



# F.A.Q.

## DOS LTD & MH370

### MH370: Frequently Asked Questions



#### *1-MH370 could potentially be in a water depth of 6000 meters. Does DOS have full ocean depth capability?*

Our deep tow side scan sonar Mak-ix and our ROV Comanche are both rated to 6,000m. Both assets have worked continuously for extended periods at depths down to 5,900m.

#### *2-What is DOS's experience in working at these kind of depths?*

DOS/John Lethbridge have worked continuously since 2010 on projects between 3,000 to 5,900m. The John Lethbridge, over the last 4 years, has worked at sea for approximately 300 project days/year, which equates to more than 1,000 project days of work. This experience is probably unique.

#### *3-DOS -Lessons Learnt?*

Working on a daily basis at depths down to 5,900m has given DOS an unique, unparalleled experience concerning the causes of equipment failure which can manifest themselves due to changes in material/equipment composition & functioning at extreme depths. As a consequence, based on our experience, we have taken a thorough investigative approach to provide technical solutions to overcome these issues, when they've arisen, to ensure continuity and uninterrupted subsea operations.

In addition, DOS has changed and modified their work procedures, together with critical spares management controls, to mitigate these specific extreme depth causes of failure and to ensure that we can work at such great depths, on a continuous basis, uninterrupted.

#### *4- Personnel/Team Experience?*

Do you suffer from a high personnel attrition rate? Our DOS Team has been working together for 5 years. Most of the key people have been working with DOS much longer, since 2006. Our recruitment policy for personnel requires that they have experience in both Side Scan Sonar Survey, navigation and ROV Operations and Maintenance. Trainee personnel work on all systems to understand all of our activities and what will be expected from them. In the last 4 years, from a team of 20 people, we have lost only 3. For information, 2 of these people are offering their services to re-join the DOS team for the MH370 project.

#### *5- Sonar Launch & Recovery Procedures -is this straight forward/simple?*

Absolutely not. This is a complicated/critical procedure that requires a lot of experience from a well-trained team working together. The weight of the Sonar tow fish is 1 ton and it is connected through a 50m length of tether to a 1.2 ton dead weight. The launch and recovery procedure is a delicate manoeuvre, particularly in difficult sea conditions, where our team have become experts in this operation through many years of experience in order to ensure personnel safety at all times, which is paramount, and to ensure that the equipment isn't damaged.

#### *6- Have you Experienced Major Side Scan Sonar Breakdowns?*

We have never faced any major side scan sonar failures or seabed groundings during our side scan sonar operations over a period of 4+ year's continuous operations. We know all of the potential areas for failure points with the Side Scan Sonar and we are prepared with all necessary spares onboard to deal with any eventuality. In our experience, we often find that OEM manufacturers are not fully aware of their own potential failure points for their equipment. We are producing and supplying feedback to these OEM's for issues which we come across (which helps them and us), so that they can address and rectify them going forward.

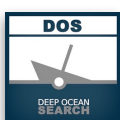
Our experience is probably unique, as our standard working depth on operations is not 4000m once or twice a year, but nearly every day. Over 4 years of operations, we have experienced 2 mechanical termination failures and have lost our Side Scan Sonar on both occasions.

By using our ROV we recovered the sonar from the Seabed on each occasion in a few hours. After each recovery diagnostic checks were carried out, together with any repairs found necessary, including re-terminating the cable, using our own onboard experienced personnel in a period of less than 24 hours (including compound drying time).

#### *7- Does that mean that you are able to re-terminate you own Sonar and ROV umbilical cables at sea?*

Yes, as mentioned above. Our staff have undergone specific training in the cable manufacturer's factory to gain the knowledge and competence to re-terminate cables (including fibers optics). We can carry out this operation at sea by ourselves, without the need to return to port for specialist external support/intervention.

We understand that this is quite an unusual capability to have our personnel properly trained and competent to deal with any eventuality. We can and need to work on a self-sufficiency basis, eliminating as far as possible any need to return to port and consequential lost time. As a result we enhance our operational capability and efficiency.



### *8-What about repairs to other system components?*

Can these be done at sea? Our maintenance plan considers 3 types of failures: i) Components that we can repair at sea, ii) Components that need spares and outside intervention as they cannot be repaired at sea, iii) Single point failures that are covered by special procedures. Within our offshore team we have one specialist Systems Engineer in charge of all the systems and one specialist Electronics Engineer to cover all possible electronic issues. All mechanical and/or hydraulics issues are supported by the ship's Chief Engineer and our onshore engineering department.

### *9-Have you experienced any major ship breakdowns?*

DOS's team have been using the John Lethbridge since 2006 and we have undertaken major upgrades, including the mobilization of the Sonar/ROV spreads and a new control and survey Suite. We have also instigated many vessel improvements and work to a strict Planned Maintenance regime, which covers all the propulsion plant, generators and auxiliaries and hotel services etc. which ensures the vessel's operational reliability.

The vessel is managed by V.Ships, the world's largest ship management company, who manage approx. 1000 vessels worldwide. The vessel's Superintendent is very experienced and has worked and managed the vessel for a number of years, together with a very experienced & dedicated team of deck & engineering officers. To answer your question, we have had during the last 12 months 100% vessel reliability, with no operational down time.

A further point to mention is that the vessel was redeployed in June 2014 from Cape Town, South Africa, to the Caribbean region and back to Cape Town, arriving 2nd August. This has involved two very long sea passages which have been achieved with no issues or technical failures.

### *10-Is your ship able to handle bad sea conditions?*

The John Lethbridge was built as a deep sea/ocean going Ice class trawler, in Hull, United Kingdom. She has excellent sea keeping characteristics and provides DOS with an excellent platform along with great operational flexibility in difficult sea conditions.

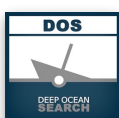
### *11-The Ship was built in 1965 – will her age be a problem?*

In spite of her age the John Lethbridge is fully in Class with Lloyd's Register. She underwent her 5 yearly Special Survey in July 2012 and she has also recently completed her Annual Class & Statutory Surveys on 16th May 2014 with no issues. All her full term Class & Statutory Certificates were suitably endorsed. The vessel is maintained in excellent condition. She has a thorough planned maintenance data base system on board, which is strictly adhered too, with all maintenance routines completed when due.

The vessel has been fully operational, with no lay-up time and has been working consistently on Deep Ocean Search projects. She has provided 100% reliability during the last 12 months, with zero down time.

### *12-Have you had any serious accidents whilst operating at sea?*

As of this date, DOS/John Lethbridge have a clean safety record and they have not experienced any major accidents or safety issues. The vessel operates to strict HSE specific procedures, inclusive of Risk Assessments, "Tool Box" talks Pre/Post Ops etc.



### *13-How does your experience reflect in your efficiency?*

DOS have a track record of having the ability to work continuously, always on their own, for extended periods of time, working at extreme water depths, several hundred nautical miles offshore and away from shore support, year after year. This hard-won experience and capability gives DOS an unique insight/understanding of what is needed to work in the conditions expected and confidence in knowing that DOS have the necessary skills and endurance and can provide the necessary services for the MH370 search program.

This confidence doesn't just come from knowing that our assets/hardware can do the job (Ship/ Subsea Assets) but also from the fact that this type of search operation is what we do every day, where our experienced personnel can operate and maintain the vessel and subsea assets etc., far offshore, without the need for any outside intervention and where DOS can focus and concentrate on the essential task in hand- which in this case, is finding the plane debris. It's our day job.

### *14-Why do you have a ROV onboard?*

The ROV is onboard for two main reasons:

a. The security of knowing that in the case of a major incident, where for instance we may have lost the side scan sonar, we have the capability in being able to recover it so that we can quickly return to work, with minimal down time.

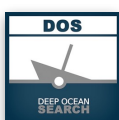
b. Should we encounter a side scan sonar contact, which warrants investigation, we have the immediate capability to be able to deploy the ROV for investigative purposes to clarify/identify/ confirm the target, without having to rely on other vessels/assets to transit to the work site just to check each and every potential contact found during the side scan sonar search. In our experience, these contacts will be numerous. Having this capability improves the efficiency of the search effort, removes unnecessary delays where a target can be quickly investigated and where if proved it's not what we're looking for, we can quickly continue on with the search, which is the ultimate goal in this project. We therefore plan to keep the ROV on board, for the obvious benefits/flexibility which it gives us.

### *15-Does the ROV generate additional costs?*

No, the ROV will not generate any additional costs to our service as it is a permanent fixture on board our vessel for our own search projects and for the reasons given above. The ROV is operated by the same subsea team that operates the Side Scan Sonar. So there are no additional technical/manpower costs, because as said, the subsea team is the same for both.

### *16-Can you confirm that a single team runs both ROV and Sonar?*

Yes, as mentioned above, DOS uses a single survey team to run both spreads (ROV/sonar) as well as the navigation and data process services which are standard in our everyday work. Some onboard systems are used for both the side scan sonar and the ROV, such as subsea positioning (USBL) and navigation software. Both control/commands are in a single survey room, which allows staff to share data and resources for both types of Ops.



### *17-Is the Ship fitted with a Multibeam Echo Sounder?*

This expensive device is not of great use for our type of operations. We consider that altimetry data coming from satellite surveys is good enough to prepare survey planning for deep tow operations. This kind of data is almost free as opposed to expensive multibeam surveys. In addition a hull mounted multibeam hasn't sufficient accuracy and footprint to help to detect the kind of target we are looking for in this water depth. Our vessel is however fitted with a full ocean depth single beam echo sounder that is used during towing ops to anticipate seabed slope changes for the safety of our side scan sonar tow fish altitude.

### *18-Does your survey planning consider bathymetry?*

How are you optimizing it? What are the key points of efficient survey planning? We build our survey planning via several key points such as bathymetric data, surface currents, wave prediction, weather forecast, surface area to cover etc. All this data allows DOS to anticipate the best ship time usage with a low waiting on weather time and the best zone orientation for the management of tow operations. In addition, survey planning is organized to overlap each pass to be sure of achieving full coverage of a search area, so that there is no risk of an area not being "seen".

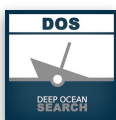
Our experience allows us to cover 80% of any survey field in only 50% of the full survey duration time. That gives us the opportunity to find the target faster. The remaining 20% of the survey field area, if needed, would then utilize the remaining 50% of time allocated. In addition, DOS utilize a procedure, which minimizes the time needed to conduct each "turn", so that the sonar can get back on track as quickly as possible and thus speeds up the time required for a given search area. A less experienced survey team, used to conducting sonar ops in shallow water might need twice the amount of time for a turn compared to what we would normally do it in and would consequently have less time available for survey logging.

### *19-What is the frequency of your sonar?*

Our Mak-iX sonar is using both 30 kHz and 100 kHz frequencies. Our main survey work is done with 30 kHz.

### *20-How is low frequency sonar able to detect a small object, which would be "difficult to see"?*

The location of underwater objects is not linked with resolution but with "detection capacity". It is important not to confuse discrimination ability, which requires high resolution images, with detection capacity which is linked with other physical parameters. The sonar's signal dynamics and backscattering specifications provide the detection efficiency looked for, by ensuring that any non-natural debris which can generate a particular/special return is detected and registered as an "unusual signal". Any unusual signal has to be considered as a possible target object through a special process which we employ and which allows a decision to be made as to whether this anomaly is a target or not. Simplified, the most appropriate device for this kind of debris search is the one which guarantees the best signal reflectivity with the highest footprint possible. Using Low Frequency sonar, as with DOS's MAK-Ix sonar, a very large swath (3000m) is possible which does indeed have a nonlinear low longitudinal resolution.



However, this low resolution will not affect its capacity to detect a strong/particular return coming from the kind of debris produced by an aircraft or aircraft remains and will give the range necessary to cover the ground quickly. The target will be not missed by our sonar, except in the rare case of it being in pieces and hidden in rocks or a crevice. Further target detail will require a second survey line to be run, this time at a higher frequency, to increase resolution and discrimination. It will show that something is there which needs visual checking or not. This approach is entirely different to those who might wish to use high frequency sonar, which is extremely expensive in comparison to an LF system, both in time and money. DOS's Mak-iX has detected many small objects, including, for example, a suction anchor (diam 2m x height 0.5m) at a range of 1200m.

DOS can demonstrate this capacity. We are confident that low frequency sonars are the most suitable tool for this project. In the future, a new generation of synthetic aperture sonars will allow high resolution with large swath. This kind of unit will keep detection efficiency and will add the discrimination capacity at any kind of range.

### *21-So you do not need high Frequency/Resolution Sonar?*

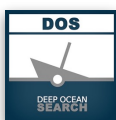
No, as per comments above, our Mak-Ix can detect an aircraft and/or a debris field produced by an aircraft crash at great range. The high resolution will only be necessary to discriminate debris details at short range and map the debris field prior to an ROV debris survey.

### *22-How accurate is your absolute position on any target found?*

DOS is using a fully integrated positioning system based on several devices: -DGPS with differential correction coming from satellite subscription (worldwide coverage) -Ultra Short Base Line positioning system allowing us to track a responder beacon on our towfish. We are using the XBLUE POSIDONIA which is the only unit in the world that allows us to track at very long ranges - up to 9000m. -An Inertial Navigation System, provided by IXBLUE, is fitted on the towfish that allows inertial positioning and high recurrence of data. -Doppler Velocity Log unit that feeds the INS with the speed of the towfish. This set of sensors allows an absolute positioning of approx. 0.2% of the slant range between ship and towfish. For example, on a previous project, we had 20m absolute accuracy on a target found at 4800m depth, 8000m behind the survey vessel.

### *23-How can you be sure to avoid the "False Certainty" trap? By this we mean "how can we be certain that any area surveyed and pronounced free of debris is in fact free?"*

In other words, how can we be sure that the area or box coordinates are correctly positioned and are not out by any margin, which may contain the debris looked for?" This has been identified by the ATSB as posing the biggest risk for the MH370 search. The answer lies in the knowledge that the sonar position is known at all times and can be proven to be known. This means that any system which relies on approximate sonar positioning (an estimation called 'lay-back') which assumes where the sonar is, or any system which does not have real-time information being relayed back from the sonar to the ship and into the ship navigation system is therefore inaccurate and no guarantee can be made as to which area coordinates have really been covered. This positional error gets worse with depth as the sonar fish position gets harder to predict and where 'through water' acoustic systems break down due to the range between ship and sonar and consequently the unknowns increase. The position of DOS's sonar is known at all times, as explained above. DOS may be one of the few companies in the world which can guarantee that they will not fall into the "false certainty" trap.





### *24-How can you identify your target? What is your analysis process?*

Are there people able to analyze this kind of data? Every single target goes through a post process analysis. This process is conducted by a trained team that has experience/access to DOS's historic project survey searches. This experience has been built up month after month from ultra-deep water surveying. Two mine warfare veterans from the French Navy provide our team training and review personally 100% of our acquisition data. These veterans approve all post-process data produced by our team. This experience is a very time consuming process and is one that is always in progress.

Most competitors' surveyors are coming from a multibeam survey background which accounts for approximately 80% of the survey market. These surveyors generally have minimal knowledge of sonar data or interpretation. Experience with very long range sonar operations at low frequency needs to be acquired/learned over a long period of time to be properly understood. DOS's personnel are quite unique within the survey industry, through their knowledge of deep-tow, low frequency operations and by the sheer volume of sonar operational experience that they've acquired.

### *25-What is the process that conducts you to identify a target?*

Discovered in real time acquisition or not, each target follows an identical post process control process, running through different steps, including if necessary sonar overlap comparisons on each target. The rendering and analysis of the data allows the team to confirm or not if the target found matches the target sought. In addition, our senior sonar specialists (on the ship or off it) conduct their own process analysis and then compare their results with the on-ship post -process team results, before any confirmation is made that the target found fits the target "criteria" for the project. In the case where there is a sufficient level of interest/confidence in the target found, a ROV dive is made for confirmation purposes. The decision to interrupt survey operations for an ROV dive would be made in the case of MH370 with client rep approval.

### *26-Do you need to go back to port to switch between Side Scan Sonar and ROV Ops?*

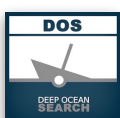
No, we do not need to go to port. At any time sonar ops can be interrupted and the subsea team can switch to ROV ops at any time. The ship can change seamlessly between either type of operations. As said previously, the team are fully trained to operate both the side scan sonar and the ROV. Each spread has its own independent LARS, winch and cable.

### *27-Are you able to start a ROV survey/salvage operation after identification?*

Yes. In case of positive identification, the DOS team can start immediately a debris survey, i.e. a black box search, or other debris of interest (subject to volume/weight), recoveries under client rep request/control (MH370).

### *28-Can you lift some samples, such as a black box?*

Yes, our ROV can recover and lift a black box. Our team is trained to securely store boxes on board.



*29-Can you recover human remains if such is required?*

Should there be a request/order to recover human remains, an appropriate medical specialist team and equipment would need to be provided by the client. In accordance with the "Guidance on the Underwater Location and Recovery of Aircraft Wreckage and Flight Recorders", produced by the Aircraft Accident and Incident Investigation Expert Group of the ECAC in November 2012, this operation requires refrigerated containers and a legal team that are supplied by the client. DOS will recover human remains if instructed to do so. Our team would hand over responsibility to others once these remains are recovered to the deck.

