

2015

12th Annual

MANNED

UNDERWATER VEHICLES

SYMPOSIUM



Underwater Intervention

February 10-12

New Orleans, LA USA

2015 MTS MUV Schedule

Time	Room 244 Day 1	Room 244 Day 2	Room 244 Day 3
8:30-9:00			ABS Rule Change Proposals 2015 By: Roy Thomas American Bureau of Shipping, USA
9:00-9:30	World Overview of Manned Submersible Activity in 2014 By: William Kohnen MTS MUV, USA	Glass Pressure Vessels and Landers as a Complement to Manned Submersible Operations By: Kevin Hardy Global Ocean Design, USA	Learning from Classification of Manned Submersibles: Case studies of benefits By: Jonathan Struwe, Robert Surma DNV-GL, Germany
9:30-10:00	An Outsider's Perspective: Ocean Exploration, the Next Generation By: Oliver Steeds Consortium, UK	Innovative Fabrication Technology for Acrylic Spheres By: Heinz Fritz, Heinz Fritz K., Germany W. Stuber, Evonik Industries, Germany	2014 Overview of Navy Undersea Rescue Command and NAVSEA Regulatory Activity By: Mark Schleef, US Navy, URC By: Wally Jones, Phoenix Int., USA
10:00-10:30	Break	Break	Break
10:30-11:00	DSV ALVIN Operations in 2014 By: William Bruce Strickrott WHOI, USA	Complete 360 degree Camera for Submersibles By: Brad Thomas Battelle, USA	MTS Manned Underwater Vehicle Committee 10:30 to 12:00PM ANNUAL MUV, C
11:00-11:30	Inheritance of Tradition and Spirit - The Nexus of SHINKAI 6500's 25 year History By: Itaru Kawama JAMSTEC - Japan	ICTINEU 10Kwh Pressure-tolerant Li-po Battery Qualification for 6000m By: Carme Parareda, ICTINEU Submarins, Spain By: Ewen Raugel, IFREMER, France	
11:30-12:00	30 Years of Building of Submersibles in Finland By: Hannu Tiainen Mobimar Ltd., Finland	US Manufacturing Technology for Pressure Vessels for Human Occupancy By: William Kohnen, Hydrospace Group, USA	
12:00-1:30	Lunch	Lunch	
1:30-2:00	New Type of 6,000 meter Manned Submersible By: Stockton Rush OceanGate Inc., USA	Validating FEA Methodology: Strain Predictions and Testing By: Kyle Robinson, Joe Crouch Southwest Research Inst., USA	
2:00-2:30	Evolution of TRITON Submersibles By: Jarl Stromer TRITON Submarines, USA	Deep Challenger 1/5th Scaled Modelling Program By: Bruce Sutphen Sutphen Marine LLC, USA	
2:30-3:00	Overview of Submersible Activities 2014 By: Phil Nuytten Nuytco Research Ltd., Canada	Design, Analysis and Testing of Carbon Fiber Reinforced Plastic (CFRP) Structures By: S. Volonakis, E. Chatzidouros ALS Marine, Greece	
3:00-3:30	Break	Break	
3:30-4:00	The SEAL Carrier a Fast Surface Boat Able to Submerge By: Carl Hagman James Fisher Defence, Sweden	MTS MUV Operations Consensus Standard By: Kip Peterson Thorsborg Institute, USA	
4:00-4:30	Technology Innovation and Commercialization - 101 By: Colleen Hahn Gryphon Media Strategies, USA	MTS MUV Consensus Standard Work Group Session Open Work Meeting MTS MUV Members	
4:30-5:00			
5:30-7:30	MTS Manned Submersible Reception Cocktail Party MARRIOTT Hotel		

Welcome to the 2015 MTS MUV SYMPOSIUM

Dear Colleagues,

Last year's Manned Underwater Vehicles Program celebrated Woods Hole Oceanographic Institution's deep submergence vehicle (DSV) *Alvin* and the significant contributions made in ocean science and exploration from *Alvin*'s missions. *Alvin* stands as a symbol of the impact manned submersibles have in promoting technological advancement, oceanographic exploration and education on all levels. We were fortunate to have many of the members of the *Alvin* team who were responsible for the refit participate in our panels. A highlight from our 2014 conference was the amazing tour of the RV *Atlantis* and *Alvin*, for all our members.

Last year's MUV session theme was the international nature of our industry. Although this year the program is focused on subsea tools and technology, we also celebrate another international milestone. We have the privilege of celebrating 25 years of Japan's *Shinkai 6500*. Mr. Itaru Kawama of JAMSTEC and his team will present a brief history of the development, technology challenges and milestones of the more than 50 years of manned ocean exploration which led to the ultimate launch of the *Shinkai 6500* in 1989. MTS MUV wishes to recognize this long term vision as an international achievement.

There is no other symposium in the world that assembles the breadth of specialized knowledge that you will find gathered here at Underwater Intervention (UI), and in particular the Manned Underwater Vehicle program. Throughout UI, members and attendees have the opportunity to see overviews of industry activities and new product presentations, access to opinions, technical insight, knowledge, information and rare networking opportunities. In addition, by attending UI's exhibition hall on the show floor, you can directly access a full technical program on ROVs, AUV's and diving systems, and leave with up to date information on the current status of anything happening in the underwater arena.

This year, the Manned Underwater Vehicles Symposium will focus on subsea tools and technology advancements. A variety of sessions throughout our 3-day conference represent perspectives from those individuals who are engineering new equipment and technologies to address subsea challenges and harsh ocean environments. We also have an outsider: Oliver Steeds, TED TALK Reporter and Explorer, who will speak on "Ocean Exploration and the Next Generation." Mr. Steeds has reported on a great many grave human situations around the world and amidst all these high priorities, sees a special challenge in the subsea arena.

Our session begins on Tuesday, February 10th at 9:00am and will include presentations and panel discussions, culminating with a reception and cocktail party at the Marriott Hotel at 5:30pm. The following day, our panel discussions will continue to review the consistent milestones that were achieved as a result of advances in material science, new technological developments, adaptations from other industries and new innovations by the dedicated engineers and researchers involved in manned underwater vehicle programs around the world. We will also be taking an active role in developing consensus standards for our industry. This is a wonderful opportunity for us to take a leadership role in drafting regulatory language that serves us best according to our needs, as opposed to being dictated to. This is not undertaken lightly, but on the foundation of many years as an MUV community endeavoring to invest some time for the future.

Finally, whether your business interactions are international or local, business-to-business or business to government, MUV is the intersection between engineering, technology advancements and the spirit of human subsea exploration. Thank you to our speakers for their time and presentations. Thank you for attending and for your participation. Thank you to our generous sponsors and thank you to Underwater Intervention for making this all possible.

Welcome to Underwater Intervention 2015. Cheers to *Shinkai 6500*, to international ocean exploration, and the underwater ventures represented in our 12th MTS Manned Underwater Vehicles Program.

William Kohnen
Chair, Manned Underwater Vehicles
Marine Technology Society








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Manned Underwater Vehicles

*Cocktail Reception
Tuesday, February 10, 2015
Marriott Hotel, 2nd Floor Atrium
5:30 - 7:30pm*

Sponsored by:



12th Annual MTS MUV Program

MANNED UNDERWATER VEHICLES PROGRAM

Day 1 - ROOM 244 - Tuesday, February 10

9:00-9:30 **World Overview of Manned Sub Activity in 2014**

by: William Kohnen, Hydrospace Group, USA

A yearly review of the state of the Manned Submersible industry in 2014. The overview will look at developments in all branches, including international research, tourism activity, leisure and security developments. This will include a summary of submersibles under Classification, operating and in construction, review of the industry trends and regulatory highlights for the year.

9:30-10:00 **An Outsider's Perspective: Ocean Exploration, the Next Generation**

By: Oliver Steeds, TED TALK Reporter & Explorer, UK

Newspaper headlines tell us that we must pay attention to the conditions of the oceans worldwide, yet we do little. How is it that a flood of numbers and data has distanced us from developing a closer relationship with our oceans? It is as if the people of Planet Earth have become disconnected from the world of Planet Ocean.

Somehow we need to activate a chain of events. That chain of events starts when people care. Once people care, changes in politics become possible. Might it be that the problem is not one of technology, but one of politics and human outreach? We need a new journey of exploration – akin to the Space Race – for the deep ocean to reconnect people. While the ocean is becoming increasingly accessible to us through ROVs, AUVs and MUVs, we need more of all of types, and specifically MUVs. Only when we put people in the heart of the epic new era of exploration will imagination trigger a sense that we have the power to change, manage and prosper, and that ocean politics matter. This presentation will provide an outsider's perspective that places this priority among so many other headline issues facing the world.

10:00-10:30

Coffee Break

10:30-11:00 **DSV ALVIN Operations in 2014**

By: William Bruce Strickrott, WHOI, USA

DSV Alvin Operations in 2014 presents an overview of recent scientific and engineering research operations in the submersible's first year following its overhaul and new NAVSEA certification.

11:00-11:30 **Inheritance of Tradition and Spirit - The Nexus of SHINKAI 6500's 25 year History**

By: Itaru Kawama, JAMSTEC, Japan

SHINKAI 6500 was completed in November 1989. In these 25 years of exploration the DSV has logged more than 1400 dives through 2014. Shinkai 6500 evolved alongside many people, weaving a broad range of relationships, national and international, as she continues to carry the dreams of operators, scientists, and engineers. More than anything, her history is also a history of all the challenges and people that have grown up in its sphere of influence. When one looks back on her history, it becomes clear that it has evolved as a natural extension of over sixty years of submersible developments in Japan. In this presentation, SHINKAI 6500's history will be interwoven with the history of manned submersibles in Japan.

11:30-12:00 30 Years of Building of Submersibles in Finland

By: Hannu Tiainen, Mobimar, Finland

In the aftermath of the WWII Finland was prohibited from having submarines. However, an authoritative review made in the 80's stated that the prohibition only applied for owning military submarines, not for building of civil submarines. This revelation opened a totally new market for the Finnish shipbuilders and created certain hype. Suddenly, there were four companies designing and building research and tourist submarines: Laivateollisuus, Malmari & Winberg, Oceanics and SubMarine. These companies do not exist any longer, but the work is continued by Mobimar Ltd.

The tourist submarine market today is quite different from the 80's. Surprisingly many of the submarines made 20 odd years ago are still operational in their original resorts, so selling a new submarine means quite likely that we have to find first a new operation resort with the right properties. The good things are that the clients take their projects more professionally and that the national authorities have become better informed of environmental and safety issues.

Our present submarine generation is the Mark V family, which has three basic hull sizes: 35 passengers, 50 passengers and 65 passengers. This presentation will tell more about the Mark V submarines, their design and the present tourist submarine market.

12:00-1:30

Lunch

1:30-2:00 Innovations, Adaptations and Borrowed technology in the Creation of a New Type of 6,000 meter Manned Submersible

By: Stockton Rush, OceanGate, USA

The presentation will cover the current status of the Cyclops deep manned submersible project including the design, construction and dive results for the 500M prototype, Cyclops 1, production schedule and design details of the 3,000M and 6,000M carbon fiber hulls and related components as well as dive plans for 2015 and 2016. Also to be covered will be the operational result and plans for the submersible launch, retrieval and transport system and its future uses and configurations.

2:00-2:30 Evolution of TRITON Submersibles

By: Jarl Stromer, Triton Submarines, USA

With the advent of the Triton 1000/2 in 2008, Triton Submarines, LLC made a quantum leap in the development of manned submersibles. Even among other existing acrylic NEMO sphere submersibles such as the JSLS and Deep Rovers, the Triton 1000/2 represented improvements in visibility, foot print, weight and displacement, surface stability and freeboard and simplicity. The Triton 1000/2 carries two occupants to a depth of 1000 feet (305 meters). The Triton 3300/3 carries three occupants to a maximum depth of 3300 feet (1000 meters) in an all transparent acrylic pressure boundary. It was used in the deep trenches off the coast of Japan in 2012 to film a live specimen of the elusive giant squid (genus *Architeuthis*) in its natural habitat. The development of the Triton product line of submersibles has also stimulated the advancement of associated technologies, such as the fabrication of ever larger diameter and thicker walled acrylic NEMO spheres. Having built seven manned submersibles to date, Triton Submarines, LLC is at the forefront of the manned submersibles industry. The presentation will review the evolution of the Triton series of submersibles and the legacy that lead to the development of a lighter displacement lower profile submersible in the Triton 1000/3 LP, a faster, sleeker submersible in the Triton 1000/1 HS, and a greater passenger carrying capacity with the Triton 1000/8. The presentation will also cover advancements in co-operation with our technology partners in the study of glass as a pressure boundary material, with the ultimate goal of producing a manned submersible capable of diving to full ocean depth (36,000 feet, 11,000 meters) in an all transparent pressure boundary.

2:30-3:00 **Overview of Submersible Operations in 2014**

By: Phil Nuytten, NUYTCO Research Ltd, Canada

Nuytco Research is a world leader in the design, manufacture and operation of manned submersibles and ADS. Nuytco saw another busy year in 2014. A power point and video presentation will review the activities of the diving suits, Exosuit, and manned one-atmosphere DeepWorker and Dual DeepWorker submersibles. The presenter is Dr. Phil Nuytten, inventor of several of the one-atmosphere work systems in use today. The presentation runs approximately 20 minutes and is narrated by the speaker.

3:00-3:30

Coffee Break

3:30-4:00 **The SEAL Carrier a Fast Surface Boat Able to Submerge**

By: Carl Hagman, James Fisher Defence Sweden
Ben Sharples, James Fisher Defence

For more than 10 years James Fisher Defence Sweden has developed and produced a hybrid surface/submerged craft, under the name of SEAL Carrier. The SEAL Carrier is specially designed for independent transport of a combat diver unit to, within, and out of an area of operation where there is a need for covert infiltration. The craft operates both as a fast surface boat and as a wet submersible. Similar concepts often include an ordinary surface boat and a pure underwater Swimmer Delivery Vehicle, the SEAL Carrier combine them in one platform. Development of the craft combines innovative technical solutions, high end engineering and a lot of testing and user experience to fulfill the complex requirement specification. In my presentation I will give you insight in what challenges we have faced along the many years of development and production.

4:00-4:30 **Technology Innovation and Commercialization - 101**

By: Colleen Hahn, Gryphon Media Strategies, USA

The ocean environment is the original “disruptive” influence. Marine equipment, technology and service companies face a variety of challenges when bringing new products and solutions to market. These types of ventures are founded by engineers, researchers or technologists focused on solving a narrowly defined problem for a specific vertical application, or they are a result of programs spun out of the military and defense sector with limitations on licensing and commercialization to civilian markets. Today’s competitive market place dictates that innovation, change and “disruptive” technology are critical to propel not only an individual company forward but to lift an industry to the next level of relevance. Looking at the world with the eyes of our disruptors, no one company is so essential that it can’t be replaced and no single business model or sector is off-limits to a raw burst of change. Although technological innovation is not new to the subsea marine industry, integrated solutions offerings and alternative partnering programs are not easily embraced. Any business must respond to the demands of economic swings and competitor pressure. However, the marine equipment, technology and solutions provider has the additional burden of addressing challenges faced by the dynamic influences of the subsea environment where the cost of entry is high. The ocean environment can influence the path to entry for any product or solution and determines product design, features, longevity and endurance. Regulations, classification and extended delivery timelines factor into roll out strategies. Focused on these obstacles, when does a company ask key questions such as: Who is my customer? What is my market? What application do I focus on first to enter the market? And where do my product features and benefits hit their value proposition first?

Companies that cannot clearly articulate their customers, their market and their value are not companies but merely research projects and programs with an expiration date! Engineering and marketing must work together closely to answer these questions and create alternative road maps to achieve success. This is the first in a series of conversations about positioning frameworks and potential pathways to bring technology solutions to market and achieve success.

Please Join us for the MTS MUV Cocktail Reception

Marriott Hotel, 5:30-7:30pm

Day 2 - ROOM 244 - Wednesday, February 11

9:00-9:30

Glass Pressure Vessels and Landers as a Complement to Manned Submersible Operations

By: Kevin Hardy, Global Ocean Design, USA

Landers, historically known as free vehicles, complement the other classes of undersea vehicles including manned submersibles. Each of the other classes of unmanned undersea vehicles such as Remotely Operated Vehicles (ROVs), gliders, Autonomous Undersea Vehicles (AUVs), mid-water floats, and towed platforms, have a complementary suites of strengths and weaknesses. Component technologies such as batteries, glass spheres, syntactic, cameras and lights, may be tested using a robust, cost-effective lander prior to installation on these other classes of undersea craft. Ocean engineers and marine technicians gain valuable experience, confidence, and competence in training with deployments of landers. Landers can precede a manned submersible or ROV operation to initially survey a general area of interest, rapidly scouting for a "hot spot" among many potential dive sites. This optimizes the use of the manned vehicle, and its associated pre-dive maintenance. Landers can act as a "pack-horse" for a submersible, accepting a transfer of the samples collected by a pilot and observer. Once the submersible is recovered, the lander is recalled, ferrying the samples back to the surface. In extreme cases, a lander could be called upon to provide a tow back to the surface for a buoyancy-challenged submersible. The lander can be used to lure animals towards its position by the use of bait. Scavengers come for the bait, while predators come for the scavengers. Low-light cameras using red LEDs can image animal behavior without disturbance, while awaiting the arrival of a manned submersible scheduled to arrive at the height of the feeding frenzy. An array of landers may be placed over a wide swath of area for extremely long-term observation or monitoring. A pre-programmed event trigger can cause a lander to release, float to the surface, and radio a report of some urgency. A rapid-deployment team, using an ROV or manned vehicle, can then follow-up with in-situ observations in greater detail. The advantages and limitations in the use of glass spheres, both BK-7 and borosilicate, will be discussed. Additional references will be provided.

9:30-10:00

Innovative Fabrication Technology for Acrylic Spheres

By: Heinz Fritz, Heinz Fritz Kunststoffverarbeitung, Germany

Wolfgang Stuber, Evonik Industries, Germany

The presentation will cover new production processes and technology to realize a unique quality, secured reproducibility and reliable delivery date for Acrylic Submarine Spheres. A range of aspects are presented including:

1) Monolithic Acrylic Blocks from Evonik Industries

Evonik Industries production technologie generate a unique monolithic acrylic quality, which can be used for all kind of flat submarine windows. Dr. Otto Röhm invented the acrylic material and used the brandname PLEXIGLAS®. The company Röhm belongs now to Evonik Industries. Description why we have ot use different brandnames for the acrylic produced by Evonik Industries (Brandname ACRYLITE® for North America, PLEXIGLAS® rest of the World).

2) New production process.

The production starts with an already checked and tested monolithic block. No inclusions, no distortions, proofed physical properties. A new production process developed from Evonik Industries and certified by the Germanischer Lloyd secure that the unique properties of PLEXIGLAS® will be unimpaired. With this highly reproducibility process it is possible to generate the blanks to machine spherical sector windows, as well as hemispheres.

3) Fabrication process

Due to a very accurate machining process the required dimensions with extrem good tolerance variation can be secured.

4) Special bonding agents for glueing hemispheres together

Evonik Industries produce all kinds of acrylic adhesives to bond PMMA. So HFK is able to adapt the adhesive to the specific grade of the PMMA base material and the specific requirements of the bond. Slight chemical background of the

most important chemical and physical key factors to control a glue polymerisation. Also for the spheres is a very specific glue type developed used and approved. Glueing does not describe really the used technology. It is more a type of cold welding.

- 5) Material testing on the realized, original bonds. After each sphere is glued, specimens are cut from the original bond are used for the testing. 50% tensile strength of the base material is requested in the PVHO code to fulfil the minimum requirements. The bonds of company Fritz are able to provide nearly 100%.

10:00-10:30

Coffee Break

10:30-11:00

Complete 360 degree Camera for Submersibles

By: Brad Thomas, Battelle, USA

Many of our modern underwater vehicles still have restricted views for the operators. This is especially true for manned submersibles and Remotely Operated Vehicles (ROV). This paper will discuss the benefits of utilizing a new camera technology, HorizonVue(TM), to allow the operator complete situational awareness. HorizonVue(TM) provides the operator with a single view to assist with vehicle navigation, obstacle avoidance, and manipulator operation. The camera provides the operator with real-time 360 degree video. This reduces the operator burden of mentally piecing multiple camera views into a coherent understanding of the surrounding environment. The unique design also provides an undistorted view both in and out of the water. This constant view feature helps the operator to understand distances to objects whether on the bottom or on the surface. The camera can also be used to queue other pan, tilt, and zoom (PTZ) cameras which can remove the need for the operators to zoom out, pan, and zoom in when transitioning between objects. For tourist operations the camera provides the operator a view of both sides of the submersible and can also be used to supplement the customers view. In essence, this allows customers a complete view of both sides either through their own viewport or a monitor. To further enhance the experience each view can be electronically zoomed and panned individually. The HorizonVue(TM) camera also has no moving parts and is smaller, lighter, and requires less power than conventional PTZ cameras. HorizonVue™ is small enough to be used on the Bluefin Hovering Autonomous Underwater Vehicle (HAUV) to conduct inspections of underwater infrastructure. The technology can also be scaled to larger higher resolution sensors for greater image resolution.

11:00-11:30

ICTINEU 10Kwh Pressure-tolerant Li-po battery qualification for 6.000m.

By: Carme Parareda, Ictineu Submarins SL, Spain

Dr. Ewen Raugel, IFREMER, France

The Ictineu pressure tolerant li-po batteries were designed to provide the ICTINEU 3, a manned submersible for 1200 meters depth, with a high power, high density energy system. In 2012 the lithium-polymer batteries development was completed and functional testing started. Along 2013 they were installed in the ICTINEU 3 and fully tested on workshop, pool and harbour tests where they proved a high performance and endurance, completely fulfilling the expectations under real conditions.

These 10.4 Kwh each pressure tolerant battery modules are easy to implemented in any kind of vehicle or underwater station as well as safe in operation and maintenance. Now that the system has been fully validated, it can be easily adapted and certified to other underwater vehicles, manned or unmanned, due to the modularity of the system and the compliance with international rules and standards. They have been approved by DNV-GL for the manned submersible ICTINEU 3, so the highest standards of quality and safety are ensured.

Indeed, several companies and institutions have showed interest on the implementation of this battery modules in other submarine vehicles and applications, so different possibilities of integration have been studied for each client needs. Up to date, new tests are being performed in order to qualify the battery for up to 6.000m applications. Additional cycling and testing data obtained confirm the battery robustness and endurance. In order to provide better performance qualities and to ease the implementation on any type of vehicle, several improvements have been analysed

and will be implemented in new units. Also to provide improved quality and guarantees the company aims to obtain the DNV-GL certification in a near future, and is now working on the definition of procedures and test plan. The use of li-po pressure tolerant batteries shows as the definitely solution for deep water applications where they will play and important role to radically reduce the weight of the vehicles as well as improve their performance and operability. In the ICTINEU3 application, based to the li-ion-polymer battery system and its hydrodynamic design, the vehicle is expected to be able to travel 20 miles underwater at a cruise speed of 1.5 knots.

11:30-12:00

US Manufacturing Technology for Pressure Vessels for Human Occupancy

By: William Kohnen, Hydrospace Group, USA

All submersible or submarine designs rely at their core on the technology and design concepts of Pressure Vessels for Human Occupancy. While the technical requirements, challenges and design objectives are broad and diverse on all pressure vessel designs, these are under sharper scrutiny when dealing with human safety. Hydrospace's 25 years of experience in Space and Subsea Systems integrating complete design, analysis, fabrication and testing capabilities specialized in metallic and non-metallic pressure vessels for human occupancy ranging from Submersible Pressure hulls, to medical systems, diving systems, altitude chambers and space simulators. These sophisticated pressure vessels bring specific design objectives, program challenges and regulatory requirements which add complexity to certify projects. Hydrospace's experience with ASME, PVHO-1, classification societies (ABS, DNVGL) and system manufacturing experience groups a consortium of manufacturing experience under one umbrella. This creates a unique center for US designed and fabricated, state-of-the-art PVHO pressure vessels for submarines, submersibles, medical, diving or space chambers.

12:00-1:30

Lunch

Advanced Underwater Engineering Session

1:30-2:00

Validating FEA Methodology: Strain Predictions and Testing

By: Kyle Robinson, SwRI, USA

Joe Crouch, SwRI, USA

A client came to SwRI for an ASME Boiler & Pressure Vessel Code analysis to be performed on their widget—a Side Pocket Mandrel (SPM) for artificial oil and gas lift involving internal and/or external pressure and axial tension and compression. SwRI was asked to perform a finite element model mesh sensitivity study, simulate the test conditions, then work closely with testing personnel to determine 20 biaxial strain gage locations. A pressure test was then performed to compare the strain gage test data with the FEA predictions. The FEA predictions differed from the test values by an average of 3.0% with a standard deviation of 3.7% percentage points in areas that experienced greater than 200 microstrain. Areas experiencing lower strain levels did not correlate as well. In general, the correlation of the axial gages was not as good as the hoop gages and may have suffered from a transverse strain or Poisson effect.

This presentation will discuss:

- The SPM finite element analysis: 2.4 M node model vs submodeling using more manageable models
- Strain gage placement considerations based on both FEA and testing constraints
- Postprocessing FEA results to gather strain predictions that make sense with test gages
- How to predict gage readings in areas with strain gradients
- The engineer/technician “handshake” for strain gage laying and DAQ
- Strain gaged load testing

2:00-2:30 **Deep Challenger 1/5th Scaled Modelling Program**

By: Bruce Sutphen, Remote Ocean Systems, USA

The initial intent of the scaled model testing for the Deep Challenger Project (later renamed DEEPSEA CHALLENGER) was to analyse the Launch and Retrieval system (LARS) and processes for the vertical orientated prismatic canoe body of the DEEPSEA CHALLENGER. However, after pulling the vehicle model in the negative “x” direction, it was quickly realized that the vehicle was completely unstable in yaw. This instability quickly changed the scaled modelling program’s objective from launch and retrieval development to determining the dynamic stability of the Manned Underwater Vehicle (MUV) design geometry. Early testing found the ride quality to be not desirable. The program then focused on testing and development of a robust passive solution that optimize speed and ride quality for the full ocean depth (FOD) descent and ascent translations.

2:30-3:00 **Design, Analysis and Testing of Carbon Fiber Reinforced Plastic (CFRP) Structures for Deep Underwater Applications**

By: Spyridon D. Volonakis, ALS Marine, Greece

Elias V. Chatzidouros, ALS Marine, Greece

Subsea vehicles and generally structures that are designed to operate underwater require pressure-resistant housings for components such as computers, cameras, sonars, batteries, electronics for communications and navigation, etc. This is also a critical factor for most of the autonomous underwater vehicles (AUVs) which are employed today for various applications, science, inspection, survey, etc. The material of choice today for building pressure housings and AUV hulls is metal and especially titanium which can offer a fair balance between weight to displacement ratios, corrosion resistance and high strength. Metals are the materials of choice, also for their inherent ability to yield before they fail, for the isotropy of their mechanical properties and for the relative straight forward manufacturing processes. As the operating sea depth increase so does the pressure housings and AUV hull’s weight, which translates to greater floatation and power requirements—more foam, larger frames, bigger vehicles, and larger ship for deployment. In this sense Carbon fiber reinforced plastic (CFRP) housings/hulls offer substantial gains in terms of weight to displacement ratio, compared to metallic constructions. CFRP composites structures are ¼ lighter than titanium structures of the same strength, while having inherent corrosion resistant properties. In this framework ALS has designed, analyzed with FEA (Finite Element Analysis) and tested in IFREMER, a CFRP pressure housing at 406 bar (4060 m sea depth) and simulations and tests exhibited remarkable agreement with FEA results deviating only 2.7% from the experimental results in terms of failure pressure and 0.5% in terms of volume reduction. The CFRP pressure housings were manufactured using filament winding method. The aforementioned results exhibit the remarkable potential that CFRP can offer in pressure housings and AUV hulls, especially for deep sea underwater missions.

3:00-3:30

Coffee Break

3:30-4:00 **“Consensus Operating Standards” For Manned Underwater Vehicles Committee**

By: Kip Peterson, Thorsborg Institute LLC, USA

A recent maritime media article stated that if you don’t know the following acronyms and what they represent, you and your organizations could have a very expensive education: EPA, ECA, USCG, STCW, IMO, SOLAS, Tier III, ISO, OSHA, DNV-GL, ABS.

The preceding acronyms are only a sample of the agencies/ organizations that are regulating everything operating in the oceans. We have been informed several times that there could be US federal regulations on the commercial operations of manned submersibles/submarines, but it hasn’t happened yet and several manned undersea vehicle operators have created their own specific protocols that are not uniform or consistent within the MUV industry. Currently, while commercial tourist submarine operators have well established operating procedures, national rules need to be modernized and expanded to include the MUV industry’s other commercial uses of manned underwater vehicle operations/

operators. In an increasingly tense climate of homeland security, both national and international, greater governmental control is an inescapable reality for what is largely considered as an “unregulated minimally controlled independent group of pioneers”.

This is the time to be proactive for the MUV community to come together to create the “Consensus Operating Standards” on the commercial operations of manned underwater vehicles. It’s objective is simple, yet challenging: To be able to put forward an industry recommended resource to the government to consider and accept, as they have in other aspects of the marine operations, guidelines which could become the ‘de-facto” basis for the government to allow the MUV industry to self-regulate in the same manner as the ADCI has been granted by the Federal Government to be the source of operational standards within the commercial diving industry.

4:00-5:00

MTS Manned Submersible WORKING GROUP SESSION MUV Operations Consensus Standards

Chaired by William Kohnen, MTS MUV Chair

This is the first Work Group session to outline the plan for the MUV Consensus Operating Standards. This discussion is the first start of an evolving document that will be developed through input from all members of the Marine Technology Society’s MUV Committee. These Consensus Operating Standards are not meant to replace existing classification rules. They will augment the technical expertise and inspection that currently occurs with the classification agencies/societies that are active in the manned undersea vehicle community and is not designed or expected to impinge on the technical standards derived by the classification societies. They are meant as an industry standard OPERATING consensus on the operations of manned underwater vehicles, whether classed or unclassed, commercial or non-commercial, civilian or military. In due time, these industry standards will assist in the negotiations with the marine insurance industry as it will be the MUV industry’s guidelines for operations of manned undersea vehicles that will have a positive impact on rates and coverages for manned underwater vehicle operators who comply with the Consensus Operating Standards.



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Day 3 - ROOM 244 - Thursday, February 12

8:30-9:00

Overview of the ABS Underwater Rule Change Proposals for 2015 (Annual ABS - Industry Meeting)

By: Roy Thomas, ABS, USA

Open meeting of the American Bureau of Shipping (ABS) with the subsea industry to review proposed Rule changes to the ABS Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities. These Rule changes include a proposed new chapter dealing with Ambient-Pressure Submersibles. This meeting facilitates an open dialogue with the industry on current issues that work well or do not work. All active designers, fabricators, owners and operators are invited to attend and provide feedback.

9:00-9:30

Learning from Classification of Manned Submersibles: Case Studies Emphasize the Benefits

By: Jonathan Struwe, DNV GL, Germany

Robert Surma, DNV GL, Germany

What can we learn from decades of experience with Classification of Manned Submersibles? While there is a growing interest in the sub surface, the experience how to increase safety for human life and how to improve submersible technologies is growing also. This paper presents case studies which produce proof that a third party approval of manned submersibles is more than a legal thing or a formal fulfillment of requirements. In fact, summarizing the challenges discovered during approval of several manned submersibles, at least five topics highlight the need for evaluation by a competent third party:

1. Material certification for load bearing elements
2. Welding approval and non-destructive testing
3. Design calculations
4. Drawing review
5. Constructional surveys

The past has shown that involving an authorized inspection representative already during the design phase and during order processes of materials can save thousands of dollars and avoids schedule delays as this support can make the difference between success and failure. Furthermore, in case of unforeseen manufacturing problems, designer and manufacturers of manned submersibles benefit from cooperation with an independent party. Based on the experience made with manufacturing and testing of pressure vessels for underwater applications it is not unlikely that problems occur which can immediately stop the complete project. Having a third party approval included in the contract agreement, reinforces the designer's interests and enables the possibility of an accepted, technical safe, short-term solution. During this presentation an exemplary design and manufacturing process of a manned submersible will be discussed one with and one without third party approval.

9:30-10:00

2014 Overview of Navy Undersea Rescue Command and NAVSEA Regulatory Activity

By: Mark Schleef, US Navy, Undersea Rescue Command
Wally Jones, Phoenix International, USA

The presentation will provide a year's overview of the activities of the Undersea Rescue Command, based in San Diego. This includes the submarine rescue vehicles of the US Navy, the FALCON PRM and the ADS systems. In light of the incident of the PRM in 2013, some update will be provided on the status of the repairs. A brief overview of the regulatory activities of NAVSEA will also be presented with regards to work being done on the P9290 rules.

10:00-10:30

Coffee Break

10:30-12:00

***MTS Manned Underwater Vehicles 2015 Yearly
Committee Meeting***

By: William Kohnen, Chair, Manned Underwater Vehicles, MTS, USA

ALL MTS MUV Members and Industry delegates are invited to attend, participate and join in the planning for the committee work for 2015.

2015 SPEAKER BIOS



Dr. Elias Chatzidouros, PhD
Naval Architect & Marine Engineer
ALS Marine

ALS MARINE LTD
85 Vouliagmenis Ave Glyfada
Athens GR16674 Greece
Tel. +30 210 9607077
Email echatzidouros@alsmarine.gr

Dr. Elias Chatzidouros, Naval Architect and Marine Engineer, PhD, is Technical Manager and R&D Director of ALS MARINE CONSULTANTS Ltd. His work experience includes research associate in 3 European integrated Projects, including “NATURALHY”, “MOJO”, “SUSY”, and senior researcher in “MOSAIC and “LASHARE”. Senior researcher in two National projects, one for building a 350-700 bar CGH2 Pressure Vessel [“Compressed Liquid Tank (5000 psi and 1000 psi) manufactured by filament wound composite materials (carbon fibers and epoxy resins)”] and the second DEEP CO-HOUSE. His consulting work includes, “SEA DIAMOND” wreckage oil removal and several ship salvage cases; structural assessment of submersible “Compuerta”, engineering assessment of the Hellenic natural gas pipeline grid for the company DESFA. Dr. Chatzidouros has a strong experimental background in material testing including, mechanical characterization, fracture toughness testing, fatigue testing, acoustic emission monitoring, and extensive experience in hydrogen related corrosion and failure, including mechanical, microstructural and fractographic aspects of corrosion and failure mechanisms. He also possesses a strong structural analysis background in marine structures and pipelines through the use of finite elements, rules and standards and common engineering practice, along with extensive experience in numerical simulation of failure, including crack propagation. He is the author of 2 journal papers and 5 conference papers, and an established expert for the EUs DIRECTORATE-GENERAL for REGIONAL POLICY in the appraisal, implementation and monitoring of Cohesion policy interventions as of 09/04/2014. Education: Naval Architect and Marine Engineer, graduated from the National Technical University of Athens, PhD in Pipeline Engineering and hydrogen related corrosion of pipeline steels, for onshore and offshore installations.



Joe Crouch
Manager, Marine Offshore Systems
Southwest Research Institute

Southwest Research Institute
6220 Culebra Rd.
San Antonio, Texas 78238 USA
Tel: +1 (210) 522-4295
Email: joseph.crouch@swri.org

Joe Crouch, P.E. is Manager of the Marine Offshore Systems Sections at Southwest Research Institute. His group includes both the Marine Structures and Engineering Section and the Ocean Simulation Laboratory, which are primarily engaged in projects for the offshore energy and marine industries, but do support project efforts in many other industries as well. Joe participated in the design, fabrication, test and certification efforts that produced the pressure hull for Woods Hole Oceanographic Institute’s Alvin. Principally a designer and structural analyst, he has 23 years of experience in diverse industry settings with projects ranging for deep space, aerospace, land based and deep ocean.



Heinz Fritz
Founder
Heinz Fritz Kunststoffverarbeitung

Heinz Fritz Kunststoffverarbeitung
Gewerbstraße 11
DE-89542 Herbrechtingen, Germany
Tel: +49 69 07324 988-115
Email: hf@heinz-fritz.de

Heinz Fritz was born 1949. His background is in mechanical engineering, specializing in plastics engineering studies. In 1984 he took over parental company HEINZ FRITZ, which he has since developed from a small garage facility to a high tech establishment. Meanwhile it is a worldwide recognized company in the processing of acrylic glass, especially if there are technical high complex projects or huge application. Heinz Fritz has immense knowledge, experience and required technical equipment. For example: 5-axes milling machine operating in space of 20 by 5 by 2,5 meter or oven for thermoforming and annealing in dimension of 15 by 4 by 4,5 meter... Heinz Fritz provides perfect solutions and products with the help and assistance of his wife, his two sons and 40 longtime, highly qualified employees. Now HEINZ FRITZ is able to provide its unique technique of gluing. The joints are nearly invisible. The strength of the joint is within the range of raw material – with high repeatability and accuracy. MADE IN GERMANY. Certified by German Lloyd. This new technic of acrylic processing is excellent, suitable to send human beings – sitting in vitreousspheres - to the depth of deep sea.



Carl Hagman
Technical Director
James Fisher Defense Sweden

James Fisher Defence Sweden AB
Rindö Västra, 185 41
Vaxholm, Sweden
Tel: +46 8 541 318 80
Email: carl.hagman@theseal.se

Carl Hagman is Technical Director at James Fisher Defence Sweden – responsible for design and production of JFDS products and has worked at JFDS for the last 10 years. Carl is a Naval Architect (MSc) from the Royal Institute of Technology in Stockholm, Sweden.



Colleen Hahn
President & CEO
Gryphon Media Strategies

Gryphon Media Strategies
P.O. Box 1252
Middleburg, VA 20118 USA
Tel: +1 (703) 851-6944
Email: cmhahn@gryphonmediastrategies.com

Colleen Hahn is the President and Chief Executive Officer of Gryphon Media Strategies. Her twenty five plus years of marketing and communications expertise has built brands and launched emerging technology and products into rapidly evolving markets. From the energy, defense and marine sectors to entertainment and media, Hahn's client roster has included: Autonomous Marine Systems Inc., Mission Secure Inc., the Red Cross, the A.I.A, I-Direct, Roam Secure Inc., and she has been part of the executive leadership teams at Scratchless Disc Inc., Saetheon Technology Group, OceanGate Inc., Ruder Finn and the Northern Virginia Technology Council. Hahn's programs focus on market data analysis and research as a foundation in the development of comprehensive plans and campaigns that strengthen, advance and evolve company brands.



Kevin Hardy
Founder
Global Ocean Design

Global Ocean Design
7955 Silverton Ave., Suite 1208
San Diego, CA 92126 USA
Tel: (858) 560-2913
Email: krhardy4438@gmail.com

Kevin Hardy joined Scripps Institution of Oceanography/UCSD in June 1972. During the ensuing years, he deployed deep ocean robotic landers from inside the Arctic Circle to the southern oceans and around the world, including numerous ocean trenches. He retired from Scripps in June 2011, though continuing to assist Scripps' hadal scientists, including a trip to the Mariana Trench in August 2011. Then, in October 2011, he was personally recruited by James Cameron to join his Deep Sea Challenger Mariana Trench Expedition. As Jim Cameron's "Lander Commander," he oversaw the design and construction of the unmanned landers that repeatedly dove to the deepest oceans depths of the western Pacific in March 2012. The landers acted as recon scouts and marine life aggregation platforms for Cameron's submersible, as well as a stand-alone collection and sensor platforms. Hardy founded Global Ocean Design to continue the development of free vehicle components and systems for an increasing number of university and government projects.



Wally Jones
SRDRS Maintenance Manager/PRM Pilot
Phoenix International

Phoenix International Holdings, Inc.
P.O. Box 181110
Coronado, CA 92178 USA
Tel: (619) 545-6901
Email: wjones@phnx-international.com

Wally Jones is Maintenance Manager for Phoenix International Holdings, Inc. and Lead PRM Pilot for the Navy's Submarine Rescue Diving and Recompression System Program at Undersea Rescue Command, Naval Base Coronado, San Diego, California.



Itaru Kawama
Senior Engineer of Marine Technology & Engineering
Japan Agency for Marine-Earth Science and Technology

JAMSTEC
2-15 Natsushima-cho
Yokosuka 237-0076 Japan
Tel: +81-46-867-9936
Email: itaru@jamstec.go.jp

Mr. Itaru Kawama is Senior Engineer of Marine Technology and Engineering Center in Japan Agency for Marine-Earth Science and Technology (JAMSTEC). Currently he is in charge of a maintenance control and planning for JAMSTEC fleet as a coordinator in Research Fleet Dept., but he had joined SHINKAI operations team as a pilot and mechanic, so he has over 15 years of experience in the field of a deep-sea research. His first presentation for UI conference was about a development of lithium-ion battery for SHINKAI in 2005. After this conference, he joined MTS and MUV committee. Also, he has had the experience of joining the cruise of Johnson-Sea-Link Submersible, so he is interested in various technologies for deep-sea submersibles. He graduated from National Merchant Marine College, in Japan.



William Kohnen
President/CEO
Hydrospace Group Inc.

Hydrospace Group Inc.
9559 Center Avenue, Ste P
Rancho Cucamonga, CA 91730 USA
Tel: +1 (951) 323-5377
Email: wkohnen@HydrospaceGroup.com

Mr. William Kohnen is President of Hydrospace Group specializing in high reliability underwater vehicles, integrated solutions for manned submersible intervention and all sectors of pressure vessels for human occupancy. Mr. Kohnen combines 25 years of engineering experience in aerospace and submersible vehicle design. He directs technology and business development for underwater vehicle design, power plant & propulsion systems and PVHO pressure hull technology where high reliability and safety are paramount. He is co-founder of SEAmagine Hydrospace Corp. manufacturer of manned submersibles which delivered nine ABS classed submersibles to date. Mr. Kohnen has a background in aerospace with a M.Sc. Elec. Engr. from McGill University, Canada. He was named MTS Fellow in 2014 and has been chair of the Marine Technology Society Manned Underwater Vehicles Committee since 2003 leading the MUV program at Underwater Intervention conference to represent the manned submersible industry. Mr. Kohnen is an active member of the ASME Pressure Vessel for Human Occupancy (PVHO) Committee. He was industry representative on the ALVIN Replacement HOV Oversight Committee (RHOC) for NSF. He has 25 years experience working with the US Coast Guard and ABS rules and regulations for building submersibles, is a member of the ABS Special Committee on Underwater Systems and Vehicles and member of the Deep Submersible Pilots Assoc.



Phil Nuytten
Founder
Nuytco Research Ltd.

Nuytco Research Limited
216 East Esplanade
North Vancouver, B.C.V7L 1A3 Canada
Tel: +1 (604) 980-6262
Email: nrl@nuytco.com

An internationally recognised pioneer in the diving industry, Phil Nuytten has spent 40 years creating deepwater dive products that have opened the ocean's depths to exploration and industry. Through his companies, Nuytco Research and Can-Dive, he has developed the technology to allow longer-length diving expeditions with increased safety. Nuytten's one-atmosphere systems – the hard-suits 'Newtsuit' and 'Exosuit', and his deep-diving "DeepWorker" submersibles – are renowned internationally. This deep diving equipment, along with Nuytten's military submarine rescue system (designated 'Remora' by the Royal Australian Navy and 'PRMS' by the US Navy), is standard in nearly a dozen of the world's navies. Contract work has taken him to oilfields, submarine construction sites and sunken wrecks around the world. Phil Nuytten has spent over forty years developing undersea systems that have the safety of the diving technician as their common theme. His goal has been to provide scientific, technical, military, and sport divers full access to continental shelf depths without the hazards of decompression, so that humans can explore, learn about, and protect the world's oceans.



Carme Parareda
Co-founder, Administrator and COO
ICTINEU Submarins SL.

ICTINEU Submarins SL
Industria 12, 08980
St. Feliu de Llobregat Spain
Tel: +34 933 094 274
Email: cparareda@ictineu.net

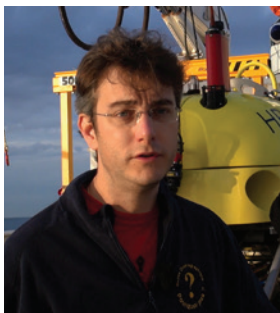
As a Surveying Engineer she worked in the service of the Cartographic Institute of Catalonia for 15 years, since 1992, in the field of geodesy, high accuracy positioning and GPS navigation techniques. In 2004 she re-oriented her career to ocean observation and underwater technology, co-founding in 2004 the Ictineu Institute, Catalan Submarine Research Centre where she is the Secretary, and in 2007 ICTINEU Submarins SL. At the same time she coordinated the Argo Maris Foundation activities (sea exploration and outreach). She is a board member of the Catalan Maritime Cluster. A traveller who loves adventure sports and mountaineering, after crossing Mongolia by bike, she sailed across the Atlantic twice. She co-wrote a book l'Atlàntic a quatre mans (The Atlantic four hands).



Kip Peterson
CEO
Thorsborg Institute, LLC

Thorsborg Institute, LLC
235 Autumn Wood Lane
Roswell, Georgia 30075 USA
Tel: +1 (770) 518-0704
Email: KEP@Thorsborg.com

Kip Peterson is the founder and CEO of Thorsborg Institute, LLC an international consultancy firm with a global strategic consultancy practice that works with governments, the World Bank and other institutions and has an active hydrospace division that is involved with undersea research and training. Kip has done business in 97 countries; been a presidential appointee for trade development; is a World Bank expert consultant and is an experienced offshore US Merchant Marine Master and professional diver and has sailed on the world's oceans in commercial and research vessels. His decades of professional maritime expertise are augmented by a degree in Marine Biology, a graduate degree in international policy and management and his certifications as a professional research diver/instructor with 43 years of experience.



Dr. Ewen Raugel
System Engineer
IFREMER

Ifremer
Technopolis 40, 155 rue Jean-Jacques Rousseau
92138 Issy-les-Moulineaux France
Tél.: +33 (0)1 46 48 21 00
Email Ewen.Raugel@ifremer.fr

Dr. Raugel is system engineer at IFREMER in the underwater systems unit, with a background in energy supply systems, especially fuel cells and batteries. Since 2011, he is project manager for the development of the new IFREMER's hybrid ROV, which made its first sea trials in December 2014.



Kyle Robinson
Research Engineer
Southwest Research Institute

Southwest Research Institute
6220 Culebra Rd.
San Antonio, Texas 78238 USA
Tel: +1 (210) 522-4295
Email: kyle.robinson@swri.org

Kyle Robinson is a mechanical engineer from the Marine Structures Section at Southwest Research Institute in San Antonio, Texas. Originally from Bastrop, Texas, he has been at SWRI for over seven years, designing and analyzing ASME Division 2 and 3 pressure vessels, large-article test frames, and he recently completed work on the spherical, titanium replacement hull for the 6500-meter ALVIN research submersible now being deployed by Woods Hole Oceanographic Institute.



Stockton Rush
CEO & Founder
OceanGate Inc.

Oceangate Inc.
909 NE Boat Street
Seattle, Washington 98105 USA
Tel: +1 (425) 939-8409
Email: stockton@oceangate.com

Stockton Rush is Chief Executive Officer and Co-Founder of OceanGate Inc. As CEO, Rush is responsible for OceanGate's financial and engineering leadership, shaping the company's strategic direction with a clear vision focused on developing the next generation of manned submersible solutions for subsea operations in the commercial and defense sectors. Over the past 20 years, Rush has overseen the development of multiple successful IP ventures. He most recently served on the Board of Directors for Seattle's BlueView Technologies, and currently serves on the Board of Directors of Entomo, an enterprise software developer focused on post-sale channel management and financial reporting. Rush also serves as Chairman of Remote Control Technology, Inc. (RCT), a manufacturer of wireless remote control devices for several Fortune 500 industrial clients, including Exxon, Conoco-Phillips and Boeing.



Mark Schleef
Contracting Officer Representative & Global
Submarine Rescue Operations NAVSEA PMS391
Submarine Escape & Rescue Program

NAVSEA PMS391F4
Bldg 497 P.O. Box 357049
San Diego, CA 92135-7049 USA
Tel: 619-545-3392
Email: mark.schleef@navy.mil

Mark Schleef is Program Analyst / Contracting Officer Representative, Operations and Maintenance Contract & SRDRS FMS Support Equipment Contract / Global Submarine Rescue Operations Representative at Undersea Rescue Command, Naval Base Coronado, San Diego, California.



Ben Sharples
Technical Director
James Fisher Defence

James Fisher Defence
Cartside Avenue, Inchinnan Business Park
PA4 9RW United Kingdom
Tel: +44 (0)141 812 8700
Email: b.sharples@jfddefence.com

Ben is James Fisher Defence & Divex's Technical Director, and as such is responsible for product development across all subsea vehicles and breathing systems. Ben has been with the company for 18 years since graduating with a Bachelor's Degree in Civil Engineering from The University of Manchester Institute of Science and Technology in 1996. Ben was initially employed by Rumic as a Design Engineer, where he designed and supervised the manufacture of the majority of the UK Submarine Rescue System assets, as well as being part of the operations team. When Rumic was acquired by James Fisher plc in 2004, Ben joined the board of the new company, James Fisher Defence as Projects Director, where he oversaw the delivery of the Singapore Navy's new rescue system, the Republic of Korea's new rescue submersible, and the setup of JFD's submarine rescue capability in Australia. Ben has management oversight of James Fisher Defence Sweden the home of the Seal Pod and Seal Carrier range of vehicles Ben grew up in the Lake District in the north of England. Ben lives with his partner Claire and 18 month old daughter Lily in Scotland. He is currently building a family home.



Oliver Steeds
TED TALK Reporter & Explorer
Digital Explorer

Digital Explorer
Arch 462, Kingsland Viaduct
83 Rivington Street
London, EC2A 3AY United Kingdom
Email: oliver@digitalexplorer.co.uk

Oliver Steeds is an explorer-adventurer and a critically acclaimed international investigative journalist and broadcaster. He specializes in original investigations and reporting the under-reported often in hostile environments. Oliver's investigations have included exposing ongoing chattel slavery in Niger and Mauritania; the theft of malaria treatment drugs in the 'malarial capital in the world' in Uganda; grave robbing in Peru; thousands of mentally impaired people being abducted into slavery in China; antiquity smuggling in Israel; hidden ethnic wars in Burma; tens of thousands of people dying in China's coal mines; the lives of 9-11 hijackers in Saudi Arabia, and al Qaeda gun markets in Yemen; how marine reserves can replenish collapsed fishing stocks and untapped energy possibilities from tidal power to creating synthetic fuel from plastics. Oliver has worked with dozens of tribal groups around the world from West Papua to the Sahara, from the DRC to Saudi's Aseer, including investigating and exposing major land rights violations against the Saami Reindeer herders in Sweden, the San Bushmen in Botswana, the Samburu in Kenya and the impact of the Australian Government's controversial emergency legislation (aka 'the Intervention') on the lives of Aboriginal people. His investigations have appeared on Channel 4's Dispatches and Unreported World, Channel 4 News, ABC Nightline, NBC Today, Al Jazeera's People & Power, Witness and Earthrise. He has been nominated for the Rory Peck Impact Award, Best Current Affairs Programme, Livingstone Award for Young Journalists and Overseas Press Awards.



Bruce Strickrott
Manager and Senior Submersible Pilot, DSV Alvin
Woods Hole Oceanographic Institution

Woods Hole Oceanographic Institution
266 Woods Hole Road
Woods Hole, MA 02543-1050 USA
Tel: +1 (508) 548-1400
Email: strickrott@whoi.edu

Bruce Strickrott is the Expedition Leader/Pilot of the manned deep submergence vehicle Alvin, operated as a part of the U.S. National Deep Submergence Facility at Woods Hole Oceanographic Institution. He has worked as a member of the Alvin Group since 1996 and has over 300 dives as Pilot in Command. Bruce obtained an Ocean Engineering degree from Florida Atlantic University and while there he worked as a dive master and mate aboard the R/V Oceaneer IV. Bruce is a veteran of the U.S. Navy, working on naval surface vessels, including during Operation Desert Shield/Desert Storm. When not working on the R/V Atlantis (Alvin's support ship) he is working toward promoting science, math and engineering education to high school students.



Jarl Stromer
Engineering Manager
Triton Submarines

TRITON Submarines
9015 17th Place
Vero Beach, Florida 32966 USA
Tel: +1 (772) 770-1995
Email: jarl@tritonsubs.com

Jarl Stromer holds a Bachelor of Science degree in mechanical engineering and has focused his career in the field of pressure vessel technology. He has held the position of Senior Engineer at the American Bureau of Shipping where he was responsible for the design review of underwater systems and vehicles from 1986 to 1996; a decade that saw the greatest proliferation of tourist submersible in the history of manned submersibles. As a member of the team at Triton Submarines, he handles all regulatory compliance issues, in addition to various project management and procurement responsibilities. Mr. Stromer has served as a member, participant, or contributor to a long list of industry organizations, including: ASME PVHO Standard, Member of Main Committee, Sub-Committee - Viewports, and Sub-Committee – Accreditation; Association of Diving Contractors Technical Committee (promulgated the ADCI Consensus Standard); International Maritime Organization (IMO) Adhoc Committee for Tourist Submersibles; ABS Special Committee on Underwater Vehicles, Systems and Hyperbaric Facilities; ASME BPV Code, Subgroup on Materials (SC II). Mr. Stromer has received various professional certifications and accreditations during his 28 years in the pressure vessel industry, including: Authorized Inspector, National Board of Boiler and Pressure Vessel Inspectors, and Certified Welding Inspector, American Welding Society. He has been an invited lecturer on the subject of submersibles at shipyards and universities.



Jonathan Struwe
Inspection Engineer Pressure & Underwater
Technology, DNV-GL SE

DNV - GL
Brooktorkai 18
20457 Hamburg, Germany
Tel: +49 40 36149 8925
Email: jonathan.struwe@dnvgl.com

Jonathan Struwe, an Inspection Engineer for Underwater Technology, is part of the Underwater Technology Section of DNV GL and was mainly involved in the recent manned submersible classification activities of DNV GL. Currently, he leads the newbuilding classification and modification approval of the diver lock in/out submersibles S351 and S301. The technical experts at DNV GL's Underwater Technology Section are dealing with approval and analysis of a wide range of underwater systems and provide, besides approval according to the GL Rules for Underwater Technology, technical expertise based on an engineering approach.



Wolfgang Stuber
Market Segment Manager
Evonik Industries AG

Evonik Industries AG
Kirschenallee
64293 Darmstadt, Germany
Tel: +49 6151 18-3704
Email: wolfgang.stuber@evonik.com

Born in 1961, Mr. Stuber completed his Mechanical Engineering studies in Darmstadt Germany. He started his career in 1988 at the Röhm GmbH Company. At that time, the company was owned by the 3rd generation of the Röhm family. Dr. Otto Röhm was the inventor of acrylic glass and established the brandname PLEXIGLAS® for his acrylic glass production. The company is now part of Evonik Industries AG. His Current position since 2002: He is market segment Manager Specialty Glazing with worldwide responsibility. He has more than 26 years of experience in cast acrylic. Executed positions: Responsible Engineer for the chemical production part of cast plants; Senior Engineer for the biggest acrylic cast plant in Germany.



Bruce Sutphen
Director of Engineering and Technology
Remote Ocean Systems
US Project Manager
DEEPSEA CHALLENGE Expedition

Remote Ocean Systems
5618 Copley Drive
San Diego, CA 92111 USA
Tel: (858) 565-8500 x 148
Email: bruce Sutphen@cox.net

Bruce has 27 years of professional tenure focused on scaled modeling and project management and evaluation for the commercialization of technical and robotic programs. Bruce's expertise spans composite design, fabrication, hydrodynamic optimization and stabilization for grand prix yachting and subsea robotic programs, technology evaluation for private and public subsea programs. His experience includes: Production Director and Composite Optimization Specialist for the build of Stiletto (OSD Advanced Composite Insertion Craft); project manager the build of Steve Fossett's Marathon Racing Maxi-Catamaran PlayStation (aka Cheyenne or Virgin Oceanic); development and optimization of over four America's Cup racing yachts; James Cameron's U.S. Project Manager for DEEPSEA CHALLENGER (DSC), with responsibilities ranging from running the scaled-model vehicle dynamic stability testing to managing the composite development, Lower Pod robotics fabrication, launch & retrieval systems. Bruce was also a member of the DEEPSEA CHALLENGE Expedition Team on the successful manned and unmanned expedition dives to the Mariana and New Britain Trench's. Currently Bruce is Director of Engineering and Technology for Remote Ocean Systems.



Dr. Robert Surma
Head of Unit Ship Systems
Materials and Components, DNV GL

DNV - GL
Brooktorkai 18
20457 Hamburg, Germany
Tel: +49 40 36149 8925
Email: robert.surma@dnvgl.com

Dr. Robert Surma has studied process technology at the University of Dortmund and Technical University of Hamburg (TUHH) before he was working and researching at the TUHH in the field of fluid mechanics / fluid dynamics where he received his PhD. After joining Airbus Industries (Aerotec) as system engineer for oxygen systems, he started at Germanischer Lloyd (GL) in the Department Pressure and Underwater Technology as project engineer. Since then he had different roles and responsibilities, amongst others was appointed Head of Department Steam Boilers and Pressure Equipment and Head of Competence Center Materials and Components. He is Vice President of legacy Germanischer Lloyd. In the new merged company DNV GL he is heading the unit Ship Systems, Materials and Components, amongst others being responsible for Materials, Welding, Engine and Propulsion, Electrical Systems and Automation, Machinery Systems and Marine Products as well as Pressure and Underwater Technology. He is a lecturer at the Technical University of Hamburg for high pressure application in apparatus construction.



Brad Thomas
Principal Research Engineer
Battelle

Battelle
505 King Avenue
Columbus, OH 43201 USA
Email: thomasba@battelle.org

Brad Thomas is a Principal Research Engineer at Battelle in the Maritime Systems Business Unit. He has over 15 years of experience designing and building equipment for use underwater. Mr. Thomas has a Bachelors degree in Mechanical Engineering with a specialty in Design for Manufacturing and is a registered Professional Engineer in the State of Ohio. His experience ranges from mechanical design to lead systems engineer and is the current Product Manager for the HorizonVue™ technology. Mr. Thomas is also an avid photographer who enjoys taking pictures of both nature and his children participating in sports, 4H, and dance.



Roy Thomas
Engineering Manager
American Bureau of Shipping

ABS Corporate
ABS Plaza, 16855 Northchase Drive
Houston, TX 77060 USA
Tel: +1 (281) 877-6384
Email: rthomas@eagle.org

Roy Thomas has worked with the American Bureau of Shipping (ABS) for the past 11 years and serves as the Engineering Manager of the Corporate Chief Engineer's Office. Mr. Thomas has extensive experience with the Classification of underwater vehicles, systems and hyperbaric facilities for commercial and military applications. He has served as the lead design review engineer on numerous projects involving underwater vehicles, systems and hyperbaric facilities of every possible form and design. Over the years, he has played an active role in updating the ABS Rules for Underwater Vehicles, Systems and Hyperbaric Facilities and has authored new sections on Diving Systems, Lock-Out Submersibles, Atmospheric Diving Suits, AUVs, ROVs, Lithium Batteries, etc. Mr. Thomas has previously worked as a seagoing marine engineer on board tankers and has hands-on experience in the running, maintenance and overhaul of marine machinery. Mr. Thomas holds a master's degree in Naval Architecture from Memorial University of Newfoundland, Canada with a specialization in underwater vehicles. He also holds a bachelor's degree in Marine Engineering from Marine Engineering and Research Institute, India.



Hannu Tiainen
Marketing Manager
Mobimar Ltd.

Mobimar Ltd.
P.O.Box 86
FIN-20101 Turku Finland
Tel: +358-(0)207 698515
Email: hannu.tiainen@mobimar.com

Hannu Tiainen is one of the founding partners of Mobimar Ltd., a marine technology company in Finland. He holds today the position of Marketing Manager with special responsibility of IT. He has 40 years' experience in marine industry and he has worked with submarines since 1989. In addition to projects in Finland, he has acted as a project manager in shipbuilding and submarine projects in Scandinavia, Germany, France, Russia, Egypt and Iraq.



Spyridon Volonakis
Managing Director
ALS Marine

ALS Marine
85 Vouliagmenis Ave Glyfada
Athens, GR16674 Greece
Tel: +30 210 9607077
Email: svol@alsmarine.gr

Spyridon Volonakis, Commander (ret) Hellenic Navy, Naval Architect and Marine Engineer, Ph.D, Cand., is Managing Director of ALS MARINE CONSULTANTS Ltd. He served 21 years in the Hellenic Navy. For most of his career, he served in submarines of the Hellenic Fleet. He retired on his own will in 2003. For 6 years (2003-2009), he held the position of the head of the Underwater Activities in the Hellenic Centre for Marine Research. From April 2007 since January 2008, he was the Manager of the European Regional Office of the Society of Naval Architects and Marine Engineers (SNAME) based in Piraeus, Greece. He is experienced in the underwater and submarine technology and in Structural Studies. He is author or co-author of 2 journal papers, 9 reviewed conference papers and more than 10 technical reports, scientific responsible of 5 projects, and has actively participated in a numerous of national and European research projects. Lecturer in Frederic University in Cyprus. Education: Naval Architect and Marine Engineer, Ph.D. Cand., NTUA, MEng in Naval & Marine Science & Technology, Diploma Naval Officer, Hellenic Naval Academy, Chartered Engineer, and Chartered Marine Engineer registered in the British Engineers Council.



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Spyridon Volonakis, Managing Director
85 Vouliagmenis Ave Glyfada
Athens, GR 16674, Greece
Tel: +30 210 9607077
Email: svol@alsmarine.gr
www.alsmarine.gr



Blue Turtle Engineering

Lee Frey, President & Chief Engineer
6430 Floridana Avenue
Melbourne Beach, FL. 32951 USA
Tel. +1-321-917-1624
Email: lee@blueturtleengineering.com
www.blueturtleengineering.com



ABS

American Bureau of Shipping
Roy Thomas, Engineering Manager
ABS Plaza, 16855 Northchase Drive
Houston, Texas 77060 USA
Tel: 1-281-877-5800
Email: rthomas@eagle.org
www.eagle.org



Bulgarian Academy of Sciences Institute of Oceanology

Iliya Shtirkov, Head of Research
Submersible Department
PO Box 152 Varna 9000 Bulgaria
Tel. +359-52-370-483 io-bas.bg
Email: ilkoshtok@yahoo.com
www.io-bas.bg



Atlantis Submarines Int'l Inc.

John Witney, VP Engineering
West 6th Avenue
Vancouver, BC V5Y-1K8, Canada
Email: jwitney@atlantissubmarines.com
www.atlantissubmarines.com



Cayman Islands Shipping Registry

John Aune, Deputy Director, Global
Operations and Commercial Services
133 Elgin Avenue, P.O. Box 2256
Grand Cayman KY1-1107 Cayman Islands
Tel: +1 345-949-8831
john.aune@cishipping.com
www.cishipping.com



Battelle

Tim Rennick, P.E., Manager, Maritime Systems
505 King Avenue
Columbus, Ohio 43201, USA
Tel. +1 614.424.5865
Email: RennickT@battelle.org
www.battelle.org



China National Deep Sea Center

Feng Liu
#6 Xianxialing Road
Qingdao P.R. China
Email: liufeng@comra.org
www.ndsc.org.cn



Blue Marble Exploration

Guillermo Sohnlein, Co-Founder & CEO
Tel: +1 (703) 346-3041
Email: guillermo@bluemarbleexploration.com
www.bluemarbleexploration.com



China Ship Scientific Research Center

Ye Cong, Director Engineering
222 East Shanshui Road, Binhu District
Wuxi, Jiangsu 214082 P.R. China
Email: yec@vip.163.com
www.cssrc.com.cn



Deepflight

Graham Hawkes, Founder
1160 Brickyard Cove Marina, #B17
Point Richmond, CA 94801
Tel: +1 (510) 236-3422
Email: info@deepflight.com
www.deepflight.com



EYOS Expeditions Ltd.

Rob McCallum, Founding Partner
Kissack Court, 29 Parliament St.
Ramsey, Isle of Man, IM8 1AT, British Isles
Tel: +1 801 390 7025
Email: rob@eyos-expeditions.com
www.eyos-expeditions.com



Deep Sub LLC

Chris Welsh, Sub Owner
PO Box 12723
Newport Beach, CA 92658
Tel: +1 949 278 2012
Email: chris@deepsubl.com
www.deepsubl.com



FAU Harbor Branch Oceanographic Institute

5600 US 1 North
Fort Pierce, FL 34946
Tel: (772) 466-9876
www.fau.edu/hboi



Digital Explorer

Oliver Steeds
The Ocean's Academy
Arch 462, Kingsland Viaduct
83 Rivington Street, London, EC2A 3AY
Email: oliver@digitalexplorer.co.uk
oceans.digitalexplorer.com



General Dynamics Electric Boat

Dan Gietzen
75 Eastern Point Road
Groton, CT 06340
Tel: 860-433-3000
Email: dgietzen@gdeb.com
www.gdeb.com



DNV - GL

Harald Pauli, Department for Pressure
Vessels & Underwater Technology
Brooktorkai 18
20457 Hamburg, Germany
Tel: +49 40 36149 8925
Email: harald.pauli@dnvgl.com
www.dnvgl.com



GEOMAR Helmholtz

Karen Hissman, Tauchboot-JAGO-Team
Zentrum fuer Ozeanforschung Kiel
Wischhofstr. 1-3, Geb. 8D/134
24148 Kiel, Germany
Tel. +49 -431-600-2253
Email: khissmann@geomar.de
www.geomar.de



DOER Marine

Liz Taylor, President
1827 Clement Ave.
Building 19, Alameda CA 94501 USA
Tel: (510) 530-9388
Email: liz@doermarine.com
www.doermarine.com



GSE Trieste

Giunio Santi
Piazza Bergamo, 18
24040 Ciserano BG, Italy
Tel. +(39) 035 882629
Email: info@gsetrieste.it
www.gsetrieste.it



Evonik Cryo LLC

Britt Nordby, Strategic Markets Manager
299 Jefferson Road
Parsippany, NJ 07054
Tel: 973-929-8200
Email: britt.nordby@evonik.com
www.evonik.com



Global Ocean Design

Kevin Hardy
7955 Silverton Ave. Suite 1208
San Diego, CA 92126 USA
Tel: 858-560-1799
Email: kevin@globaloceansdesign.com
www.globaloceansdesign.com



Hawaii Undersea Research Laboratory (HURL)

Terry Kerby, Chief Pilot, Director of Submarine Operations, 1000 Pope Road Marine Science Building (MSB) 303 Honolulu, HI 96822 USA
Tel: (808) 956-6335
Email: tkerby@hawaii.edu
www.soest.hawaii.edu



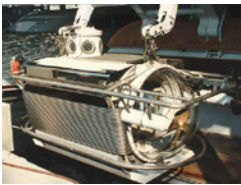
Hickey Underwater Vehicle Consulting LLC

Patrick Hickey
1061 Cobb Hill Road
Waterbury, Vermont 05676 USA
Tel. +1 (802) 272-7530
Email: jpatrickhickey@gmail.com



Heinz Fritz Kunststoffverarbeitung

Heinz Fritz
Gewerbestraße 11
DE-89542 Herbrechtingen, Germany
Tel: +49 7324 988-0
Email: info@heinz-fritz.de
www.heinz-fritz.de



Hoffman Marine

Pete Hoffman
2585 SE 12th Street
Pompano Beach, FL 33062 USA
Tel: (954) 943-2417
Email: pete@subdive.com
www.subdive.com



Hellenic Center for Marine Research

Dimitris Sakellariou, Research Director
Geologist, Coordinator of Underwater Operations Department
19013 Anavyssos, Greece
Email: sakell@ath.hcmr.gr
www.hcmr.gr



Hydrospace Group Inc.

William Khonen, President/CEO
9559 Center Avenue, Ste P
Rancho Cucamonga CA 91730 USA
Tel: +1 (951) 323-5377
Email: wkhonen@hydrospacegroup.com
www.hydrospacegroup.com



ICTINEU Submarins SL

Carme Parareda, COO
Industria 12, 08980
St. Feliu de Llobregat, Spain
Tel: +34 933 094 274
Email: cparareda@ictineu.net
www.ictineu.net



IFREMER, Underwater Systems Department

Viorel Ciausiu, Director of Nautile Operations
Zone Portuaire de Brégailon
83507 La Seyne sur Mer, France
Tel. +33 (0)494304966
Email: Viorel.Ciausiu@ifremer.fr
www.ifremer.fr



International Maritime Inc.

Don Walsh
Myrtle Point, Oregon USA
Tel: +1 (541) 572-2313
Email: imiwalsh@mac.com



James Fisher Defence Sweden

Carl Hagman, Technical Director
Rindö Västra
185 41 Vaxholm, Sweden
Tel: +46 8 541 318 80
Email: carl.hagman@theseal.se
www.theseal.se



James Fisher Defence

Ben Sharples, Technical Director
Cartside Avenue
Inchinnan Business Park
PA4 9RW, United Kingdom
Tel: +44 (0)141 812 8700
Email: b.sharples@jfddefence.com
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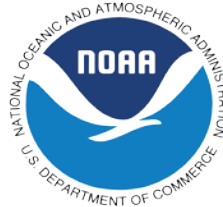
JAMSTEC

Itaru Kawama, Senior Engineer for Marine Technology
2-15 Natsushima-cho
Yokosuka 237-0076, Japan
Tel: +81-46-867-9936
Email: itaru@jamstec.go.jp
www.jamstec.go.jp



Lockheed Martin

Dan Mcleod, Senior Program Manager
Riviera Beach, FL 33404 USA
Tel. +1 (561) 494-2064
Email: dan.mcleod@lmco.com
www.lockheedmartin.com



NOAA Office of Ocean Exploration and Research

Karen Kohanowich, Acting Director of the National Undersea Research Program
1315 East West Highway, SSMC III, 10th Floor
Silver Spring, Maryland 20910 USA
Tel.: (301) 734-1010
Email: karen.kohanowich@noaa.gov
explore.noaa.gov



Mobimar

Hannu Tiainen, Marketing Manager
Pansiontie 56, 20240
Turku, Finland
Tel: +358 20 7698500
Email: hannu.tiainen@mobimar.com
www.mobimar.com



Nuytco Research Ltd.

Phil Nuytten
216 East Esplanade
North Vancouver, B.C. V7L 1A3
Canada
Tel: +1 (604) 980-6262
Email: nrl@nuytco.com
www.nuytco.com



Monterey Bay Aquarium Research Institute (MBARI)

Megan Davis, PhD, Interim Executive Director
7700 Sandholdt Road
Moss Landing, California 95039-9644 USA
Tel: (831) 775-1700
Email: mdavi105@fau.edu
www.mbari.org



Oceaneering Advanced Technologies

David Ried, Deputy Program Manager of Submarine Rescue Systems
7001 Dorsey Road
Hanover, Maryland 21076 USA
Tel: (443) 459-3700
email: dreid@oceaneering.com
www.oceaneering.com



NAVSEA

Roger Schaffer, Deputy Director, Submarine Safety and Quality Assurance
Naval Surface Warfare Center
1333 Isaac Hull Ave, SE
Washington Navy Yard, DC 20376-7101 USA
Tel: (202) 781-5425
Email: roger.schaffer@navy.mil
www.navsea.navy.mil



OceanGate Inc.

Stockton Rush, CEO
909 NE Boat St.
Seattle, WA 98105 USA
Tel: +1 (425) 939-8409
Email stockton@oceangate.com
www.oceangate.com



NAVSEA

PMS399 - Special Operations Forces (SOF)
Undersea Mobility Program Management
Tommy Beals
Tel: +1 (202) 781-0518
Email: tommy.beals@navy.mil
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OceanWorks International

Elan Groberman
#120-6741 Cariboo Road
Burnaby BC, CANADA V3N 4A3
Tel: +1 604 415 0088
Email: egroberman@oceanworks.com
www.oceanworks.com



National Institute of Oceanology

Dr. M. A. Atmanand, Project Director
Velachery – Tambaram Road
Pallikaranai
Chennai 600, 100 India
Tel: +91 44 6678 3303
Email: atma@niot.res.in
www.niot.res.in



Pacific Subsea Saipan, Inc.

John F (Jack) McClure, Vice President/ COO
Lowerbase, Mangrove Place, Seaplane Ramp
PMB 672 PPP, PO 10,000, Saipan MP 96950
Tel: 670 322 7734
Email: jack@saipansubmarine.com
www.saipansubmarine.com



Phoenix International Holdings

Wally Jones, SRDRS Maintenance
Manager/PRM Pilot
P.O. Box 181110
Coronado, CA 92178 USA
Tel: (619) 545-6901
Email: wjones@phnx-international.com
www.phnx-international.com



SEAmagine Hydrospace Corp.

Charles Kohnen, Co-Founder
1420 N. Claremont Blvd., #204B
Claremont, California 91711 USA
Tel: +1 909 626 6262
Email: charles.kohnen@seamagine.com
www.seamagine.com



PSUBS

Jon Wallace, Co-Founder
PO Box 53 Weare, NH 03281 USA
Tel: (603) 232-9157
Email: jon@psubs.org
www.psubs.org



Shanghai Ocean University

Dr. Cui Weicheng, Dean, Hadal Science and
Technology Research Center
No.999, Hucheng Huan Road
Shanghai, 201306 P.R. China
Email: wccui@sjtu.edu.cn
en.sjtu.edu.cn



Rebikoff-Niggeler Foundation

Joachim and Kirsten Jakobsen
Rocha Vermelha, Apt. 249
Praia do Almoxarife
P - 9900-451 Horta, Portugal
Tel.: +351-91 985 8539
Email: info@rebikoff.org
www.rebikoff.org



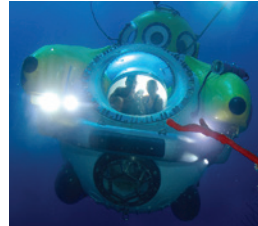
Southwest Research Institute

Kyle Robinson, Research Engineer
6220 Culebra Rd.
San Antonio, Texas 78238 USA
Tel: +1 (210) 684-5111
Email: kyle.robinson@swri.org
www.swri.org



Remote Ocean Systems

Bruce Sutphen, Director of Engineering
and Technology
5618 Copley Drive
San Diego, CA 92111 USA
Tel: (858) 565-8500 x 148
Email: brucesutphen@cox.net
www.rosys.com



Stanley Submarines

Karl Stanley
Honduras
Tel: 011-504-3359-2887
Email: karl@stanleysubmarines.com
www.stanleysubmarines.com



RINA - USA

Bruce Garabaghi
13450 W Sunrise Blvd #350
Fort Lauderdale, Florida 33323 USA
Email: fortlauderdale.office@rina.org
www.rina.org



State Marine Technical University, St. Petersburg

Kyrill V. Rozhdestvensky, D. Sc., Vice-Rector,
International Science & Education
3, Lotsmanskaya
Saint Petersburg, 190008 Russia
Tel: +7 (812) 714-2923
Email: kvrxmas@yahoo.com
www.smtu.ru



Russian Academy of Sciences, P.P. Shirshov Institute of Oceanology

Anatoly Sagalevich, Head of Deep
Manned Sub Laboratory
Nakhimovsky prospect 36
Moscow 117997, Russia
Tel: +7 (499) 124 79 94
Email: sagalev1@yandex.ru
www.ocean.ru/eng



Sub Aviator Systems

Jay Wade
336 36th Street, Suite #379
Bellingham, WA 98225, USA
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Sub Mare Technologies
Fredrik Gerhardsson
Sweden
Tel: +46 491 760 217
Email: cjf@submaretechnologies.com
www.submaretechnologies.com



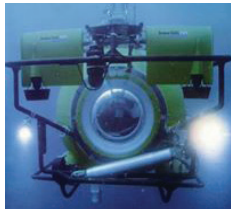
Triton Submarines
Jarl Stromer, Engineering Manager
9015 17th Place
Vero Beach, Florida 32966 USA
Tel: (208) 687-9057
Email: jarl@tritonsubs.com
www.tritonsubs.com



Submergence Group
Brett Phaneuf, President
4 Water Street
Chester, CT 06412 USA
Tel: (860)526-4911
Email: brett@submergencegroup.com
www.submergencegroup.com



U-Boat Worx B.V
Erik Hasselman, Sales and Marketing Manager
Oosterhoutseweg 77
4816 KC Breda
The Netherlands
Tel: +31 (0)76 5713096
Email: e.hasselman@uboatworx.com
www.uboatworx.com



Tank Doctor Aquatic Systems
Mike Caudle, President
209 Aerotech Drive, Unit # 8
B2T 1J4 Canada
Tel: (902) 873-3939
Email: tankdoctor@msn.com



Undersea Hunter Group
Shmulik Blum
#SJO 314
PO Box 025331
Miami, FL 33102-5331 USA
Email: shmulikbl@underseahunter.com
www.underseahunter.com



Thorsborg Institute, LLC
Kip Peterson
235 Autumn Wood Lane
Roswell, Georgia 30075 USA
Tel: +1 (770) 518-0704
Email: kep@thorsborg.com
www.thorsborginstitute.com



Waitt Institute
Ayana Johnson, PhD, Executive Director
P.O. Box 1948
La Jolla, CA 92038-1948 USA
Tel: 858-551-4400
www.waittinstitute.org



Teledyne Brown Engineering
Earl Presson, Director
300 Sparkman Drive NW
Huntsville, AL 35805 USA
Tel: 256-726-1000
Email: earl.presson@tbe.com
www.tbe.com



Woods Hole Oceanographic Institution
Bruce Strickrott, Manager and Senior
Submersible Pilot, DSV Alvin
266 Woods Hole Road
Woods Hole, MA 02543-1050 USA
Tel: (508) 289-2252
Email: strickrott@whoi.edu
www.whoi.edu



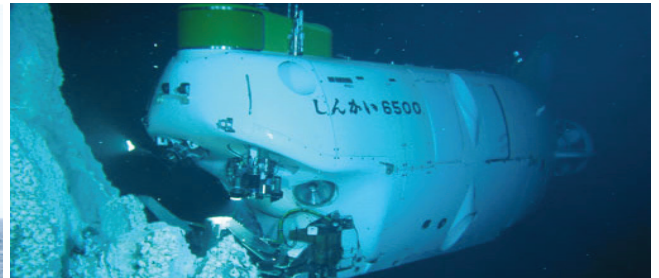
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| 1960 “Kuroshio II” launched | 1989 “Shinkai 6500” launched |
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Chairman: William Kohnen
HydroSpace Group
Tel. (951) 323-5377
Email: wkohnen@hydroSpacegroup.com

Co-Chair: Vance Bradley
Tel. (772) 812-0260
Email: vbra676539@aol.com

Treasurer
Kip Peterson
Thorsborg Institute, LLC
Tel. (770) 518-0704
KEP@Thorsborg.com

Marketing-Sales
Colleen Hahn, CEO
Gryphon Media Strategies
Tel. (703) 851-6944
cmhahn@gryphonmediastrategies.com

Secretary
Daniel Lance
Lance Industries
Tel. (609) 805-1644
lanceind@gmail.com

Committee Web Site: mtsmuv.org
MTS Website: mtsociety.org

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