in a relatively short period of time which required the Altair to move through the water at relatively high speeds. However this high speed meant that the cable and “fish” were lifted by the drag effect and consequently dragged too high over the sea bed. We would have preferred a cable of at least 400 metres considering the search speed we selected and the search width we applied in the area around 125 metres deep.
10. Sonar picture of a wooden wreck registered using a 50 meter cable when depth was less than 80 metres and the sea bed flat.

**Cable too short**

When a side scan sonar is used to search for wrecks, the “fish” should be pulled along the sea bed for approximately 20 percent of half the total search width. With a search width of 200 metres to one side, the “fish” should be dragged 40 metres above the seabed. Low search height above the seabed creates a drag shadow which is extremely valuable as concerns locating and identifying wrecks of vessels which usually show a relatively high profile. The shorter the distance from the sea bed the longer and clearer the shadow of objects that stick up becomes. If the sea bed is comparatively flat, an even shorter distance from the seabed further improves discovery chances.
We assessed that a crashed, low winged DC-3 would show an extremely low sonar profile as it was probable that the wings would be resting on the seabed and the body of the plane was only three metres high. Our compromise between probability of registration and desirable size of search area meant that we breached the rule of thumb concerning search height over the sea bed.

At the same time we put our faith in the abilities of the sonar. As we were using sound waves the strength of the reflected sound pulses also showed the hardness of the seabed, which mostly consisted of glacial mud. The plane’s harder surface of aluminium was expected to produce a contrast picture of the plane against the softer seabed, even if it was registered from above. We assumed that the plane was relatively intact as no identified parts of the wreck, except the lifeboat, had been found. Consequently we had hoped that the plane would be found even using a relatively high search height above the seabed. This method had been used successfully in other plane search expeditions abroad.

A reflection; with KTH’s current sonar (Datasonic Chirp) and a 250 metre cable we would have been able to register the plane to a high degree of certainty.

11. A successful side scan sonar picture from KTH’s new equipment.

From Decca to GPS

In 1989, one of our greatest difficulties was that there was no affordable satellite-based GPS system on the market to assist with positioning. Neither did we have electronic sea charts or map plotters. We had to use the Decca system (radio long wave) whose “fixed errors” gave an accuracy level for point positions of fifty metres as a best case scenario. At certain times of the day the error could be more than one hundred metres.

With the Decca and a gyrocompass it was however, possible to steer with precision and search according to a sufficiently accurate pattern. The replicability of Decca positioning – i.e. coming back to where you started – was sufficiently good. It was not until the following year, 1990, that a satellite navigation system (a Raytheon costing SEK 22 000) was purchased. Plotters with electrical sea charts had to wait a few more years.
Conclusions

- Our search area was correctly calculated in all aspects.
- Unfortunately our combination of technology and method were not sufficient to locate the wreck.
- Our search in 1989 is the first, known attempt to locate the DC-3 after 1952.

12. The blue areas show the R/V Altair’s search areas between 1989 and 1992, the green areas show where the Navy searched while the red areas (the red circle) have not yet been searched.
Roger Bengtsson

Background – first some personal reminiscences
On 12th June 1952 – the day before the DC-3 was shot down – I experienced my first end of term celebrations. Class 1 of primary school was over and we celebrated in the school yard with all the classes lined up in ultra straight lines, flags, lilac and the special summer song, tramped out on the school's asthmatic organ. I was just eight and I attended Riksby Folksskola in Bromma.

This school is located a few hundred metres south of Bromma Airport and the woods between the school and the Airport fence were where we played. If we ate our school lunch really fast we boys just had time for a quick visit to the Airport where exciting things happened almost all the time. Just close to our vantage point there were some barracks, and if we were really lucky a plane would be parked by them!

It was not until the end of the 1980s when I began to take an interest in the missing DC-3 that I realised that one of the planes I saw there as a boy in 1952 could have been the Swedish Air Force’s TP 79 001 as it was based at Bromma, and its parking position was exactly by 6th Transport Group barracks. The fact that the small boys of Class 1b were actually unintentionally engaged in “illegal intelligence gathering” in June of 1952 is hopefully a crime no longer actively on the books as I describe this memory!

Of course I will never know if one of the planes I saw really was the actual DC-3 in question.

The truth about another memory from that period will also never be known: just a few days before end of term on the 12th, and the incident on 13th June in 1952, my mother and father and I took an outing by car to Drottningholm Palace. The exact point in time is easy to establish thanks to my mother’s diary. Just when we had crossed Drottningholm Bridge I saw a group of grownups, happy and enjoying life, sitting in the sun just in front of the restaurant. The ladies were wearing light summer dresses and the men their Air Force uniforms – a fact that a wide-eyed, flying-crazy eight year old noted with excitement.

When I, as an adult, was collecting material as preparation for the search I met Ulla-Britt Blad – wife of the lost navigator Gösta Blad – and we fell to talking about the period just before the incident. Ulla-Britt told me about a happy event around a week before the disappearance. Gösta and some of his Air Force friends had organised an outing to Drottningholm together with wives and girlfriends. After lunch at the restaurant the group had settled on the lawn in front. I asked: “Were the men in uniform?” Ulla-Britt answered: “Of course they were! And us girls looked wonderful in our summer dresses!”

Background
After the S/S Hansa was located and explored in 1988, the Altair Group began to search for the DC-3, Air Force TP 79 001. The Soviet Union had then yet to implode or to admit their part in its disappearance, these events did not occur until 1991/92. The work of locating the aircraft was undertaken against a background of strong scepticism from certain established historians, journalists, employees of the defence forces and others (a long list). Theories and assumptions about what had happened to the plane and its crew were legion.
Rumours and conspiracy theories continued even after the Soviet admissions – and will probably continue to do for ever. Examples: The DC-3 was forced down in a Baltic state... It is buried in the mud at the bottom of a lake outside Riga... The crew were picked up on the surface by a special ship... It was pulled along the seabed by a sub-marine... The crew were alive and living in a prison camp in Siberia together with Raoul Wallenberg etc. etc. Not least some of the crew members’ families contributed to the steady stream of new theories, efficiently disseminated by ignorant megaphone journalists and editors.

Calculations before the search
I calculated (document dated 16th May 1989) a drift path for the only, positively-identified, part of the plane – an opened but not inflated life raft. My calculations included:

- Basic data from SMHI’s computerised oil drift forecast programme which gave a certain idea of the uncertainty of spread. However no meaningful positions were identified from the spatter of buckshot that appeared across SMHI’s large-scale overview without coordinates or useful references.
- Historical weather calculations for the area east of Gotska Sandön for the period in question from the Marine Forecast Service at SMHI.
- Wind records from Gotska Sandön, reported without the help of measuring instruments but with the help of considerable experience (by the lighthouse keeper Gunnar Hörlin etc.)
- Log books including wind observations from 4 - 5 vessels participating in the search operations in 1952.
- Drift path tables from IMO (International Maritime Organisation) and Stockholm Radio MRCC (Maritime Rescue Coordination Centre), complemented by the Coriolis Effect.
- Statistical current charts of the Baltic Sea.

The decisive tactical issue was: in what condition did the uninflated life raft drift for 45 hours? As it was found? That is totally unpacked and in a vertical position, sunk under the surface of the water? Or was it still packed and, like a parcel, partially floating on the surface of the water? These two variations each produce drastically different drift paths: if the object is above the surface of the water will it be primarily affected by the wind and the surface currents? Or was it totally sunk under the surface of the water and driven by SMHI’s calculated background currents?

SMHI reports direction differences in its oil drift forecasts based on differences in depth of object in centimetres. How deeply did the raft float and what was its wind-facing surface? I assumed a “continuously developing” life raft during its drift period. The variables I selected proved to be – with hindsight – a drift path very close to reality with a difference of only one or two degrees. The wreck lay approximately 1 M (one nautical mile = 1 852 metres) east of the drift path I calculated in May 1989 (approximated to a straight line).

My shortest calculated drift distance for the life raft was 10.0 M. Its maximum distance was estimated at 15.0 M. The real drift distance proved to be 10.5 M, which gives the raft an average speed of 0.24 knots.

The position of the wreck – as shown by Marin Mätteklinik location – lies within the Altair Group’s primary search area, mapped and searched during the first 48 hours. In the search report it is stated that the R/V Altair, on 23rd May 1989 between 16.24 hours and 17.47 hours, searched using a side scan sonar (EG & G) between latitudes 58°25´ and 58°18´ going south along longitude 20°17.50´. One engine with propeller was found at latitude 58°23.549´ longitude 20°17.518´.
A discussion on why the Altair did not succeed in registering the wreck in 1989 is included in the chapter on Altair Group activities.

I reported to the Defence Force about the expedition in May 1989. In this report it is stated that the Altair, using its side scan sonar – within the primary search box of approximately 3 x 5 M where the plane is located – detected that an anthropogenic (non-natural) object was at approximately 140 metres depth. As the paper-based material recording the registration has not been preserved, speculations are meaningless as concerns what may have been registered and exactly where it was registered.

After the location of the wreck in June 2003, we know that the theoretical assumptions of the Altair’s first search expedition in May 1989 were applicable.

**Conclusions**

- Our search strategy in the form of the calculated search area was correct. However our search technique and technology were faulty.
- We assumed that the plane would be relatively undamaged and would give a clear echo. The search width was adapted to large-scale plane parts of at least five metres in one direction. This assumption was correct.
- We prioritised a large search area rather than searching each area twice with a narrow search width and crossed paths.
- Were we sailing right over the wreck just when the sonar was performing at its weakest? The GPS positions of the wreck parts tend to be collected along our search longitude 20°17.50’.
- Did we sail too fast – approximately 5 knots – so that the “fish” was dragged too high over the seabed to produce interesting echoes? Our cable was definitely too short – only 150 metres – in an area of great depth.
- In spite of the lack of map plotters and GPS, the precision of the Altair’s positioning was sufficient. The Altair was positioned using a figure display Decca and steered using continuous micro-adjustments of the autopilot connected to the gyrocompass. The positioning should have been sufficient thanks to well-overlapping search paths.
- In 1989 I estimated that the probability of finding the plane – according to our assumptions and with available equipment – to between 50 and 75 percent. Today I am prepared to decrease that figure.
14. Primary search area.
15. Primary search area clarified.

Discussion on various proposed search areas

SMHI’s initial drift path calculations – on which the Navy’s search expeditions between 1991 and 1996 were partially based – place the centre of the search area at between approximately 11 and 20 km east and southeast of the wreck. The variation in distance depends on the selection of the variable “ΔZ” that SMHI leaves open for interpretation. (It is connected to the unknown depth float of the life raft).

SMHI’s later calculations (ordered by the Commander-in-Chief and dated 18th October 1991) stated a search circle with its centre at latitude 58°24´ longitude 20° 26´ with a radius of 10 km. This search circle is in agreement with SMHI’s initial calculations; the drift path passes through the centre of the circle.

The area of the circle was supported by radar analyst Gunno Gunnvall at the beginning of the 2000s who, in his report of 23rd March 2000 (HKV MUST Radarund) (Swedish Armed Forces Head Quarters, Military Intelligence and Security Service, Radar), recommended a search within SMHI’s “red circle” starting from the west. By then Gunnvall had complemented previous material with an in-depth analysis of the Soviet radar material (see Gunnvall’s chapter). The distance between the centre of the circle (10 km radius) and the wreck was approximately 4.5 M i.e. 8.3 km. Consequently it lies within the circle and almost due west of the circle centre.

Analysis: the “SMHI red circle” includes a surface area of 314 square kilometres. MMT’s (Marin Mätteknik) vessel the Triad searched, according to information received, a total of 711 square kilometres for a period of 46 project days before locating the wreck.
Perspective on surface area of circle: MMT would theoretically have needed around 20 days to search the entire circle, 10 days to look at the western half. Circle-formed search areas are not appreciated by the crew carrying out the practical work on deck – they prefer the minimum of time-consuming changes of direction, the opposite of which applies when searching in a circle formation.

The Navy’s searches
I participated – as consultant search technician – from the initial search in 1992 and in several of the Navy minesweeper's total of eight expeditions. Initially, the areas already searched by the Altair were regarded by the Navy as “less hot” and the search area was extended and complemented with other strategies.

Net finds by fishermen, the description given by the Soviet pilot, the search operation’s find reports – including the oil sightings and “yellow objects, probably the crew” – and the theory about the “Sandön plane” caused the search area to primarily be extended west from the estimated point where the shooting took place – please refer to the discussion under the heading “Other theories”.

At this time Captain Lars Flemström – navigator of the Air Force rescue helicopter (FRÄD) (Air Force Rescue) – contributed to the search scenario; including an assessment of the shoot area and search techniques around the Gotska Sandön hypothesis.

The Navy commanders’ clear doubts about searching at great depth – over 100 metres – contributed to the fact that the easterly limitation line became longitude 20°15.00´ as depths increase rapidly east of this point. The equipment on the minesweeper was, for obvious reasons, not designed to operate at that depth. Neither were the Navy’s fixed sonars the most suitable equipment to use for searching large surface areas. Temperature layers in the sea mostly cause the problems. However the Navy was very close: the northeast corner of their search box 7:4 is only around a nautical mile from the wreck. The minesweeper had even planned a search box covering the wreck’s position – but was forced to break off when ordered to by the Commander-in-Chief.

Another expedition has probably searched at – or close to – the position of the wreck. In the early 1990s, Lasse Ljung’s Gotland-based ship Vega reported an interesting formation on the seabed in a position approximately 3 M northwest of the DC-3. They had no underwater camera so the position was submitted to the Navy. It is not known whether the Navy ever actually examined the position.

The Triad had, however, later been able to establish that this wreck was a 45 meter Russian submarine from WWI – sunk into the seabed so that size-wise it was the same as the DC-3. I am not aware of the motives that lay behind the Vega’s search. Perhaps they had gained inspiration from the report on the Altair’s operations that I had submitted to the Defence Force/Frank Rosenius. This report was classified as non-confidential and was copied by a journalist who was known to be connected to the Vega expedition.

Since the location of the DC-3 in June 2003, media have repeatedly stated that “everyone else was searching in the wrong place”. I hope that the fact that this is not a reflection of reality is clearly demonstrated by the summary presented above.
Roger Bengtsson, Engineer, scientific journalist and desk sailor

The ALTAIR Group 1988-1992

This text was updated in May 2005 and after the Marin Mätteknik group located the wreck of the DC-3 in June 2003.

17. R/V Altair's search area with position of DC-3.
7. DC-3 IN THE NEWS AGAIN

Bengt Grisell

Interest in the DC-3 was again generated in the autumn of 1999 after many years of silence. Once again KTH was contacted by relatives and media in order to encourage a resumption of the search. New information had been received that meant renewed search had become extremely interesting. KTH was contacted by one of the crew’s relatives who wondered if we were interested in resuming our activities (see Annex 2). Around the same time Peter Bratt published an article in the Sunday magazine of the Dagens Nyheter newspaper. In addition, a private individual who was interested in the matter contacted KTH. He was himself a pilot and had developed a new theory. He was sure that the DC-3 hade attempted to limp into Bunge on Gotland so that its probable crash site was southwest of Gotska Sandön.

Peter Bratt contacted KTH with information that he considered to be from a serious witness. From this the probable crash site was northwest of Gotska Sandön. KTH decided to resume its search with the R/V Altair and began work in the summer of 2000. Due to poor weather and new witness statements, the search period was prolonged which was made possible by the fact that most participants on board the Altair worked on a voluntary basis.

2000

In the summer of 2000, new searches for the DC-3 were financed by Dagens Nyheter (DN) and TV 4 after discussions the previous year. The search and its area were based on new, more detailed information from Russia concerning the area of the attack. One especially interesting piece of information was that one of the DC-3’s engines had been on fire. This meant that the scenario located around Gotska Sandön became less probable.

The plane observed by reliable witnesses on Gotska Sandön at the point in time when the DC-3 disappeared and which could have been the DC-3 was now suspected of being a Soviet plane, for example the PS 84 (Li2), which is a Russian version of the DC-3. This meant that the area around the official crash site became increasingly interesting. If we accepted the information that one of the plane’s engines was on fire and that it disappeared diving steeply into clouds at 4 000 metres on a westerly course, then the entire possible search area was decreased by more than 90 percent. This meant an enormous difference as concerns financial and time inputs necessary to locate the wreck of the plane.

The Altair left its home port on 5th June and began its sonar search in the morning of the following day, finishing activities when night fell. For the following ten days the searches could only be carried out for a limited period of time and the search was broken off and the Altair returned home due to bad weather conditions on 16th June.

The Altair was locked in the harbour of Fårösund by the extremely inclement weather. While we were there we received a visit from the Regional Inspector of the Coastguard, Jan Johansson. He told us that in 1997 he had reported an interesting find to the Ministry for Foreign Affairs. In 1990 a fisherman named Harry Nygård, working on the fishing boat the Krutsand, stated that the body of a plane had come up in their trawler nets and that from its size it could very well have been the DC-3. As the body of the plane could destroy their nets due to its size, they were forced to cut it loose and release it back into the sea.
After this extremely interesting information it was decided to search the area where the fisherman said that the plane body had been dumped. The Altair left its home port on 2nd July and began searching with an echo sounder in order to find the underwater ridge where the Krutsand had picked up the plane. Then a sonar search was initiated. No interesting indications were registered. The Altair returned home on 16th July.

The search period was extended due to the poor weather conditions and the new information which was assessed as extremely interesting. In spite of this increased search area, there was no trace of the DC-3. Positions were unfortunately extremely vague as Harry Nygård was not involved in navigation on the Krutsand. One area considered promising was searched by sonar, almost 140 square kilometres.

In an article in DN on Saturday, 8th July that year (2000) a map was published showing the areas searched by KTH and the Navy. On this map the recent, most interesting area was shown as a circle and, in error, as already searched. Actually this was an area that was planned for searching. This area had been developed and identified as extremely interesting by the radar expert Gunno Gunnvall. The area in question had been based on new radar calculations made by him using his and SMHI’s later calculations.

He recommended that we should search in the red circle (314 square kilometres) beginning from the west (see Annex 3). Several years later reality would show that the DC-3 did actually lie in this circle. After all the articles about the DC-3, the new chances of locating it plus media interest and opportunities for financial sponsoring, as expected new tips on where the plane might be also arrived. One person, with a background in the Air Force, asserted that they had picked up flyers with yellow life jackets on the same day as the incident south of Gotland. A diving group in Gävle stated that they had found information in the Ministry for Foreign Affairs’ archives that showed exactly where the plane was located. For this information – they would charge us one million SEK! Everyone who studied the Ministry’s archives, and there were lots of them, knew that this was a fairly tasteless attempt to make easy money, especially considering the reason we were trying to find the DC-3.

2002

In an article in Svenska Dagbladet on 15th June new calculations carried out by Gunno Gunnvall and others were published. They were based on his analysis and summary made on 23rd March 2000. This was, in principle, the information I had previously received from Gunnvall by letter on 27th April 2000. A map included in the article showed the area in question in the form of a circle with a radius of 10 kilometres and a centre at position latitude 58° 24´ and longitude 20° 26´ (314 square kilometres). This circled area was also published in Dagens Nyheter on 9th June 2000.

After discussions with Gunno Gunnvall and others involved in November 2002, we realised that to a great degree of certainty, the wreck was located within this circle in its westerly half. As the most westerly part of the circle had already been searched in 1989 (see Chapter 6), we intended to search in the eastern half and work our way west as this was virgin territory. With hindsight we know that the plane lay far to the west in an area we had already searched.
Gunno Gunnvall made a proposal for a request to the Prime Minister’s Office for search funding on 3 December 2002. At the same time we took a decision to contact the families of the crew of the DC-3 in order to ask them to sign a letter in which they expressed their hope that the search would be resumed due to the new information that had come to light. A request to the Prime Minister’s Office, based on Gunno Gunnvall’s proposal, was submitted in February of 2003 signed by the President of KTH, Anders Flodström, and the leadership of the Underwater Technology Department at KTH (see Annex 4). Annexed to this request were signed requests from; Ulla Britt Blad, Ingrid Inga Bok, Sigrid Carlsson, Karin Lisshagen Johnson, Birger Lisshagen, Annika Lisshagen, Birgit Nilsson, Siv Svensson and family, Roger and Britten Ålmeberg, Eva Ålmeberg (see Annex 5) – all relatives of the missing crewmen.

We were now extremely optimistic about the preconditions for finding the DC-3 in the newly identified area which had decreased radically down to around five-seven percent of the previous area. We went to the press and I said “I am convinced that the DC-3 is here somewhere” indicating the “red circle” (Gotlands Tidningar, 31 October 2002).
In reply to our request to the Prime Minister’s Office, which was submitted around 19th February we received a refusal from the Ministry of Education (see Annex 6). In reply to this refusal Gunno Gunnvall wrote a letter to the Prime Minister Göran Persson in which he stated his criticism of the processing of the matter (see Annex 7).

In an article the families of the crew stated their anger at how the government had dealt with the matter and at the government’s reluctance to contribute SEK two hundred thousand to the search (Svenska Dagbladet 25th May 2003). After this disappointing decision, a private individual named Henry Thunholm, in cooperation with Mikael Holmström from Svenska Dagbladet, expressed their intention of establishing a committee aimed at fundraising in order to be able to complete the search of the red circle.

On 10th June 2003 the DC-3 was located. A group cooperating with the Marin Mätteknik company of Gothenburg had, through a private initiative, begun searching the red circle. The numerous previous searches done by others had finally produced a result. By excluding areas previously searched, the red circle became the centre of attention. The DC-3 was found in the red circle which was made public much later. Finally our search was over; it was a great relief for many people but especially for the family members who had waited for this for more than fifty years!

With hindsight it could be said that it is a little unfortunate and puzzling that a private initiative was necessary in order to bring resolution to a national trauma in which the state was involved at all stages. Several government authorities had been in possession of all the necessary resources to find the plane for the previous ten year period.

As the government took a decision to recover the DC-3, KTH offered to help with a relatively new freeze dredging technique in order to secure forensic evidence during the operation (see Annex 8). This offer was rejected by the Navy as the specialist group appointed for the task considered that the use of this technology was totally unrealistic. However this technology was later used to recover objects that were located outside the plane (see Press Release in Annex 9).
8. AFTERWORD
Bengt Grisell

Directly after the DC-3 crashed, Gotska Sandön became interesting due to the fact that an oil slick, four hundred metres in diameter and spreading, was discovered almost immediately after the incident. An extensive examination using a cable drag and hard hat divers was carried out for several days afterwards without being able to explain how the oil slick had occurred. In addition, five witnesses on Gotska Sandön had seen a plane that could have been the DC-3, circling the island. These indications meant that most people were sure that the plane had crashed south of Gotska Sandön. This was unfortunate as the position of the life raft and the calculations of its drift path and crash site were consequently not awarded the same amount of importance. After fourteen days the search was abandoned.

When KTH initiated its search for the DC-3 using the R/V Altair in 1989, the possible crash area was considerable. The area had very few borders and could include the entire sea area from Kopparstenarna in the west, Gotska Sandön all the way to the position of the life raft when it was found. Several aluminium parts had been found in trawlers’ nets within this enormous area, which misled the search somewhat. The advantage of carrying out those innumerable hours of fruitless search was that certain areas could then be removed from possible areas.

The Gotska Sandön scenario became totally uninteresting after November 1991, when the Soviet pilot described how he had seen the DC-3 dive steeply into cloud cover at 4 000 metres with one engine on fire. This reduced the possible search area by 93 percent. After careful calculations by the radar expert Gunno Gunnvall, a circle with a radius of ten kilometres was constructed in which the DC-3 was assumed to lie.

In the spring of 2002 this was published in the Swedish press showing the areas searched by the Navy and KTH. The red circle became the centre of attention. KTH had searched this area in 1989 and 1991, however all the old and new information weighed together, plus new developments in underwater technology, rekindled interest in it. When the DC-3 was found, the question of why its position was kept secret for several months must also be asked.
9. THANKS TO EVERYONE WHO, IN THEIR DIFFERENT WAYS, HELPED TO LOCATE THE DC-3

The list of people who have contributed to the finding of the DC-3 is long. Through private initiatives, the disappearance of the DC-3 was kept in the public eye in spite of lukewarm support from authorities. Without the support of the many who voluntarily contributed their time and effort it would not have been possible.

The families of the crew members were the most seriously affected. In spite of the fact that the plane has now been found, several families are still living without knowing the fate of their loved ones. We hope that they may find a little comfort in the knowledge that many people have tried, with energy and commitment, to come closer to a solution to the mystery of what happened to the DC-3.
ANNEXES


4. Funding request to Prime Minister’s Office, KTH, 12th December 2002.

5. Request to Prime Minister’s Office from crew’s families included as an annex to KTH’s funding request of 12th December 2002.


7. Letter to Prime Minister of Sweden, G. Gunnvall, 22nd May 2003.


Livbätens avdrift
Beräknad för tiden kl. 11.25
den 13/6 — kl. 08.27 den
15/6 1952.

Avdrag av sjökart nr 7
Skala 1:500.000
(1 höjd med Gotska Sandön)

Livbätens avdrift har beräknats med hjälp av bifogade vinduppgifter, bilaga a; samt avdriftskurva enl. bilaga b (vinaström). Hänvisning till Coriolis-accelerationen har tagits genom ökning med 10° på vindriktningssvörden.

Stockholm den 29/6 1952

[Signature]

Flygningenör
The drift path of the life raft

Calculated for 11.45 on 13th June to 08.27 on 15th June 1952

North Part of Sea Chart No. 7
Scale 1:500,000
On a level with Gotska Sandön

The drift path of the life raft has been calculated with the help of attached wind records, (Annex A), plus a wind/current drift curve according to Annex B. The Coriolis Acceleration has been taken into account by a 10% increase in wind direction figures.

Stockholm, 29th June 1952

(Signed)

Gösta Zetterqvist, Flight Engineer
On 14th September 1999 I was at a seminar entitled “Guide to Russian sources on Swedish history during the twentieth century” at the Swedish National Archives. At one point a map of the search carried out by the Catalina seaplane before it was shot down was shown. The lecturer then handed over to Seppo Isotalo who went to the podium and described its route and discussed the DC-3 incident.

After the lecture I contacted Mr. Isotalo and he told me about the new information that had been supplied about the course of events leading up to the DC-3 being shot down. He asked me about the possibility of resuming the search from 1989, and I answered that we were prepared to do so if new indications appeared. He gave me the map of the Catalina’s route plus his name, telephone number and address. He also said that there was a relevant press release which he faxed to me some days later. He also rang me and engaged in long discussions with Bengt Grisell.

On 18th September one of the DC-3 crew’s family members – Karin Johnsson – rang Bengt Grisell and asked if he was interested in resuming the search. An article by Peter Bratt about the DC-3 incident was published in the Sunday supplement of DN around the same time.

The following week Bengt received a telephone call from Captain Anders Jallai who was interested in a cooperation project aimed at locating the DC-3. Bengt told him that new information had been received that would motivate the resumption of the search. Anders Jallai was also shown the press release.

On 28th September a meeting was organised onboard the Altair. The participants were Anders Jallai with two of his colleagues, Bengt Grisell and myself. They were interested in making a documentary about the DC-3 and videoing the plane on the seabed. Bengt suggested that they should begin by contacting the Russians for an interview. Then we made a joint decision to resume the search. Anders was extremely enthusiastic and had a theory about the flight path of the DC-3. He was convinced that the plane had attempted to make it to Gotland (Bunge) after it had been hit. The crash site was consequently south of Gotska Sandön. He was convinced that the DC-3 lay on a 70 metre sandbank located southwest of Gotska Sandön. He based his ideas on the fact that he was able to put himself in the shoes of the Captain of the DC-3 as he was a flyer himself.

I explained that we had carried out extremely extensive sonar searches around all of Gotska Sandön without finding anything resembling a plane although several wrecks of ships had been found. If the plane had crashed in this area, it had probably been buried in the sand which had, in fact, happened to the wrecks of ships around the island. After this meeting, Bengt Grisell gave all his documents to Anders Jallai who intended to continue his research.

At the end of October, Peter Bratt contacted Bengt Grisell concerning the searches and a meeting was arranged at KTH. Anders Jallai and I participated. Peter Bratt had a map with him on which the DC-3’s route had been marked according to the latest witness statements. Peter Bratt felt that the witness was credible and that the probable crash site was northwest of Gotska Sandön. No previous information had indicated this area.

At the meeting it was decided that Peter Bratt would ask his employer (the newspaper) to contribute financially (SEK 100 000) to a search by the Altair in the spring of 2000. Peter Bratt gave the map to Anders Jallai who put it with the other documents. After this, three more meetings were held at KTH.

On 22nd November Bengt Grisell presented a letter to Peter Bratt that was addressed to DN plus a specification of the Altair with equipment and a list of expedition participants and their CV’s.
Anders Jallai had placed several conditions on his participation in the expedition. He had demanded that he be leader of the expedition, in spite of the fact that he had no nautical qualifications or knowledge of the technology. We were prepared to discuss this but the financiers TV 4 and Dagens Nyheter (DN) refused to agree to his other demands for intellectual property rights to pictures and material from the search, and that anything found would belong to him personally. This was an unreasonable request as this material was the necessary incentive for interest and commitment from the media.

Consequently Anders Jallai withdrew from the project saying that he could not reach an agreement with DN and TV4.

Lorelei Randall
November 1999
Hej Bengt

Tack för saken. Tack också för facen jag fick i förrygd. Jag visste alltså inte att Du hade sökt i det området som täckte den västra delen av "SMHI:s röda cirkel".

Jag tror alltså att DC-3-an gick i vattnet relativt långt österut och detta av följande skäl:

1) SMHI:s beräkning av livbåters ursprungsläge
(5824/2026, radie 10 km öster om den röda cirkeln)


3) Den sovjetiska radarkartans plottäger visar ej att DC-3:an skulle ha rött sig västerut. Den sovjetiske jaktföraren har överkänning upptaget att han såg DC-3 an brinnande försvina brant (!) ned i molnen på västlig kurs (molnöversta bedömt 4000 meter). Vad han såg skulle dock kunna ha varit början på en spiralrörelse med snabbt minskande höjd varvid DC-3:an ej rött sig särskilt mycket västerut.

Min rekommendation kvarstår därför:

Sök vidare inom "SMHI:s röda cirkel" med början västerifrån


Vi hörs mera

Gunnar Gunnarsson
To Bengt Grisell
From: Gunno Gunnvall
27th April 2000

Dear Bengt,

Thanks for your hospitality. Thank you also for the fax I received the day before yesterday. I did not know that you had searched within the area that covers the westerly part of SMHI’s “red circle”.

I believe that that DC-3 hit the water relatively far to the east for the following reasons:

1. SMHI’s calculations concerning the original position of the life raft. (5824/2026, radius 10 km i.e. the red circle).

2. The interrupted radio signal which, according to the telegrapher at F2, must have been sent at 11.23 at the earliest, more likely towards 11.24. As this signal was transmitted on short wave, can the DC-3 have already been at a very low height? Just before it crashed?

3. The Soviet radar air surveillance’s plotted positions do not show that the DC-3 had moved towards the west. It is true that the Soviet fighter pilot stated that he saw the DC-3 disappear, on fire, in a steep! dive into the cloud cover on a westerly course. (Upper side of cloud cover estimated as at 4000 metres). However what he saw could have been the beginning of a spiral movement with rapidly decreasing height so that the DC-3 did not actually move much farther towards the west.

Consequently my recommendation remains:

**Continue searching within SMHI’s red circle starting from the west.**

I enclose copies of the two documents given to me by Roger Bengtsson which concern a possible wing at N5834.3 E 1928.0 (approx). Personally I do not believe however that this can be the DC-3 as it would have had to stay in the air for a period of at least 15 minutes after being hit. For the same reason I do not consider the plane over Gotska Sandön to be of interest. This may have been a Soviet reconnaissance plane passing low over the island.

We’ll be in touch,

(signed)

Gunno Gunnvall
Annex 4

Statsrådsberedningen
103 33 STOCKHOLM

Hemställan om medel för sökning efter den 1952 nedsjutna DC-3:an


Nu föreligger emellertid nya förutsättningar för ett framgångsrikt sökande. En fördubblad analys av de sovjetiska radartdata har gett vid handen att flygplanet står färdeväg i något ostligare och att

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det vid beskjutningen hunnit något längre norrut jämfört med tidigare bedömningar. Detta pekar mot att sökningen bör ske i ett område med tyngdpunkt cirka 70 km öster om Gotska Sandö. Detta styrks av de beräkningar som SMHI gjort avseende var den ovannämnda livflotten bör ha hamnat i vattnet.

En ytterligare förutsättning är att ALTAIR idag är utrustad med en av Wallenbergsstiftelsen bekostad sidan sonar som kan betrakta som det modernaste och effektivaste sättet att genomföra sökning i det aktuella området. Det förhållande att inget vrakgods hittades kan tyda på att DC-3:an gått i vattnet relativt mjukt och bör kunna återfinnas "i ett stycke".

Mot bakgrund av ovanstående hemställer undertecknade att Regeringen ställer medel till förfogande samt uppdrag åt KTH att under sommaren 2003 inom en kostnadsram av högst 200 000 kronor söka efter DC-3:an i ovan nämnda område.

Ovissheten om besättningens öde pågår fortfarande de anhöriga. I bilagan uttrycker de sin önskan att den föreslagna sökningen kommer till stånd.

Anders Flodström

Bengt Grisell, projektledare
Undervattensteknik
KTH
From: Royal Institute of Technology  
To: The Prime Minister's Office  

12 December 2002  

Request for funding for the continued search for the missing DC-3, shot down in 1952  

As is generally known a Soviet fighter plane shot down a Swedish signals intelligence plane on 13th June 1952 over international waters in the Baltic Sea. There were eight crew members on board; three from the Air Force and five from the National Defence Radio Institute. Some type of admission was made by the Soviet Government on 24th June that the plane had been shot down but that this occurred because Soviet airspace had been violated.

Two days after the disappearance of the plane a non-inflated life raft was found. It was established that this belonged to the DC-3 and that it contained shell fragments of Soviet manufacture. No further trace was found of the plane or its crew.

Over the years information has been received concerning the presence of “Swedish flyers” in Soviet prison camps which would indicate that at least some of the crew of the DC-3 survived and were captured. Requests for information have been made from the Swedish government. In 1991 considerable progress was made when a Swedish delegation visited Russia and was able to interview the pilot who shot down the DC-3. Documents were also supplied that described the course of the incident and how the Soviet air surveillance perceived the flight paths of the planes. On 18th November 1991 the Soviet Ministry of Defence published a statement in which it was admitted that “… the Swedish plane was shot down by a Soviet fighter plane over open sea 100-110 kilometres west northwest of the town of Ventspils. The crew members, in all probability, were killed.” The incident was considered to be a serious violation of generally accepted international legal norms, apologies were offered and deepest condolences were sent to the relatives of the crew.

During the period 1991-1995 the Swedish Navy attempted to locate the DC-3 several times. The research vessel Altair has, under the command of Bengt Grisell, been utilised for the search several times since 1989, unfortunately without result.

However now there are new preconditions in place for a successful search. A more detailed analysis of the Soviet radar data has produced information that the plane’s flight path was somewhat more easterly and that, after being shot down, it was farther north than was stated in previous calculations. This indicates that the search should be concentrated on an area with its centre approximately 70 km east of Gotska Sandön. This is reinforced by the calculations made by SMHI concerning where the previously described life raft could have hit the water.

A further precondition in place is that the Altair is currently equipped with a side scan sonar (financed by the Wallenberg Foundation) which may be regarded as the most modern and efficient method of implementing a search of the area concerned. The fact that no pieces of the wreck have ever been found may indicate that the DC-3 hit the water relatively softly and will probably be found in one piece.
Considering this background the undersigned requests the Government to allocate funding and to task KTH to, during the summer of 2003, search for the DC-3 in the area stated. Funding requested amounts to a sum of SEK 200 000.

Not knowing what happened to the crew has caused much suffering to their families. In the enclosure to this letter, family members have expressed their support for the proposed search.

(signed)
Anders Flodström
President KTH

(signed)
Bengt Grisell
Underwater Technology
KTH
Hemställan från anhöriga till DC-3:ans besättning

Undertecknade anhöriga till besättningen på den år 1952 nedskjutna svenska DC-3:an hemställer enträget att Regeringen verkar för att den av Kungl Tekniska Högskolan föreslagna sökningen kommer till stånd.

[Signaturer]

Pia Sjöberg
Lina Bladh
Frida Johansson
Irene Almberg
Ingrid Berg
Catarina Holmgren

Bengt Lisshagen
Berta Wiberg
REQUEST FROM MEMBERS OF THE FAMILIES OF THE CREW OF THE DC-3

All the following signatories are members of the families of the crew of the DC-3 that was shot down in 1952 who now solemnly request the Government of Sweden to provide the relevant assistance to KTH so that a new search may be carried out.

(signed)

Ulla Britt Blad, Ingrid Inga Bok, Sigrid Carlsson, Karin Lisshagen Johnson, Birger Lisshagen, Annika Lisshagen, Birgit Nilsson, Siv Svensson and family, Roger and Britten Älmeberg, Eva Älmeberg
Anm: Annan utbildningsdepartementet
Kungl. Tekniska högskolan
Anders Fredström
104 44 STOCKHOLM

Ansökan om bidrag till sökning av DC3

Ärendet
Kungl. Tekniska högskolan har ansökt om bidrag till sökning av en stortad DC3.

Regeringens beslut
Regeringen avslår ansökan.

På regeringens vägnar

[Signature]
Thomas Ostros

[Signature]
Max Kesselberg
From: Ministry of Education  
To: Royal Institute of Technology  

16th April 2003  

**RE: Application for funding of search for DC-3**  

Matter:  
The Royal Institute of Technology has applied for funding for the search for one DC-3 that crashed in the Baltic.  

**Government Decision**  
The Government refuses the request.  

On behalf of the Government  

(Signed)  

Thomas Östros  

Max Kesselberg
Annex 7

Gunno Gunnvall
2003-05-22

Statsminister Göran Persson
Statsrådsberedningen
103 33 STOCKHOLM

Angående den är 1952 av sovjetiskt jaktflyg nedskjutna svenska DC-3:an

I skrivelse daterad 12 december 2002 (kopia av skrivelsen bifogas) och ställd till Statsrådsberedningen hemställda Kungliga Tekniska Högskolan (KTH) att Regeringen skulle ställa medel till förfogande samt uppdra åt KTH att med forskningsfartyget ALTAIR under sommaren 2003 söka efter nämnda DC-3:a.

Skrivelsen kom dock ej att avsändas från KTH förrän i mitten av februari 2003; detta beroende på att man ville få med skriftliga värdanden från flera av besättningens anhöriga. Den bör ha inkommit till Statsrådsberedningen omkring den 19 februari.


Men önskvärdheten att klarlägga flygplanbesättningens öde är ju inget utbildningsärende. Skälet till att skrivelsen ställdes till Statsrådsberedningen var en önskan att frågan skulle bedömas på högsta möjliga nivå. På lägre nivå skulle kanske UD eller Fö varit rätt instans.


Jag bedömer att det nu finns goda möjligheter att återfinna vraket och att stöftet av åtminstone några besättningmedlemmar finns kvar ombord. Både av hänsyn till de äldrande anhöriga och för att kunna avskriva misstankar att svenska myndigheter undanhåller information anser jag det är önskvärt att vraket hittas så snart som möjligt. Vadjar alltså till Er herr statsminister att personligen ta ställning i denna fråga.

Högaktningssfullt

Gunno Gunnvall
Re: the Swedish DC-3 shot down by a Soviet fighter plane in 1952

In a letter dated 12th December (copy enclosed) addressed to the Prime Minister’s Office, KTH requested funding from the Government for the research vessel the Altair to search for the DC-3 during the summer of 2003.

This letter was not, however, sent from KTH until the middle of February as it was considered important to include a written appeal from several family members of the missing crew. It should have been received by the Prime Minister’s Office around 19th February.

According to a Government decision dated 16th April 2003 (no. U2003/773/UH) signed by the Minister of Education Tomas Östros, this request was refused. The fact that this matter had been passed over to the Ministry of Education must be because KTH reports to this ministry.

However, the wish to find out the fate of the crew of this plane is not an educational matter. The reason the request was sent to the Prime Minister’s Office was to ensure that the matter received consideration at the highest possible level. At a lower level then perhaps the Ministry for Foreign Affairs would have been the correct destination.

Who is then writing this letter? Some of my history in this field is shown in the enclosed clipping from Svenska Dagbladet. I have followed this incident for the greater part of my life (I was born in 1936) and have been employed at the Air Force Staff and the National Defence Radio Institute, as well as the Defence Staff and at HKV MUST where I was responsible for following up foreign flight operations around Sweden. I have worked on background information to Government when Swedish air space has been violated. I retired in 2001.

I now feel that there is a good chance to discover the wreck of the plane and the remains of at least some of the crew members. Both in consideration of the aging relatives of the crew and in order to be able to counter suspicion that Swedish authorities are withholding information, I consider it desirable to identify the location of the wreck as soon as possible. I therefore appeal to you personally Prime Minister to adopt a personal position on this matter.

Yours sincerely

Gunno Gunnvall
Teknik för bärgning av den år 1952 nedskjutna DC:an


Om regeringen beslutar att vraket efter DC:an skall bärgas har KTH under senare år utvecklat teknik som säkerställer kvalitén på bärgningen och därmed också den påföljande undersökningen.

I kortetet går tekniken ut på att man nedelst kylkompressorer fryster ned flygplanskroppen, och vattnet, till ca minus 10 grader. Beroende på den energimängd man tillför kompressorn, i form av alaström, tar detta ett eller två dygn. Man har då frusit ned hela flygplanskroppen (150 kubikmeter) och därmed också stabiliserat svagheter i konstruktionen som uppstått under femto år i saltvatten.

Fördelen är också att alla föremål och lämningar av de omkonna inte rubbas ur sitt läge under bärgningen, vilket kan vara en avgörande faktor för en meningsfull identifiering av besättningen samt utrönande av händelsesförloppet vid nedskjutningen.

Lyftkraften i vattnet, från det frusna vattnets lägre densitet är vid 150 kubikmeter ca 12 ton. Planet väger på botten ca 8,2 ton. Planet eller flygplanskroppen placeras vid bärgningen i en mindre flytdocka för vidare transport till en lämplig plats för en kontrollerad uppstigning samt påföljande undersökning.

KTH har utvecklat denna teknik i syfte att kunna genomföra säkra bärgningar av radioaktivt material, exempelvis marina kärnreaktorer eller andra för miljön och människans farliga substanser. Tekniken har redan kommit att användas vid bärgning av förgiftat sediment i sjöar och hav.

Jag vill del PM Frysteknik för bärgning under vatten, med tillägg.

Anders Flodström
Rektor KTH

Bengt Grisell
Undervattensteknik, KTH

Kopia till Överbefälhavaren
From: KTH
To: Government
2 July 2003

Technique for recovery of the DC-3 shot down in 1952

Since 1989, KTH has searched for the missing DC-3 shot down by a Soviet fighter plane in 1952. This search has been carried out periodically in cooperation with the Swedish Navy. We can now, with great satisfaction, observe that it has been found.

If the Government takes a decision to recover the wreck, KTH has, during the last few years, developed a technical method that secures the quality of the recovery and consequently all the following examinations and analyses.

Briefly the method means using cooling compressors to freeze the body of the plane, and the water, to -10°C. This may take one or two days depending on the amount of electricity that can be fed into the compressor. The entire plane body will thus be frozen (150 cubic metres) and any weaknesses in the construction that have occurred during 50 years’ of emersion in salt water will then be stabilised.

Another advantage is that all the objects and crews’ remains will be retained in position during recovery, which may be a decisive factor as concerns meaningful identification of crew members and reconstruction of the course of the incident.

The rising force necessary, in the water, from the lower density of the frozen water is approximately 12 tons at 150 cubic metres. On the seabed the plane weighs approximately 8.2 tons. After recovery, the plane, or the body of the plane, is then placed in a smaller scale mobile dock for further transport to a suitable location for controlled thawing and examination.

KTH has developed this technique with the aim of secure recovery of radioactive material, for example marine nuclear reactors or other substances dangerous to humans and the environment. It has already been used for the recovery of polluted sediment layers in lakes and seas.

Please examine the enclosed memo on freezing techniques for underwater recovery, with additions.

(signed)

Anders Flodström
President

(signed)
Bengt Grisell
Underwater Technology, KTH
Frysmuddring med massivt strömbehov

Bärgningen av DC 3:an


För en lyckad insats behövdes en rejäl extern kraftkälla för att klara av att driva fryskompressorena och inte minst för att klara av deras höga startströmmer. Vid start drar varje frysggregat 494 Ampe Totalt behövde vi en kraftkälla på minst 700 Ampere för att kunna starta det andra aggregatet men redan var i drift. I driftläge drar varje aggregat nämligen 200 Ampere.

HES

Den mest lämpliga kraftkällan var att använda Försvarsmaktens nyramtagna HES-system. Systemet går på 400 Volt/50 Hertz precis som frysggregaten och ett halvt system, dvs tre elverk och ett ställverk, räckte för att leverera 900 kVA (kilovolttampere).

Dessutom har HES-systemet funktioner för fjärövervakning av elkraftsystemet, påpekar FMV:s Per-Ove Holgersson som ansvarat för installationen av systemet samt för utbildandet av bärgningsfai Belos maskinpersonal. Från ställverket drog vi helt enligt ner en nätverkskabel till Belos maskinkomb att personalen där kunde ta del av all data från systemets operatorspanel.

Datainformationen som kan vara bra att ha koll på rör allt från spänningar, strömmar, effekter och d till bränslenivåer och motor- och containertemperaturer.

Om temperaturen i en elverkscontainerns skulle stiga över 45 grader så utfärdar systemet ett lar driftpersonalen, berättar Per-Ove. HES-systemet har goda kylegenskaper, så en hög temperatur skul på att något är fel.

HES-systemets elverk drivs av diesel. Den inbyggda tanken rymmer 1.200 liter och räcker för drift i 48 timmar med en extern extratank kan elverken tanka sig själva, men i detta fall valde vi att tanka manuellt från Belos egen bunkerbank en gång per dygn.

Den 22 april kördes frysggregaten igång ute på Belos. I själva startögonblicket använder sig HES-systemet alltid av samtliga elverk som är inkopplade till ställverket, i detta fall tre stycken. Efter starten känner systemet av hur mycket ström som behövs och stänger ner överflödiga elverk till standby-läge, för att automatiskt gå igång igen ifall något av de andra elverken skulle falla i detta fall gick ett av de tre elverken ner i standby-läge. HES-systemet har fungerat mycket bra, sågs Lundin.

Utdrag ur FMV nytt nr 2/2004.....

Publicerad: 2004-07-02
Freeze dredging with massive current inputs

The recovery of the DC-3

In June 2003 the Swedish DC-3 shot down in 1952 was discovered at a depth of 125 metres outside Gotland. When the complicated task of recovering the body of the plane had been completed the next problem was how to recover the parts and debri that had lain around the plane.

There were two possible methods. Either use manned diving vessels to clean off the seabed or freeze dredge it. The freeze dredging method was selected which consisted of sinking large metal plates onto the seabed and then freezing them down to minus degrees. After a couple of hours the seabed is also frozen to a certain depth. Then the plates are pulled up to the surface bringing with them all the sediment and debri that has been frozen to them.

In order to succeed in this process a large scale, external power source is necessary to manage the freeze compressors and not least to be able to deal with their high levels of starting current. At start each freeze compressor needs 494 Ampere. In total a power source of 700 Ampere was necessary to be able to start the second compressor while the other was operational. For operations each compressor requires 200 Ampere.

HES

The most suitable source of power to use was the Defence Force’s newly developed HES (high efficiency current supply) system. This system uses 400 Volt/50 Hertz just as the freeze compressors do and a half system, i.e. three electrical plants and a switchgear box were enough to deliver 900 kilowatt amperes.

“In addition the HES system includes functions for remote monitoring of electrical power systems,” states Per-Ove Holgersson of the Swedish Defence Materiel Administration who was responsible for the installation of the system, plus for the training of the mechanics on board the recovery vessel the Belos.

“From the switch gear box we simply ran a network cable down to the Belos machine room so that personnel there could read all the data from the system’s operating panel.”

Information that is good to know includes everything from tension, current and effect to fuel levels and engine and container temperature.

“If the temperature in one of the electrical plant containers were to exceed 45C, the system alarms the personnel,” says Per-Ove. “As the system includes efficient cooling, high temperatures would indicate that something was wrong. The HES is run on diesel and has an integral tank that holds 1 200 litres which is enough for a number of hours of operation. With an external extra tank the generators can fill up themselves but in this case we chose to fill them manually from Belos’ bunkers once a day.”

On 22nd April the freeze compressors aboard the Belos were started up. At the actual moment of starting the HES system used all the electrical plants connected through the switch gear box, in this case three of them. After start up the system registers how much current is necessary and closes down excess electrical plants to stand-by. So that they can automatically start up again if another plant fails. In this case one of three plants went into stand-by mode.

“The HES system worked extremely well.”

Extract from “FMV Nytt” no. 2/2004….

Published 2 July 2004