Lancashire Combined Fire Authority
Resources Committee

Meeting to be held on 30 November 2022

Subsurface Rescues using Remotely Operated Vehicles

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Executive Summary

The Drone Team have been investigating the use of an underwater Remotely Operated Vehicle (ROV) in search and rescue operations. Responding to persons in difficulty in water incidents is a foreseeable risk and therefore suitable training and equipment should be made available for responding crews. The outcomes of a recent pilot of a subsurface ROV are summarised in this report.

Recommendation(s)

To seek Member support for the procurement , and future deployment of a high specification Remotely Operated Vehicle (ROV) in support of water rescue operations. Anticipated capital costs of c. £80,000 would be funded from the existing innovation budget and built into the Capital Programme if approved.

Background Information

In March 2021, the National Fire Chiefs Council (NFCC) published a position statement entitled "Rescues of submerged casualties" which includes the following text:

"The HSE have indicated that not preparing for a foreseeable risk, including rescues of submerged casualties, is unacceptable. Fire and rescue services may face action if they are found to be exposing their staff to a situation that involves an intervention to save a submerged casualty. Operational discretion is not seen as applicable in circumstances that require actions not supported by legislation, policy and procedure, when there is evidence to support this is foreseeable."

NFCC position**: "**Unless services are able to address the identified gap in the required resources, equipment, training, and the actions that are required to remain compliant with legislation, when attending an incident involving a casualty that is submerged – All rescues of a submerged casualty should be taken from the land, the surface of the water or by personnel in the water maintaining the correct levels of Personal Protective Equipment (PPE). Rescuers should be competent to risk assess and carry out rescues and should maintain the correct levels of PPE. Operational discretion should not be used to remove PPE, enter confined spaces underwater or act outside of service policy to go underwater.

There may be specific sub-surface situations that can be controlled to allow a rescue attempt. These situations will usually be when the casualty is visible and submerged in shallow water. The NFCC will consider future National Operational Learning cases but

are unlikely to re-evaluate existing guidance unless they include new evidence, alternative safe systems of work or equipment, or other technical solutions that are deemed as a potential improvement in this matter."

Lancashire Fire and Rescue Service (LFRS) Response

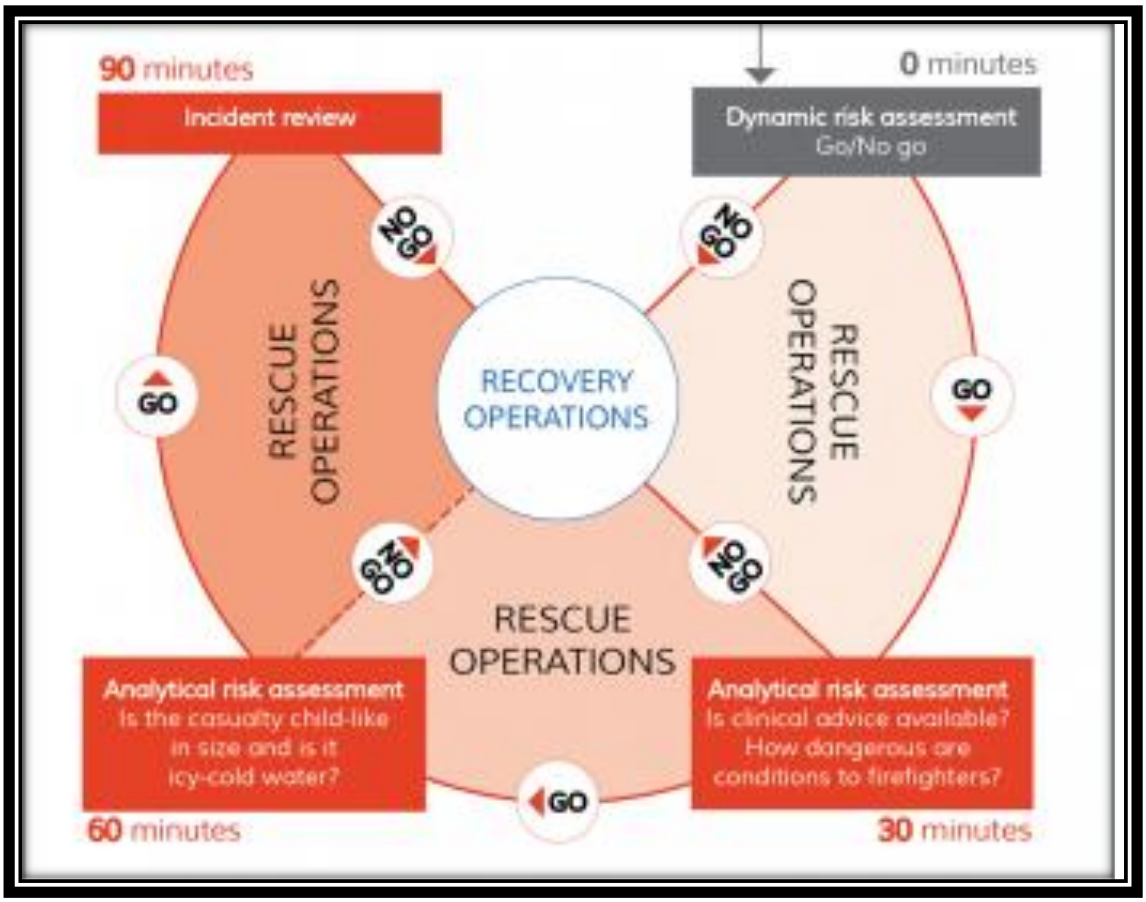
LFRS has sought to minimise the impact of this necessary operational restriction through investments in Swift Water Rescue Technician (SRT) equipment such as reach poles. This only goes a short way in closing the capability gap that now exists for submerged casualties.

Remotely Operated Vehicles (ROVs)

A ROV normally involves a small submersible which houses a battery, propellers and a camera with high powered lighting. It is connected to the land via a tether cable which carries the command wire. The controller is held by the pilot on the bankside.

Photo: Remotely Operated Vehicle (ROV)

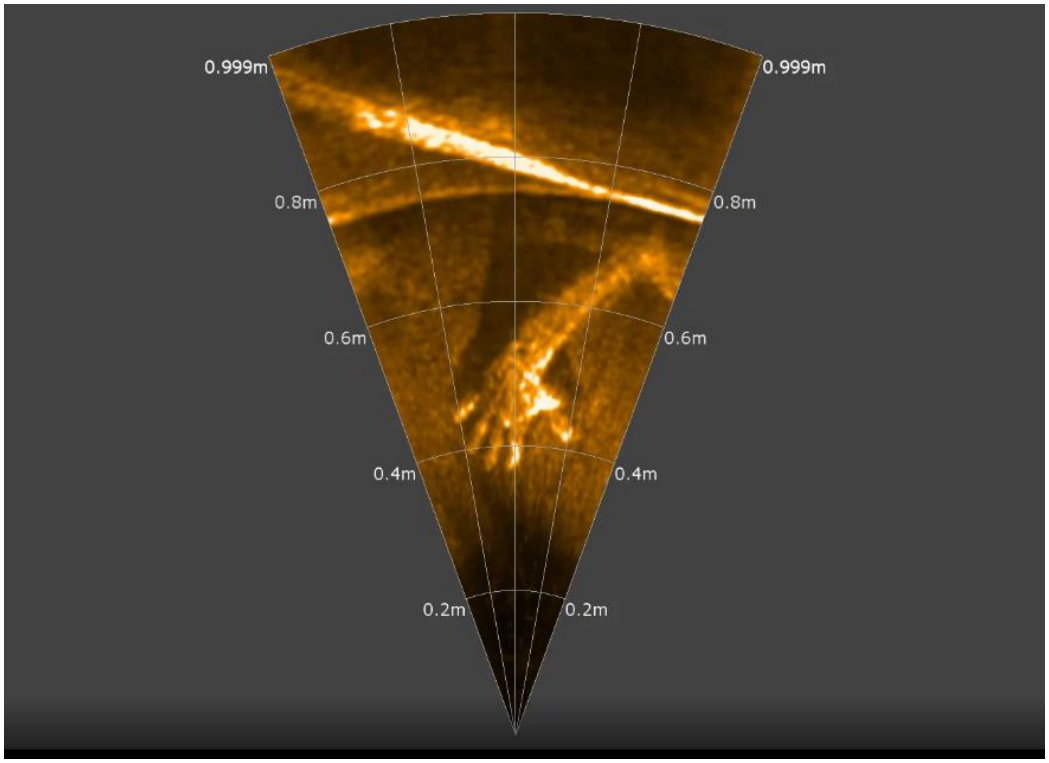
In order to fully close this gap, the Drone Team secured a small amount of investment from the Research and Development group (c.£3,000, photo above) for an underwater Remotely Operated Vehicle in order to conduct feasibility trials, to prove concept; the purpose of its use was to assess its potential for life saving operations and to identify a list of necessary requirements of a fully capable unit. A recently submerged person can present a viable rescue for up to 90 minutes according to national guidance (below). During this time the Fire and Rescue Service (FRS) and other Blue Light responding partners must be seen to be responding or there is a likelihood that others will intervene.



Research Findings

The LFRS ROV, manufactured by FiFish, was procured for less than £3k, but capable of demonstrating most of the basic functions of the more expensive industrial ROVs. Importantly it had a claw which could be operated by the pilot.

In order to get a wider understanding, LFRS attended a ROV expo in London and invited two of the largest manufacturers – FiFish and Deeptrekker to demonstrate a number of their ROV models at Fleetwood Campus. In order to improve our understanding of SONAR the team also visited Blueprint Subsea in Ulverston who allowed LFRS pilots to use sonar equipped ROVs in Lake Windermere. The company was very helpful and provided a number of recovery videos to the team to show how casualties are located in real life.



All of the models investigated had a long battery life in excess of 90 minutes. Some were more rugged than others, but several important requirements were identified beyond the anticipated operational requirements. These are outlined below.

Vision

The degree of detritus in the water severely limits normal camera vision, and high-powered lighting (an absolute necessity at night) can further exacerbate rather than solve this problem, similar to using high beam headlights in the fog. During trials the ROV was able to locate a child dummy casualty at the bottom of Rivington Reservoir in good, clear and still water. It was noted though as the operation went on that the propellers quickly stirred up sediment and vision became poor. This is a conceivable scenario for rescues even in excellent conditions. Search is therefore very difficult with normal cameras either day or night.

> *Requirement: An ROV requires SONAR in order to search and 'see' through the water. SONAR is particularly valuable in identifying air voids in the water created by recently submerged casualties.*

Positioning

ROVs cannot access GPS underwater. It is possible however, to know the depth via a barometer and the aspect (the direction the ROV is facing) via a compass. The tether cable is buoyant so it is feasible to get an approximate location of the ROV on a straight run underwater from shore. An available option is to surface the ROV which is not ideal practice once a casualty has been located.

> *Requirement: An underwater positioning system is required in order to gain precise location data for a casualty. This has a number of other benefits in that the ROV calculates where it is and can stabilise this position accurately against water flows. The positioning system can enable systematic search patterns to be*

employed by operators (i.e., we know exactly where the ROV has been and where it is going).

Casualty Recovery to Surface

No easily transportable ROV can bring a submerged casualty to the surface using just power from propellers. This idea was quickly dismissed during trials. A number of factors can influence the difficulty in raising a person, including size, weight, clothing, buoyancy and water current. The team looked into the feasibility of attaching and operating items such as air lifting bags. Attaching recovery systems was very difficult with the claw operating in good visibility and no current. The only realistic chance of success is to attach the ROV onto the casualty (or more likely their clothing) using an interlocking claw to allow proper grasp. This was confirmed as being in use for body recovery in other parts of the world. A manual hauling from above/alongside via the tether cable would then be required.

This 'grab and retrieve' method was achieved during the trials at Fleetwood Nautical Campus with a higher rated ROV model (the current LFRS £3k ROV did not have sufficient strength in claw or tether cable). It must be noted that moving a casualty was easier from land (i.e., at a low angle) rather than from directly above which meant lifting the weight of the casualty and the ROV. Much of the recovery involved getting momentum established in the first instance. It is likely that a recently submerged casualty would be more buoyant than the weights/dummies used in trials.

Requirement: An ROV must have a sufficiently strong claw grasp & tether cable in order to raise a submerged casualty by manual means from bankside/boat.

Operation

Operating a ROV in a 3D 'blind' environment such as murky water is a challenging proposition. The drone pilots are used to operating without sight of an aerial drone but the ROV brings another dimension in that it was able to rotate vertically to face upwards or downwards. Some ROVs such as the FiFish can fully rotate in all three directions and on a number of occasions the ROV was upside down without the pilot being aware of its aspect. Other ROVs were demonstrated however, that stayed level with the surface and the camera rotated on a gimbal much like an aerial drone. This was far more controllable for the pilot and much more suitable for systematic searches.

Requirement: The ROV needs to have a simple operation method which eliminates the ability for the ROV to rotate vertically, giving the ability to carry out systematic searches.

Control

ROVs are provided with a controller for the pilot to operate. In the case of the LFRS FiFish ROV, a simple controller was provided and a smart phone was used to see the camera feed via an app connected by wi-fi. The controller's simplicity added to pilot confusion as many of the commands and settings were located on an app instead. The use of a smartphone to operate the ROV was understandable due to its costs, but the app often required a reset during operations. LFRS has learned this limitation already with drones and thus uses standalone, manufacturer-built controllers for its operational drones. In trialling SONAR, it was noted that some manufacturers did not integrate the sonar output into the controller, and a laptop or similar device was also required.

Requirement: The ROV needs to be provided with a manufacturers specific controller which integrates all of its functions and imagery.

Recommendation

LFRS has deployed a ROV three times to incidents (as at 11/2022) over the 2022 summer period in order to assist rescue teams in recovering casualties from under the water. All three incidents demonstrated the value in deploying the ROV. Unfortunately, these incidents also demonstrated the ineffectiveness of the existing subsurface rescue. In fact, a submerged casualty was located within seconds of the first ever ROV deployment despite extensive searches already having taken place by crews and other agencies.

In order to deliver a realistic search and casualty recovery capability Fire and Rescue Services will need to deploy a ROV currently costing in the region of £70-80k. The complex nature of operations would require a significant investment in training for SRT or boat crews, but much less so with the Drone Pilots who have immediately transferable skills. The ability for the ROV to search for objects in addition to casualties should not be overlooked in this regard.

Therefore, the recommendation is for the Combined Fire Authority to support the procurement of a higher capability subsurface ROV, thereby enabling the Service to become the first nationally to have improved underwater body location and potential rescue capability. An investment of around £80,000 is anticipated which would be funded from from the existing innovation budget and built in to the capital programme, if approved. The deployment of this will place additional pressuers on the Drone Teams revenue budget, which is currently overspent. A review of its deployment is currently underway to ensure it is only mobilised where required.

Business risk

LFRS previous subsurface rescue solutions have proven ineffective in locating a submerged casualty. In deploying a technological solution, LFRS will dramatically improve the chances of a successful outcome whilst reducing the moral pressure on firefighters and the public to attempt dangerous rescues themselves.

Sustainability or Environmental Impact

Warm summers inevitably lead to tragic events involving teenagers entering cold water. Despite extensive preventative programmes, these incidents occur every year and 2022 demonstrated the link between warmer weather and drowning.

Equality and Diversity Implications

None

Data Protection (GDPR)

The proposal will involve the processing of personal data given the ROVs have the capability of capturing imagery, albeit far less intrusive than aerial drones which are already in use.

HR implications

None

Financial implications

A number of ROVs were demonstrated which were significantly more expensive than the LFRS FiFish. In order to meet the above recommendations an ROV would cost around £80,000. A significant proportion of this cost would be for sonar and positioning systems which are provided by another company to the ROV manufacturers, but integrated by them. Servicing costs differ between manufacturers but are minimal as the units tend to be necessarily sealed. The propellers are the main issue and most manufacturers provide training to operators in order to service their own equipment. Manufacturers also use magnetic drive propellers which eliminate damage to the prop shafts should they become entangled. These have an extremely long service life - well beyond the usage anticipated by LFRS.

As stated above the purchase could be funded from the Authority's Innovation Reserve, which currently stands at £0.25m.

Local Government (Access to Information) Act 1985

List of background papers

Paper:
Date:
Contact:

Reason for inclusion in Part 2 if appropriate: N/A