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The Evolution of the Perry Slingsby Submarine Rescue Vehicles

JOHN MORTONSON
ENGINEERING MANAGER
PERRY SLINGSBY SYSTEMS LIMITED
INGS LANE
KIRKBYMOORSIDE
YORK
YO62 6EZ

PSSL received an order in 1994, from the Republic Of Korea Navy for a SRV. The ROKN after analysing the effectiveness of the then existing Submarine Rescues Systems decided that they wanted a vehicle very much like LR5 but with the issue of TUP addressed.

PSSL supplied LR5K which did exactly as the client requested. The issue of TUP was addressed by the fitment of a larger central chamber – capable of carrying ten men under pressures of 5 barg. PSSL was able to facilitate this and other improvements (without any increase in vehicle weight or size) by the application of our ROV technology to SRV applications. Hydraulic and electrical circuits including power packs, valve packs and junction boxes were mounted externally thereby releasing internal space for rescues.



LR5K was delivered in 1996, shortly afterwards The British Naval Authorities decided to modify the rear half of LR5 to delivery a larger rescuee capacity and an effective TUP facility even when operating from a Ship of Opportunity. This modification was completed in the year 2000.

Meanwhile NATO starting a feasibility study into the possible provision of a NATO Submarine Rescue System

Many concepts were investigated and analysed but the choice was eventually narrowed to just two:

- A Battery Powered Manned Vehicle
- B Remotely Operated Rescue Vehicle

Grossly simplify the comparison can be summarised in terms of the advantages of the two concepts. The advantages of the Battery Powered Manned Vehicle include:

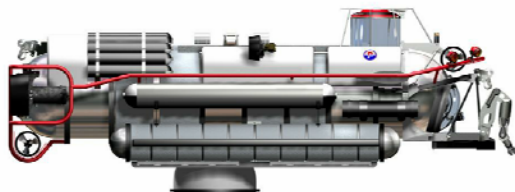
1. Being manned provides both tactile and in-situ feedback
2. There is no possibility of umbilical entanglement
3. No umbilical drag

Whereas some of the advantages of the Remotely Operated Rescue Vehicle are:

1. No limits to the amount of power that can transmitted to the vehicle
2. High quality audio, video and sensor communications.
3. The structural link of the umbilical can provide a means of deployment and recovery in high sea states.

Whilst the NATO discussions continued activity in the International Submarine Rescue Arena also continued.

In 2001 PSSL agreed a technical specification with the Chinese Navy for a SRV capable of operations to 500 metres and with a rescue capacity of 19. The commercial terms were finally agreed and this vehicle is currently under construction at the PSSL's premises in North Yorkshire.



The Authorities of India and Singapore started discussions re- the supply of Submarine Rescues systems with an initial order from Singapore being placed with PSSL for an Intervention ROV – capable of delivering emergency stores to a DISSUB in order to maintain life until a SRV arrives to effect a rescue.



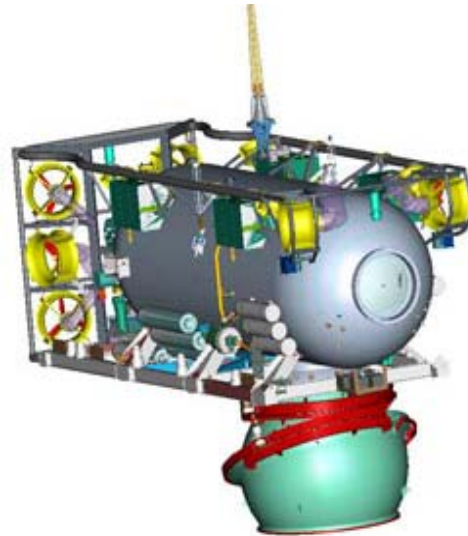
At the time of writing this both the Indian and Singapore SRV orders have yet to be placed.

In addition the ROKN has identified a need for a second SRV and discussions currently continue.

Ten years ago the Australian Navy established the first Remotely Operated Rescue Vehicle Remora – it is fair to say that like many firsts this system has suffered from being on a learning curve.



However the concept of a RORV system proved attractive to the US Navy who pulled out of the NATO discussions and in due course placed an order with OceanWorks International for a comprehensive rescue system called PRMS.



Meanwhile the NATO Studies and discussions continued and 2003 the French, Norwegian and British Authorities signed a MOU which resulted in a RFQ addressed to a total of seven previous identified prime contractors. The contract was won by Rolls-Royce whose team consisted of Divex supplying the Deck Decompression chambers, The Engineering Business supplying the Launch and Recovery System and PSSL providing the SRV.

The SRV design is based on proven established principles – but the three primary perceived advantages of the RORV concept have been addressed:

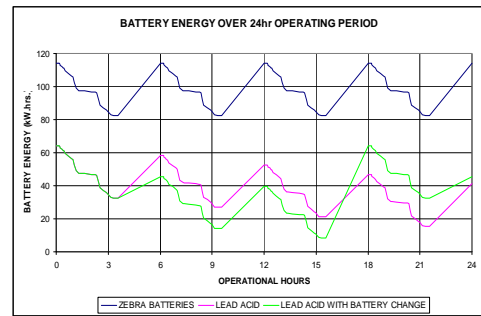
Power.

The NSRS SRV is equipped with Zebra batteries replacing the Lead Acid cells fitted to previous vehicles. These batteries employ Nickel Sodium Chloride cell chemistry and provide high energy densities. Compared to an equivalent Lead Acid battery arrangement the Zebra Battery modules provide approximately 100% more stored energy at about 60% of the weight, in fact the NSRS SRV has approximately 102kWh capacity for the main power users, electric propulsion and hydraulic power systems, and approximately 17kWh for instrumentation, control, communications and life support systems.

This amount of stored energy allows high powered systems to be installed without compromising mission durations, or alternatively permits for extended missions where high power utilisation is not required.

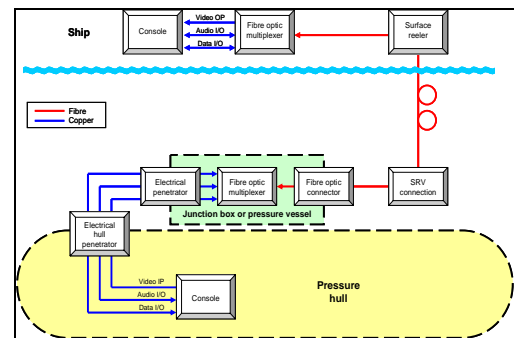
A further advantage provided by the Zebra battery system is its ability to accept charge more quickly than lead acid batteries and traditional chargers.

The higher discharge rate allows for more powerful propulsion and hydraulic systems to be fitted to the vehicle. The NSRS SRV is 3.5 times more powerful than any previous PSSL SRV – critical for mating with DISSUBs in high current conditions. The higher charging rate capacity is also highly desirable. A rescue scenario may well include several cycles from the MOSHIP to the DISSUB and back again. If we assume that the time spent in the water expending power is four hours and that the time spent on deck is 120 minutes. Then as the graph below indicates the state of charge of the Zebra batteries reaches an equilibrium regards of the number of dives undertaken.



High quality audio, video and sensor communications

The NSRS SRV is connected to the MOSHIP by a 5mm diameter, neutrally-buoyant, fibre optic cable.



This allows for the transmittal of high quality audio, video and sensor communications without the disadvantages of a larger and heavier umbilical connection. The neutrally-buoyant umbilical isolates the SRV from the MOSHIP surface motions and the very small diameter results in only small current-induced drag forces being exerted on the vehicle. The other critical advantage is that during potential entanglement the breaking load of the cable is only 400kgf, so even if the umbilical is wrapped around both the vehicle and a subsea object (thereby negating the effect of guillotine fitted to the SRV) the propulsive force of either vehicle's main or auxiliary propulsion would sever the umbilical. In the event of umbilical breakage the SRV comms would revert back to 'through water communications' maintaining the full operability of the vehicle.

Deployment and recovery in high sea states

Perhaps the greatest challenge in the design of the NATO Submarine Rescue System is the need to perform diverless recovery operations thus allowing rescues in higher sea states. This is particularly difficult when operations are over the stern on a Ship of Opportunity.



Diverless recovery requires two distinct operations. Firstly establishing a connection between the SRV and the MOSHIP and secondly using that connection to recover the vehicle through the air-water interface.

The proposed method of connection uses a line running to a clump weight deployed to the sea bed. The vehicle establishes a connection (via a small diameter messenger line) around the clump weight line and the vehicle and clump weight are driven/brought to the surface. The messenger line is connected to the LARS. When the messenger line is tensioned a capture unit (attached to a heavy lift line) is lowered down it and latches on to the vehicle. Recovery is completed by lifting of the vehicle via the capture unit.

There are many other new features on the NSRS SRV including a closed circuit Independent Breathing System allowing long term survival in a potentially poisonous environment and on-board DISSUB toxic gas analysis capability – building on the lessons learnt during the Kurst tragedy.

The following photographs show the SRV during the later stages of the build programme. The final photograph shows the new NATO Intervention ROV which will replace the current

Super Scorpio vehicle used to good effect in the Russian manned submersible rescue.

