International Submarine Engineering Ltd.

Corporate Profile

Remotely Operated Vehicles

Autonomous Underwater Vehicles

Human Occupied Vehicles

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Innovation through Experience

About Us

International Submarine Engineering Ltd. (ISE) was formed in August 1974 to develop, manufacture and sell Remotely Operated Vehicles (ROVs) by Dr. James R. McFarlane, OC, CD, P Eng, FCAE.

At that time the offshore service industry supported subsea oil and gas activities with manned diving spreads and Human Occupied Vehicles (HOVs). Both systems required large support ships for their operation. In the early 1970s, the introduction of high-density electronics and the significant rise in the cost of support ships presented the opportunity to develop, manufacture and market an assortment of smaller high-endurance robotic vehicles for various subsea tasks.

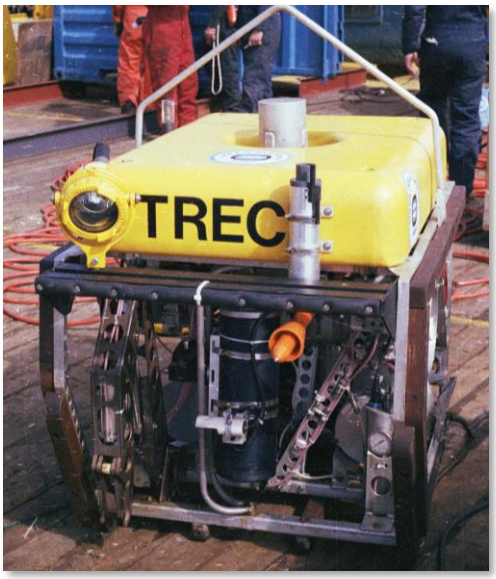
Over the past 44 years, our achievements have been recognized with awards from many international oceanographic agencies. We have delivered more than 200 underwater vehicles and over 400 robotic manipulators. ISE and our staff have received various awards from international bodies such as IEEE. Most recently, ISE received the Marine Technology Society Compass Industrial Award. ISE's founder, Dr. James McFarlane, was also presented with the MTS Compass Distinguished Achievement Award for Outstanding Contributions to the Advancement of the Science and Engineering of Oceanography and Marine Technology. In 2009, ISE was inducted into the Offshore Energy Center Hall of Fame and was also named as one of Canada's top 40 defence companies. In 2011, Dr. McFarlane was also awarded with a lifetime achievement award from the Diver Certification Board of Canada for his significant contributions to the underwater industry.

There have been many 'firsts' and records for ISE: the first commercial ROV in the North Sea in 1975; the first manipulator on a commercial ROV in 1976; the ROV TREC ends divers performing walking inspections of pipelines in the Gulf of Mexico in 1979; the first subsea blowout inspection on the Ixtoc-1 in 1979; the first semi-submersible Autonomous Underwater Vehicle (AUV) DOLPHIN in 1982 developed for military applications; the first AUV survey ever done in 1983; followed by the longest AUV mission under the ice with THESEUS in 1996. At 1.27 metres in diameter and 10.7 metres in length, THESEUS is one of the world's largest AUVs.

ISE currently designs and manufactures ROVs, AUVs, HOVs, semi-submersibles, autonomous and remotely operated surface vehicles, robotic manipulators and software control systems.

Remotely Operated Vehicles (ROVs)

TROV (Tethered Remotely Operated Vehicle)
One of the first ROVs developed by ISE in 1976



TREC ROV - 1977
Replaces divers for pipeline inspections

ISE's ROV product lines form one of the core elements of its overall business structure. We have designed and built ROVs for commercial, scientific and military applications. Our ROVs are delivered in standard or custom configurations to meet our customer's requirements from 10 HP to 600 HP and up to 6000 metres of depth.

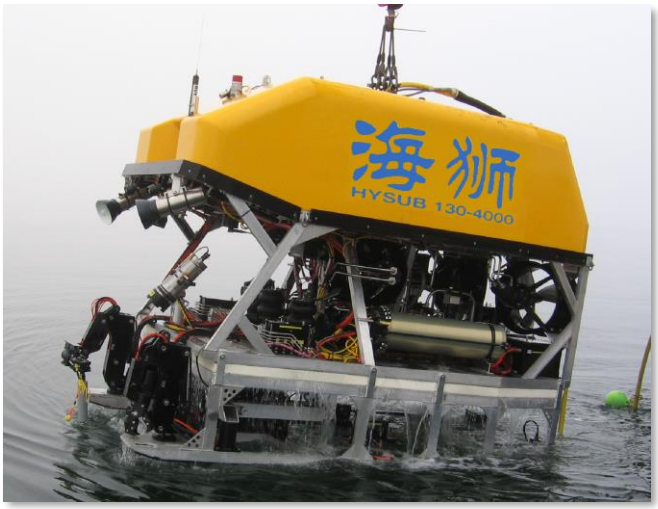
ISE designed and manufactured one of the world's first commercial ROV systems for the Department of Inland Waters, Canada. This vehicle was launched in April of 1975 and delivered in October of the same year and was responsible for discovering Canadian and US warships in the Great Lakes from the battles of 1812. In 1976, ISE's first pipeline support vehicle worked in the North Sea off the coast of Scotland on the observation of ballasting on the Piper Alpha pipeline. It was also in 1976 when ISE manipulators were installed on these early ROVs for the first time broadly expanding the capabilities of these early systems. By 1979 ROVs were beginning to receive greater acceptance in the offshore oil and gas sector, a trend reinforced with the replacement of divers by the ISE ROV TREC in performing pipeline inspections. There was also the offshore blowout at Itox-1 in the Gulf of Mexico in 1979 which saw the ISE TREC perform the first ever BOP remote intervention.

Since these early development and manufacturing efforts ISE ROVs have matured into well-developed, capable and robust commercial products. High bandwidth data communications via fibre optic cable was first accomplished in 1987 and this was one of the first ROV systems to completely rely on fibre for video and data transmission. Increased data transmission capability has allowed the use of sensors requiring extraordinary high-volume throughput such as 3 CCD HD broadcast quality video signals. The other benefit realized from the development of fibre optic umbilical cables was a reduction in the overall size of the cable that reduced drag and enhanced vehicle manoeuvrability.

ISE has developed numerous scientific ROVs with diverse capabilities to meet the broad ranging requirements of user groups from various scientific disciplines; biologists, chemists, geologists and oceanographers as examples.

VENTANA ROV operated by Monterey Bay Aquarium Research Institute

Some examples of our most notable scientific ROVs are: the Ventana, operated by the Monterey Bay Aquarium Research Institute (pictured above); the Canadian Scientific Submersible Facility's Remotely Operated Platform for Ocean Sciences, or ROPOS (pictured opposite); Hyper-Dolphin operated by Japan Agency for Marine-Earth Science and Technology (JAMSTEC); and, more recently, the HYSUB 130 HP ROV Sea Lion for Guangzhou Marine Geological Survey (GMGS), a division of China's Ministry of Land and Resources (pictured below).



HYSUB 130 HP ROV – SEA LION

ROPOS ROV

ROVs are not just dedicated to the subsea market; they can also be used for land-based operations. ISE has developed and manufactured innovative solutions to customer requirements. Mining is a costly and invasive operation and to ensure the most efficient operation a robotic system called Mini Mole was developed to mine the ore vein directly eliminating the extensive removal of overburden associated with some traditional mining operations.

AUTONOMOUS UNDERWATER VEHICLES (AUVS)

ARCS AUV

ISE's first AUV was the Autonomous and Remote Controlled Submarine (ARCS), shown below. The development of the vehicle began in late 1981 for the Canadian Hydrographic Service (CHS). It was designed to conduct surveys in the high Arctic. Until recently, we considered ARCS to be the third AUV built after the University of Washington SPURV program and the Ifremer l'Epaulard. However, ARCS was the very first AUV to operate in a completely autonomous manner, as the other two were always tethered, either physically or acoustically. ARCS was the first AUV to conduct a hydrographic survey in 1983.

Autonomous and Remote Controlled Submarine (ARCS)

During ARCS' operational lifespan it was modified and used for a variety of development trials to validate new designs and test the integration of new sensors. These included navigation algorithms, mine countermeasures surveys, long range mission development and fuel cell trials. ARCS was also used to develop an iceberg mapping and profiling system and to evaluate new AUV sensors including a mass spectrometer. In 2002, ARCS was retired following 18 years of operations and over 800 missions.

THESEUS AUV

ISE commenced development of the Theseus vehicle in 1992 under contract with the Canadian Department of National Defence as part of the joint US-Canada Spinnaker Project.

Theseus was originally developed to lay long lengths of fibre-optic cable on the seabed under the arctic ice pack. The vehicle completed successful deployments to the Arctic in 1995 and 1996. During the 1996 deployment, two 190 km cables were laid in 600 metre water depths under a 2.5 metre-thick ice pack.

Theseus under the Arctic Icecap

Until very recently, Theseus was the largest AUV in operation and held the record for the longest AUV mission – 460 kilometres, all of which was under ice.

Theseus was retired after the final mission in 1996. It is still owned by Defence Research and Development Canada (an agency of DND) and is stored at ISE.

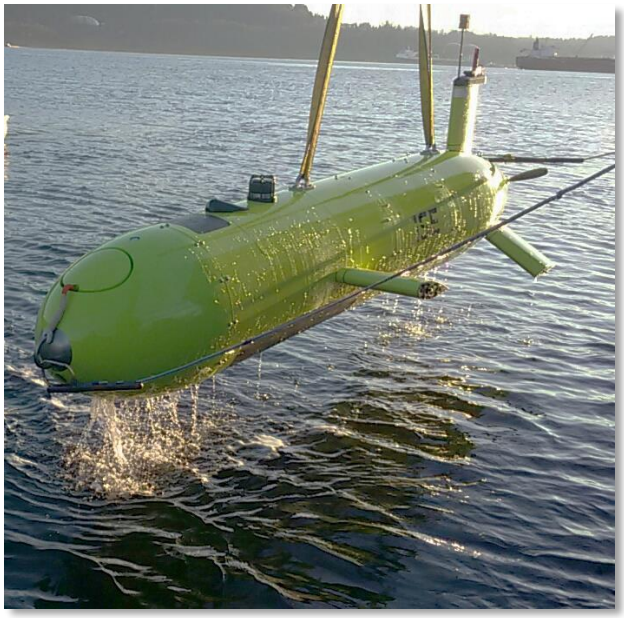
EXPLORER AUV

The University of Bremen's Explorer off the coast of France in 2008, working with Ifremer

In 2002, ISE started development of a smaller AUV known as Explorer, based on the successful modular designs of our earlier vehicles. The prototype vehicle was developed and tested in 2003 and delivered to the French oceanographic agency, Ifremer.

The Explorer AUV has been well received by the scientific community around the globe. It is recognized as a capable, stable and reliable survey platform configurable to carry a myriad of payload sensors. Explorer is available in various configurations, with depth ratings to 6000 metres, and long range endurance options up to 85 hours. Successes within the scientific community and the flexibility of the platform have led to Explorer being well received by commercial survey companies.

Explorer is now in use around the world, with owners including Ifremer (two vehicles), the University of Bremen, the University of Southern Mississippi (USM), Memorial University of Newfoundland, Japan Coast Guard, Fukada Salvage and Marine Works Co., Ltd., the University of Tasmania (UTAS) and Natural Resources Canada (NRCan) (two vehicles).



ISE Explorer AUV performs sea trials near Burrard Inlet, Vancouver, BC

ARCTIC EXPLORER AUVS

In September 2009, ISE delivered two 5000 metre Explorer AUVs to Natural Resources Canada. In 2010 and 2011, they were deployed to the Canadian Arctic to conduct seabed surveys supporting Canada's submission under Article 76 of the United Nations Convention on the Law of the Sea.

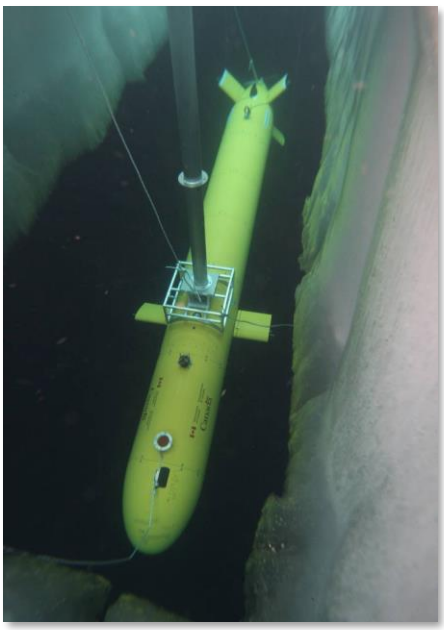
NRCan 5000 M AUVs

In April 2010, one of these vehicles completed a 10-day mission in the Arctic at depths to 3160 metres, travelling a distance of 1100 kilometres under the ice without being recovered from the water. This distance is further than that travelled continuously by any other conventionally powered AUV. It also recorded the very first seabed survey by an AUV underneath Arctic ice.

Pictured opposite, is the ISE Arctic Explorer being launched through an ice hole during the 2010 Arctic deployment.

This was followed up by the 2011 Arctic deployment, conducted aboard the Canadian Coast Guard icebreaker the Louis St. Laurent. The AUV conducted a successful 115 kilometre survey to depths of over 3000 metres at 88.5º North.

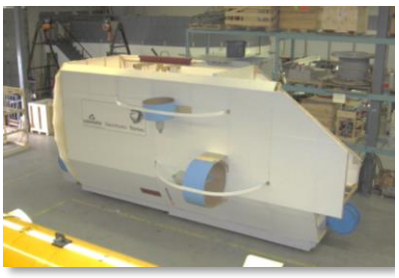
An important aspect of this Explorer AUV delivery is the continued operational and logistical support ISE provides to the client. In the case of the NRCan AUVs this included on-site support during the Arctic deployments.



ISE Arctic Explorer AUV being launched through an ice hole.

HYBRID AUV

In 2007, ISE began work on the Swimmer project for Cybernetix S.A. of Marseille, France and Total. We designed a hybrid AUV system for work in deep oil fields. It comprises a shuttle AUV that carries and deploys a lightweight electric inspection and intervention ROV.



Swimmer Hybrid AUV Model

RECENT EXPLORER SALES

FUKADA EXPLORER AUV WITH RAMP BASED LAUNCH & RECOVERY SYSTEM

Some of our most recent Explorer sales includes Fukada Salvage & Marine Works Co., Ltd. in Japan and the Japan Coast Guard. Both vehicles were configured for commercial survey operations. Each is equipped with a side scan sonar, a sub-bottom profiler and a multibeam echosounder. They are also supplied with a self-articulating, ramp-based launch and recovery system, which enables them to be launched and recovered in inclement weather and up to Sea State 4.

AUV with self-articulating ramp-based Launch and Recovery System (LARS)

UNIVERSITY OF TASMANIA 5000 M AUV

In 2016, ISE was contracted to build a 5000 metre depth Explorer class AUV for the University of Tasmania and the Antarctic Gateway Partnership project. This Explorer is ISE's fourth under-ice capable AUV that builds on the success of Theseus and the two Arctic Explorer vehicles owned and operated by Natural Resources Canada. This Explorer was delivered to the University of Tasmania in 2017, and is being used by the Antarctic Gateway Partnership, an Australian Government funded initiative to build further polar research capability in Tasmania. This Explorer is being utilized by a talented group of scientists and operators taking the under-ice capable vehicle into unexplored environments. Explorer's variable ballast system will facilitate unique science operations such as sediment and ice sampling. This will be a novel use for Explorer's variable ballast system, which has been utilized previously on Explorer and Theseus AUVs to facilitate parking and cable laying.

UTAS AUV

SEMI-SUBMERSIBLES

Dolphin

In the early 1980s, we developed the Dolphin semi-submersible. It was built as a stable platform for offshore hydrographic survey and mine countermeasures. Since 1982, we have built thirteen of these vehicles for the Canadian Hydrographic Service (CHS), the US Navy, Rockwell International, and the Canadian Navy. Dolphin has evolved into the Dorado minehunting semi-submersible vehicle and is equipped with our Aurora Towfish sensor platform.

DOLPHIN

Dorado

The Dorado semi-submersible is the successor to Dolphin. In 2000, successful towing trials were conducted at speeds of 10 knots and depths of 200 metres. Since then, many operational trials have been conducted in the United States, France, Italy, and Canada.

DORADO Remote Minehunting System

Aurora Towfish

The ISE Aurora is an actively stabilized vehicle that can accommodate a variety of wet and dry payloads and carries mine countermeasure sonars. It is deployed from a semi-submersible or ship and helps to reduce scope, enhance line following, and shorten manoeuvring turns.

Development of the new generation of commercialized ISE Aurora Towfish was recently completed and two were delivered to MDA Systems Ltd. in January 2018. The vehicle design is modular, allowing the hull to accommodate wet and dry payloads of varying sizes. Aurora Towfish has been designed with a large, actively controlled main wing to control depth. The large downforce created by the wing reduces the cable scope and layback, particularly with unfaired cables, enhancing the positional accuracy of the Towfish. Active tail planes control Towfish attitude and stability. A mounting rail for sonar arrays is fitted to the bottom of the Towfish making it possible to accommodate a broad number of sonars. The Aurora Towfish is designed to operate at speeds of up to 12 knots.

AURORA Towfish

Innovative Solutions

ISE strives to ensure our products feature the most up-to-date designs and technology; we place special value in research and development. We combine our development work with partnerships involving universities, government agencies and specialist companies. ISE has developed and engineered products ranging from vehicle controllers with custom positioning algorithms, mission specific sensors, power sources and vehicles operated on both land and sea. It is this experience that allows us to develop innovative solutions for new requirements. Our current research and development activities are centred on extending AUV autonomy and developing prototype platforms with intervention capabilities.

We enjoy creating innovative solutions for underwater applications. In addition to our core products of ROVs and AUVs we have also developed robotic products and been heavily involved in new concepts and designs. Some examples listed below:

- RMS – the Remote Minehunting System, a combination of semi-submersible and towfish (pictured on previous page) with interchangeable sensor arrays.
- SmartPumpTM – a robotic gas station for refueling passenger cars for the Shell Oil Company.
- Special Purpose Dextrous Manipulator (SPDM) Testbed Manipulator for the Canadian Space Agency astronaut robotic arm manipulator training station.
- Private Submersible – a ten passenger American Bureau of Shipping certified submersible rated to 365 metres.
- Mini Mole – high grade narrow vein autonomous mining vehicle for Placer Dome.
- PRMS – ISE collaborated with OceanWorks on the Pressurized Rescue Module System for US Navy Submarine emergency evacuation system.

Pressurized Rescue Module System (PRMS)

Private Submersible

Customer Base

Since ISE was formed we have built strong and lasting relationships with many different organizations around the world. Our goal is to develop long lasting relationships with our suppliers, partners and customers. Some of our customers are listed below.

Organization:	Location:	Organization:	Location:
AT & T Ltd	USA	Monterey Bay Aquarium Research Institute (MBARI)	USA
Bedford Institute of Oceanography	Canada	Memorial University of Newfoundland	Canada
Bremen University, MARUM	Germany	Nordex Willco AS	Norway
British Oceanics	UK	Ocean Works of Asia	Japan
CGG Veritas	France	Oceaneering International Ltd	USA
C and C Technologies	USA	Shin Nippon Kaiji	Japan
Cybernetix SA	France	Shell Oil Products Ltd	USA
Department of National Defence	Canada	Southwest Research Institute	USA
Department of Defense	USA	French Ministry of Defence	France
Det Norske Veritas	Norway	Fugro Chance Inc.	USA
DCN International and DCNS	France	Fukada Salvage & Marine Works Co., Ltd.	Japan
Société ECA SA	France	University of New Brunswick	Canada
Ifremer	France	University of Southern Mississippi	USA
Institute of Ocean Sciences	Canada	University of Tasmania	Australia
JAMSTEC	Japan	US DoD (DARPA)	USA
Japan Coast Guard (JCG)	Japan	UK Ministry of Defence	UK
John Hopkins University (APL)	USA	US Navy	USA

Quality Assurance

ISE's AUV Quality Assurance (QA) program is certified under ISO 9001:2015. The program has evolved since it was introduced over 25 years ago. It began as a Canadian Government requirement to meet NATO AQAP standards for military projects. In 1994 we adopted the ISO model for QA programs and achieved initial certification at the first attempt in 1996.

We are audited annually by SAI-Global, an international ISO certification organization and we successfully passed our latest surveillance audit and updated our accreditation to the latest ISO 9001:2015 in July 2017.

Every project benefits from a tailored QA program encompassing all components and procedures. Our internal processes are evaluated regularly. Also, our key suppliers are involved with our QA program. The overall focus of the company QA program continues to be in improving the level of customer satisfaction and lowering the cost of doing so.

CERTIFICATE OF REGISTRATION

This is to certify that

International Submarine Engineering Ltd.

1734 Broadway Street, Port Coquitlam , British Columbia V3C 2M8 Canada

operates a

Quality Management System

which complies with the requirements of

ISO 9001:2015

for the following scope of certification

The registration covers the Quality Management System for design, development, manufacture and services of underwater vehicles and auxilary equipment.

Certificate No.: CERT-0103191
File No.: 800341
Issue Date: July 6, 2018

Original Certification Date: July 14, 2009
Certification Effective Date: June 17, 2017
Certificate Expiry Date: June 16, 2020

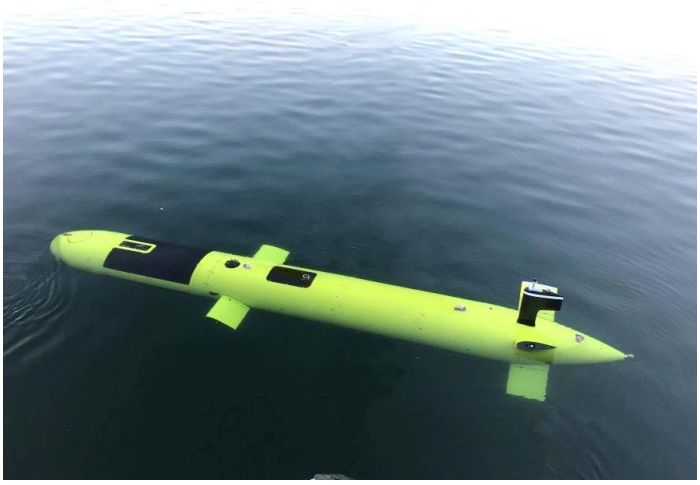
Kevin Goodwin
General Manager Technical Services
SAI Global Assurance

ISO 9001

SAI GLOBAL

In Summary

International Submarine Engineering Ltd. has proven to be a solid business partner over the years with customers and suppliers alike. ISE's vast intellectual property and experience in subsea system development supports the global underwater industry.



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