‘The Silent Red Sea’

After a long wait deep wreck photographer Leigh Bishop finally gets his hands on one of the UK’s latest CE approved closed circuit rebreather’s, a product likely to capture the attention of serious and advanced divers. As the new Ouroboros rebreather arrived he had no time to wait around and headed straight off to Egypt for a taste of the ‘Silent Red Sea’.

As frustrating as it was when the new Ouroboros closed circuit rebreather arrived I had little time to lift the lid off the carbon Kevlar case to investigate deeper before I had to catch a flight to Sharm El Sheik in Egypt. Like several other lucky divers around the world I would be heading to the Egyptian Red Sea to train on what appeared to be the most sophisticated piece of diving equipment I had ever laid my hands on. I closed the lid packed my cameras and prepared for the journey to Egypt, the week ahead was full of expectations not least to mention some intense training and in water skills I should have had under my belt years ago.

Our instructors for the week would be both marine engineer Kevin Gurr and extreme cave diver Phill Short, individuals that had been instrumental in the design & development of the unit and the popular VR3 dive computer which the unit’s software is based on. I hadn’t seen the unit for over eight months as Kevin Gurr was working on the CE testing side of things. Before that and a number of years building up to the final CE tests I had been selected to work with Closed Circuit Research Ltd as a development diver, diving the Ouroboros rebreather with the team and providing feedback specifically tailored to my field of exploration.

Even in the last eight months whilst the unit had been locked away for final tests it had changed even more than I remembered, from case design and in water trim to improved software upgrades. According to the manufacturer **“**the control system setup, decompression modelling and alarm systems have been evolved from a system that incorporates a knowledge base and proven design for diver interaction with underwater computer systems. In addition the modularity and reprogram-ability of the software systems provides a future-proofing of the system design”. Time will tell I thought!

This was all sounding very futuristic certainly the unit looked the part but at the back of my mind I was kind of hoping that it wasn’t a little too over engineered not to mention complicated. The first day wore on and the CE approved product that had supposedly set new standards was thus far reassuring my initial confidence. As

sunset fell across our first day on the Egyptian Red Sea the gathering of international divers had become familiar with fundamental the basics of preparation and software operation, with time for a quick dive before darkness the first production units entered the water. Even as a development diver I had joined the Egyptian trip with the first customers to familiarise myself with the new software as well as learning some new skills I should have had under my belt years ago.

The Ouroboros rebreather incorporates a completely back mounted system similar to the US military Mk15.5/16 with improvements over other previously available commercial units. The first improvement is mechanical and combines a more robust breathing loop (due to the internal counter-lungs) with armoured breathing hoses. Everything is protected within a carbon Kevlar shell.

The second is in the electronic computer systems for control, logging and decompression requirements analysis. The unit adopts a no tools ethos and has been designed with user preparation in mind, a self packing scrubber meant no tapping the side of the canister for ten minutes and dives could be turned around very quickly indeed. Having said that the quick turn around time is stolen back from you during the pre dive checks which at first seem to take an age as I'll soon describe.

The solenoid, controllers and software power systems on this unit are independent to the breathing loop making the unit intrinsically safe. With the lack of metal components inside the loop internal condensation is also reduced to a minimum. Oxygen cells are positioned in the unit in such a way as to avoid water contact whatever position the diver moves into, thus reducing problems furthermore of water across the cells membrane. It is well known that moisture variations reduce the life time of cells, therefore should you wish to store your cells (as may be the case in a hot country) between dives you simply unscrew the connecting jack plugs, remove the small bracket that holds the 3 cells at the heart of the unit and slip it into you pocket for the trot back to your tent, accommodation, expedition camp, hotel or whatever. No special tools are required.

The software is designed to draw minimal power from the batteries, which give a minimum of 40 dive hour's dependant on backlight use. All on board electronic systems are powered by ordinary batteries that can be purchased from any store in the

world. The unit incorporates two litre cylinders although larger cylinders can be adapted if required although Kevin pointed out to me that the low volume 3.2mm stainless pneumatics of the systems are designed for minimal gas usage likewise are the counter lungs that also run on minimal volume. Two litre cylinders may run adequate for most dives, deep wreck divers and serious cave divers can supplement this by simply plugging in off board gas supplies when required.

I always liked the idea of a complete back mounted rebreather that would rid your chest and shoulders of all the normal goings on of a rebreathers counter lungs and pipe work, how nice it would be to have a simply harness like the good old open circuit days. Like everything there is a little give and take and back mounted rebreathers are renowned for poorer hydrostatic breathing characteristics, i.e. easier to breathe out than in. An original factory development unit I dived a year ago had uncomfortable breathing characteristics in some orientations. This I feared may not have been rectified in the new production unit, although I have to admit of the 15 hours I spent on the unit underwater in Egypt the other divers and myself alike noticed no problems with the breathing characteristics.

The point was raised and Kevin took time to show us the extensive work he had done in the design of the flow dynamics and work of breathing to compensate for any hydrostatic imbalance. I wasn't keen on the larger size of the breathing hoses and mouth piece although this is perhaps because I'm accustomed to other units with smaller hoses. The hoses themselves are the similar to that are used in pilot breathing systems and are protected by ballistic nylon and an internal stainless steel spring, making them crushproof and very durable. The automatic diluent valve kicked in nicely on descents and could be isolated when not required, interesting also was the fact that off board gas plugged into the unit and like onboard gas is directed dynamically through the ADV or the Solenoid depending on what the selected gas is, be it diluent or oxygen. A nice feature also is the oxygen shut off valve isolating the solenoid in the event of a failure and allowing manual gas injection.

In keeping with a philosophy of reliability, safety and diving style variance, the Ouroboros can also function completely without the main electronics computer system. The unit incorporates a backup independent PO2 display system that shows both the milli-volts and normalized PO2 reading for each cell. This provides an alternative and /or backup system that gives the diver adequate information on which to perform or complete a dive, manually controlling the setpoint through the manual O2 addition valve. A breathing circuit with a low resistance work of breathing, dual back mounted counter-lungs, partial flood recovery and an efficient radial canister completes the system. Hea presto!

The scrubber is of a radial donut design with a patent system inside to assist dwell time and molecular collision, which in CE testing proved 40% more efficient over other tested scrubbers. Set high in the top of the unit some 2.7kg of lime within

managed to shift the weight to make my in water trim just right and running on minimum loop volume, for once I found myself using a lot less weight than I usually dive with.

As the week evolved I became more familiar with the new electronics, a significant difference to the old development unit I was privileged to test, especially the pre dive check screens. The design incorporates a wet contact activation system. On entering the water it maintains a life sustainable po2 if pre dive checks are missed in addition the alarms will warn the operator. I thought the pre dive check screens of which there are approx 20 prior to entering the water were a little over the top although on reflection, in reality these are serious checks that every rebreather diver should do before entering the water, the Ouroboros however reminds you to do them, which can only be a good thing and reduce future incidents. Kevin Gurr told me that he had designed at least 16 of the 20 check screen functions based on factual evidence of serious rebreather incidents hopefully in order to prevent Ouroboros users making the same fatal mistakes. After you have made your way through the screen checks and made a five minute countdown pre breath to activate the chemical reaction as well as to check for Co2 breakthrough, the systems diverts to operational mode. If I had one comment of dissatisfaction it was that a software bug warned me not to dive due to a system operation fault which told me to check the alarm screen status. On doing so the system appeared operational and cleared as I entered the water, two days after returning home Kevin had made a posting on the Ouroboros user's forum, stating a new upgrade had identified the bug I had encountered. Even since writing this article the company has released several upgrades making the unit even more user friendly.

Each dive we made in Egypt began with an open circuit bailout test on the wreck before the main skills were introduced by the instructors, On this particular day our live-aboard Emperor Divers charter had moored over the 'Thistlegorm' and the dive of this particular morning found us on the topgallant forecastle for a skill session before exploring the remainder of this famous wreck. The first skill would be a hypoxic drill simulating the po2 in the loop below that of a sustainable life supporting level, this assumes the solenoid or manual injection has failed and that visual & tactile alarms have activated. The alarms are incorporated into a heads up display as well as your primary electronics, to back this a vibrating mouth piece is also activated. As my experience grew on the unit over the week so with it did my confidence in what I originally perceived to be a complicated apparatus. As and when an alarm was actuated during a dive instead of falling into an alert state of panic I would simply

check the alarm status screen and deal with the situation while the unit continued to maintain function. For example the stack countdown timer would alarm to remind me I was drawing towards the end of my scrubber life; while the HUD light remained in alarm status the vibrating alarm could be deactivated. All alarms relating to serious issues would re activate after a pre determined time or if the state changed.

High pressure rubber contents hoses, especially oxygen ones are regarded as a weak point and have been know to cause serious fires if they burst, Ouroboros electronics incorporate high pressure transducers accurately monitoring cylinder contents on the wrist computer, thus no hoses which equals no loss of gas and no FIRE! Of course the disadvantage to this is that in the unlikely event that you loose your electronics you also loose the knowledge of your cylinder pressure contents. In theory if this was the case a qualified diver would have aborted and should have sufficient gas remaining enabling them to complete the dive. I deliberately purged the manual diluent add button which simulated a high rate of diluent usage, in turn another alarm system actuated warning me of a high pressure diluent usage. A neat little alarm if ever I thought, especially if you happened to encounter a loss of gas you would not normally have known about because it is on your back and out of site or if the system developed a leak during the pre-dive checks.

All alarms are recorded into the systems memory which can be downloaded from the electronics pod via an infrared port to the users laptop computer for analysis, the software details the entire dive from stack temperature and usage to Po2 levels and even whether you aborted the pre dive five minute stack pre breathe. Beware big brother is watching! There were numerous features I enjoyed about the electronics and numerous features I continued to discover as the week went on and when a period of time went by without activating any menus underwater the average PO2 reading from the cells was enabled as a full screen screensaver. Another screen I discovered

gave me an abundance of information of what was going on not to mention what the Po2 of the programmed diluent should be at the depth I was currently at! Should I wish to analysis it against a dill flush if in the event of trying to identify a problematic cell reading, that's of course if the systems intelligent computer hadn't already sorted it for me and disabled any 'rogue' oxygen cells as such.

Another skill incorporated into the Ouroboros module one course is flying the unit on the heads up display (HUD) without the use of your primary electronic controller or back up passive O2 display. A neat arrangement of LED's mounted on the divers mouth piece behind obvious marked displays show alarm status, decompression and both solenoid and oxygen information. As experience was gained so did the operation of flying the unit by the HUD alone, during the truly silent night dives along the reefs the brightness was simply adjusted during the dive.

Diving rebreathers really comes into itself when surrounded by the inhabitants of the reef, the ability to approach and swim with fish and wildlife without them being apprehended is a serious advantage to photographers. During the dives in the Red Sea the divers swam endlessly with turtles and all manner of interested fish, the silent no bubble approach is certainly the key and to be able to enjoy this with the sophistication of the Ouroboros technology was something else indeed.

The primary diving skills required to use the Ouroboros are all covered during the weeks course accompanied by some rather intense and testing in water survival skills. My first closed circuit dives were made during the early 1990's using the Prism and later a rebreather that went on to be called the Inspiration not to mention the Cis-Lunar MK4 some ten years ago now. Since those days I've made quite a number of CCR dives to say the least! What could I learn new in the water I asked myself,

well I'll be the first to put my hand up and say quite a lot actually. These guys really put me through the paces and when I thought I wasn't being watched how wrong I was as Phill Short produced a mirror to spy on his students as he led the way around those Red Sea wrecks! Each dive would then be followed by a thorough debrief where we could all learn from each others dives and problems that may have arose. Kevin chose Egypt as a location for the first Ouroboros course simply because of the in water time that can be gained from the environment and all year round weather conditions. Of course there are the logistics of flying with your unit however packed inside the units flight case which comes with the rebreather the weight comes in at a handy 32kg right on the limit of baggage handling and not too big to send you to oversize baggage. The Ouroboros rebreather has been designed for military, commercial, scientific, professional and sports diving. The design of the unit has been achieved with a no-compromise approach to rebreather design, incorporating specific fundamentals in reliability and safety, ease of maintenance, simplicity in operation with sophisticated alarms and monitoring, flexibility in operation and modularity, redundancy in system failure solution scenarios, upgradeability and reprogram-ability.

Although the design is new, the experience of the personnel concerned encompasses knowledge and experience gained in over 15 years of development and use of underwater electronic products, as well as in extreme diving. The product is an evolution of the best parts of rebreather design, coupled with a fully upgradeable full function control system. So what of factory support, the Closed Circuit research and design team are now occupied full time with development and software engineering and clearly state each unit comes with complete factory and technical support. So look out for regular bulletins on product accessories. This product is priced at hefty $14,000 and is perhaps not an average entry level rebreather. The well thought out on board safety and back up that is manufactured into the design has already attracted some of the world's most serious technical divers, my initial concerns over weight, size and ease of use, having initially dived the test units, have subsided. Since writing this cave divers have been recording depths of 600ft on the unit and regular 330ft dives have been made by British wrecks divers in the ocean.

Find out more www.ccrb.co.uk
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