BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

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Sea Search Operations

The search operations for flight AF447 can be broken down into several phases:
• surface searches;
• searches for the recorders' underwater locator beacons (ULB) (phase 1 of the undersea searches);
• searches for the wreckage (phase 2 of the undersea searches).

The search zone was initially defined based on the airplane's route and its last known position. It covered an area of over 17,000 km^2.

The surface searches focused on possible transmissions from ELT[1] beacons and the localisation of floating debris. This led to the recovery of bodies and parts of the airplane from 6 June 2009 onwards.

[1]The airplane was equipped with three emergency locator transmitters (one automatic activation ELT and two manual activation ELT's). One manual activation ELT was recovered. Its switch was found to be in the OFF position.

A variety of acoustic devices were deployed in the zone to locate the airplane's Underwater Locator Beacons (ULB) between 10 June and 10 July (phase 1). These searches did not succeed in finding either the beacons or the airplane.

Another team worked in the zone to try to locate the wreckage with the aid of a side-scan sonar and a remotely operated vehicle (ROV) between 27 July and 17 August 2009 (phase 2). Despite these efforts, the wreckage was not located.

At the end of these two phases, an international working group was set up to prepare the third phase of the undersea searches, planned for the beginning of 2010.

Difficulty of the Searches

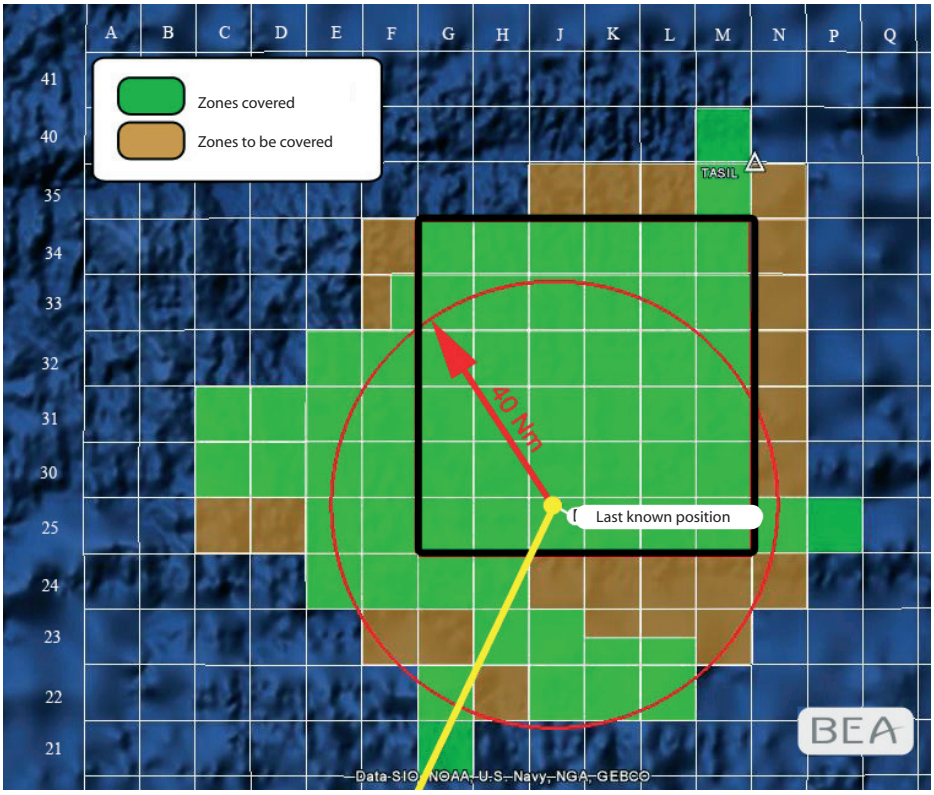
The first difficulty is the remoteness of the zone, which requires transits of the order of two to four days from ports such as Praia (Cape Verde), Natal (Brazil) or Dakar (Senegal).

The absence of any trace of the accident in the first days and absence of an emergency distress message and radar data complicated the searches. The environment is also very unfavourable since the search zones are above the Atlantic ridge close to the equator. This implies that the underwater terrain is rough, with great variations in depth over short distances.

The proximity to the equator affects the modelling of the currents in the estimated accident zone. The lack of available on-the-spot data and the complex oceanic dynamic (notably due to the seasonal start of the north-equatorial counter-current during the month of June) also make it difficult to model the marine currents. These factors contributed to making the reverse-drift calculations imprecise, added to which it was necessary to make them over a period of five to six days, which accentuated the gaps.

Description of Phases 1 and 2

At the end of thirty-one days of acoustic searches in phase 1, a little over 22,000 km had been explored by the means deployed in the zone, which represents proportionately about 74% of the zone to be covered (see following illustration).



Zones covered by the means used in phase 1

This result was mainly obtained thanks to the means employed by the French Navy and the US Navy. No signals were detected from the flight recorders' ULB's and no parts of the wreckage of F-GZCP could be located after the underwater observations of the sea bed.

For phase 2, the IFREMER towed sonar array (TSA) was installed on the "Pourquoi Pas?" ship in Dakar during preparation. For this exploratory mission to deep undersea sites, the "Pourquoi Pas?" was equipped with its multibeam echosounder, the towed sonar array, the Victor 6000 ROV and the Nautile submarine. This phase was concentrated on the squaring line (J-M 24), which had not been explored because of a lack of time. The bathymetry of the zone, made up of a plain and slight slopes, was compatible with the use of the TSA.

An area of 1,230 km^2 was covered during phase 2, completed by reconnaissance dives. None of the detections corresponded to airplane debris.

During this mission, a detachment of the French Navy Hydrographical and Oceanographic Service completed knowledge of the topography of the zone and carried out a complete bathymetry of the zone within a circle of 40 NM centred on the last known position.

Preparation of Phase 3 of the Undersea Searches

Because of the importance for the investigation of finding the wreckage, the French government decided to launch another phase of undersea searches. To prepare this third phase, the BEA formed an international group, to which it associated Airbus and Air France.

I. Set-up of the international group

The group comprises the following organisations:

- Air Accident Investigation Branch (AAIB, United Kingdom),
- Bundesstelle für Flugunfalluntersuchung (BFU, Germany),
- Centro of Investigação e Prevenção of Acidentes aeronãuticos (CENIPA, Brazil),
- Interstate Aviation Committee (IAC/MAK, Moscow, CIS),
- National Transportation Safety Board (NTSB, USA),
- Secrétariat Général à la Mer (SG Mer, France),
- US Navy (USA).

The efforts will be focused on two main areas:

1. Defining the search zones;
2. Selection of the means to conduct the searches and recover the relevant parts of the wreckage.

The group called on experts from the following organisations for the localisation work:

• Société Collecte Localisation Satellites (France)
• Ecole Normale Supérieure (France)
• Laboratoire de Physique des Océans / IFREMER (France)
• Laboratoire de Physique des Océans / CNRS (France)
• Institut de Mathématiques de Toulouse (France)
• Institute of Numerical Mathematics of the Russian Academy of Sciences (of Russian Federation)
• Mercator Océan (France)
• Météo France (France)
• National Oceanography Centre (United Kingdom)
• Service Hydrographique et Océanographique de la Marine (France)
• Woods Hole Oceanographic Institution (USA)

Defining the search zone consists of:

• Expanding the collection of data around the last known position,
• Refining the modelling of the structures of the current in this zone around the date of the accident,
• Estimating the drift of bodies and debris,
• Proposing a probability distribution in relation to the localisation of the wreckage.

II. Provisional Programme for the Operations

The preparatory work must be completed in January 2010 so that the means can be deployed in the zone from February 2010 onwards.

A search duration in the zone of sixty days is planned. If the wreckage is localised, a campaign of undersea observation, mapping, raising some parts and equipment from the wreckage and, if need be, the recovery of any human remains will follow the searches.