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FRV *Alba na Mara*

Cruise 1009A

CRUISE REPORT

22-28 June 2009

Diving Project Plan: 03/2009

Project: 10240 (FRDIV1)

Ports
Loading: Fraserburgh, 17 June 2009
Departure: Fraserburgh, 22 June 2009
Arrival: Fraserburgh, 28 June 2009
Offloading: Fraserburgh, 29 June 2009

Objectives

- Undertake "work up" dives and basic rescue training;
- Train personnel in the operation of the manned Towed Underwater Vehicle (TUV III) aboard the research vessel "FRV *Alba na Mara*"; and
- Test all TUV operational systems.

Personnel

Alba na Mara

M Breen	(Diving Officer, In Charge)
K Summerbell	(Equipment Officer)
M Burns	(Diving Comms. Engineer)

Shore Based

M Harding	(Assistant Equipment Officer, 22 – 25 June 2009)
J Mair	(Assistant Equipment Officer - Boats)
B O' Neill	(Diver)
M Harrald	(Diver)
P MacDonald	(Powerboat Coxswain, 24 – 27 June 2009)

Diving Support Boat: "*Dignity*"

Diving Equipment (On Board):

Towed Underwater Vehicle (TUV) & associated equipment;
Hard-wire communications system;
SCUBA Breathing Apparatus;
Miscellaneous personal diving equipment;

First Aid Equipment (Inc. Therapeutic Oxygen)
Nitrox pumps (x2), Gas Bank (Mobile Quad),
Underwater Photography and Video equipment.

Diving Equipment (Ashore):

Mobile Air (Breathing) Compressors (x1);
SCUBA Breathing Apparatus;
Miscellaneous personal diving equipment;
First Aid Equipment (Inc. Stretcher)

Fishing Gear

BT 158 – Bottom Trawl
Trawl Doors (Modified Morgere Doors)
Clump weight (2x50kg)(for towed reference marker)
Scanmar – Door Spread (with floats), Wing Spread, Headline Height, Depth & Speed.

Narrative

These objectives were completed during two different Diving Operations:

A. Preliminary Training and Work-up Dives; and

B. TUV Specific Training and Engineering Trials

Loading & Transportation

The *Alba na Mara* was loaded in Fraserburgh on Wednesday 17 June with fishing gear, diving equipment, diving gas, TUV, cables and communications equipment in preparation for departure on Monday 22 June, 2009. On the same day, containerised equipment was transported directly to Lossiemouth harbour and sited on the North Pier. A shore base, including secure containers and changing facilities, was established at Lossiemouth harbour.

The Diving Team and equipment travelled from the Marine Laboratory on Thursday 18 June, rendezvousing at Burghead Harbour at 1000. The launching slip at Lossiemouth Harbour is currently being renovated, so the RIB was launched at Burghead and sailed around to Lossiemouth on Thursday 18 June.

Operation A: Preliminary Training Operations

Operation A began on 18 June 2009 at Lossiemouth. Weather conditions prevented any diving, but training with the new diving boat ("*Dignity*") continued as planned. Coxswains familiarised themselves with the operational procedures for the boat and practiced close quarter manoeuvres in the harbour. They also took the opportunity to practice manoeuvres with the boat in the moderate swell that had developed offshore, including simulating "man over boat" drills. Work up dives and rescue training were postponed until Monday 22 and Tuesday 23 June 2009 and were conducted in shallow water (<20m) off the Halliman and Covesea Skerries (Site 1).

Staff returned home for the weekend of 20-21 June 2009: leaving Lossiemouth on 19 June 2009 at 1300 and returning for 1000 on 22 June 2009

"Work-up dives" are for the purpose of re-familiarising the diver with using appropriate diving equipment at the anticipated working depth.

Operation B: TUV Training Operations

Operation B began on Monday 22 June 2009 and was conducted on known and "clean" fishing tows between Burghead and Lossiemouth. This location provides a large area of shallow water in which the TUV training can take place and where the maximum depth can be easily kept below 25m.

Alba na Mara rendezvoused with the *Dignity* at 1530 outside Lossiemouth Harbour. The TUV and associated equipment was prepared on board *Alba na Mara* prior to arriving at Lossiemouth. The Diving Team and the crews of the Alba & *Dignity* then practiced manoeuvres with the TUV (unmanned), including: deployment, recovery and emergency procedures. This continued the following morning.

Diving operations with the TUV began on the afternoon of 23 June. The first dives used the vehicle alone, initially to test the TUV operational systems (i.e. rudders, hydroplanes, buoyancy control, onboard instrumentation and voice communications) and then practice basic manoeuvring.

On Wednesday 24 June TUV operations were postponed until the afternoon because of fog (TUV operations require a minimum visibility of 300m). P MacDonald joined the Diving Team on *Dignity* in the morning. Training progressed to manoeuvring the TUV around a towed clump-weight – to provide a point of reference for the pilots to navigate to. These dives were also used to measure the lateral range of movement in the TUV, by attaching Scanmar distance units to the TUV and the wire towing the clump weight.

Operations continued on Thursday 25 June, starting with a dive to test an upgrade to the hardwire voice communications system that would allow easier diver to diver communication. Unfortunately, there was considerable interference when using this upgraded format (Format B – "four-wire"), which limited the clarity and volume of voice communications, so the system was reverted to the original format (Format A - "two wire") which had proved very effective for surface to diver communication on earlier dives. Diving operations continued throughout the day, with further TUV dives on the towed clump weight, until they were aborted at 1730 due to a poor sea-state (because of a strong easterly breeze (ESE 6) against an ebbing tide).

Friday 26 June began with a TUV dive to test modifications to the communication system, Format B. While improvements were made, this system still did not have the clarity of voice communications demonstrated in format A; all subsequent dives reverted to Format A. A further three TUV dives were conducted that day to enable the TUV pilots to practice manoeuvres around a trawl (BT158). M Harding returned to Aberdeen that evening to prepare to join a survey cruise on Sunday 28 June.

Operations on Saturday 27 June were limited by the availability of staff and the planned departure time for *Alba na Mara* (@ 1430). Two TUV dives were conducted: the first alongside BT158 and the second with the clump weight. *Alba na Mara* departed for Fraserburgh at 1415; arriving in Fraserburgh at 1950. Shore based staff returned to Lossiemouth with the *Dignity* and then travelled to Aberdeen that evening by road.

For general operation of the TUV please refer to the "TUV – Operation & Communications Protocols".

Demobilisation and Transportation

Diving operations finished on Saturday 27 June, 2009. The *Dignity* was transferred from Lossiemouth to Burghead on Sunday 28 June, from where it was recovered (at 1430) and transferred to Altens by road.

The shore-based staff demobilised the shore-base in Lossiemouth and prepared it for transportation. The *Alba na Mara* return to port at 1950 on 27 June and was demobilised and offloaded on Monday 29 June, 2009.

All staff and equipment returned to Aberdeen by Monday 29 June, 2009.

Summary of Results & Conclusions

In general, all objectives were achieved: the training went well, a number of operational characteristics of the Towed Underwater Vehicle (TUV) were investigated and the FRV *Alba na Mara* again proved to be a good working platform for the TUV.

Training

This cruise/diving project has enable the Diving Team to train its own personnel and the crew of the *Alba na Mara* in the operation of the Towed Underwater Vehicle (TUV), in preparation for the research cruise 1509A. The training was successfully completed at a number of different levels:

i) Operation of the new diving support boat "*Dignity*" – this project has been the first opportunity for the Diving Team to train with the new boat.

ii) Work-up Dives & Rescue Training – as with all diving operations, it is important for the divers to re-familiarise themselves the diving equipment and protocols that will be used on the project, including emergency procedures.

iii) TUV Operating Procedures for Surface Personnel – while the TUV is in operation, the Diving Team and the crews of the *Alba na Mara* and *Dignity* form an integral team. This team is coordinated by the Dive Supervisor through key personnel: the skipper & mate of the *Alba na Mara*, the coxswain of the *Dignity*, the communications engineer and the TUV Pilot. For the safe operation of the TUV it is critical that each member of this team has a thorough understanding of their role during normal and emergency procedures.

iv) TUV Pilot Re-familiarisation – the more experienced pilots in the team were given the opportunity to refresh their piloting skills in various scenarios, culminating in operating the TUV around a trawl (BT158).

v) TUV Pilot Training – B O'Neill & J Mair continued their pilot training and are now considered to be competent pilots of the TUV. However, both will require further training to operate the TUV around towed fishing gear.

vi) TUV Co-pilot / Observer Training – M Harding & M Harrald were introduced to TUV operations for the first time on this cruise. They were given training in various surface-based roles and had a number of familiarisation dives in the TUV. At the next opportunity, their training will continue and will focus on basic piloting skills including: pre-dive checks & procedures, making a controlled descent, manoeuvring at depth, adjusting speed, making a controlled & safe ascent (including simulated

decompression stops), post-dive checks & procedures and emergency scenarios and procedures.

Voice Communications with the TUV

On this cruise the feasibility of utilising cables from the Remote Controlled Television Vehicle (RCTV) was investigated by testing the functionality of RCTV cable #6 (Ø = 18mm), as well as the operational characteristics of the TUV with that cable (see later). This RCTV cable is a robust cable that encompasses 12 core wires, as well as 2 coaxial cables, allowing for the use of more complex communication systems and ancillary instrumentation (e.g. live feed video to the surface, scanning sonar systems, etc.). The previous TUV communications cable was relatively light weight (Ø = 10mm) encompassing only 4 core wires encased in a coaxial sheath.

Voice communications with the cable were excellent when deployed in the "two wire" format (format A)(see Aquacom STX101 operator's manual for details). Format A enables direct voice communication between the Dive Supervisor at the surface and each of the divers; with both divers operating with an "open microphone", while the supervisor must "press to talk". There is also the capability for direct diver to diver voice communication through a cross-talk function engaged by the Supervisor at the surface, but this is rarely employed.

The increased capacity in the RCTV cable allowed a more complex "four wire" format (format B) (see Aquacom STX101 operator's manual for details) to be tested. This format should theoretically enable direct three-way communication between the Dive Supervisor and the two dives, with all operating on an "open microphone". However when deployed in format B there was a significant loss in the clarity and volume of signal. Also, when only one of the divers was plugged into the communications cable in the TUV, there was considerable interference that made voice communications impossible, until the second diver was also plugged in; this interference is not experienced in format A. After testing format B on 25 and 26 June, all subsequent dives with the TUV used format A for voice communications.

Maximum Lateral Range of TUV

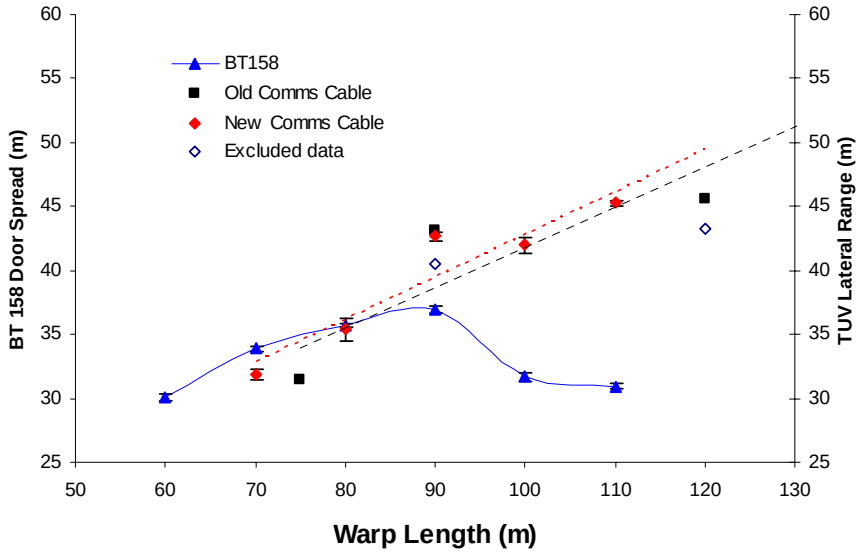
In a previous cruise (0408A) the operational capability of the TUV was tested with a RCTV umbilical cable (RCTV #3). This however proved limiting with respect to key operational characteristics, in comparison to the original two-cable system (i.e. towing wire with clip on communications cable). These limitations were: a reduced stability in the TUV (with particular respect to uncontrollable pitch and yaw movements) and a significant reduction in the maximum lateral range of the TUV. It was thought that the reduced lateral range of the TUV may have been due to increased hydrodynamic drag because of its larger surface area (Ø = 22mm; C=69.1mm) compared to the two-cable system (Ø = 8mm and 10mm; Total C=56.5mm). Therefore, there were concerns that using a more substantial communications cable (ie. RCTV cable #6, Ø = 18mm) as part of the two-cable system (Ø = 8mm and 18mm; Total C=81.7mm) would introduce similar drag induced limitations.

The relationship between maximum lateral range of the TUV and the length of towing wire is shown in Figure 1. This figure also shows that the difference in maximum lateral range observed by increasing the communications cable diameter is insignificant [old communications cable Ø = 8mm and 10mm; Total C=56.5mm; and new communications cable Ø = 8mm and 18mm; Total C=81.7mm]. This suggests that the factors limiting the lateral range of the TUV when using the RCTV umbilical cable in cruise 0408A are more likely to be due to fundamental cable construction properties, in particular its flexibility. More importantly, the benefits gained by using RCTV cable #6 (i.e. improvement in voice communications quality and reliability) should not limit the operating capability of the TUV. Previous cruises using this combination of trawl gear (BT 158 & Morgere Doors) have

demonstrated that the TUV (with two-cable system) was operating at the limits of lateral range when trying to navigate to the trawl doors. The trawl during these previous operations was typically shot with 75m of warp in a water depth of ~20m and at a towing speed of ~3 knots. The results summarised in figure 1, suggest that the TUV should be able to successfully navigate to the trawl doors, provided the warp length to the doors is >80m. However, this is greater than the typical length used in these shallow depths (i.e. ~75m) and is approaching the limits of door stability (i.e. >90m warp length) (Figure 1). Please note, these observations are preliminary and more thorough engineering trials using reciprocal tows are recommended.

Further improvements in lateral range of the TUV may be achieved with improvements to the TUV rudder design; namely, by increasing the relative area of the anterior side of the rudder (i.e. ahead of the rudder axel). This may also improve the balance of the rudders, allowing for easier operation by the TUV pilots. The feasibility of this option will be investigated for the next research vessel cruise using the TUV (1509A).

Figure 1: A Comparison of the Maximum Lateral Ranges of the TUV over a range of Towing Wire Lengths, with the Mean Door Spread of the BT158 over a range of Warp Lengths (combined data from Alba cruises 0408A and 1009A).



Preservation of Diver's Gas Supply

Two TUV dives on a previous cruise (0408A) were aborted because of interruptions to the main gas supply of one of the two divers operating the TUV. In both incidents the divers safely transferred onto their reserve gas supplies, the dive was immediately aborted and an effective and controlled ascent was completed. Subsequent investigations concluded that the divers' gas supply was most likely interrupted by repeated contact between the cylinder valve and the bulkhead of TUV cockpit, which closed - or partially closed - the cylinder valves, restricting the divers' gas supply. To mitigate for this potential hazard a valve protector has been designed and constructed by the Marine Scotland Diving Team and Engineering Department. This valve protector was successfully tested on 14 dives during this cruise. In total, there have now been 30 TUV dives without any reoccurrence of this incident.

M Breen
7 July 2009