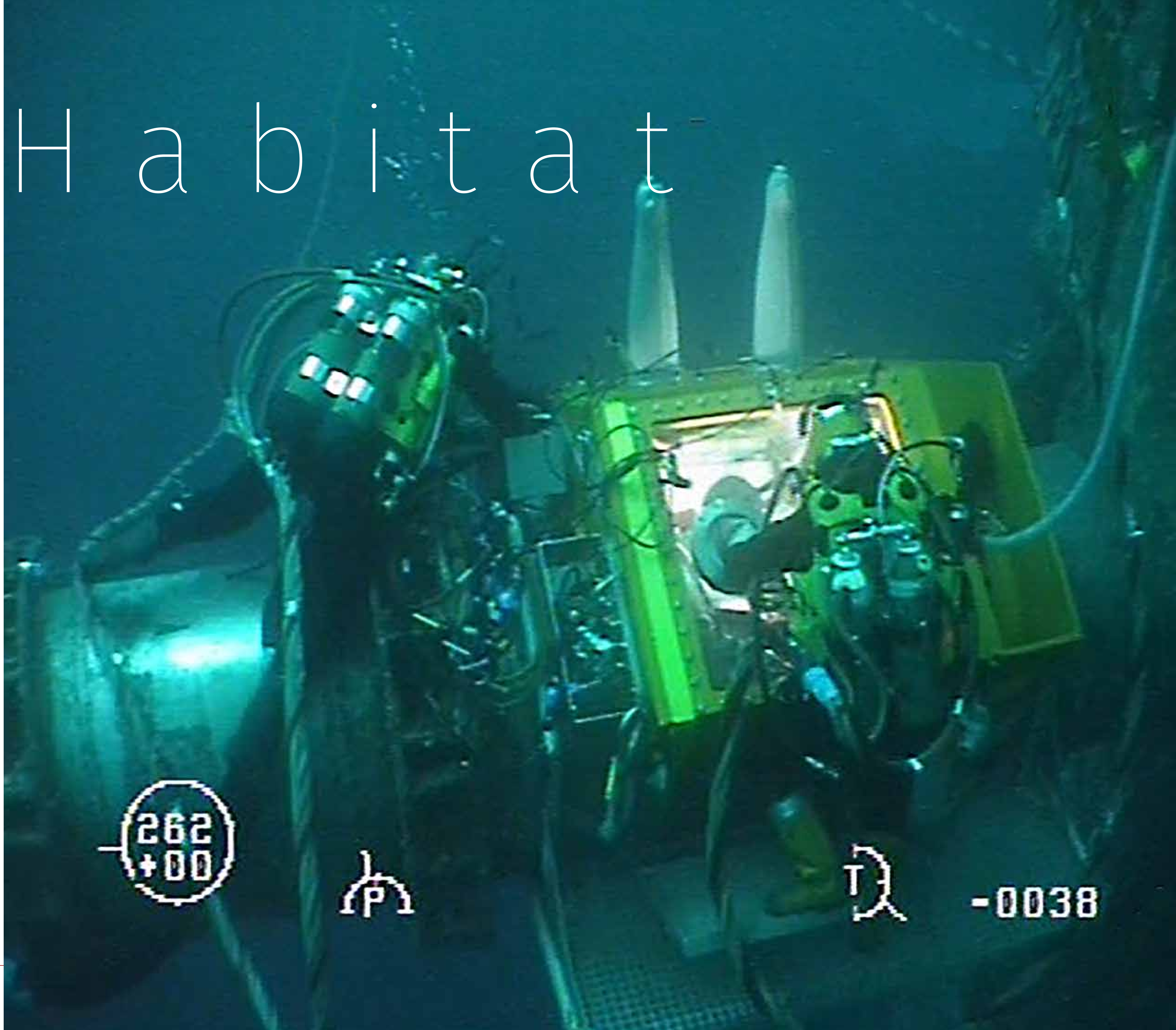
µ - Habitat



DCN Diving, a global hyperbaric specialist, recently employed its novel underwater micro-habitat (µ-Habitat) system to execute repairs on a North Sea platform jacket. In total, four welds were successfully conducted on horizontal and 45deg diagonal support braces in water depths up to 76m.

Ever maturing North Sea jackets subject to high fatigue stresses, high utilisation and a low redundancy design often results in fatigue cracking.

If not closely monitored, these fatigue cracks can propagate both through and around the circumference of a brace relatively quickly—ultimately leading to severance. Historically, when confronted with a loss of structural integrity, operators were faced with two options; expensive subsea repairs or decommissioning the asset.

It is important that the crack be removed entirely prior to repair welding – should a portion remain, the weld repair could crack relatively quickly. The most effective way of removing the cracks is by excavating the defect. DCN, for example uses Hydro-Carbon-Arc-Gouging techniques.

There are two main methods of underwater welding -– dry and wet.

WET

Wet systems involve diver welders working directly on prepared underwater metal surfaces using special consumables in which the electrode has a modified chemistry to produce a very localised gas blanket that emulates the dry atmosphere.

Wet welding is normally used for temporary repairs, welding anodes etc. It is, however, unsuitable for permanent repairs such as to a load-bearing structure or pressure-containing pipelines.

The deeper the weld, the greater chance of increased porosity (gas bubbles in a solidified weld) and so the wet welding technique is limited to around 30 – 35m.

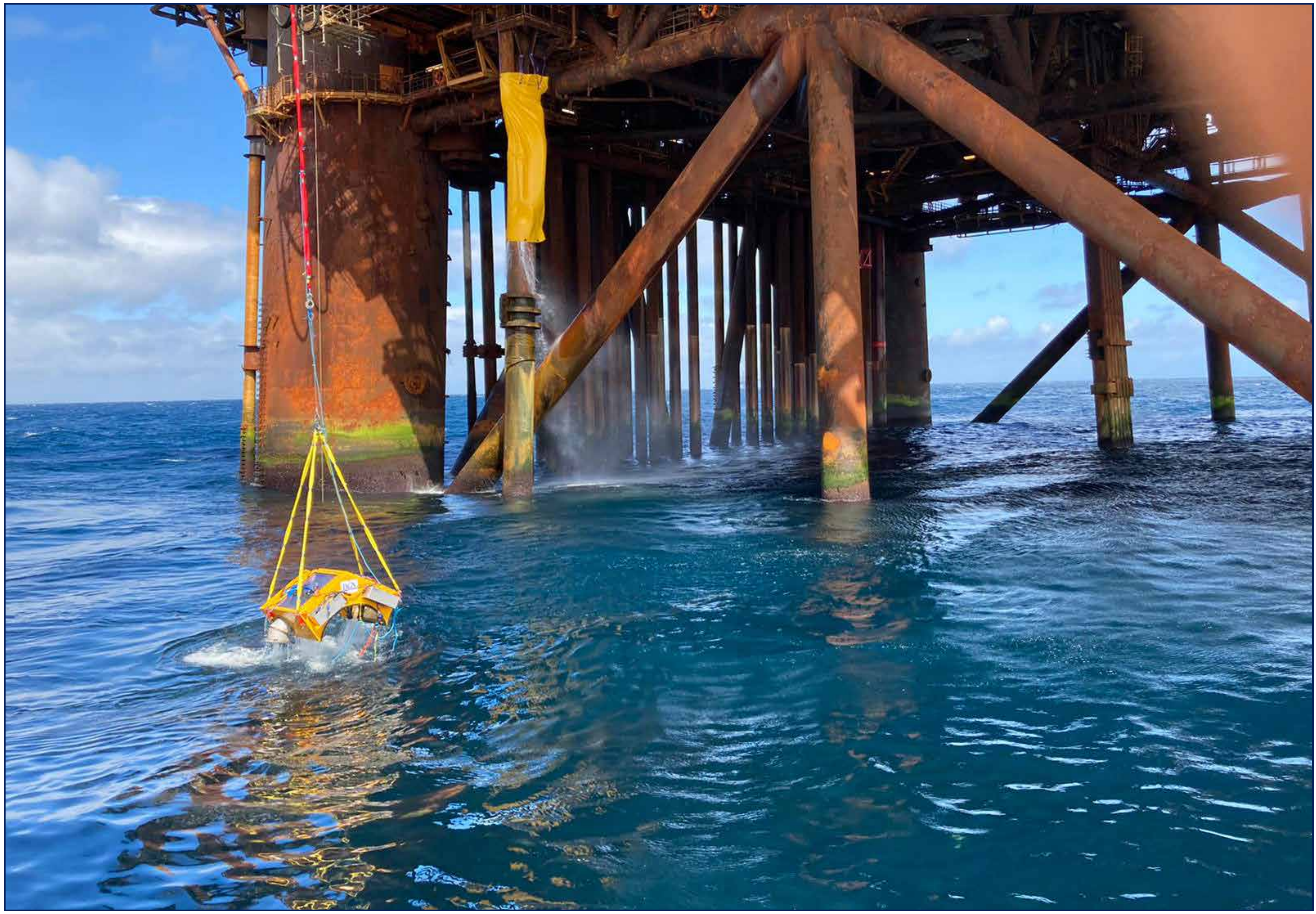
"In order to achieve a high-quality subsea weld, a number of main demands have to be satisfied," explained Earl Toups, Hyperbaric Welding & NDT Manager at DCN Diving.

"It is beneficial to pre-heat the repair area prior to welding as this slows the cooling of the weld pool and reduces the residual hardness of the weld making it less prone to cracking.

"The most common way of preheating the weld area is to use electrical resistance or induction systems but these techniques cannot be carried out in water. Furthermore, any surrounding water has an immediate quenching effect, raising the hardness levels and increasing the propensity of cracking.

"Water is composed from hydrogen and oxygen. Sufficient Hydrogen introduced into the weld metal often leads to hydrogen cracking which reduces its integrity. Throughout the welding process, it is imperative that in-process welding defects are removed by grinding to keep the weld free from discontinuities. It is very difficult to do this underwater in the wet."

The node repair habitat first developed for Ninian



Lowering the microhabitat

DRY
Challenged with executing permanent welds at 43 m and 76 m below the surface in the most cost-effective way, DCN Diving concluded that the only realistic alternative was to carry out dry underwater welding in a specially designed subsea habitat. Over the years, a wide a variety of habitat sizes have been developed depending on the application, but all have the essential aim of enclosing the weld and thus isolating it from the surrounding seawater.

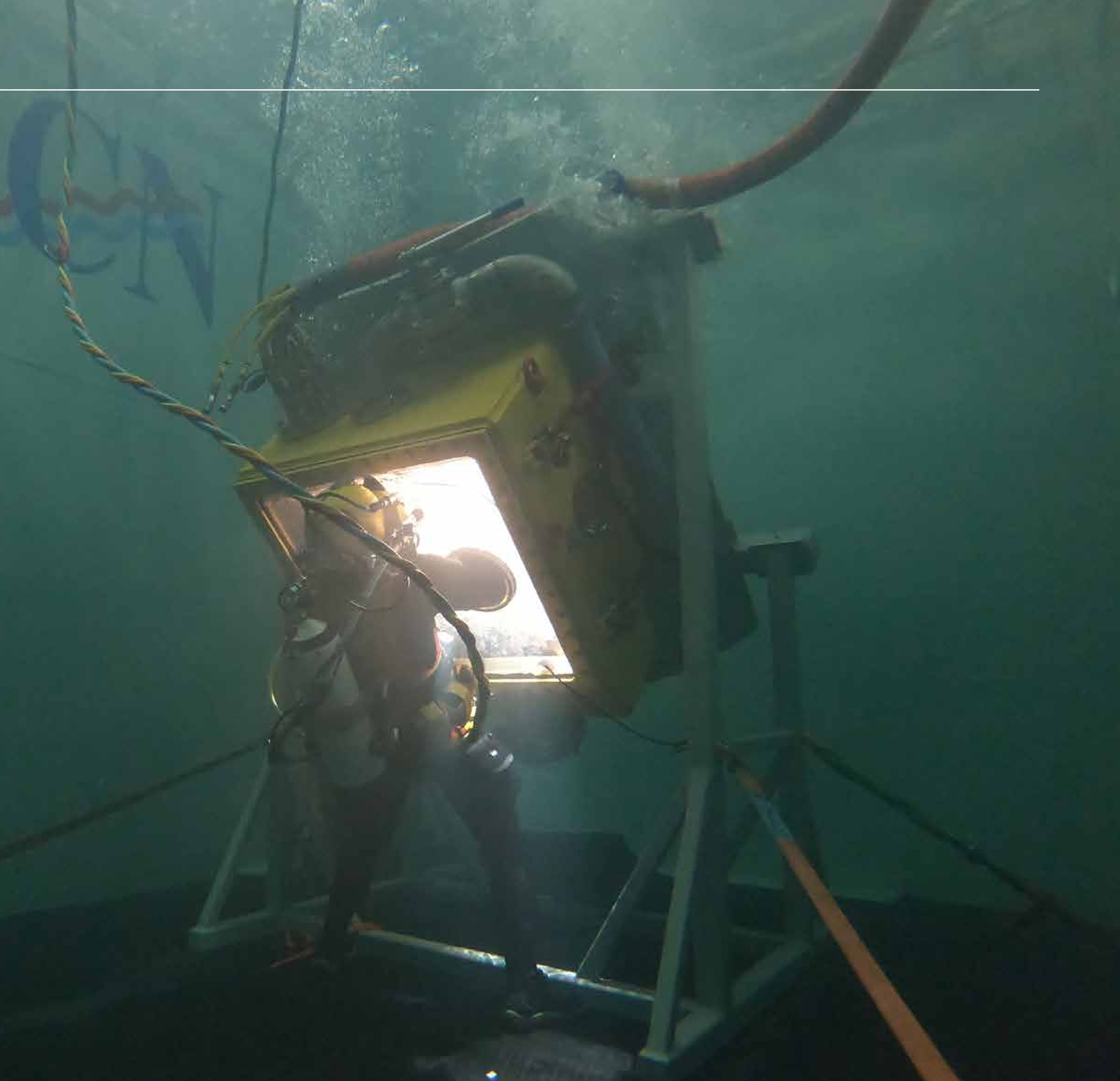
Some habitats are large enough to totally enclose an entire trunkline or node. Once the seal is made, the habitat is evacuated and the divers can enter to carry out the work in the dry atmosphere . These are extremely expensive and used where a fully enclosed dry-space is beneficial eg, for connecting large horizontal trunk lines. They are not particularly efficient for vertical and diagonal tubulars that form part of platform jackets.

At the other end of the scale, are small enclosures attached to the outside of the tubular and the water is evacuated. At the front of the enclosure is a Perspex screen. With water tight grommets, and no preheat capabilities, through which welding rod consumables are introduced.

Realising the market gap, DCN Diving explored alternate repair strategies leading to the development of its patented µ-Habitat welding system. This makes it possible to respond quicker, execute subsea repairs faster and guarantee quality at a fraction of the cost using bespoke or modular habitats.

By reducing the size, it is possible to reduce fabrication, production and handling costs. Furthermore, the smaller footprint of the µ-Habitat reduces installation time while simplifying the sealing and dewatering offshore, saving both time and money.

“This enclosure is placed against the outer wall and then securely fastened in place” said Toups. "Once in place, the weld could be worked on by divers standing on a platform outside. It would be small enough to be easily transportable



The diver using gloves to opeate the equipment

and quickly deployable on tubulars of any angle,

“Different habitats, or habitat sections, would have to be designed to match the radius of the tubular. In this case, ranging from 1200 to 1800mm.

HABITAT

“Inside the habitat is ample space for all the welding consumables and tools”, said Hyperbaric Welding and NDT Manager Earl Toups. “After being strapped to the metal wall, previously prepared and cleared of marine life to ensure a good seal, inert gas is introduced from the top to drive out all the water out leaving a dry and pre-heated metal face. The divers can then position themselves in front of one or more large Perspex panels to get a good view of the weld groove from the outside.

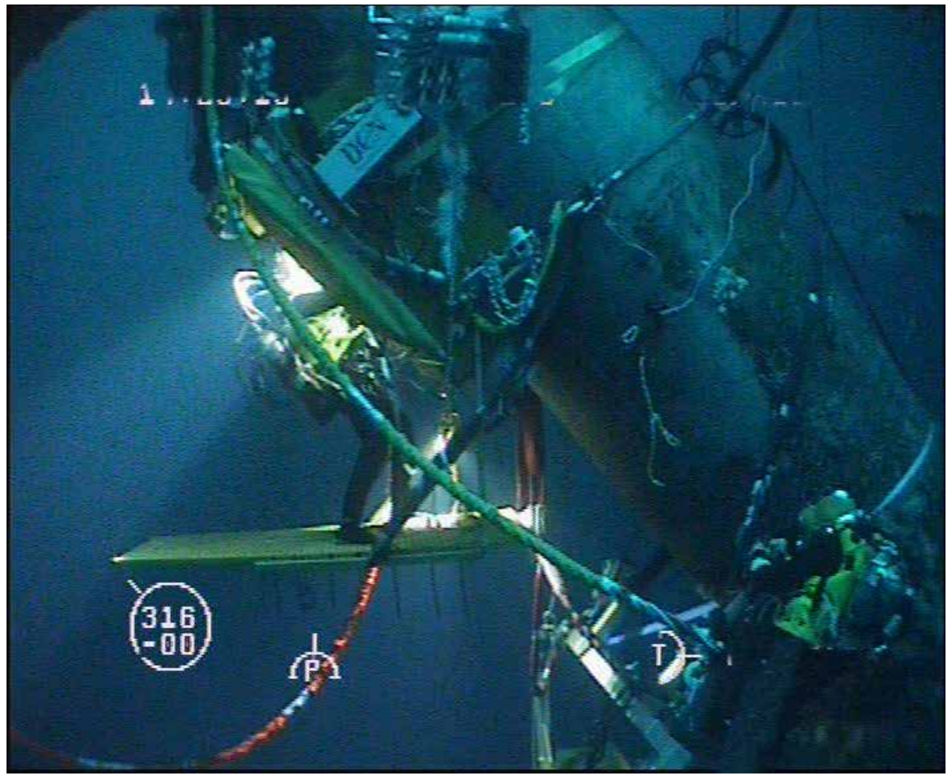
“Below this lies the access ports. When the divers insert their hands, their fingers are introduced into of rubber gloves that are integral to the microhabitat. These flexible gloves provide the interface between the wet outside and the dry clean habitat inside. They not only allow the divers to carry out the weld, but also to grind the metal and use other tools previously secured within the habitat.

“The welding process typically results in the generation of smoke which must be removed to provide good visibility. This can be easily enabled by flushing the system with gas.

This makes it possible to clean the microhabitat from the inside, or change the gloves in case a spark makes a pinhole rupture of the rubber. In one of the repairs the divers carried out on a 60mm thick member positioned at 45°, they were actually able to change the entire Perspex viewing window and recommence work without flooding the habitat or cooling the weld.”

The system was mobilised in early July on a jacket lying in the UK sector of the Northern North Sea. The work consisted of four hyperbaric welds one at 43m and the other three at 76m on tubulars with wall thickness ranging from 30mm to 60mm.

The work took just over five weeks (ahead of schedule) to successfully complete the four welds from start to finish. An intervention using a conventional habitat could easily have taken three times as long.



The diver carrying out the welding operation through the microhabitat