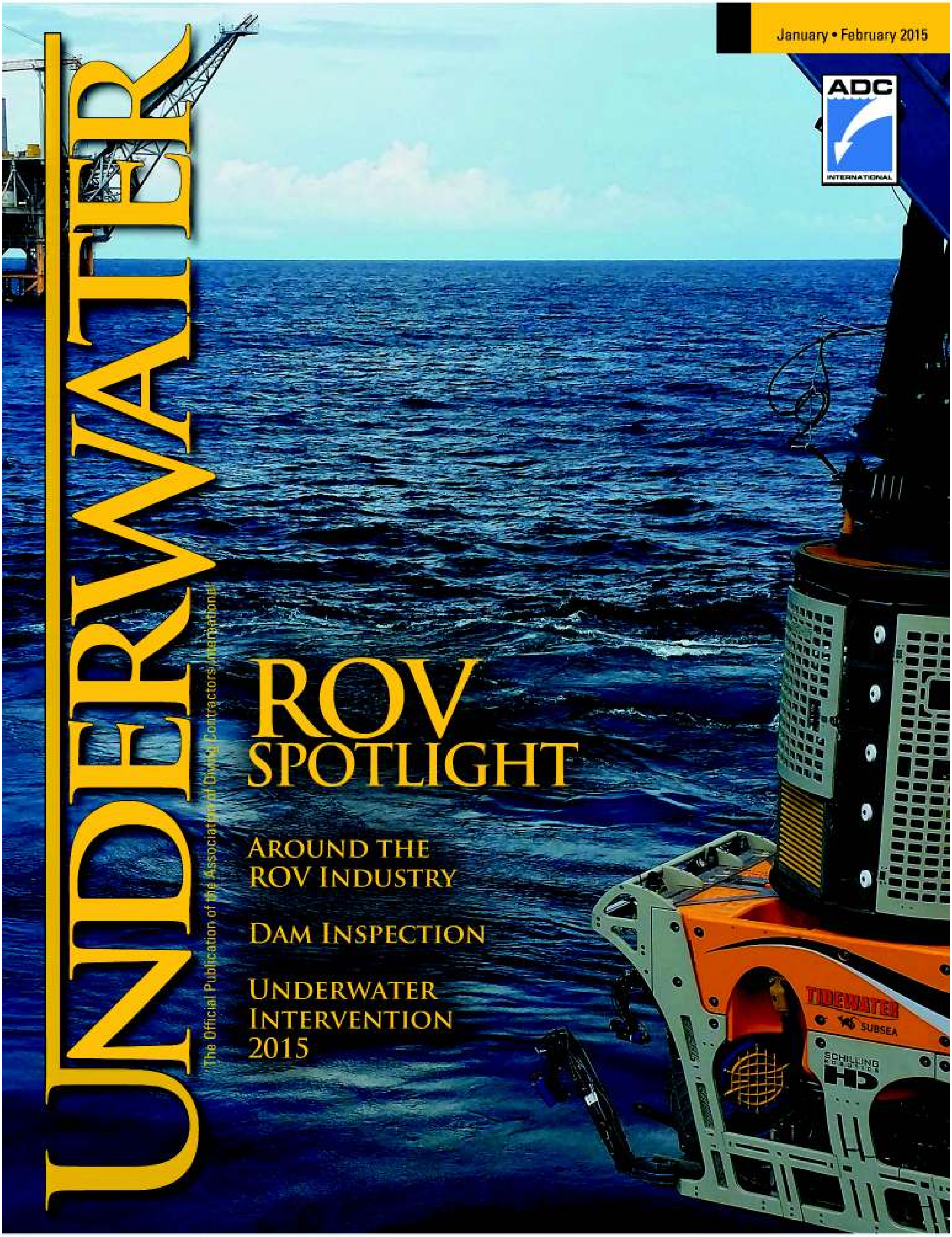
January • February 2015
ADC
INTERNATIONAL
UNDERWATER
The Official Publication of the Association of Diving Contractors International
ROV
SPOTLIGHT
Around the
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Dam Inspection
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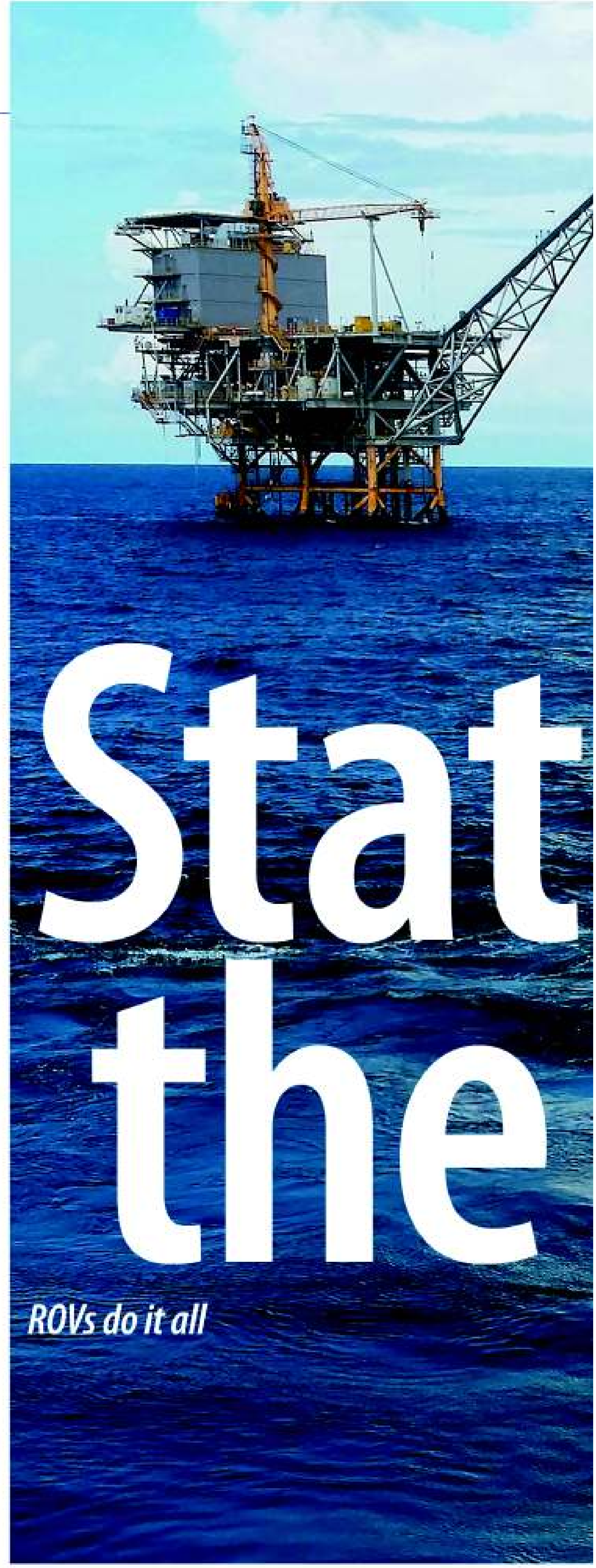

By Aaron M. Lay

THESE DAYS, WE DON'T THINK twice about how commonplace the little computers we carry around in our pockets have become. Sure, we refer to them simply as our *phones*, but making actual phone calls is just *one* of an increasingly infinite number of tasks these little marvels can accomplish at the gentle touch of the fingertip. Today, there is a generation of kids growing up who will have always had access to this technology, but for many of us, witnessing the evolution of the common cell phone has been nothing short of astounding.

By no means is cellular phone technology unique in its giant leaps in transformation. Dazzling technological advancements of all kinds have changed the way almost every job is done across countless industries. The commercial diving industry is certainly no exception here, especially when it comes to ROVs. The ROVs in use today are a far cry from their humble ancestors of the mid 1970s, which were unwieldy and very unreliable submersibles meant for the express purpose of inspection. "When we would go out in the mid-70s and test these things, if we got one to work for just two hours before we had to get it out of the water and do maintenance on it, we were *really* happy. Hell, if we just got it back *on deck* we were happy," remembers Drew Michel over a hearty chuckle. Michel was Chair for the Marine Technologies Society's ROV Committee for 21 years and has seen literally the entire evolution of ROVs first hand. Michel has no shortage of tales from the early days of ROV development. He adds, "I remember the first two [ROVs] that I ever took offshore into the oil fields, I lost both of them the first weekend. The tether broke on one of them, and it got away, and the other one got chewed up by the prop of the boat. Those are just the kinds of days we had back then."

Before the use of ROVs in the offshore oil fields, items under water needing maintenance sometimes had to be dismantled and pulled out if divers were unable to gain access for any number of reasons. Even the relatively crude ROV technologies of the late 1970s and early 1980s mitigated this significantly, but certainly not at first. Michel remembers, "When we first started back in the mid-70s, we were trying to put these things in the water to literally replace divers or to go *deeper* than divers could go at that time. The problem we had then wasn't that we couldn't do what we wanted to do necessarily. The problem was that the *reliability* of these things was just so bad that nobody trusted them [ROVs]. At that time, *no one* would design a project around using ROVs simply because they broke down all the time or got lost or destroyed or all of the above. Everything in the world went wrong with them, you name it."

As with any budding innovation, trial and error is all part of the process of improvement and development. The unreliability and failures of early ROVs ultimately led to better equipment and gave way to the ROVs now utilized around the world for a number of different tasks. And it was this new innovation that changed the commercial diving industry forever. Better ROVs became the impetus for major oil companies to begin pushing out into deeper waters. "What's really incredible about the story and history of ROVs is their impact on the oil and gas industry. When we started doing more and

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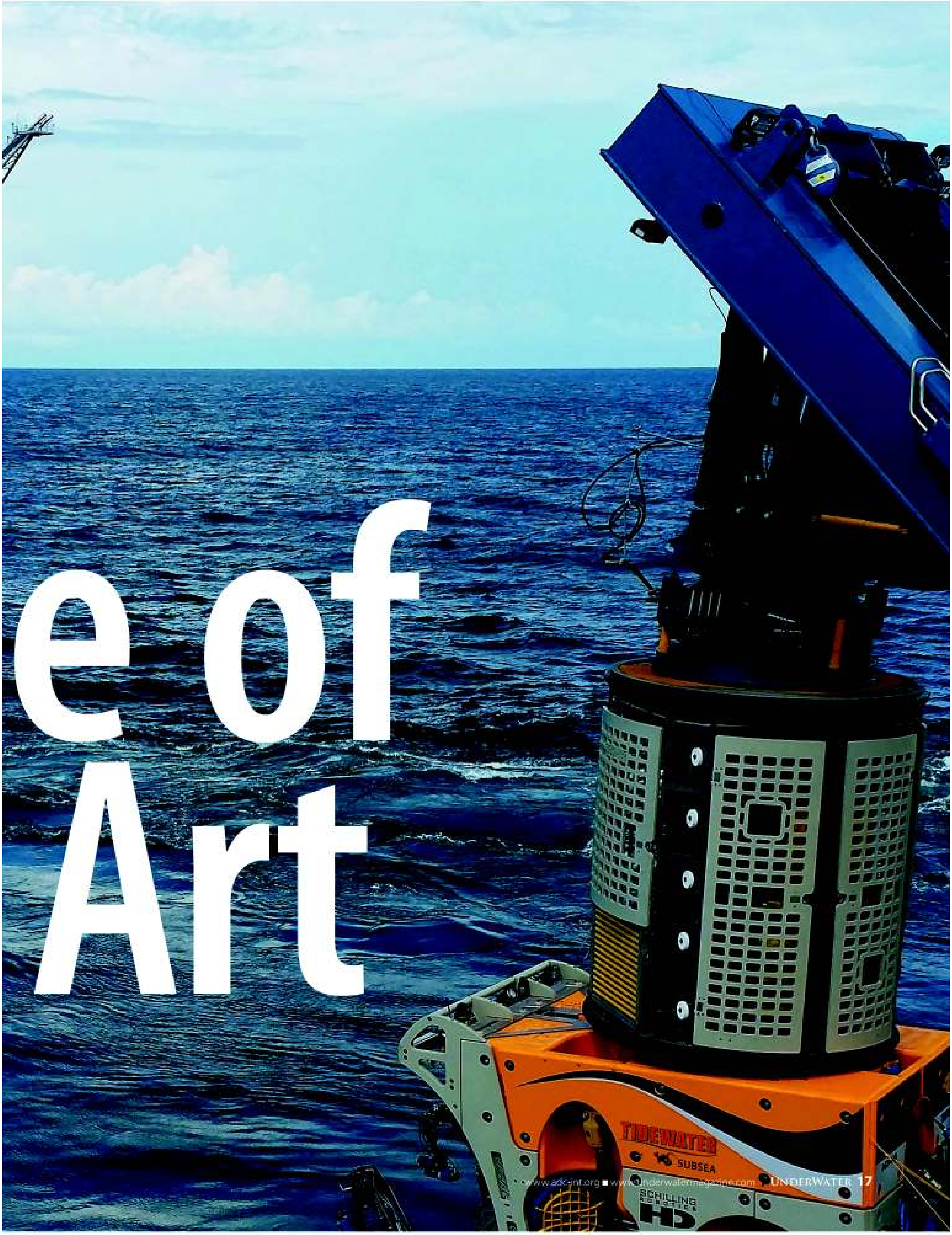
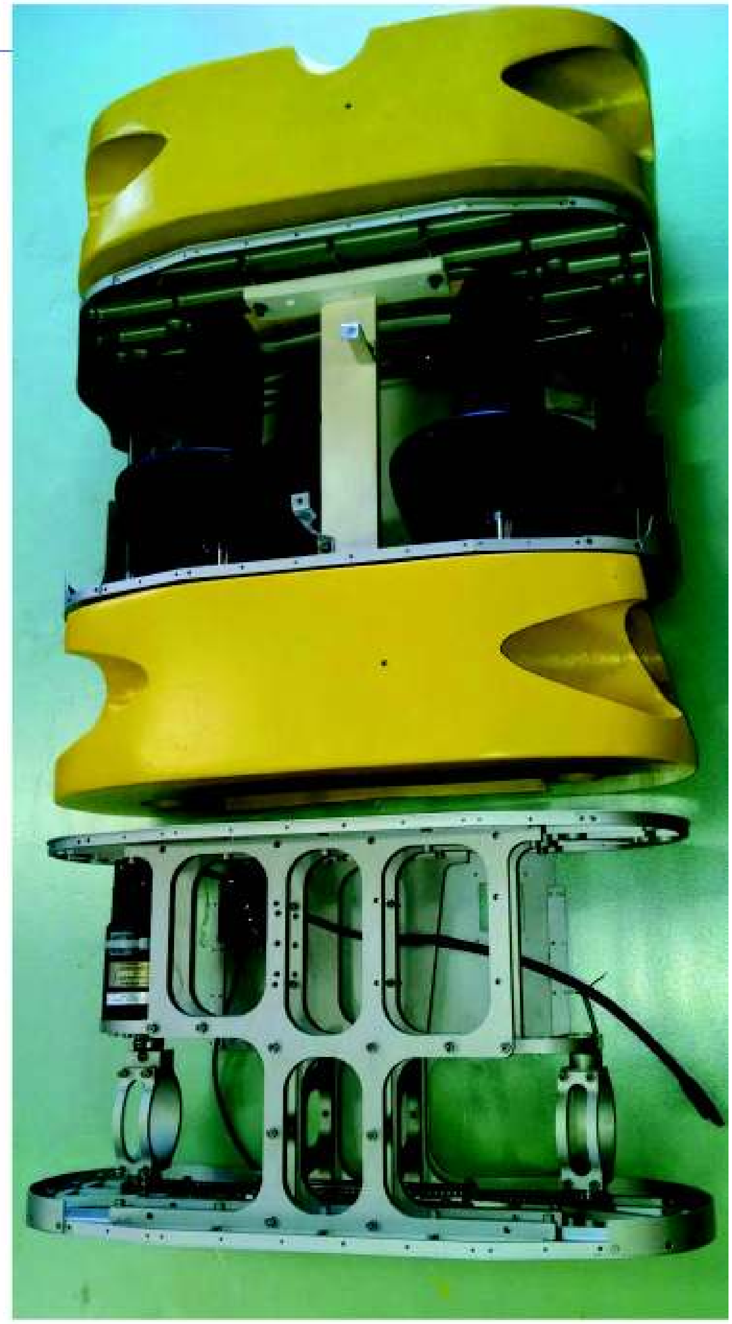


SeaView System's Chiton ROV



more things with ROVs and could actually show their capabilities, the oil industry started realizing that they could begin working in deeper water. To me that's the greatest phenomenon - that we've developed the reliability and capability of ROVs to the point where now, if [a major oil company] is designing $1 billion project offshore, they design the infrastructures and subsea portions of that project strictly around ROV capabilities."

But of course, this was not always the case. There are still countless structures inland and offshore that were built well before the advent and widespread use of ROVs, and for the most part, maintenance must be done by a diver in the water. "On older equipment, divers are typically used because they can be more flexible in terms of completing the task," explains Chuck Richards. Richards took the reigns from Michel as current Chair of the Marine Technologies Society's ROV Committee and is also President of C.A. Richards & Associates, Inc. based in Houston, Texas. Richards adds that although there are occasions that an ROV supplants a diver (and vice versa), the relationship is still fairly symbiotic. "At times, an ROV has limited dexterity on its manipulators, and it's got limited tools that it can use, whereas a diver can be pretty dexterous. If something changes while he's working underwater, the diver can usually adapt. With an ROV, that is harder to do. There are standards established by API (American Petroleum Institute) for ROV interfaces on subsea equipment, and some of the older equipment that's out there like

I have said for years that ROVs were a solution looking for a problem. It's just a matter of money. Anything that we want to do remotely, we can do...as long as somebody is going to pay for it. – Drew Michel

older platforms and wellheads just don't have that standard. When divers are called out to do the work, it is usually because an ROV can't accomplish the task, or it's more economical to go with the diver. 90% of what an ROV does underwater while it's working is just observation. If they see something awry, then they can send the work class ROV over to possibly intervene. And a lot of times, it just makes more sense to have a work class ROV ready in case intervention *is* required. Work class ROVs have at least two manipulators, multiple cameras and generally at least one sonar. They also have the ability to attach a skid on the bottom to perform some tasks, whether it's a hot stab on a hydraulic pump or to cut something or any variation of tasks."

Richards admits that another reason that work class ROVs are the standard in the offshore sector is simply a matter of size. "The small observation class ROVs are just not used offshore. They're too shallow-rated and are hardly used. They don't have the power to work in high currents, and they're dragging this long umbilical around, so work class ROVs and observation class ROVs for offshore have to have enough power to be able to work and maneuver and get the ROV where it needs to go in currents and deepwater."

Although ROVs are used offshore commonly for a huge number of tasks, it is certainly not uncommon to find them being implemented in the inland sector. With the seemingly infinite kinds of jobs in inland waterways all over the world, ROVs' presence inland is more prevalent now than ever. Michel states that it was in the early days of ROV innovation, after the oil companies began going deeper with the help of ROVs, that other parties began to realize the benefit of their use inland as well. "When the ROVs became more reliable, we started showing [oil companies] that ROVs could mitigate some of the risk and cost in some of the shallower water work also. Now there are places in the world, Australia being one and Alaska being another, where there are some projects going on that are in just 100 to 200 feet of water, and instead of using divers, they're using ROVs."

Oftentimes in the inland sector, it is because of sheer necessity that an ROV must be used instead of a diver. This is especially true when there is a need to inspect or service certain pieces of infrastructure that are extremely hard to access. The need to access these hard to reach inland spots is driving some of the most cutting edge breakthroughs in ROV technology today. And one such hard to reach spot is deep inside the Delaware Aqueduct. At 85 miles long, this aqueduct is the world's longest underground tunnel (See July/August 2012 issue of *UnderWater*). It starts high in the Catskill Mountains and provides New York City with approximately 800 million gallons of water a day - about half the city's total daily water supply. However, this crucial piece of infrastructure has been leaking for decades, and the New York Department of Environmental Protection (NYDEP) has been addressing the problem for some time.

In order to get a closer look at what's happening inside the aqueduct, the NYDEP enlisted the services of SeaView Systems, based in Dexter, Michigan. SeaView specializes in the development and application of some of the most state of the art, custom marine technology products in use today. And the ROV that SeaView has created to inspect the Delaware Aqueduct is certainly out of the ordinary. Matthew Cook, President and CEO of SeaView Systems, explains the inception of this project and some of the challenges that this particular job presented to him and his team, "Back in 2008, we submitted an unsolicited proposal...to build a vehicle that can go through a valve that's about 15,000 feet away from the suspected area of the leak. In order to get through the valve, we knew this vehicle had to be articulated to be made up of multiple segments because the valve is shaped like a bowling pin. It's sort of like a very fat needle valve, if you will, but it's actually a blowoff valve. It's around about 38 inches in diameter and made out of bronze, and it was built in the 30s and 40s. So, if you can imagine that this big bronze bowling pin is sitting in an enclosure, and when the valve is open, there's only an 11-inch gap between that big bowling pin and the outside concrete valve that it's sitting in. The vehicle has to be able to go around the curves of that valve, so imagine that it has to be able to curve around that in two planes." Cook adds, "It's such an awkward space to access, they haven't had a vehicle that's been able to get to it in the past."

Gaining access through this valve, which is about as isolated and cumbersome as it gets in an inland setting, clearly posed a huge challenge to Cook and his crew. He describes the special characteristics of their final product meant to accomplish this daunting task, the *Chiton* - named after a small marine mollusk with overlapping plates that allow it to flex over or around uneven surfaces. "We have built a vehicle that is made out of a total of nine segments. Some segments are for buoyancy, and some are for electronics, and it's all tied together with ligaments, and in the air it's kind of sloppy looking. This is just to get it through the valve, but once it gets in the water, we use water driven hydraulics to draw all those ligaments tight to make a vehicle rigid."

Cook discusses the impetus for using water hydraulics. "We can't use regular hydraulics because we're not allowed to use oil. This is all drinking water that we're working in, so if there's any other alternative, we've got to use that alternative. So we just decided to use water hydraulics to pull it all together with high tensile rope ligaments. It works quite nicely."

Since the *Chiton's* mission is one of enhanced inspection so to speak, SeaView had to make sure that its vehicle delivered more than *just* high-resolution video. "The goal is to do two things, and one is to record really good quality HD video. So, we need the vehicle to fly very stable and at the right position within the tunnel because we will do multiple passes and ultimately stitch all the video together. Also, when we find the leak and inspect it, if they decide that they want to do remedial work, they will probably want to go in and pump grout to stabilize the tunnel. To do this, they need to know where the tunnel is in space. And right now, they don't really know that clearly because the tunnel was built so long ago, and the drawings are all very old. So we are sort of geo-positioning the whole tunnel."

Cook freely admits that a project like this would not have been possible without the help of other key players in the industry doing the same kind of cutting edge work. "We are doing all of the payload control on the vehicle, but we are using another company who is a bit like us. They are more software oriented, however. They are called Greensea Systems out of Richmond, Vermont. They are doing all the control software for our vehicle. It's a really sophisticated system, and it's all fly by wire and dynamically positioned using fiber octave gyro for all the control systems. We do have an umbilical to it, and we've got constant communications. I think we've done great work with the mechanical side of things, but it's Greensea's control code that is an absolute essential part of it. They're a very cutting edge company. I think what we're doing is pretty close to state-of-the-art with this type of thing." SeaView will be doing trials in March 2015, but when they get to actually perform the penetration remains to be seen.

As smart and motivated people in the workforce continue to harness technology to find better ways to work and solve problems, we will continue to see the tools we use become more efficient and innovative. It is remarkable to imagine that 30 years from now, SeaView System's *Chiton* ROV may seem antiquated to us…just as the ROVs of the mid 1970s and cell phones of yesteryear.