CADC Magazine

The official magazine of the Canadian Association of Diving Contractors

Fall/Winter 2013

INSIDE:

The Snow Must Go On: Winter Diving in Canada

Using Sonars for Unmanned Diving Inspections: Part II

Look Before You Leap: Hazard Identification and Risk Assessment

CADC

Canadian Association of Diving Contractors

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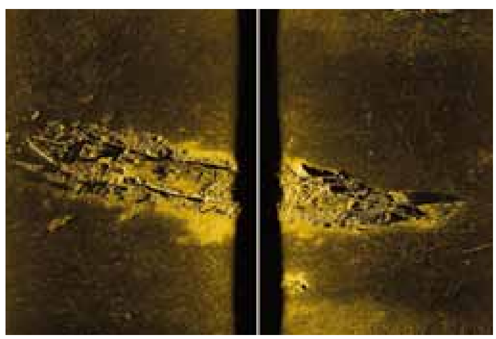


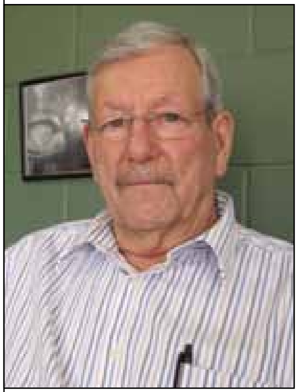
UP FRONT

ON THE COVER

FEATURE STORIES

NEWS

Diving in the winter in Canada is unique to our geographical location; however, there are differences across our country. We sat down with diving contractors from different regions to learn more about winter operations—diving in ice, slush and frigid waters—and the challenges that come with diving in winter conditions. The cover of this edition of CADC Magazine features a police joint force ice dive exercise. Photo by Doug Elsey (www.DougElsey.com).



Glenn Costello
CADC President

Creating a Standard of Excellence

As I soak up the last bits of summer and think of what is to come, the idea of trundling off to a warmer place during the winter begins to appeal more every day. I tell myself to stop whining. We live in what is probably the best country on the planet. So what if we have a few crooked senators? It beats having a crooked government, doesn't it?

In preparation for winter, our fearless leader, Doug Elsey, is giving us instructions on how to survive the winter. Coupled with that is an article by renowned sonar expert Mark Atherton. In the conclusion of his two-part series, he tells us how to avoid the danger of chilling winter dives by sticking one of his magic sonar gizmos in the water that—we are told—can do a much better inspection job than a raggedy-assed diver.

On a more serious note, I attended a meeting of behalf of the CADC at WorkSafe BC for purposes of discussing changes to the diving regulations. The meeting was well represented by different factions of the diving industry, and everyone had the opportunity to argue either for or against the proposed changes. In any event, the issue was put on the backburner for now and will, no doubt, be raised again at some future date.

Safety has been—and always will be—a major concern in our industry. We must all remember to use safe diving practices and ensure that everyone in the industry is aware and watching for issues that could cause harm to divers.

The CADC, Doug Elsey and our association members have worked hard to create a standard of excellence. It is important to share our experiences so that we can learn from others what should or should not be done. Let's keep our minds and communication lines open for news in the industry and remember to share. It is through you, our members, that we are successful in keeping the CADC in the forefront of today's underwater technology.

On behalf of the CADC, I am wishing all members a happy and safe winter season and a prosperous new year.

Doug Elsey, P.Eng.
CADC Executive Director
Photo Credit: D. Geddes

Pull on your woolly bears and tighten your toques

As this goes to press, it is the middle of October on a Monday morning and the headlines show that Southern Alberta was hit by a blinding snowstorm over the weekend—the leaves aren't even off the trees, yet! Marine operations that took place on water on Friday are now threatening to become ice by the end of the day; welcome to fall/winter in Canada!

One thing we can count on in Canada is cold weather during the year—and the ice and snow that come with it.

Our feature article focuses on what I would call "Big Ice and the Big Chill." We interviewed members across Canada about the differences and similarities in winter operations. From working in brine in the near-shore areas of the St. Lawrence River, to the ultra-cold in our Arctic, the one thing in common is the diver isn't getting any colder than basking in a "balmy" 32°F/0°C. The surface crews and gear take the hit. The joys of commercial diving in Canada… yah gotta love it!

We continue with the conclusion of Mark Atherton's article on the use of sonar in marine operations (on page 18).

If it blinks and whirs below the water's surface, Mark's insight and knowledge on using sonar for searching or inspections are second-to-none. The article is only the tip of the iceberg; check out his new book, *Echoes and Images*, which is, no doubt, about to become the go-to book for all things scanning sonar (visit www.echoesandimages.com).

Once an inspection is done—by sonar or manned inspection—what do you do with the information? Bob Clarke, P.Eng., of ASI Group Ltd. sorts out what to do with and how to present the information to your client.

Working together with labour, management and regulators on diving safety has been something the Ontario diving industry has done for years. We look at the inner workings of Ontario's Commercial Diving Trade Labour-Management Safety and Health Committee, which focuses on a workable safe industry.

If asked to inspect a moving ship's propeller while it is underway, is the first thing that enters one's mind to consider if a risk assessment is prudent? The fact is, in our industry, it is not optional—it is required! CADC director Dave Geddes discusses the importance of proper hazard identification and risk assessment.

The Canadian Underwater show is being held in Toronto, April 6 to 8, 2014. The CADC AGM will take place on April 6 at the same location. Plan to be there and take in the latest presentations on our industry.

Pull on your woolly bears and tighten your toques (Canadian, eh?). It's winter! Keep a tight hose and dive safe.

From working in brine . . . to the ultra-cold in our Arctic . . . it is the surface crews and gear that take the hit. The joys of commercial diving in Canada…yah gotta love it!

CADC
Canadian Association of Diving Contractors

Why You Should Be a Part of the CADC

Check out our members at www.CADC.CA/members

"CADC is the glue that binds the diving community across Canada," says Doug Elsey, Executive Director of the CADC.

CADC was formed in 1982 because regulators and government legislators did not and do not want to talk to individuals—they want to talk to organized groups representing the industry. The safety standards that govern your operations today are a result of past CADC members doing their job in "getting it right" so that we have a safe and workable industry today.

Safety, according to Elsey, is one of the most important issues in an industry that can be both dangerous and physically demanding. The CADC acts as a unifying body, able to communicate effectively across Canada and beyond. The CADC acts a watchdog for the industry and keeps a constant eye on regulations and standards. Because of their diligence in monitoring these standards and regulations for commercial diving across Canada, the industry has become a much safer place.

As a member, you are adding to the voice that is the CADC, effectively allowing the industry to be heard, especially when it comes to lowering insurance rates.

Some of the benefits CADC membership offers are:

- Constant communications on jobs coming up that you may be interested in bidding on. This is done weekly or biweekly as we send out tender information across Canada.
- Information available on our website (www.CADC.ca) and the CADC- sponsored websites www.UnderwaterINDUSTRY.com and UnderwaterJOB.com.
- The JOBS website (www.UnderwaterJOBS.com), where you can post jobs and look for qualified people.
- The members' mail-list server that allows you to instantly contact ALL of the members when you need advice, gear, personnel, etc.
- Diving insurances exclusively for CADC members—backed by Lloyds and brokers who know the diving industry.
- Reduced rates on gear from our associate members.
- This very magazine, with articles on companies, jobs, safety, etc., to keep you informed.

Not everyone can join CADC. Those members who apply have to agree AND demonstrate that they operate in a safe working environment. One cannot join by simply filling in the form—you have to have a demonstrated level of safety and competence in operations to CSA Standards 275.2 (Operations) and CSA 275.4 (Competency).

For more information, please check out our website at www.cadc.ca or e-mail: info@cadc.ca. We look forward to hearing from you!

Photo Credit: Doug Elsey/ www.DougElsey.com

CANADIAN ASSOCIATION OF DIVING CONTRACTORS

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☐	Contactor	Under $1,000,000	$650
☐	Major Contactor	Over $1,000,000	$1000
☐	Associate Member	(Sales & Service to the industry including educational, military, public service, etc)	$450
☐	Individual Professional (non voting)	Individual industry consultant or profes-sional	$175
☐	Supporting Member (non voting)	Corporate or Govt Supporting Member	$1000

Please complete form and provide a Business Card for all contacts in your organization

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Area Code: ______ Phone: __________ Fax:________ Website:____________

Company Contact 1 ______________________ Title: ______________

Email Address: ______________________ Direct Line: ______________

Company Contact 2 ______________________ Title: ______________

Email Address: ______________________ Direct Line: ______________

Business Founded: ____________ CADC Member since: ________ # of Employees: ________

General Description of the Business: ______________________

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Mission Statement: " The Canadian Association of Diving Contractors (CADC) will represent it's members common interests with regards to safety and environmental standards, client satisfaction, and government intervention within our industry. The CADC will actively promote the use of its members and will supply its members with information and tools to ensure their competence, improve their performance and safety."

CADC

PROCESSING INFORMATION FOR APPLICATION (NEW OR RENEWALS)

We hereby apply for membership in the Canadian Association of Diving Contractors as a:

☐ Contractor ☐ Major Contractor ☐ Associate Member ☐ Prof. Individual. ☐ Supporting

We declare that revenues derived for the preceding 12 months fall into the category of ______________ ___________________________ (see Membership Dues Structure on preceding page) and have therefore tendered our check / remittance for the sum of $_____________________.

Make check payable to: Canadian Association of Diving Contractors
Or contact "info@CADC.CA" for PayPal, Bank Transfer Information

If approved for membership in the Canadian Association of Diving Contractors, I pledge to foster safety in all in all areas of activity; to comply with all regulations as set out by the authority having jurisdiction or - in the absence of regulations - to observe minimum standards as identified in current CSA Z275.2 Occupational Safety Code for Diving Operations + CSA Z275.4 Competency Standard for Diving Operations and Safety upgrades to the standards as approved by the Board of Directors, to maintain high standards with regard to business ethics, employee relations, the public image of the underwater industry and, further understand that the By-laws of CADC permit investigation of reported violations and, if necessary, termination of membership.

Company: ____

Signature of Company Officer: ___________________________ *Title* ______________________

For completion by the first-time applicants and applicants re-applying after a three year lapse. If applying for General Membership at least two of the following references should be from current CADC General Members. New members may require additional trade information or proof of good standing from their compensation board if requested by CADC for membership approvals.

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References Contacted : ____

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Executive Director: ______________________ Date: ______________

Membership Committee: ______________________ Date: ______________

Applicant Notified: ______________ (date) Certificate Mailed / Transmitted: ______________ (date)

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Awareness and preparedness help keep divers safe while cold weather diving. Precautions with equipment and machinery (like Expertech Marine's set-up, below) keep the professionals safe in every season.

The Snow Must

Winter Diving in Canada

By Paul Adair

Canada is an immense geographically-diverse country, where the temperature can vary wildly from season to season and from coast to coast to coast. The weather is so important that even our Canadian identity is seen to be intricately interwoven with our relationship to the outside environment, particularly during the wintertime.

For a diving company that works during the long winter months, the extreme cold is not just a discomfort to overcome; it provides additional challenges to operations that are considered strenuous under ideal conditions.

Maneuvering moving ice in Quebec

While it is true that the winters are cold in Quebec, it is the transition from winter to early spring that will cause the most concern for divers in la belle province.

"In our province, we consider that winter conditions start in October, with the freezing cold humidity. But water conditions are at their worst in February and March because of the ice movements, which are extremely dangerous for divers. Also, the water levels rise in the spring, becoming muddy and the flow is at its most powerful," says Yves Becotte, president of MVC Océan Inc.

To avoid the potential dangers of moving ice, a diver must remain alert of his surroundings and be able to evaluate the changes in weather to avoid being caught unaware by errant ice flows. Ice deflectors may also be used to help divert the ice out of the work area and around the vulnerable diver.

"When we dive in the Port of Montreal and have some backed-up ice flowing down, we need to take special precautions and install ice deflectors or dive into tunnels to ensure the safety of the divers from being dragged away by ice," says Becotte. "An ice deflector could be a back hoe suspending a plate of steel to block the incoming ice and protect the diver. It could also be a simple pipe that would ensure that, if the ice were moving, it would not break the umbilical and place the diver in jeopardy."

Marc-André Desy, president and owner of Expertech Marine Inc., also stresses that extra awareness and preparedness are the two things that will help keep a diver safe during the winter months; advice that rings true not only in Quebec winter conditions but in all cold diving regions across the country. And while there is always the potential for disaster when cold water diving, it is by taking these precautions, that the profession itself is very safe for divers, regardless of the season.

"We are vigilant with our equipment and take into account the cold and its impact on the staff and on the machinery," says Desy. "A safety plan is drawn out and each team player has his tasks to perform. Everyone has to do their part in maintaining a safe and comfortable diving environment."

Go On:

In the extreme cold, the crew suffers freezing conditions on the surface and the cold takes a toll on the equipment used to support the diver, slowing the pace of diving operations. Photo provided by Expertech Marine.

In order to further protect the diver from the elements, the province of Quebec, on the recommendation of the Commission de la Santé et de la Sécurité du Travail (CSST), has taken the additional step of legislating the mandatory use of hot water suits while conducting extreme cold water diving operations within the province.

When the thermometer drops to sub-zero temperatures, it is often the diver in the water who has the enviable job. On the Great Lakes in the dead of winter, it is the crew left on the ice who are most affected by the cold.

"As far as the diver goes, he's laughing," says Gord Hay, chief diving instructor of the Canadian Working Divers Institute. "In the water, it's above freezing, there is no wind chill, and, most likely, he is wearing long underwear—if not that, than a hot water suit. The guys on the ice who are holding the hose are the ones that really feel it. But we are a tough industry and we don't put up with a lot of whining. The fact is, sometimes you're cold."

An O.D.S. Marine Ltd. diver preparing for cold weather diving.

Not only does the crew suffer the freezing conditions on the surface, the cold also takes a toll on the equipment used to support the diver, slowing the pace of the diving operations.

"Once you get under -20°, I would say that you are doing about half the work you would normally do in warmer temperatures," says Hay. "There is just a fair bit more to do and a lot more preparation to consider when diving in the cold. It takes a lot longer to get the equipment going, sometimes taking up to three hours before everything is up and running. You will go out to start the compressor and it won't even want to turn over unless you keep it constantly plugged in."

Aside from the common complications that arise when working under freezing conditions, there are

Diving in Lake Erie in February. Photo provided by ASI Group Ltd.

When diving in the cold, there is a lot more preparation and it can sometimes take hours longer to get equipment up and running.

Photo provided by Expertech Marine.

some benefits to operating in the winter, such as better access to remote locations and easier delivery of materials.

"If we can, we will actually leave some jobs until the winter sets in," says Hay. "When we lay pipelines in the winter, you can just set the pipe across the ice. You don't have to worry about getting barges in or be concerned about windy days. In fact, for some of the jobs we do, we can't even get in to the site until it freezes because of the need for ice roads; it's not like you can fly in a bunch of eight-inch pipe."

Whistling winds on the prairies

Winter diving in central Canada is, for the most part, the same as diving in any of the other cold water conditions across the nation—at least, below the surface. On the ice, however, the barren surrounding landscape above the tree-line provides a number of issues for diving crews.

"At some of the remote sites, you are up against many of the same things as in other areas, except that it might be colder," says Garth Hiebert, president of Dominion Divers. "The wind is pretty much unimpeded for thousands of miles as there aren't any trees to speak of. On a cold, wind-swept stretch of lake with very little snow insulation, you're sometimes forced to cut ice as thick as five feet just to get down at the water."

Going into the rivers of the prairies can be demanding on the diver, even at the best of times. In the summer, the water tends to be clogged with silt and sediment, almost completely absorbing the light from above. It's not much better in the winter, when the visibility increases slightly because of ice, allowing the diver to see a couple of inches in any direction. Additionally, the temperature of the water seems to drop as it moves past the diver, simulating a wind-chill below the surface.

"If you are working in shallower depths, and especially in moving water, the water seems to be able to get super-chilled and can actually get lower than it normally would," says Hiebert. "You definitely tend to feel the difference. You need to keep active because, if you are not working hard, you really do get colder faster."

When you combine extremely cold weather conditions with quickly moving water, like when it flows over the top of a dam, ice can propagate and form what is called frazzle ice. This frazzle ice then clumps into balls of slush, which can pose a real problem for hydro generating stations by blocking intake valves.

"These slush balls that form are very sticky and very heavy," says Hiebert. "Sometimes it's much easier to get into the slush than get out of it just because of how heavy it is. You can find yourself having to go through from anywhere between five to 10 feet of this stuff. And because the slush is lighter than the water, it tends to be suspended toward the surface. It is really more like diving through a Slurpee than open water."

Tricky tides in BC

Some might say that British Columbia is often looked down upon by fellow Canadians for having a milder (some might even say non-existent) winter when compared to the rest of the country. While average temperatures will not drop to the extreme lows of their provincial neighbours, BC does have its fair share of cold winter conditions.

"The very large lakes, such as the Okanagan, may have some freezing on the shoreline but rarely toward the middle," says Glenn Costello, president of Vancouver-based CanPac Divers Inc. "It just hardly ever gets cold enough to put ice cover over the whole lake. But when you get into northern BC, or with smaller lakes, that's a different thing altogether and they will freeze over."

Along the coast, divers will need to contend with high currents, rough seas and tidal forces that fluctuate with the seasons. In some cases, the tides can cause the surface to rise and fall up to 15 feet and cause significant problems for divers through narrow outlets.

"In Vancouver, we get first and second narrows and the tide will run up to seven knots through them," says Costello. "A diver simply can't work in anything past 1.5 knots. Anything above that and he will be holding on by his fingernails."

Like the moving ice in Quebec, a diver can best protect himself from the tidal influences by being aware of the conditions in which he is diving. Being prepared and knowledgeable

Slush balls, which are lighter than the water, tend to be suspended toward the surface and can make it seem more like diving through a Slurpee than open water.

Photo provided by Expertech Marine.

Moving ice can be dangerous. Divers must evaluate the changes in weather to avoid being caught unaware by errant ice flows. Photo provided by MVC Océan.

of upcoming weather trends is of paramount importance to the diver in order to keep out of harm's way.

Plummeting temperatures in the remote Arctic

Over 40 per cent of Canada's total landmass is considered to be part of the Arctic. It is barren tundra that captures the essence of the Canadian winter: harsh, cold and unforgiving. It is also an area that is increasingly frequented by diving companies that are hoping to invest in the vast, untapped potential of the area.

Some of the major economic motivators for divers in the Arctic: ship repair and ship husbandry, offshore drilling support, and the installation and maintenance of municipal drinking water and sewage treatment systems in extremely remote conditions.

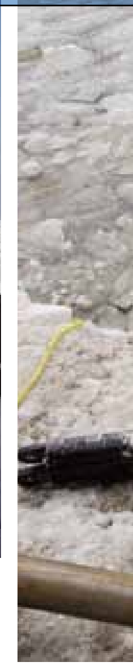
"In some of these little villages, there is just nothing there," says Bill Stark, marine operations manager at Northern Underwater Systems/Arctic Divers/ Canadian Detwatering. "There are few lights, maybe an administrator, and usually a member of the RCMP. But, other that, there is really nothing up there for support."

This lack of logistical support creates a number of problems for a diver in the high Arctic. Something taken for granted in the urban south, such as obtaining medical assistance in case of emergency, is harder to come by in the north and, unfortunately, help is not always just a phone call away.

"Any time that a diver is that much further away, it can change a job from a simple two-day thing into a complex,

Photo provided by Canadian Working Divers Institute.

When it comes to moving ice, a diver's best protection from tidal influences is being aware of the conditions in which he is diving.



two-week thing, and that's just the way it is," says Stark. "It's not uncommon in the Arctic for days to pass where commercial flights just don't happen. And it's extremely common in the Arctic to have weather conditions that won't allow a helicopter to take off. So any medical issue that may arise through diving is compounded by the remoteness. Fortunately, we have not had any incidents to date."

Additionally, the isolation of the region can result in mechanical deficiencies when it comes to making repairs on equipment that will inevitably fail due to the extreme cold. Because of this, it would be wise for a diver to become familiar with the locals in the community in which he operates.

"I tell my guys to make friends with the mechanic at the airstrip and he'll be your best source for parts," says Stark. "If there is a doctor in the community, make him aware of you and reasonably aware of what you are doing up there, so that he is not surprised when somebody gets dragged in with a medical problem related to diving."

Being that far north, temperatures plummet and the nights are long. This will create excruciating ultra-cold conditions for diving crews. Because of this cold, almost all of the equipment needs to be shrouded or kept indoors to remain functional.

"We've had crews working at -60° and you just can't get a lot done because the equipment doesn't want to work when it's that cold," says Stark. "You have less than three hours of daylight during the winter, so you find yourself working off of headlights and light standards more often than not. Everything is driven by the conditions up there."

Under the ice pack of up to 30 feet of permanent ice, the conditions are—for the most part—excellent, with a visibility of up to 200 to 300 feet and with generally negligible tidal forces. Ironically, however, the water of the Arctic Ocean isn't all that much colder when compared to the rest of the country, falling to approximately -2°.

"It really doesn't seem to matter a whole hell of a lot whether it is salt water or fresh water; it will still take the warmth out of you the same way," says Stark. "Water is a caloric sink, transferring heat 25 times faster than air. Water at -2° on your skin feels just like getting burned. If you were to take your glove off in that kind of water at that temperature, you will have a matter of seconds before you've basically got a useless lump of wood on your wrist."

Battling brine across Canada

The final cold water condition that will pose a challenge to divers is not unique to any one region of Canada. Brine conditions can be found across the country and are located where there is simply a higher salinity to the water, whether it is in an oceanic or industrial setting.

The brine itself is dense and has a high specific gravity, making it more difficult to submerge. Also, the higher concentration of calcium chloride found in brine allows it to drop well below 0°

An O.D.S. Marine Ltd. diver braves ice-cold water to get the job done.

without freezing over, the principle being similar to the use of salt on the highway, where the roads can appear wet at -20°.

The ambient temperature of a super-saturated industrial brine pond can fall as low as -12°, considerably lower than either fresh or salt water temperatures. Even with the best suits in the world, a diver will start to feel the chill within 20 minutes where, normally, the best suits should provide protection for hours.

"We dove into a brine pond two winters ago at a potash mine in Saskatchewan," says Hiebert. "The mine used water to get the potash out of the clay and that water was a super-concentrated brine. It got very, very cold, getting well below zero without freezing over. We had to come out and have a truck of hot water heat the diver in a tub in between dives, just to get our bodies back to normal. It was a miserable cold."

Using Sonars for Unman

Part II

By Mark W. Atherton

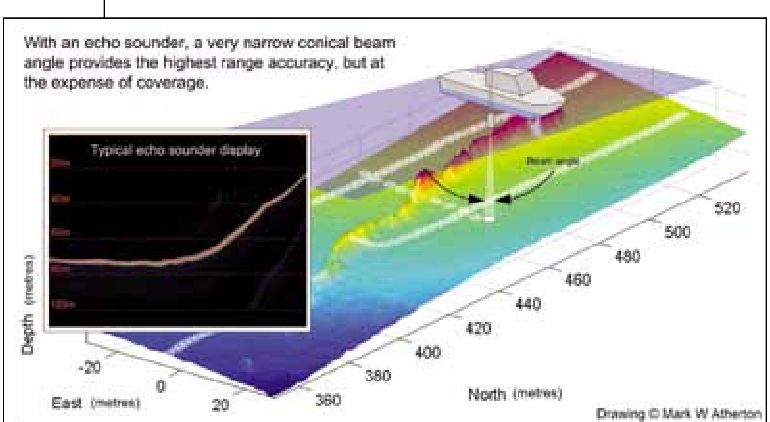
In the Spring 2013 edition of *CADC Magazine*, we ran the first part of this two-part series on sonar in diving inspections. Read on for the conclusion to this look at how sonar technology can affect diving operations.

Active sonar is a device that transmits acoustic energy into the water column and measures the elapsed time of the echoed returns. The most common sonar systems used to augment diver inspections include echo sounder (also called a depth finder or fathometer), side-scan sonar, and scanning sonar (also called mechanically scanned or radial sonar) with imaging and/or profiling capability. Each system has its application strengths and inherent limitations.

The echo sounder (the simplest of systems) is almost exclusively used to determine water depth. The sounder's transducer (the system component that transmits and receives the acoustic energy) is aligned so the acoustic pulse projects toward the seabed. Within the sonar electronics is a clock that measures the time from transmit to receiving the echoed return.

To derive distance, the clocked time is multiplied by an in-water speed of sound (approximately 1500m/4921′ per second); this gives the total or "two-way" distance the pulse travels. Since the water depth is of interest, the two-way distance is halved and graphically presented/displayed as a numeric value. The "accuracy" of the data is a function of the transducer beam angle, the seabed slope (and/or transducer pitch/roll) and applying the correct in-water speed of sound used to calculate distance.

The maximum range of an echo sounder (or any sonar) is a function of its frequency. The strength of the system is simplicity of operation and ease of data interpretation. When echo sounder data is time-tagged recorded with accurate position and pitch and roll information, highly accurate two- and three-dimensional plots and bottom depth contours can be generated. The weakness of this system is its limited coverage and being able to position the vessel-mounted transducer above a scour hole or point of interest, especially in high current or areas with limited vessel access.



Typical echo sounder coverage and display.

Side-scan

Side-scan subsea electronics are often mounted in a hydrodynamically-shaped, towed instrument (called a towfish) that has transducers on either side of its long axis. The sound energy transmits via the transducers perpendicular to the tow direction. When sound energy collides with targets in its path—the seabed—some is reflected back to the sonar, where it is detected and processed. The result is a plain-view record of the bottom, with the image built by narrow acoustic pulses scrolling similarly to the line-by-line image scrolling from a printer.

Side-scan is an unbeatable, wide area search and seabed-mapping tool. Its resolution is function of its frequency and its transducer's horizontal beam angle; high frequency and narrower horizontal beam angles improve record clarity. Typically pulled via a cable containing electrical conductors behind the survey vessel, side-scan produces the best image when towed at a fixed speed in a straight line and at a determined altitude above bottom (range dependant).

When completing a side-scan search, deploy a marker buoy when a target of interest appears on the display. This is followed by a second search line run on a reciprocal heading and reversed alignment. When the target reappears, deploy a second marker buoy. Assuming the tow cable length and ship's speed are the same on both search lines, the target is close to midpoint between the two markers and offset from the vessel course by the perpendicular measured distance of the target from the towfish. Alternatively, the operator can electronically mark a target using an integrated sonar/chart plotter when the towfish position and its heading are known.

Measurement and geographic "accuracy" between two side-scan targets is a function of knowing the towfish position (that is, on the end of a cable behind the vessel), towfish heading and applying the correct sound speed. Most side-scan system software includes a slant-range correction function, which works when the seabed is flat. It does not scale the image correctly on a sloped bottom.

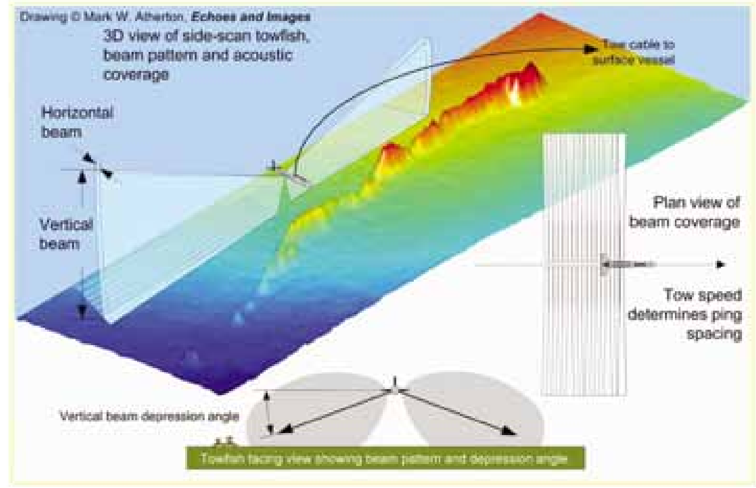
The strengths of side-scan are the image clarity and survey coverage speed. With single-beam side-scan (where a single

ned Diving Inspections:

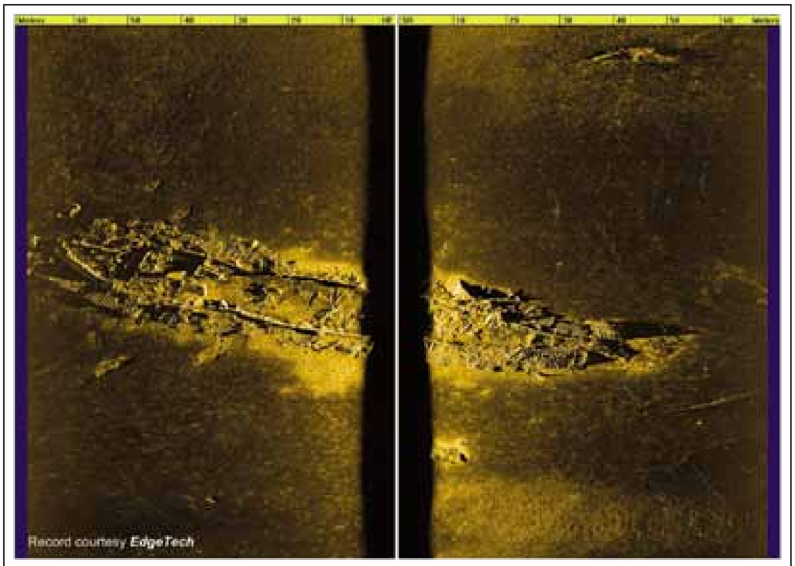
pulse is transmitted and received before the next is transmitted), the tow speed is typically between three and five knots (1.54-2.57m/sec).

There are operational limitations to using side-scan. Any instability of the towfish (often due to vessel pitch and yaw movement transmitted down the tow cable) degrades the image. Also, the need to position the towfish close to the seabed enhances the risk of losing the instrument in areas of dramatically changing slopes, or the presence of mid-water lines or anchor cables. It is often difficult to obtain complete coverage adjacent to structures or when vessel steerage or alignment are restricted. Although some operators have bracket-mounted the side-scan towfish to visualize underwater structures, the need to maintain a straight line and survey at a fixed speed limits this tool for most bridge, pier and other substructural inspections.

Side-scan is not the tool to position divers on a target in real time. Towing side-scan and trying to direct a diver to a target is both ineffective and potentially dangerous.



Side-scan sonar beam coverage.



A 900kHz side-scan sonar image of the Yankee shipwreck.

Scanning sonar

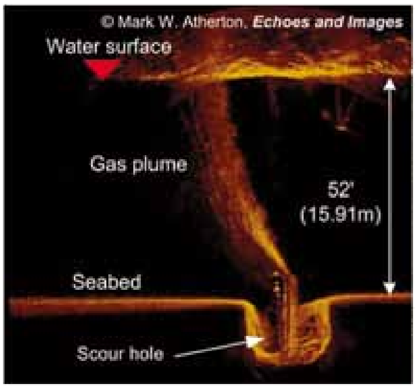
Scanning sonar operates much the same as side-scan, but does so from a fixed position. The sonar head produces an acoustic pulse that travels through the water column, and echoed returns are often processed and presented in a polar plot resembling a radar screen. After each ping, a motor in the sonar head turns the transducer and the ping process repeats.

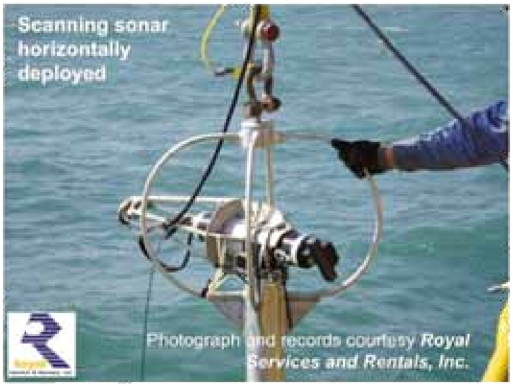
The key to collecting great scanning sonar data is head stability. Keeping the sonar in a fixed position for the time needed to collect the scan produces the clearest images. Depending on the selected range, this can take a few seconds to a minute or more (range and resolution dependant).

Typically deployed on a remotely operated vehicle or mounted in a tripod, scanning sonar image clarity, like its side-scan counterpart, is heavily influenced by the transducer beam angle and sonar head stability.

Unique to scanning sonar is its multiple modes of operation. Although model and manufacturer specific, scanning sonar software may include side-scan and echo sounder functionality and dual transducer models that allow multiple frequencies and/or imaging and profiling capability with a single head.

Because sonar operates in a radial pattern from a fixed position, the operator can deploy the head in any orientation to match the underwater structure alignment. It also allows visualization of most substructural elements, as long as the head remains stable. Deploying equipment underwater is where commercial diving companies excel over other sonar users.

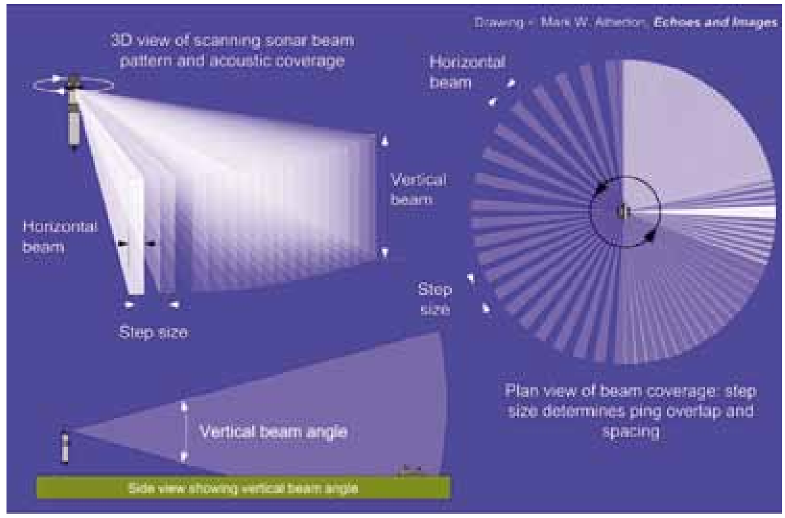




Vertical visualization of a gas well blowout.

A significant component of the diving industry is rigging; designing a deployment system for an instrument weighing a few kilograms to remain stable is typically a non-issue.

Scanning sonar is the system for positioning a diver in real time. Deploying scanning sonar lets the team identify targets and potential hazards before the diver descends. Once the diver is on bottom, the operator scans the area and guides the diver to targets of interest. Recording the sonar data verifies target investigation and area coverage and provides images of the substructural elements and surrounding seabed. Submitted with the diver report, these images establish an undisputable record of the substructure condition during the survey.



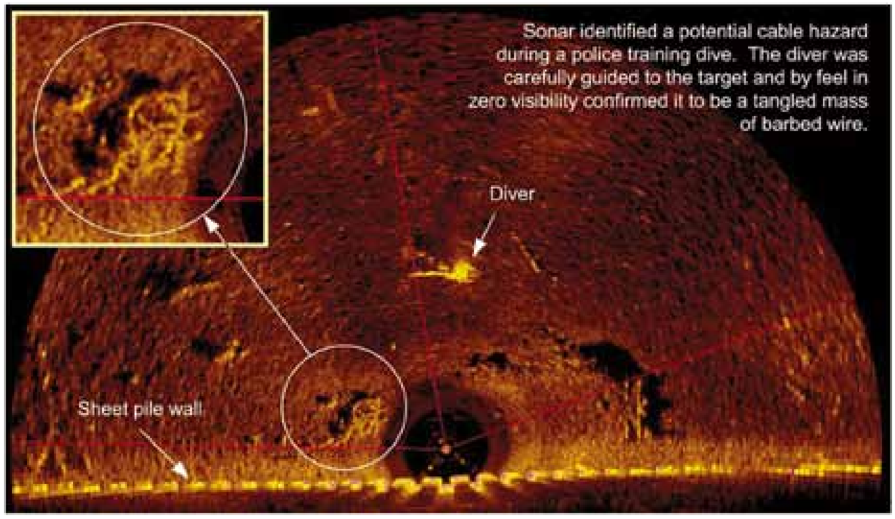
Scanning sonar imaging beam coverage.

Monitoring the dive site with scanning sonar

Fitting scanning sonar with a conical beam transducer gives echo sound profiling capability with the added advantage of scanning through 360°. Unlike a conventional sounder that must be moved to obtain additional coverage, the scanning sonar motor turns the conical transducer through the arc of profile coverage interest. This opens up applications for scour hole, under dock, intake, outfall, dredge and other profile inspection projects.

Beam angles, applying the correct speed of sound constant, and target to sonar geometry influence scanning sonar accuracy, just like its side-scan and echo sounder counterparts.

The strength of scanning sonar—its multimode capability while generating images from a fixed position—is also one of its limitations. Any movement to the head during data collection degrades image quality. The fact it is positioned stationary to obtain the clearest images also limits the speed of data collection.

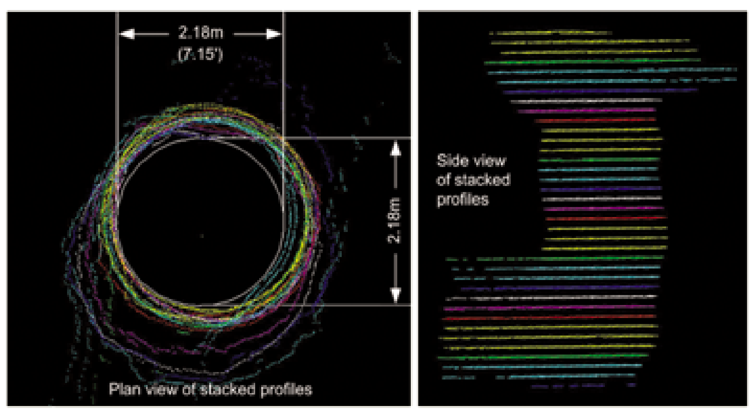


Augmenting diver inspection with sonar imagery virtually eliminates the issue encountered in the seawall inspection and discovery of the outfall.

So it begs the question, what—if any—sonar services do today's commercial diving companies need to offer, and what financial commitment does it take to provide that capability? There is no one answer to the sonar services or inventory needed by a commercial diving company. The market potential and competition dictate this.

And before making the sonar investment, understand that great sonar data comes from training and system familiarization; the best operators in the sonar business have made these commitments.

Times have changed since that 1984 confrontation with the crusty commercial diver and his attitude that sonar was there to replace his job. The need to get a diver to the underwater worksite isn't being alleviated; using technology to make diver intervention safer and more efficient *is* the industry's direction. Sonar is part of that process.



Data courtesy Marvin Emert, *Royal Services and Rentals, Inc.* Drawing © Mark W. Atherton, *Echoes and Images*

Scanning sonar profiles data of a vertical rockshaft, with precise shaft diameter measurements to design a liner and prevent rock from calving and passing through a hydroelectric turbine. Deploying the scanning sonar in a cage and collecting horizontal profiles at predetermined elevations provided the data set to complete the shaft liner design.

Mark Atherton is Special Projects Manager at Kongsberg Mesotech Ltd. Segments of this article are modified excerpts from *Echoes and Images, The Encyclopedia of Side-Scan and Scanning Sonar Operations* by Mark W. Atherton and an article coauthored by Mark W. Atherton and Brian Abbott, which was originally published in *Bridge Design and Engineering Magazine, issue 45.*

It's All in the Details:
Proper Data Storage & Project Documentation

By Bob Clarke

Once data starts coming in from a diving inspection, how you store it, sort it and present it to the client is crucial. Learn more on data management, the best techniques, the equipment you should be using, and the importance of project documentation.

Data management, as it relates to inspection projects, starts with knowing why the data is being collected in the first place, and is followed by what is being collected. This helps identify which techniques and equipment are best suited for the work. Different techniques and equipment have different formats for documenting findings, be it through the use of written notes, logged numbers, photographs, images and video or streams of recorded digital information that have to be correlated in a meaningful way so they contain and present useful information to the client now and in the future.

> In this digital age, there is nothing wrong with hand-written notes entered on properly organized forms.

Date, time, location, description—those are the basic components that need to be documented, along with every observation, photograph or sensor reading. Usually, a local coordinate or reference system is used as the common thread to correlate the information and present it using written descriptions, images, tables and graphs (strongly recommended over tables of numbers). If a local coordinate or reference system doesn't exist, establish one **and document it** as part of the report prior to commencing the inspection using a permanent location for the origin, or zero starting point. When logging data, start with the relative position, followed by the observation, so that it's not forgotten in the process, and establish a standard method of reporting. It is useful to record time as part of the data entry again, before the narrative portion is entered. This may seem redundant but when more than one technique is used, time is the easiest means of tying information together. For example, most video systems and digital cameras provide at least the date and time as a video overlay, which can directly correlate to the written observation for that area. Also, if work is being conducted from different locations, the only common marker for events will be time.

In this digital age, there is nothing wrong with hand-written notes entered on properly organized forms. Some clients require this format, using ink on numbered pages (much like diver log books), so that the information taken on-site forms a permanent record. If there are alterations or errors, a single-line strikeout (with signature) followed by a subsequent entry can be used. I have known inspections to be transcribed from a recording made throughout the inspection. This may seem to be convenient for the inspection crew, but also poses too many chances for errors, missed information and misunderstandings during the transcription process. Also, there is nothing to present to the client upon completion of the inspection and, in my experience, clients generally want the report almost immediately.

When more sensors are being used on a given project, digital data entry and management is about the only way to handle all of the inputs and still move the inspection along at a reasonable rate. Where this can be automated, so much the better, but human interface is always needed for quality control and to adjust or alter the inspection to capture anomalies or provide more detail when warranted. A good starting place is a simple spreadsheet or word processing program that uses a template for data entry.

Date, time, location, description—those are the basic components that need to be documented, along with every observation, photograph or sensor reading.

As mentioned, automation is great and the internet is full of useful routines that can be used to automate time stamps or logging of serial data inputs into spreadsheets or word processing documents. Templates are very simple to set up with rows and columns for specific data entry into a table, and they give a professional appearance through the use of company logos (freeze the top title rows and necessary columns so you don't lose track of which column to use for data entry). Typing in the observation notes certainly keeps the text legible, and the spell check functionality in most word processing and spreadsheet programs helps the inspector generate a presentable report almost immediately.

When the data needs to be sorted or filtered according to multiple criteria, such as the level of defect, location, or type of defect, it may be time to take the next step to an actual database program. While there are specialized database systems that are geared for the offshore industry and bridge inventories, the expense of these systems and the technical savvy needed to properly use these systems is only warranted by those companies specializing in those services. Using off-the-shelf generic database software, forms can be readily developed to automatically enter repetitive data, log file names of photographs, perform interactive functions with external sensors using programmed graphical buttons, and to check for complete data entry prior to moving on to the next blank record.

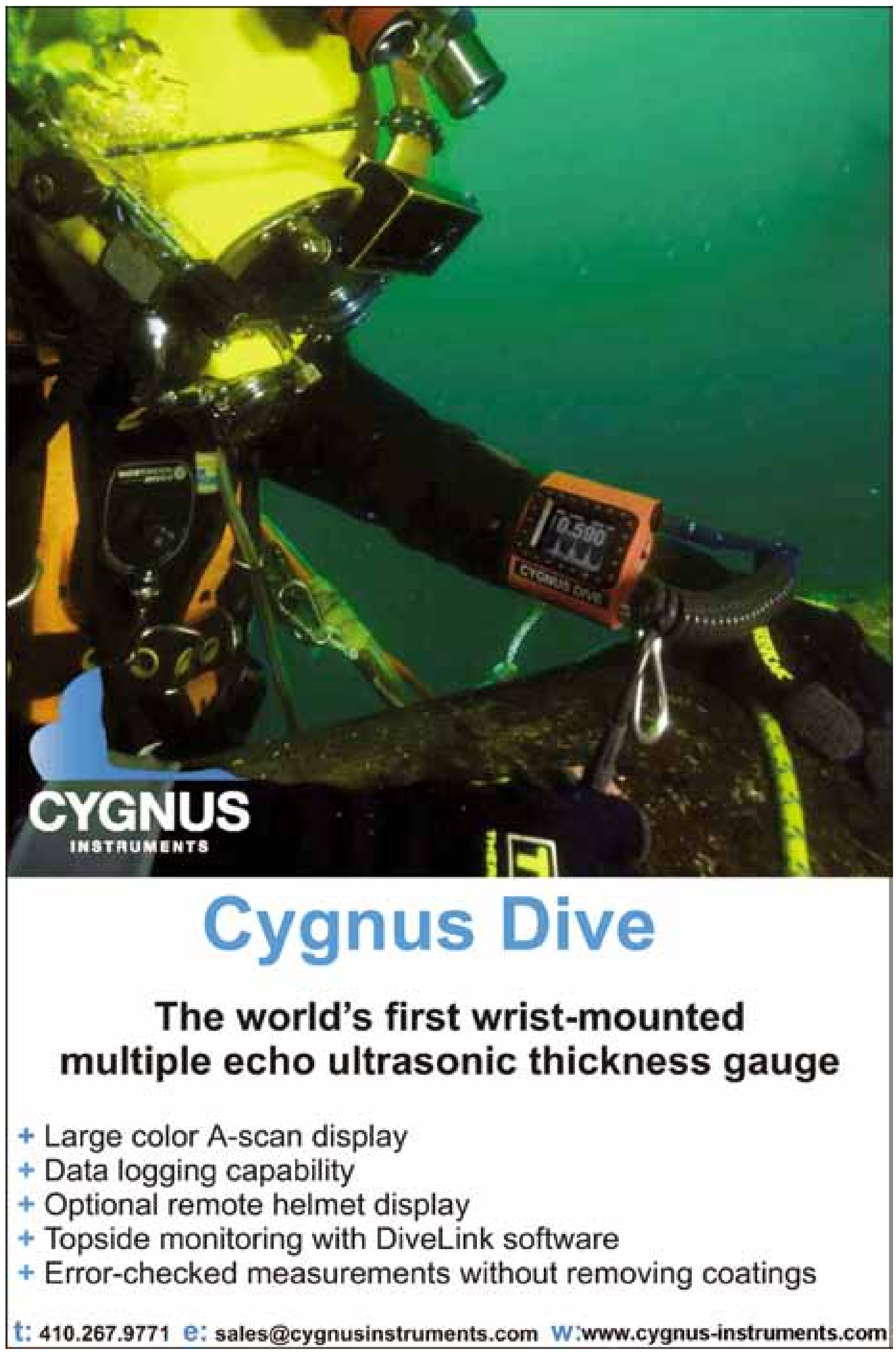
A true database ties together multiple tables of information that have a common link between them. Some sensors and digital video streams generate these tables automatically without intervention by the operator using software that uses a common thread with the other tables; here's where the time stamp really comes into its own. If the data is being collected using one computer, then that time stamp can originate with that computer's clock and will be consistent throughout all of the tables of data. Where more than one computer is being used, it is best to use a utility that keeps the clocks synchronized or use an external GPS timing signal to both systems; if not, personal experience has made me painfully aware that clocks will drift apart and make data correlation very difficult.

Once the data has been collected, processed and delivered to the client, *always* keep a copy of that final report for your own records, along with a copy of the raw data. The client may not have a good system in place for archiving their own data and it is not uncommon to be asked for replacements several years later. Again, using time (dates of the projects) is a good way to file them. I strongly suggest to keep an index that can be used to cross-reference reports with client names (consistency in client names is key, here), so they can be identified later.

Where those copies are kept is just as important. I found it interesting that when I looked up "paper document storage," one of the top hits was the Canadian Conservation Institute—there appears to be a lot more to document storage than boxing it up and putting it aside. Avoid using the basement for your "archives." Basements flood, are often damp, are prone to mildew and will quickly ruin your paper and even digital records. With the advent of secure cloud-based or online storage, digital copies of information can be reliably stored and backed up away from your office. I suggest doing some quick research using your favourite search engine, then review your picks and select a service that matches your needs.

With most of my work being inspection-oriented over the past 30 years, two pages on data management is certainly a challenge for word management. I hope I have addressed a few of the key elements to help manage your data in its acquisition, preparation, presentation and archiving.

Bob Clarke, P.Eng., PMP, is Sr. Operations Manager for the Marine Services Division at ASI Group Ltd.



Images of Innovation

1. An MVC Océan diver during installation of a water intake in the freezing waters of Kangiqsualujjuag, a community north of Kuujjuag, QC. Photo provided by MVC Océan Inc.
2. A diver working on a river intake lift station. Photo provided by Advance Diving Projects.
3. The MVC Océan team resurfaces the piles of a bridge at Pont Duplessis in Trois-Rivières, QC. Photo provided by MVC Océan Inc.
4. February in Lake Huron. Photo provided by ASI Group Ltd.
5. A work station based on the Batiscan River in Quebec, while doing an underwater inspection of a bridge's pile. Photo provided by Expertech Marine Inc.
6. "Let's face it, diving is fun and we get PAID for it!" Photo taken in BC and provided by Camcor Dive Services Inc.
7. The MVC Océan team working on construction of an erosion protection in the Port of Montréal. Photo provided by MVC Océan Inc. Ltd.
8. A diver entering water while doing an underwater inspection in the Batiscan River in Quebec. Photo provided by Expertech Marine Inc.
9. Installation of the new water intake for the city of Vaudreuil, QC. Photo provided by MVC Océan Inc.
10. An O.D.S. marine dive crew using a 300-ton crane in -40°C weather to pull ice blocks for diver and material access during installation of concrete sediment barriers in the Trent River in Trenton, ON. Photo provided by O.D.S. Marine Ltd.
11. A student emerging from a training tank outside during the winter after being trained in using a hot water diving system. Photo provided by Institute maritime du Quebec.
12. Fish farm diving on the west coast of BC at its finest! Photo taken in BC and provided by Camcor Dive Services Inc.

UnderwaterINDUSTRY.com
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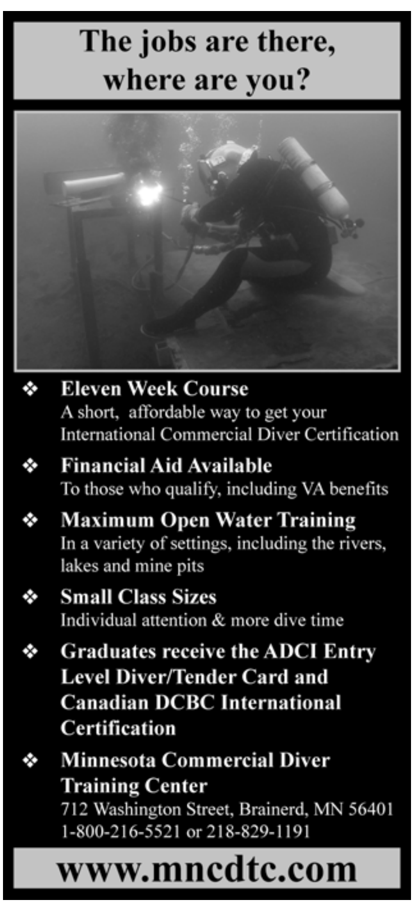

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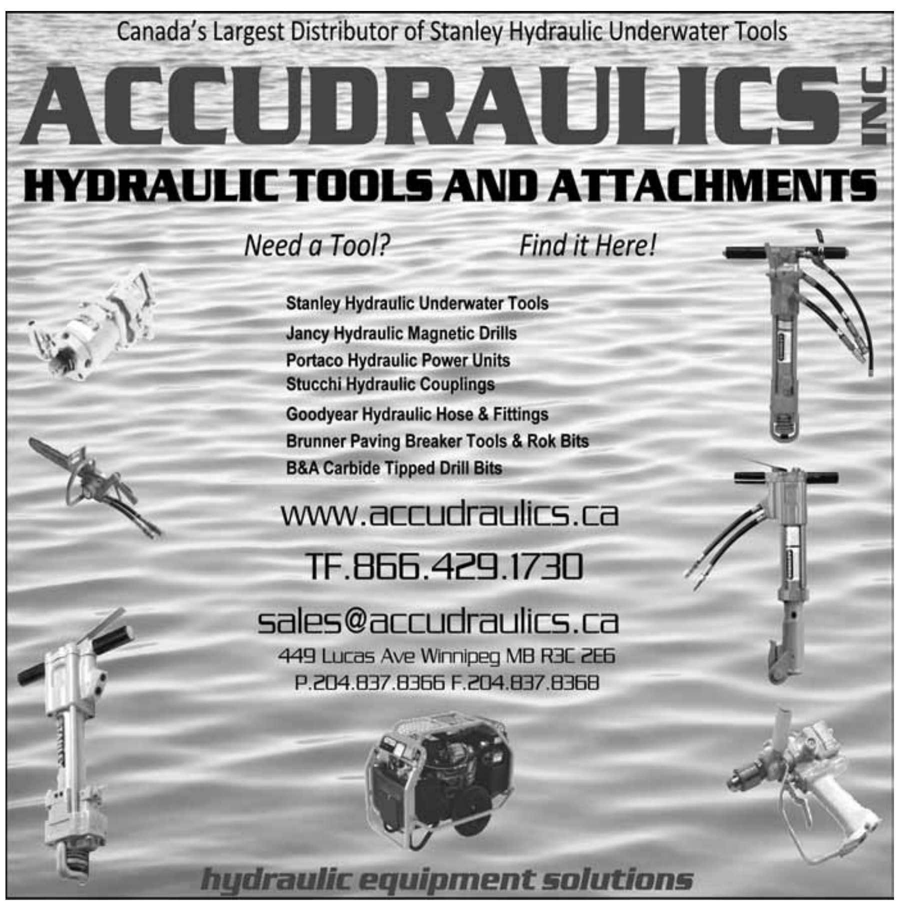

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Diver's Toolbox: Look Before You Leap: Hazard Identification and Risk Assessment

By Dave Geddes

Look before you leap; develop your hazard identification and risk assessment strategy!

MOBILIZATION					
Task	**Hazard**	**Consequence**	**Quantify Risk**	**Control Measure**	**Residual Risk**
Training / Familiarization ①	Unfamiliar OHS regulations. Incomplete training/ familiarization. Unfamiliar work scope. Unfamiliar personnel. Unfamiliar equipment. ②	Injury to personnel. Damage to equipment. Spill to environment. ③	3C (Med) ④	CM: Provide training and familiarization for all project personnel. ⑤ CM: Record of training and familiarization for all project personnel is on record. CM: Sub-contractors continuity (familiarity with dive site and mobilization process). CM: Tool box talk.	2B (Low) ⑥

As we start to gather the paperwork for a new project, one of the first things we have to develop is our hazard identification and risk assessment strategy.

The requirement for detailed risk management and planning is to provide assurance to those involved with the project that all project elements are reviewed with the intent of identifying hazards and reducing the risk to a level **as low as reasonably practicable** (ALARP). It should be emphasized that not only is this usually a requirement of the client but also a legal requirement.

In this article, we will discuss Risk Management, with a focus on Hazard Identification and Risk Assessment (HIRA). Simply, a HIRA is a careful examination of what, in your work, could cause harm to people, equipment or the environment, and allows you to determine if you have taken adequate precautions to prevent harm.

HAZARD: Anything with the potential to cause harm.
RISK: The likelihood (chance/probability) that harm will occur, and the degree of impact.
CONTROL MEASURE: Something (control) that prevents or reduces risk.

Hazard Identification and Risk Assessment (HIRA) is a three-step process carried out prior to commencing the project. The objective is to identify the hazards associated with the project and develop or implement controls, mitigations and actions to reduce the risks to a level as low as reasonably practicable.

It is important to include all parties whose actions or omissions could affect the health and safety of persons engaged in the project, the environment, the contractor's or company's assets, and the operational/execution performance. It is essential that necessary personnel are available for all phases of the risk assessment; this can include personnel from the following:

- Operations, installations, worksite, area management and control systems to be used during the work;
- Subcontractors (commissioning, pumping, rock dumping, grouting, survey, dredging, crane, haulage, security, etc.);
- Specialists (marine, aviation, lifting, etc.); and
- Third-party operators.

Step 1 of the HIRA process is conducted in an office environment. Participants include managers, supervisors and personnel with responsibility in the project, or portions of the project. This process will take part in advance of the commencement of work and will identify required changes to the work scope or the implementation of any mitigating factors. In addition, each task of the work plan will be reviewed step-by-step to ensure all risks have been identified.

The contractor appointed to provide the work is responsible for the risk assessment. If, for some reason, the contractor is changed or replaced, the risk assessment process must be repeated.

Step 2 of the HIRA process is performed by personnel directly involved in the supervision of the work. Using the Step 1 results as a guideline, the Step 2 HIRA team will review the results and build upon them. This is an opportunity for more operational input to be included in the HIRA.

Step 3 is commonly known as the Toolbox Talk. In this session, the HIRA will be discussed with personnel who are actively involved or performing the work. The Toolbox Talk will be held prior to the start of work. All risks pertaining to the work to be accomplished during the shift, day, etc., will be discussed, and all control measures or mitigation will be reviewed.

At this point, I'm sure many of you are thinking, "Okay, great! More paperwork! But what is the protocol?" It's quite simple!

Most diving contractors use a tabular format for the HIRA process. This worksheet can be developed quite simply with the following titles: Task; Hazard; Consequence, Personnel, Equipment or the Environment; Quantify Risk; Control Measure (CM) or Mitigation; and Residual Risk.

This can then be populated during the Stage 1 process, or partially populated, in advance by the diving contractor to save time. (A note to the wise: this is best done in advance by the diving contractor; otherwise, you will be with the owner, client and his/her reps all day).

To complete the worksheet, you will need some sort of benchmark to quantify risk. There are many "Risk Matrix" formats available through Occupational Health and Safety, trade organizations and/or construction safety organizations. A worksheet and risk analysis matrix may even be supplied by the client.

For the purpose of this article, we will use the IMCA International Code of Practice Risk Matrix.

Now we can begin to develop the HIRA! Reference Figure 1 below as you go through the below steps:

Step 1: Identify the task.

Step 2: Identify the hazard.

Step 3: Consequence of the hazard.

Step 4: Quantify risk; using one of the Risk Matrix's available or proprietary products determines the risk. In this case we are using the IMCA Matrix. This describes the risk as: Possible (3), with a quantified risk of "C", which represents a Moderate Injury, or occurrence, which is a medium risk.

Step 5: To control this risk, we are going to apply "Control Measures" or mitigation.

Step 6: In applying the Control Measures, you are able to reduce the risk to an acceptable level, which, in this case, is an "Unlikely Occurrence with low risk." Any risk in the high category must be reduced to medium or low prior to the activity taking place.

This process should continue through all aspects of the project to ensure all hazards are identified and controlled. Changes to the scope of work should be expected and should be dealt with through a formalized "Management of Change" procedure.

We pride ourselves on a record of safety developed through the conformance to standards and regulations that are highly regarded throughout the diving industry. We can only ensure this continues by completing proper and thorough hazard identification and analysis and, most importantly, by involving the personnel who perform the work.

Dave Geddes is a CADC Director and Chair of the CSA subcommittee for the Competency Standard for Diving Operations, Clinical Chamber Operators and ROV Personnel. He owns and operates D.W. Geddes & Associates Inc., a consulting company for diving and hyperbaric operations. He can be reached at dwgeddes@sympatico.ca. Excerpts of this article are from OGP Diving Recommended Practice.

Figure 1

HAZARD SEVERITY OUTCOME			PROBABILITY					
INJURY	**SPILL/POLLUTION**	**DAMAGE OR LOSS OF PRODUCTION**	**Very Unlikely 1**	**Unlikely 2**	**Possible 3**	**Likely 4**	**Very Likely 5**	
VERY SERIOUS Death or multiple serious long-term injuries	>100 M3	USD$ >1 million	M	M	H	H	H	E
SERIOUS Day away from work case injury (DAFWC)	100 Ltr-100m	USD$ 50,000-1 million	L	M	M	H	H	D
MODERATE Restricted work case injury (RWC)	10-100 Ltr	USD$ 10K-50K	L	L	M	M	H	C
SLIGHT Medical treatment case injury (MTC)	1-10 Ltr	USD$ <10K	L	L	L	M	M	B
NEGLIGIBLE First Aid Case (FAC), or no specific treatment	<1 Ltr	No Cost	L	L	L	L	M	A
			L		M		H	
			Low Risk		Medium Risk		High Risk	

Diver's Safety: Commercial Diving Trade Labour-Management Health & Safety Committee

By George Iacono

Dave Gallagher, Chairperson of the Commercial Diving Trade Labour-Management Health & Safety Committee is justifiably proud of the achievements of the Diving Trade Committee in improving health and safety for those working in the Ontario commercial diving industry. An important feature of the committee is how labour and management work together with government, educators and enforcement agencies to come to a consensus on improvements in health and safety for the commercial diver, and taking into account the practical aspects of the work.

The committee is one of 40 committees in the Infrastructure Health & Safety Association labour-management network. The diving trade committee also comes under the umbrella of the Provincial Labour-Management Health & Safety Committee, which is a Section 21 Advisory Committee to the Ontario Minister of Labour.

The purpose of the Commercial Diving Trade Labour-Management Health & Safety Committee is to work for improvements in the health and safety of those working in the diving trade, with the goal of eliminating all injuries and fatalities within the trade and making Ontario the safest jurisdiction for commercial diving.

The Commercial Diving Trade Committee is made up of 24 committed diving professionals from the United Brotherhood of Carpenters & Joiners of America representing Labour; and owners and managers of diving contracting companies, including Galcon/Forand Marine & Construction Ltd., ASI Group Ltd., Diving Services, Soderholm Maritime Services Inc., Department of National Defence and Dundee Energy. Non-voting members involved in the diving industry include the Canadian Association of Diving Contractors, D. W. Geddes & Associates, Defence R & D Canada, Seneca College (King Campus), Canadian Working Divers Institute, Ontario Power Generation, Ontario Provincial Police – Underwater Search and Recovery Unit, and the Ministry of Labour.

The Commercial Diving Trade Committee has been active in improving health and safety for commercial divers in Ontario. This committee meets regularly four times each year at the IHSA Head Office in Mississauga to discuss health and safety issues affecting the diving trade, and to conduct formal business.

This committee is also actively holding working group meetings as needed to work on diving safety documents and publications, and to make recommendations on any changes to the Ontario Regulation 629 Diving Operations. The Ministry of Labour accepted many of the recommendations for legislation change that was submitted in the past by the Commercial Diving Trade Committee to improve health and safety standards in the diving industry.

Some topics that the diving trade committee has been working on include the following:

- Delta P Hazards (Δ P) in Diving Operations;

The Centre for Health & Safety Innovation.

Photo Credit: Both photos by Doug Elsey/DougElsey.com

Committee members work on diving safety documents and publications, and make recommendations on any changes to the Ontario Regulation 629 Diving Operations.

- Quality of breathing air;
- Explosives ordinance disposal;
- Diver re-certification; and
- Acknowledgement of diving as a recognized trade.

Members of the Commercial Diving Trade Committee provided commentary and feedback to the IHSA on the Diver/Supervisor Log Book RF007, which was reprinted and rebranded as an IHSA publication in 2012.

The Commercial Diving Trade Committee worked on training procedures to prepare for work for the federal government on retrieving unused explosives.

The committee is lobbying to have the hyperbaric chamber at Toronto General Hospital staffed 24 hours per day and during off-hours to ensure the hyperbaric chamber is available immediately for treatment in a diving emergency.

The Commercial Diving Trade Health & Safety Committee has made great strides, as demonstrated by the accomplishments the group has undertaken in 2012. The committee continues to be a key ingredient of the IHSA Labour Management Network and is a driving force behind the health and safety best interests of the sector.

To participate in the Commercial Diving Trade Labour-Management Health and Safety Committee, contact George Iacono at the Infrastructure Health & Safety Association, (800) 263-5024 or visit www.ihsa.ca.

George Iacono is Coordinator, Stakeholder and Head of Public Relations at the Infrastructure Health and Safety Association.

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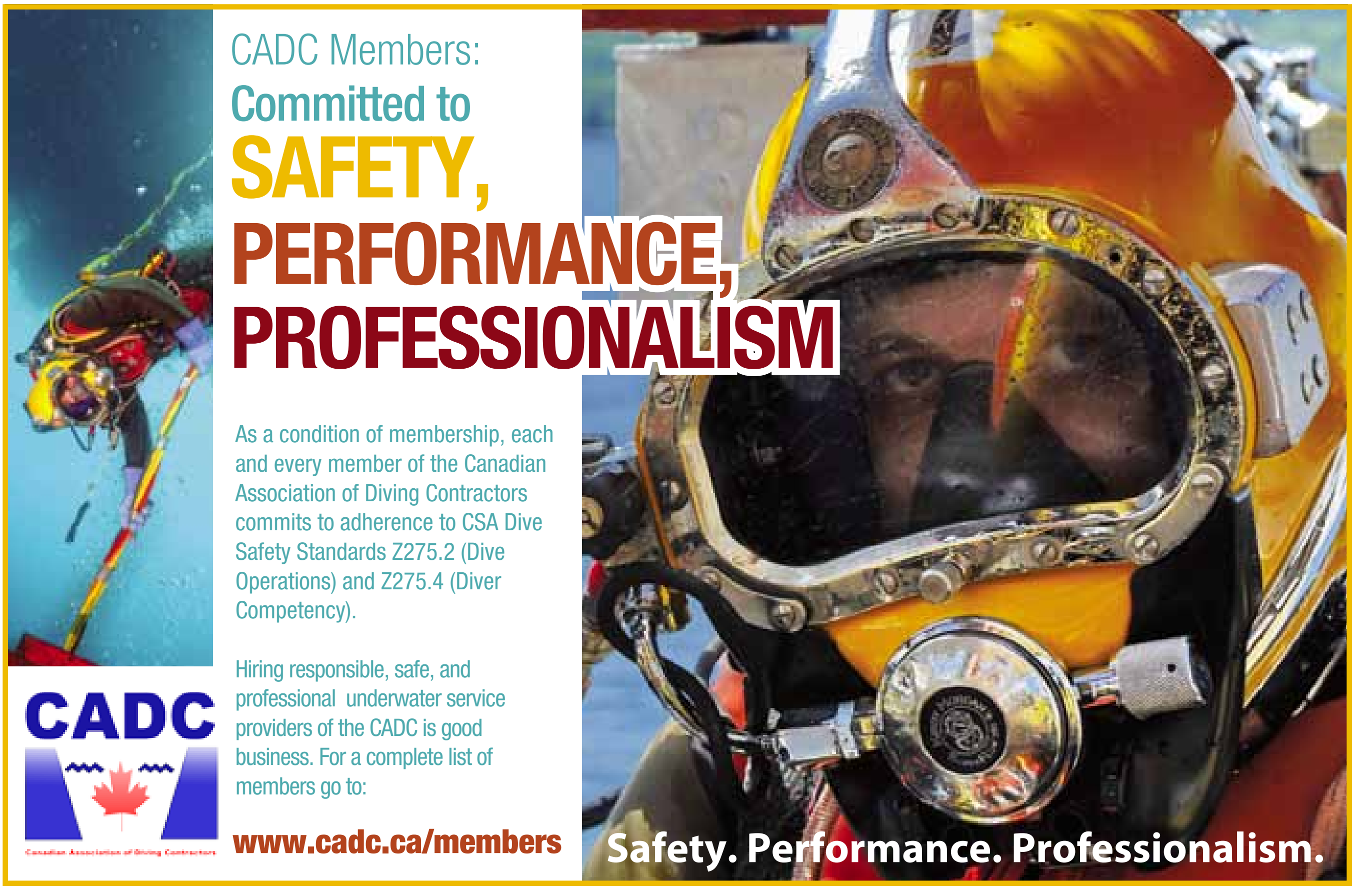
To find out how you can become a member of the CADC, visit www.CADC.ca.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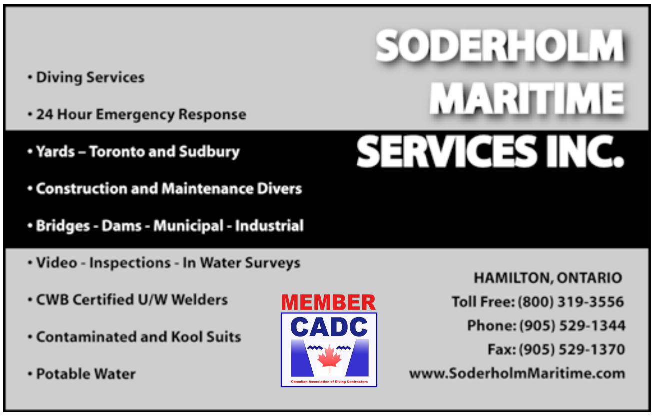
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