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GIB FAST EMERGENCY RECOVERY
AT SEA DEMONSTRATIONS
BREST - FRANCE
October 30 & 31, 2000

Version 2.00

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DCE-GESMA ship "Aventurière"

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- **List of assets that can be recovered using the described technique,**
- **List of intervention means that can be tracked.**

The 37.5 kHz pinger we were looking for

1. INTRODUCTION

In case of aircraft accidents at sea, the second priority, after conducing the rescue operations and assistance to victims, is to recover the voice and data black boxes for investigation purposes. Crashes can occur in national waters ; but also in far away countries that will ask for assistance.

As a consequence, it is necessary to have fast deployable means that can be quickly deployed from a craft of opportunity, anywhere in the world, in all sort of water depths.

Traditional Black box re-location techniques are based on listening to the black box pinger (37.5 kHz, 1 Hz repetition rate) with a directional hydrophone. The result is :

I can hear the pinger, here is the direction of the pinger !!!
Not where it is in longitude and latitude.

The technique proposed by ACSA bring immediately the answer to the real question which is : What are the latitude, longitude and depth of the pinger(s) - Two pingers, working at the same frequency that can be broadcasting in the same area! One need to get this information with an accuracy better than 3 meters so that a diver or ROV can re-locate the black box immediately even in poor visibility waters.

ACSA, a company specialised in developing advanced underwater positioning systems for military or commercial applications, offers a solution which is based on having few buoys drifting over the crash zone. In less than 1/2 day, black boxes pingers are positioned with a metric accuracy in longitude and latitude.

In shallow water an heavy weight is then lowered with a line to the sea bed by the support ship. Divers just have to follow the line to find the equipment on the sea bed. In greater water depths, the same technique applies. An UUV is used to relay the acoustic signals. Less that a day on site is necessary to reposition the black boxes even in very deep waters.

The technique applies to relocate any equipment carrying a pinger (nuclear weapons, rockers boosters, nuclear fuel containers, toxic chemicals…).

In order to demonstrate the level of performance achieved by ACSA's equipment, at sea demonstrations have been organized by DGA, in Brest on October 30th & 31st, 2000.

The object of this document is to present the results of the evaluations conducted during those 2 days.

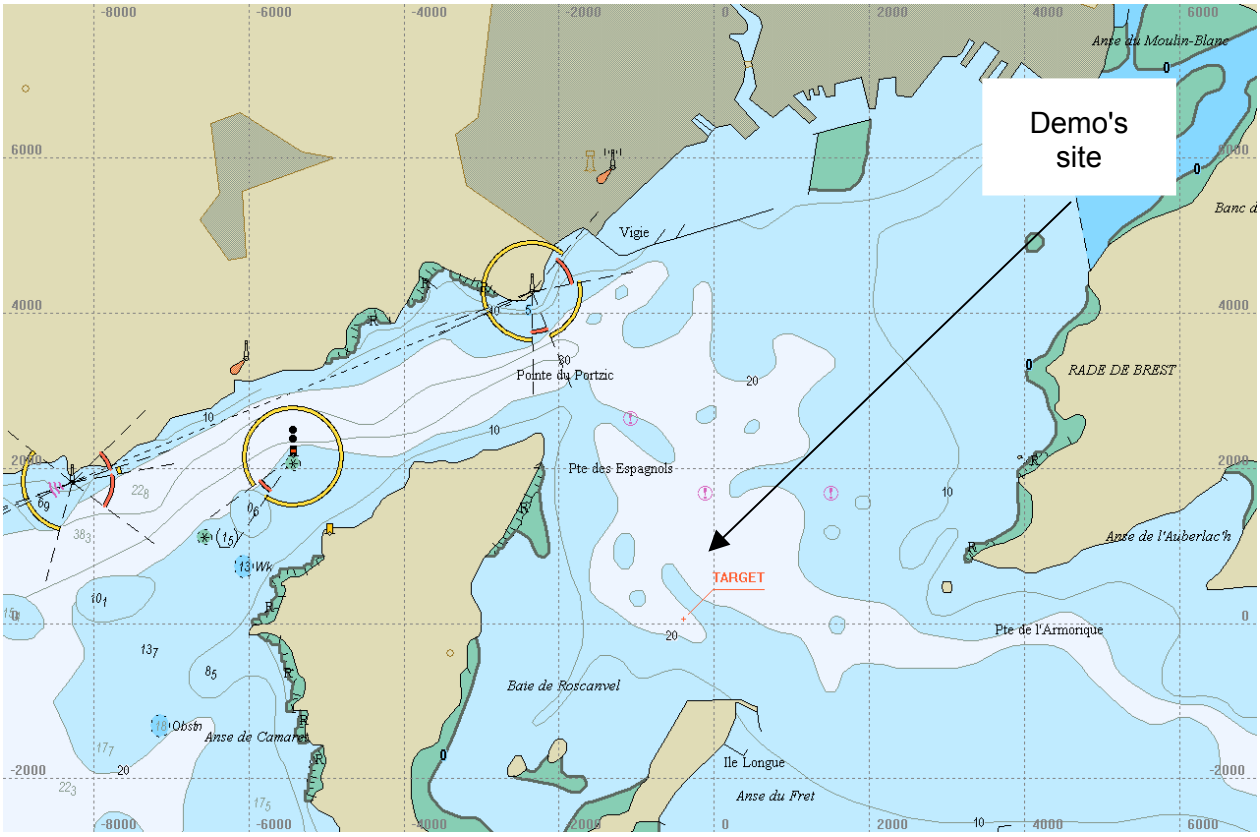
2. EXPERIMENTATION SITE AND OBJECTIVES

The demonstrations were carried inside the “Rade de Brest” (France) with DGA DCE-GESMA means: Ship "Aventurière" and a SUTEC ROV.

The objectives were to demonstrate that it was possible to conduct a complete Black Box recovery in about half a day using a set of 4 GIB buoys.

Operations are run in 2 phases:

- Search and calculation of the black box pinger's longitude and latitude (WGS-84),
- Guidance of a ROV to previously determined position using a GIB 32 kHz pinger mounted on the recovery vehicle.



This map shows the area where the demonstrations took place.

3. ATTENDEES

During the demonstrations,

DGA was represented by Sylvain Le GOANVIC, DGA/DCE-GESMA Brest. He was in charge of the mission,

ACSA was represented by Hubert THOMAS and Pierre LAGIER,

ORCA-Instrumentation was represented by Jean Michel COUDEVILLE and David LE SEAC'H.

Attended to the presentation the following persons :

Monday 30th :

- ✓ Keith COOPER, USA NAVSEA SYSTEMS COMMAND "Diving & Salvage",
- ✓ M. CHALM, French Navy, ALFANMINE Brest (MCM Group),
- ✓ Yann PIHAN, BUREAU D'ENQUETES ACCIDENTS (BEA),

Tuesday 31st :

- ✓ Conrad BELANGER, Canada Embassy in Paris,
- ✓ LA CAISSE, French Navy, CEPHISMER Toulon, Diving & Salvage Group,
- ✓ Thierry DESVALLIERES, TOTAL-FINA-ELF Paris.

Have been excused CEDRE representatives due to urgent rescue operation of a chemical cargo in difficulty near Ile of Batz.

4. EQUIPMENT USED

During the demonstrations, following equipment was used :

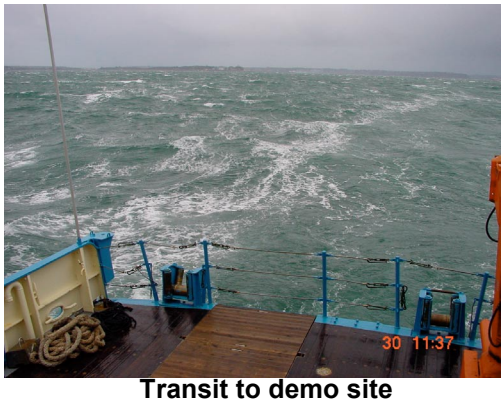
- 4 x GIB buoys (Equipped with 2 channels : 37.5 & 32 kHz),
- 1 x 32 kHz GIB pinger (synchronized and depth telemetry),
- 1 x 37.5 kHz Datasonics pinger (N°: 189),
- 1 x GIB Deck Unit and IBM-PC, adequate tracking software.

GIB Buoys on deck "Aventurière"

DCE-GESMA SUTEC ROV equipped with a GIB 32 kHz pinger.

SUTEC ROV & GIB 32 kHz pinger

5. DAILY REPORTS



Transit to demo site

Monday 30th

Weather Conditions:

Winds 20-40 Knots NW,
Sea temperature 14°C,
Cloudy, Rain

Local Time	Activity
9H30	Boarding "Aventurière" from Brest Commercial harbor and transit to site,
12H30	Mooring 4 GIB buoys and Black Box 37.5 kHz Pinger
12H34	Buoy N° 2 moored,
12H39	Buoy N° 1 moored,
12H45	Buoy N° 4 moored,
12H49	Buoy N° 3 moored,
	Moored 37.5 kHz pinger,
12H59 to 13H09	Acquiring black box signals during 10 minutes (File #2)
13H10	Black box positioned at : 48° 19.2051 N and 4° 30.4190 W
13H16 to 13H18	Acquiring black box signals during 2 minutes (File #3)
13H19	Black box positioned at : 48° 19.2056 N and 4° 30.4210 W

Waiting for tide to slow down,
Selected target waypoint: 48° 19.2053 N and 4° 30.4200 W

Mooring a GIB Buoy

13H39	SUTEC ROV in water (File #9),
13H50	ROV on target (DTG= 4 m),
13H58	ROV back to surface & recovery.

Time to rally target: 11 minutes.

Note : Local time is 2 hours ahead of GPS-UTC time.

Tuesday 31st

Weather Conditions:

Winds 10-25 Knots NW,
Sea température 14°C,
Partially cloudy,

9H30	Boarding "Aventurière" from Brest Commercial harbor and transit to site,
10H50	"Aventurière" on site ready to moor 4 GIB Buoys (File #1):
10H55	Buoy N° 1 moored,
10H58	Buoy N° 2 moored,
11H02	Buoy N° 3 moored,
11H04	Buoy N° 4 moored,
11H11	37.5 kHz pinger dropped in water,
11H13 to 11H18	Acquiring black box signals during 5 minutes (File #2)
11H19	Black box positioned at : 48° 19.1880 N and 4° 30.4772 W
11H21 to 11H26	Acquiring black box signals during 5 minutes (File #3)
11H26	Black box positioned at : 48° 19.1898 N and 4° 30.4772 W
11H27 to 11H32	Acquiring black box signals during 5 minutes (File #4)
11H19	Black box positioned at : 48° 19.1871 N and 4° 30.4745 W
11H27	Ship at anchor, ROV launched equipped with GIB 32 kHz pinger,
11H43	ROV facing Black box 37.5 kHz pinger :
12H30	End of ROV dive.

Value used as target for ROV Guidance:	48° 19.1884 N and 4° 30.4763 W,
Distance to target displayed on GIB navigation console when observing pinger in front of ROV:	1 meter,
Time to rally target:	16 minutes,
Visibility:	1 meter.

Note : Correspondence between GPS Time and ROV video tape's clock :
GPS 10:51:30 = Video 11:50:23

6. PERFORMANCES ANALYSIS

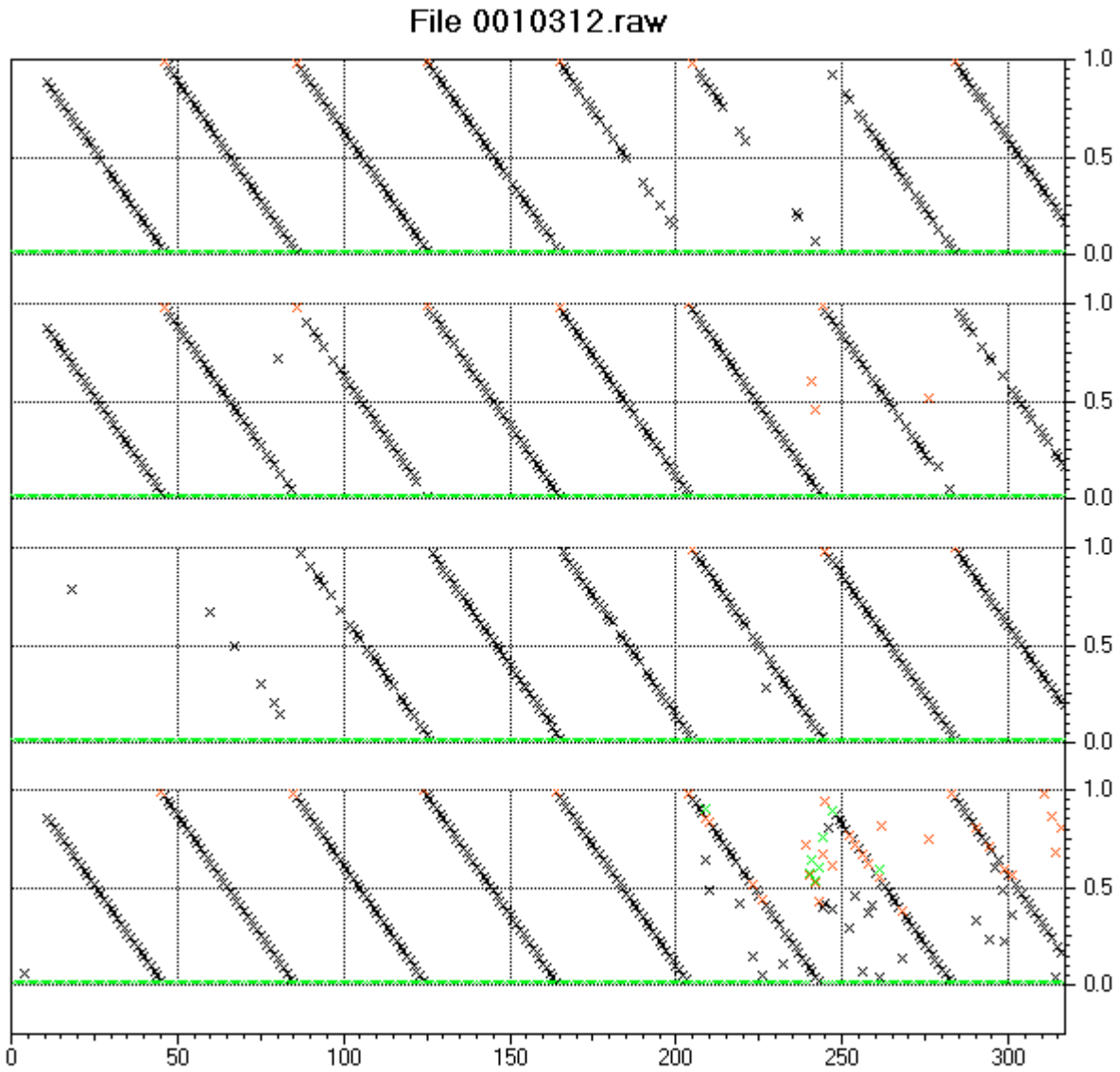
6.1 GIB Buoys deployment

The type to deploy GIB buoys by "Aventurière"'s crew was always very short (10').

This is due to the fact that the crew was well trained (Daily deployement of buoys in June 1999) and that as the square of buoys was small (300m), there was a limited transit time in between moorings.

6.2 Black Box Pinger Detection

The drawing below shows the time of arrival of acoustic pings coming from the 37.5 kHz on each of the 4 buoys during a 300 seconds acquisition sequence. No multi-path is observed.



6.3 Black Box Pinger Positioning Time

As the area was predetermined, the time necessary to acquire enough data to position the pinger was about 5 minutes.

6.4 Black Box Pinger Positioning Accuracy

On Tuesday, we acquired the pinger's data during 3 x 5 minutes sequences.

File	Latitude	Longitude
#2	48° 19.1880	4° 30.4772
#3	48° 19.1898	4° 30.4772
#4	48° 19.1871	4° 30.4745
Average	48° 19.1883	4° 30.4763

The above table shows what kind of jitter we get on the pingers' coordinates.

On Monday a distance to target, DTG, of 4 m was shown on the navigation screen when the ROV was facing the pinger.

On Tuesday, a 1 m DTG was displayed, showing a very good coherence with the ROV navigation data.

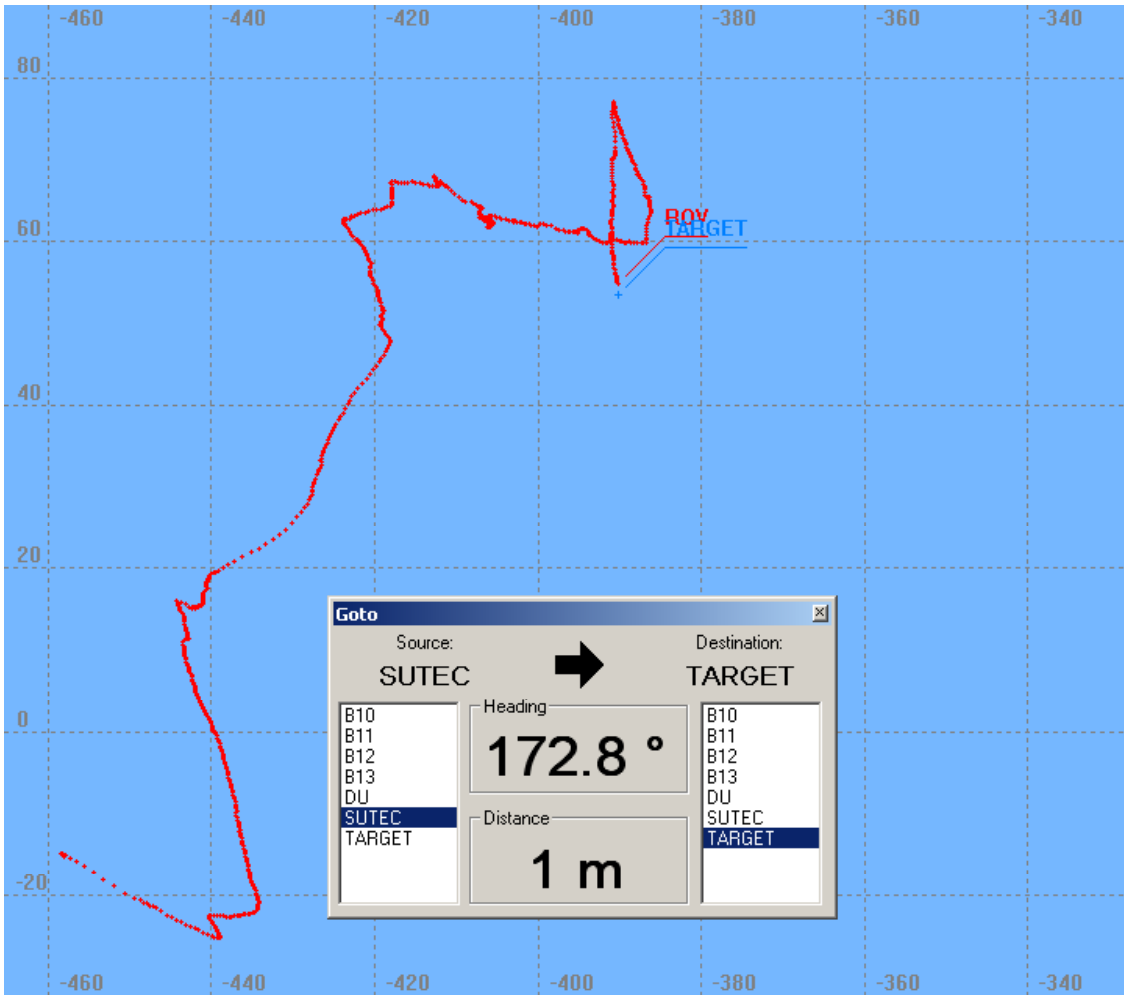
At that level of performance, pinger's offset with regard to the front of the vehicle has to be taken into account. We have not done it.

6.5 ROV Guidance

Below is the track of the ROV on Tuesday while rallying the target.

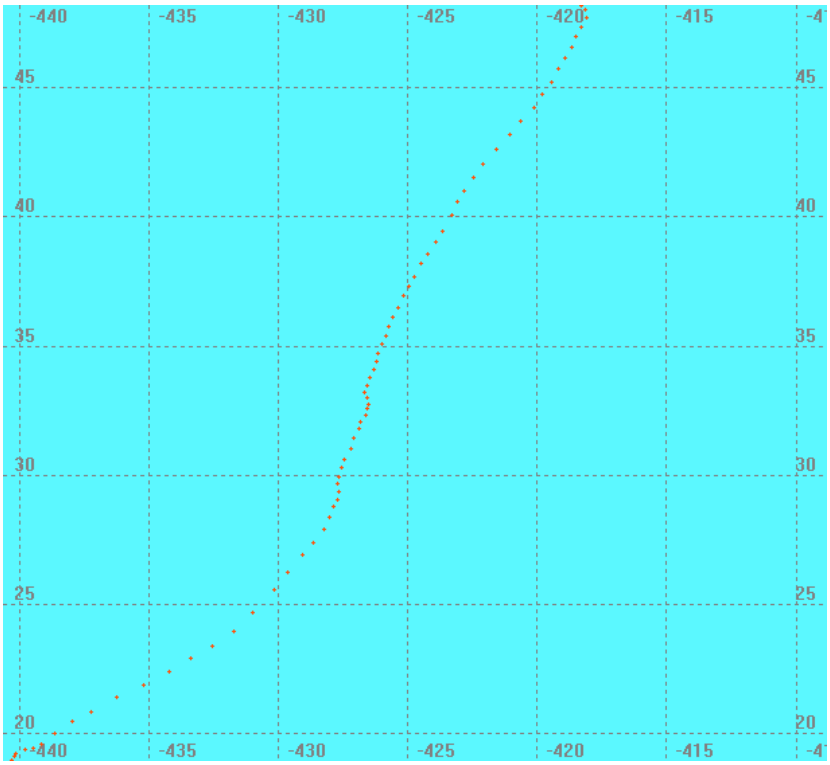
It took about 16 minutes to go from the surface to the 37.5 kHz pinger.

This value seems reasonable due to very poor visibility and current speed on the seafloor.



Track not filtered, observe excellent positions stability.

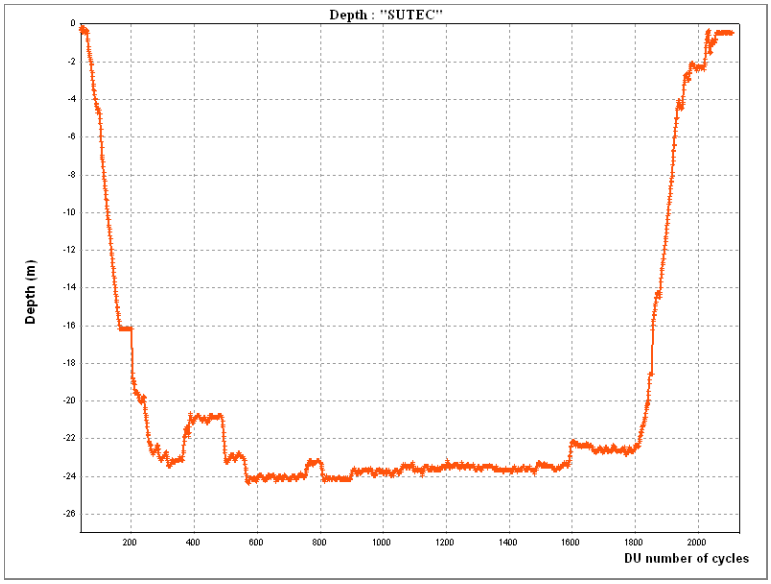
During this trip, mean quadratic error on ROV position was of the order of 1 meter, processing data with a sound velocity of 1498 m/s.



ZOOM ON ROV's TRACK (Grid 5 x 5 m) - No data filtering.
Observe excellent stability, 1 point per second.

6.6 ROV Depth Telemetry

Figure below shows the SUTEC ROV depth profile as calculated by GIB system in real time (1 point per second).



7. CONCLUSION

The results presented in this report show the nominal performances that can be achieved by a set of 4 GIB buoys to locate black boxes pingers as well as to guide an ROV. Typically, 15 minutes are necessary to get black boxes coordinates and 15 minutes to guide the ROV to a target.

Compared with long base line and short base line systems, the advantages of GIB portable tracking systems are :

- Fully portable,
- Short installation time on any craft of opportunity,
- Buoys easy to deploy & recover,
- No calibration is required,
- Real-time multi-mobiles capabilities,
- Metric accuracy in 3D,
- High repetition rate,
- Fully operator's configurable functions,
- Real-time Quality Control,
- Operations compatible with ROV, manned subs or divers.

In search and rescue operations, GIB Buoys can be used for :

- Tracking side scan sonar towfish with a high repetition rate,
- Good time stamping of position fixes and excellent positioning accuracy that allow to produce accurate mosaics,
- Fast guidance of ROVs to underwater targets for identification and recovery,
- Accurate positioning of individual debris before recovery,
- Fast relocation and recovery of Black Boxes pingers.

The equipment can also be used for manned submarine rescue operations. In such case, operations can be conducted in a much faster way than with traditional solutions.

APPENDIX

LIST OF ASSETS

The following objects can be relocated using GIB Buoys using the method hereby described provided that they carry an operational acoustic pinger :

- Chemical or nuclear containers,
- Commercial planes (>10 passagers),
- Cruise missiles,
- Drugs enforcement (smuggling, …),
- Heli dipped sonars,
- Intelligent weapons,
- Mammals,
- Military planes,
- Mines (Ops & Exercise),
- Pipeline pigs,
- Rockets boosters,
- Rockets, missiles,
- ROVs,
- Side scan sonar,
- Submarines (dry & wet),
- Sunk tankers,
- Torpedoes,
- Towed arrays,
- UUVs,

RECOVERY MEANS

The following recovery means can be tracked and guided if they are equipped with a GIB compatible pinger :

- AUVs,
- Dipped video camera (Mosaics),
- Divers & diving bells,
- Manned submarine (DSRV, …),
- Newtsuit divers,
- ROVs,
- Side scan sonar.