

## Decompression procedures - reinforcing the safety of hyperbaric workers: Feedback from the field.

By Julien ADLER



*Photo credits Implenia - Tunnel boring machine Metro Line B - Lyon*

### To the origins of the service

The occurrence of decompression sickness (DCS) among hyperbaric workers ("Mention D") is a known fact with which the tunnel boring profession - like all professions in the hyperbaric field - has to deal.

**What makes these accidents unique is that they occur despite the compliance with the regulatory decompression procedures**, that are issued from the decrees and orders of the Ministry of Labour. And the number as well as the complexity of the mechanisms at the origin of these accidents precludes any prospect of rapid improvement in the situation as things stand.

In addition to an increased risk of DCS, poorly adapted decompression procedures are also synonymous with increased arduousness, fatigue, and potential long-term effects for personnel.

Several preventive measures are however known that allow a more efficient restriction of the risk of DCS: limitation of the intervention time, use of oxygen (hyperbaric or normobaric), mechanization of the physical activities<sup>1</sup>. Nonetheless, knowing that these measures, which are added to the regulations, have a cost and that they can also impact the operational field of the companies, how can we distinguish between what is an effective safety gain and what can be considered as an unjustified over-precaution?

In such a context, Azoth Systems has developed the O'Dive PRO service, to allow hyperbaric managers to control and supervise the quality of decompression procedures in real working conditions; and to optimize both safety and operability based on objective, quantifiable and quantified criteria.

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<sup>1</sup> <https://www.btpst.fr/component/phocadownload/category/21-divers?download=204:poster-hyperbarie-2018>

## Service operation

O'Dive PRO analyzes the quality of decompression procedures by considering two indicators for which a correlation to the DCS risk has been proven: the dive exposure parameters and the quantity of microbubbles detected in the operators' bloodflow.

O'Dive PRO includes a vascular microbubble sensor (ultrasonic Doppler technology) connected to an analysis server and an information reporting site.

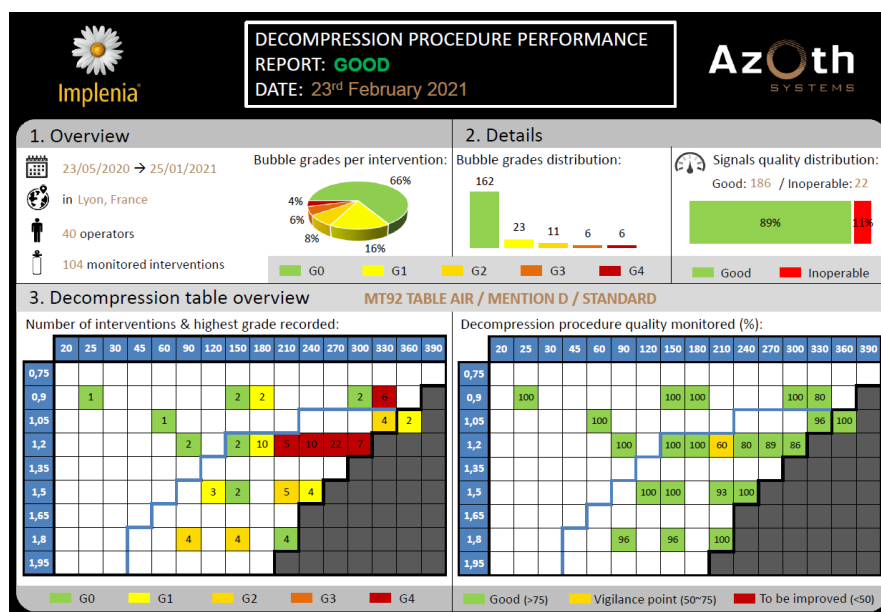
After surfacing, the intervenor places the sensor for 20 seconds under his left and then right clavicle. The signals are automatically recorded on the tablet. A visual feedback shows the operator the correct positioning of the sensor (red-orange signal on blue background). Exposure parameters are input manually or digitally imported.

The operation is done in just a few minutes, autonomously by the workers themselves. It does not require any additional human support.

## Feedback from the field

The company Implenia, in charge of drilling the extension of the metro line B in Lyon, has been using the O'Dive PRO service for almost a year. About 40 'Mention D' operators, for a total of more than 100 exposures, have performed bubble measurements after their intervention.

In practice, a simple training of the hyperbaric manager to the operation of the O'Dive PRO connected Doppler sensor was necessary. **The system was well received by the teams, who saw it as a tool to improve their safety.**

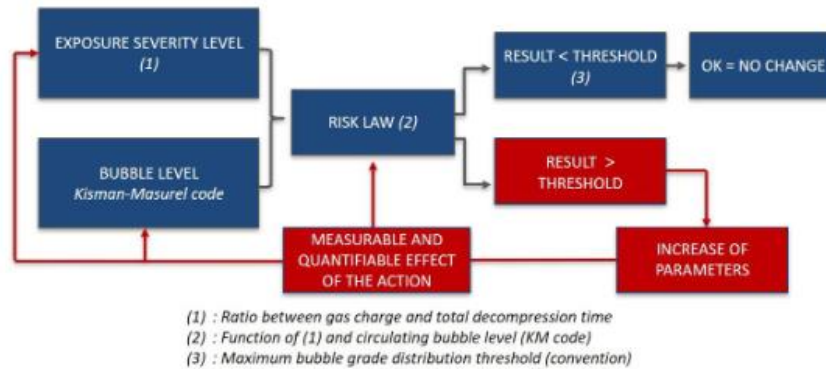


Online procedure tracking report generated by Azoth Systems

Over all the measurements, we observe that 10% of the interventions resulted in high bubble grades (G3 and G4 according to the Kisman-Masurel code). When looking more in detail at each table point, we observe that these high grades are mainly distributed in a 1.2 bar zone.

Though the bubble levels for each table point independently considered are so far judged acceptable according to the risk law determined by Azoth Systems<sup>2</sup>, a vigilance point could however be highlighted at 1.2 bar ~210+ minutes. The measurement campaign is still ongoing currently and work is in progress with Dr. Aublin Blandine (Implenia's hyperbaric referring doctor) to complementarily interpret these results with other physiological parameters (e.g. cardiofrequencemetry during the intervention).

<sup>2</sup> [http://www.dhjournal.com/images/ImmediateRelease/Hugon\\_Subclavian-VGE-scores.pdf](http://www.dhjournal.com/images/ImmediateRelease/Hugon_Subclavian-VGE-scores.pdf)



Decision support flowchart developed by Azoth Systems

## Testimonials

**Dr. Blandine AUBLIN** - Implenia's hyperbaric referring doctor

"It is always a pleasure to be involved in prevention initiatives in collaboration with companies. **Implenia was able to be innovative in combining activity and safety with regard to hyperbaric risks by implementing the O'Dive system on this site.** The ease of use of the system and the exploitation of the collected data have enabled us to be more vigilant during some specific interventions and to open up a critical mind as to the prevention measures to be proposed in the future.

It is always interesting from a scientific point of view, to observe and collect data in order **to move forward, especially in this field of dry hyperbaric exposure, which is currently in full growth and for which we must remain vigilant in order to remain perfectible.** The synergy between business, occupational health and continuous improvement is always fruitful.

**Denis VIALLE, Implenia France** - Head of Underground Works on the MBHLS site

"Implenia places safety at the heart of its concerns and of its construction sites organization.

As part of Implenia's ongoing efforts to improve safety, especially for the personnel working on our construction sites, we took the initiative of integrating the O'Dive system from the launch of the hyperbaric operations on the site of the extension of the metro line B in Lyon, thanks to the active collaboration of Azoth Systems. **This is an innovative system in the field of wet diving, but it had never been implemented for hyperbaric operations in dry environments.**

**After an initial proof-of-concept phase, which allowed us to validate the implementation and feasibility of such a system, we continued this novel experimentation in the field of tunnel boring machines throughout our hyperbaric operations. The positive feedback from the use of the O'Dive system confirms us in these orientations".**

**Karine PUYJARINET, Implenia France** - EHS Manager of the MBHLS site

"The simplicity of using the O'Dive system allowed a quick implementation on our site.

**The operators quickly adapted to the system and welcomed this experiment with interest and curiosity.**

The partnership between Azoth Systems and the site also worked well, with a very good reactivity which allowed the collection and the fast analysis of information in case of suspected DCS cases."

## Conclusion

The O'Dive system has confirmed the presence of sometimes high levels of decompression bubbles in the responders, despite the compliance with the procedures. The interest in monitoring the responders is therefore real. **To follow closely the quality of the procedures and to allow, if necessary, to make them evolve in a proportionate way, where it will be effective and by avoiding any over-reaction: such is the purpose of this system whose operating mode is entirely in line with the principle of the Deming wheel "Plan-Do-Check-Act".**

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