



CAPT Don Walsh
1931 - 2023



Trieste

1960



Alvin

1964



Nautilus

1984



Atlantis

1993



Aurora

2020



Bakunawa

2023

20th ANNIVERSARY

ANNUAL SUBMARINE SYMPOSIUM



2023



International Workboat Show, Nov. 29 - Dec 1, New Orleans, LA USA



2023 Annual Submarine Symposium

at International Workboat Show, New Orleans, USA



WED NOV-29-2023 ROOM 252

| No | Session | Speaker | Company | Presentation Title |
|----|----------------|--|--|---|
| 1 | 8:30 - 9:00 | William Kohnen | MTS - Submarine Committee Chair | Yearly Overview: State of Submarine Industry 2023 |
| 2 | 9:00 to 9:30 | <i>Bruce Strickrott Patrick Lahey Ofer Ketter Daniel Hurd Capt Burt Canfield</i> | <i>WHOI Triton Submarines SubMerge Atlantis Submarines US NAVY</i> | Research Sector Commercial Sector Expedition Sector Tourism Sector Submarine Rescue Sector |
| 3 | 9:30 to 10:00 | | | |
| 4 | 10:00 to 10:30 | COFFEE BREAK | | |
| 5 | 10:30 to 11:00 | Bruce Strickrott DSV ALVIN - Group Manager | WHOI - Woods Hole Oceanographic Institution USA | ALVIN's Deep Dive: Completing 6,500m Certification and return to science operations |
| 6 | 11:00 to 11:30 | Dr Jan Opderbecke Head of Unit for UW Systems Christian Dugue Direction Generale de l'Armement | IFREMER FRANCE | NAUTILE: 39 Years of Deep-Sea Exploration and Technological Evolution |
| 7 | 11:30 to 12:00 | Itaru Kawama Director, Fleet Maintenance and Engineering Dept | JAMSTEC - Japan Agency for Marine- Earth Science and Technology JAPAN | SHINKAI6500: Adapting to Change After 34 Years of Deep Diving |
| 8 | 12:00 to 12:30 | LUNCH | | |
| 9 | 12:30 to 1:00 | | | |
| 10 | 1:00 to 1:30 | | | |
| 11 | 1:30 to 2:00 | Dr. G.A. Ramadass Director | NIOT, National Institute of Ocean Technology INDIA | Indian Manned Submersible MATSYA 6000 |
| 12 | 2:00 to 2:30 | Charles Kohnen Co-founder, Chairman | SEAmagine Hydrospace Corp USA | SEAmagine's Submersible Pilot Training Program & Operational Standards |
| 13 | 2:30 to 3:00 | Ofer Ketter President | Submerge COSTA RICA | Operational Requirements for Submersibles on board Superyachts |
| 14 | 3:00 to 3:30 | COFFEE BREAK | | |
| 15 | 3:30 to 4:00 | Jarl Stromer Engineering Manager | Triton Submarines LLC USA | Design by Analysis of Acrylic Windows with Non-Standard Geometry for Manned Submersible Applications |
| 16 | 4:00 to 4:30 | Alasdair Murrie VP Business Development | Hyper-Sub Platform Technologies Inc. USA | Hyper-Sub Fast Boat Submarine (FBS): The Revolutionary Dual-Mode Vessel |
| 17 | 4:30 to 5:00 | Tim MacDonald Chief Pilot, Systems Engineer | INK FISH AUSTRALIA | Operating and maintaining manned and autonomous Full Ocean Depth (FOD; 10,925m) vehicles |
| 18 | 5:30 to 7:30 | <i>MTS Submarine Group</i> | <i>MTS Cocktail Reception</i> | MULATES Restaurant 201 Julia Street, New Orleans, LA |

ANNUAL SUBMARINE SYMPOSIUM 2023

THUR NOV-30-2023 ROOM 252

| No | Session | Speaker | Company | Presentation Title |
|----|----------------|--|--|---|
| 1 | 8:30 - 9:00 | Curt Cunningham Assistant Program Manager | US NAVY - NAVSEA PMS390 Undersea Special Mission Systems USA | U.S. Navy and ISMERLO's Response to Civilian Submersible OceanGate Titan: Lessons in Rescue Preparedness |
| 2 | 9:00 to 9:30 | Greg Cotten SERS Capability, Chief Engineer | JFD Ltd. UNITED KINGDOM | Through-Life IACS Classification of a Rescue Submersible |
| 3 | 9:30 to 10:00 | Stephen Armstrong Chief Technology Officer | Submergence Group USA | Manned Submersibles x Uncrewed Underwater Vehicles - Crossover |
| 4 | 10:00 to 10:30 | COFFEE BREAK | | |
| 5 | 10:30 to 11:00 | James (Dan) Lawrence Coast Guard Offshore Engineer CG-OES-2 Vessel & Facility Operating Stds | US Coast Guard - HQ MARINE SAFETY CENTER USA | SUBMARINE OPERATIONS Workshop: |
| 6 | 11:00 to 11:30 | | | Round Table workshop session on international jurisdiction for operations of submarines. |
| 7 | 11:30 to 12:00 | | | |
| 8 | 12:00 to 1:30 | LUNCH | | |
| 9 | 1:30 to 2:00 | Roy Thomas Sr. Principal Engineer | ABS - American Bureau Shipping USA | Overview of the ABS Underwater Rule Change Proposals (Annual Industry Meeting) |
| 10 | 2:00 to 2:30 | Capt Gard Clark (USN Ret) Principal | CPMQ Consulting LLC USA | Cost of Submarine Certification -Commercial Class, US NAVY P9290, and other government certification |
| 11 | 2:30 to 3:00 | Jonathan Struwe Dept Head - Underwater Systems | DNV - Det Norske Veritas GERMANY | DNV Classification Rules for design and testing of advanced underwater vehicles |
| 12 | 3:00 to 3:30 | COFFEE BREAK | | |
| 13 | 3:30 to 4:00 | Bonnie Blackburn P.E. Senior Research Engineer | SWRI - Southwest Research Institute USA | Design Considerations for Shallow Water Submarine Rescue |
| 14 | 4:00 to 4:30 | William Kohnen President/CEO | Hydrospace Group Inc USA | Carbon Fiber: Qualification by Testing of Non-Standard Pressure Vessels for Human Occupancy |
| 15 | 4:30 to 5:00 | VISIT SHOW FLOOR | | |

FRI DEC-1-2023 ROOM 252

| No | Session | Speaker | Company | Presentation Title |
|----|----------------|--|---|--|
| 1 | 8:30 - 9:00 | Roy Thomas Chair, T&R Panel OC-6 | SNAME - Society of Naval Architects & Marine Engineers - USA | Update on SNAME Book "Submersible Vehicle Systems Design" |
| 2 | 9:00 to 9:30 | Leon Adams VP, Sales & Marketing | Southwest Electronic Energy Group USA | Subsea Vehicle Endurance-Part 2: Operating Li Ion Battery Electrical Power- Lessons Learned |
| 3 | 9:30 to 10:00 | Bart Kemper Principal Engineer P.E., CPEng | Kemper Engineering Services USA | VVUQ --The Pathway for Innovation In Submersibles (Verification, Validation and Uncertainty Quantification) |
| 4 | 10:00 to 10:30 | COFFEE BREAK | | |
| 5 | 10:30 to 11:00 | Andrew Hunt Engineering Program Manager | Phoenix International Holdings Inc USA | Benefits and Technical Details of Submarine Ventilation |
| 6 | 11:00 to 11:30 | Tom Daley Product Specialist | Micropore USA | Use of calcium hydroxide for carbon dioxide (CO2) absorption in submarines |
| 7 | 11:30 to 12:00 | Jim Weir President | Poseidon Deepsea Solutions USA | Innovative Ballast Systems for Full Depth Ocean Exploration |
| 8 | 12:00 to 1:30 | LUNCH | | |
| 9 | 1:30 to 2:00 | William Kohnen Submarine Cmtee, chair | MTS Submarine Cmtee | ANNUAL MTS Submarine Committee Meeting |
| 10 | 2:00 to 2:30 | | | |



Dear Esteemed Members and Distinguished Delegates,

We extend a cordial and formal welcome to the International Workboat Show, serving as our host for the 20th Annual Submarine Symposium, proudly sponsored by the Marine Technology Society Submarines committee and the World Submarine Organization. Following a noteworthy year marked by the OceanGate event, we are honored to convene once again in the vibrant city of New Orleans. This gathering brings together manufacturers, operators, pilots, service providers, and regulators, forging a nexus at the confluence of engineering, technological advancements, and subsea innovation—all under the banner of uncompromising safety standards.

Celebrating our 20th anniversary, our commitment to uniting the global professional submarine industry remains steadfast. We extend an invitation to join us in discussions pertaining to the state of the industry, as leaders, operators, and regulators from diverse sectors—commercial, private, tourism, research, and military—deliver comprehensive insights. Anticipate overviews of industry activities, product presentations, technical analyses, and invaluable networking opportunities. Complemented by an impressive array of exhibitors on the Workboat show floor, we aspire for this symposium to serve as a conduit for new contacts, ideas, and technological solutions. The symposium boasts an impressive lineup of 32 distinguished speakers presenting 25 sessions over the course of three days. Topics include deep ocean research and expeditions, tourism and commercial operations, submarine rescue regulations, and advances in subsea technologies. Of particular note is a round table discussion lead by the US Coast Guard on regulatory protocols for the worldwide operation of submarines.

We express our sincere gratitude to our dedicated speakers for their invaluable contributions. Special acknowledgment is extended to the International Workboat Show team for graciously hosting the symposium for a second consecutive year and providing a venue for our Submarine Pavilion, featuring exhibits by more than 20 companies. Further appreciation is directed toward Underwater Intervention for their generous support, including the Think Tank stage, which accommodates an additional 10 exciting presentations on submarine technologies.

In conclusion, we extend an invitation to join us for a formal social cocktail reception at the Louisiana landmark MULATES restaurant on Wednesday night—an opportunity for a fun evening, conversation, mixing and lively local musical ambiance.

We anticipate a productive and enlightening symposium, fostering international collaboration, and advancing the frontiers of submarine exploration.

Sincerely,

William Kohnen
Submarine Committee, Chair
Marine Technology Society

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2023 ANNUAL SUBMARINE SYMPOSIUM at International Workboat Show - USA

Day 1 - Room 252 - Wednesday, November 29

8:30 – 10:00

Yearly Overview - State of Submarine Industry 2023

By: William Kohnen, Chair MTS Submarine Cmttee , USA

Join us for a comprehensive exploration of the state of the submarine industry in 2023 at the annual submarine conference. This year's opening presentation promises an insightful journey across all sectors of the industry, spanning international research, commercial endeavors, expeditions, tourism, leisure, and government/security operations. Submarine industry leaders provide succinct overviews of submarine activities in their sectors with the latest developments and innovations driving progress in submarine technology and applications.



Research Submarine Sector

By: Bruce Strickrott
DSV ALVIN - Group Manager
Woods Hole Oceanographic Inst. - USA

Commercial Submarine Sector

By: Patrick Lahey
CEO and Co-Founder
Triton Submarines - USA



Submarine Expeditions Sector

By: Ofer Ketter
President
SubMerge – COSTA RICA

Tourist Submarine Sector

By: Daniel Hurd
Operations Manager
Atlantis Submarines - CANADA



Submarine Rescue Vehicle Sector

By: CAPT Burt Canfield
Program Manager
NAVSEA PMS390
US NAVY - USA

10:00 – 10:30

COFFEE BREAK

10:30 – 11:00

ALVIN's Deep Dive: Completing 6,500m Certification and return to science operations

By: Bruce Strickrott
 DSV ALVIN - Group Manager
 Woods Hole Oceanographic Institution
 USA



The presentation offers an insightful discussion on the Deep Submergence Vehicle Alvin's pivotal upgrades to reach 6,500 meters and the initial scientific operations since certification. Operated by the Woods Hole Oceanographic Institution as part of the National Deep Submergence Facility (NDSF), this achievement marks a significant milestone for the U.S. deep submergence community. This provides an overview of the upgrades and the challenges faced along the way. Discover the lessons learned throughout this transformative process, promising to reshape deep-sea exploration. Supported by the National Science Foundation, the Office of Naval Research, and the National Oceanic and Atmospheric Administration, NDSF's commitment to advancing marine science is exemplified by ALVIN's enhanced capabilities.

11:00 – 11:30

NAUTILE: 39 Years of Deep-Sea Exploration and Technological Evolution

By: Dr Jan Opderbecke
 Head of Unit for Underwater Systems
 IFREMER
 FRANCE



By: Gen. Christian Dugué
 DGA - Direction Generale de l'Armement
 Ministry of Defense
 FRANCE



The French submersible Nautilus is fully operational and in nominal technical state, after 39 years of operation and more than 2070 dives. 2019 has seen the deepest dive of the submersible so far, at 6028m below sea surface on volcanic areas in the southern Atlantic Ocean. The general architecture of Nautilus is unchanged since first commissioning, but significant improvements have been achieved over the years on key features such as navigation, vision, data acquisition, and communication as technology has progressed over the years. With an impressive life cycle of almost 40 years to date for Nautilus, IFREMER has gained wide data sets and insight in numerous topics regarding the use and the aging of materials. The aging of the original buoyancy is controlled and predicted, the water intake and crush resistance being well understood processes on this behalf. Most of the structure of the Nautilus, in

particular the inhabited sphere and the frame are made of titanium alloy. Feedback from the experience of using this material on the submarine for more than 39 years will be discussed. Bulkhead connectors allowing to transport power and high data rate into the sphere of the manned submersible are a constant emphasis. On Nautile, the long-term observation on the most demanding connector types will be discussed. The talk will conclude on the perspectives for the next decade of developments and use of Nautile.

11:30 – 12:00 **SHINKAI6500: Adapting to Change After 34 Years of Deep Diving**

By: Itaru Kawama
Director, Fleet Maintenance and Engineering Dept
JAMSTEC - Japan Agency for Marine-Earth Science and
Technology
JAPAN



In November 2023, SHINKAI6500 celebrated 34 years since its completion, having embarked on over 1,700 dives. This fiscal year alone, it's scheduled for 15 cruises with 83 planned dives. However, the landscape of manned submersible operations has evolved significantly in recent years, marked by the challenges posed by COVID-19 and the Maritime Labor Convention (MLC). Furthermore, as SHINKAI6500 enters its fourth decade of service, it faces the issue of outdated equipment. With some critical components and instruments no longer available due to discontinuation, urgent measures are needed. Collaborative efforts with shipyards and operators are underway to address this challenge. This presentation will provide insights into the current status of SHINKAI6500 while also offering a broader perspective on the evolving underwater vehicle landscape and research fleet within JAMSTEC (Japan Agency for Marine-Earth Science and Technology).

12:00 – 1:30

LUNCH BREAK

1:30 – 2:00 **Indian Manned Submersible MATSYA 6000**

By: Dr. G.A. Ramadass
Director, NIOT
National Institute of Ocean Technology
INDIA



National Institute of Ocean Technology, an autonomous institute under the Ministry of Earth Sciences, Government of India, is developing a manned submersible with a depth capability of 6000 meters as a part of its Deep Ocean Mission. The manned submersible, MATSYA 6000, is designed to carry three persons in a 2.1-meter diameter Titanium Alloy Personnel Sphere with an operational endurance to carry out deep ocean exploration of non-living resources such as polymetallic manganese nodules, gas hydrates, hydro-thermal sulfides, and cobalt crusts, located at a depth between 1000 and 5500metres. MATSYA 6000 is designed as per the guidelines of classification and certification society DNV. The design of MATSYA 6000 has been completed with a symmetric control architecture with redundant power support systems for fail-proof operation. A novel rescue and recovery system with a pop-up buoy and guidance rope system has been developed in addition to conventional vehicle recovery systems.

2:00 – 2:30

SEAmagine’s Submersible Pilot Training Program & Operational Standards

By: Charles Kohnen
Co-Founder & Chairman
SEAmagine Hydrospace Corp
USA



Since its inception in 1999 through collaboration with the US Coast Guard, the SEAmagine submersible training program has evolved significantly. Over nearly a quarter-century, it has continuously improved, expanding from pilot skills to encompass comprehensive training for owners, captains, and topside personnel in operational protocols and industry best practices. This presentation will trace the historical development of this program, highlighting its impressive track record and curriculum. We will explore the rigorous standards upheld by SEAmagine to ensure all-encompassing submersible operations. Discover how this program has shaped the submersible industry, offering valuable insights into its evolution, effectiveness, and its vital role in maintaining safety and excellence in underwater exploration.

2:30 – 3:00

Operational Requirements for Submersibles on board Superyachts

By: Ofer Ketter
President
SubMerge
COSTA RICA



As the private submersible world expands, there is a need for integrated operational services for the Superyacht market. From submarine operations and maintenance to ocean floor mapping, to ROV rescue protocols, the yacht crews of tomorrow require real world operational training in order to safely and successfully provide their guests with a life changing deep ocean experience. This presentation will review operational baselines developed over more than 17 years of experience in submarine expeditions of all types.

3:00 – 3:30

COFFEE BREAK

3:30 – 4:00

Design by Analysis of Acrylic Windows with Non-Standard Geometry for Manned Submersible Applications

By: Jarl Stromer
Engineering Manager
TRITON Submarines LLC
USA



Triton Submarines designs and builds state-of-the-art manned submersibles for underwater exploration. A notable design feature is the unobstructed view of the surroundings provided by the transparent pressure boundary. Outward

visibility is achieved by using acrylic plastic windows of standard geometries as defined in the PVHO-1 Safety Standard. Their pressure rating can be readily determined using the graphs and tables contained therein. For a window with non-standard geometry, PVHO stipulates destructive hydrostatic testing of full size and scale model windows to validate the design. Not only does this level of destructive testing take no account of advances made in finite element analysis methods, it can also increase the cost of a large non-standard geometry window to prohibitive levels. The time has come to validate the design of non-standard geometry acrylic windows using engineering analysis instead of model testing. Examples of submersibles using non-standard geometries as well as aspects of the Design by Analysis (DBA) methodology are presented. The path to certification is also discussed.

4:00 – 4:30

Hyper-Sub Fast Boat Submarine (FBS): The Revolutionary Dual-Mode Vessel

By: Alasdair Murrie
VP Business Development
Hyper-Sub Platform Technologies Inc.
USA



Introducing the Hyper-Sub Platform Technologies' Fast Boat Submarine (FBS), a groundbreaking dual-modality, dual-use marine vessel. It seamlessly transforms from a high-speed, long-range speedboat to a pressure-proof, dry cabin submarine, setting a new standard in marine versatility. This ingenious design offers scalability and modularity, with various cabin configurations and payload options to cater to diverse Littoral Concepts of Operation. Furthermore, the FBS can adapt to emerging technologies and evolving needs through aftermarket upgrades, including autonomy and AI algorithms. As a speedboat, the FBS swiftly deploys from any dock, boat ramp, beach, or river estuary, covering vast surface distances in mere hours. When the need arises, it effortlessly transitions into submarine mode, diving to depths of 500 feet (150 meters) at the flick of a switch. Join us to explore the transformative capabilities and endless possibilities offered by the Hyper-Sub FBS, revolutionizing marine operations worldwide.

4:30 – 5:00

Operating and maintaining manned and autonomous Full Ocean Depth (FOD; 10,925m) vehicles

By: Tim MacDonald
Chief Pilot, Systems Engineer
INKFISH
AUSTRALIA




By: Matt Thigpen
Design Engineer
INKFISH
USA



The submersible Bakunawa (formerly) Limiting Factor built by Triton Submarines (model 36000/2) in 2018 is 1 of 2 Full Ocean Depth manned submersibles currently operating in the world. It is a DNV classed vehicle and has been operated by Inkfish since October 2022. The submersible is accompanied by 3 FOD autonomous landers all supported by a 68m research vessel, RV Dagon (formerly DSSV

Pressure Drop). Operating and maintaining FOD vehicles that repeatedly travel to 6000m+ sets its own set of hurdles which will be discussed in this presentation including operational considerations; accurate navigation, remote and exposed locations, dive durations, dive site details and Maintenance and upgrades; Lack of historical data on performance of equipment after repeated dives to FOD, deficit in off the shelf equipment and integrating bespoke equipment. Inkfish have just completed a 10-month refit, sea trials off San Diego and are now on route across the Pacific Ocean for expeditions to the Hadal Trench's in Philippines, Tonga, Marianna's and Southern Ocean collecting data for University of Western Australia, British Geographical Society and Oceanology.




Please Join us for the

SUBMARINE Cocktail Reception

WED. 5:30 – 7:30

Mulate's ~ The Original Cajun Restaurant

201 Julia Street, New Orleans, LA



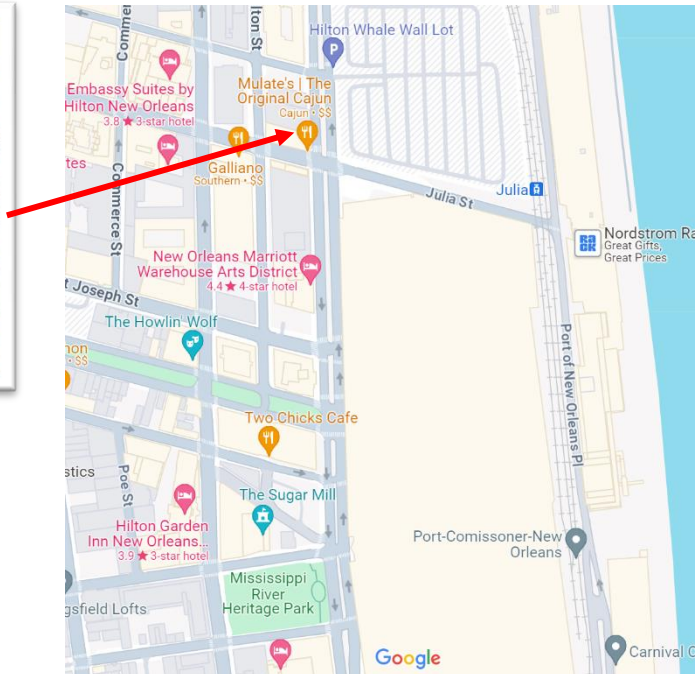
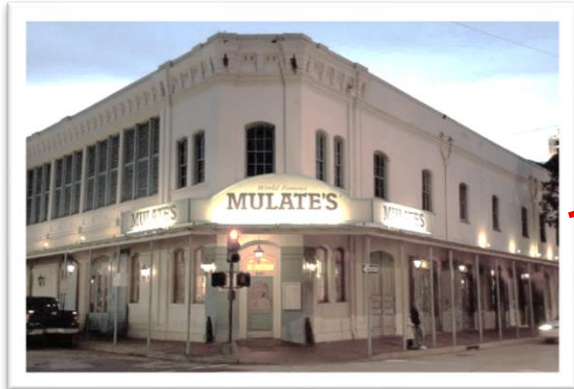
5:30 – 7:30 MULATES RESTAURANT – SUBMARINE GROUP RECEPTION

COME and JOIN US – CELEBRATE with Friends!

Drinks and Hors d'oeuvres and catching up with colleagues and friends.

The Hotel is just across the street from the Convention Center.

201 Julia Street, New Orleans, LA TEL (504) 522-1492



2023 ANNUAL SUBMARINE SYMPOSIUM

Day 2 - Room 252 - Thursday, November 30

8:30 – 9:00 **U.S. Navy and ISMERLO's Response to Civilian Submersible OceanGate Titan: Lessons in Rescue Preparedness**

By: CAPT Burt Canfield
Program Manager
Undersea Special Mission
Systems Program Office
NAVSEA PMS390
US NAVY



By: Bill Orr
Dir., Submarine Survivability
Escape & Rescue
COMSUBPAC N3SER
NAVSEA - U.S. Submarine
Force Escape and Rescue



By: Curt Cunningham
Asst. Program Manager
Global Submarine Rescue
Undersea Special Mission
NAVSEA PMS390
US NAVY



Join us to review the U.S. Navy and International Submarine Escape and Rescue Office (ISMERLO)'s strategic response to the Civilian OceanGate Titan submersible incident. This presentation sheds light on the lessons learned and emphasizes the critical importance of having well-established rescue plans in place. The primary learning objectives include providing submarine owners and operators with valuable insights into effective rescue responses, underscoring the significance of maintaining standing rescue action plans, and reinforcing the importance of submarine certification. Through this discussion, we aim to enhance the readiness and preparedness of the submarine community, ensuring the safety and security of submersible operations in the face of unforeseen challenges.

9:00 – 9:30 **Through-Life IACS Classification of a Rescue Submersible**

By: Greg Cotten
JFD SERS Head of Capability, Chief Engineer
JFD Ltd.
United Kingdom

The James Fisher Submarine Rescue System (JFSRS), operated by JFD, Ltd. under contract with the Commonwealth of Australia for the Royal Australian Navy, is home to the LR5 crewed submersible. LR5 has a storied history, most notably its involvement in the KURSK incident in the Barents Sea in August 2000 as part of the United Kingdom Submarine Rescue System (UKSRS). Over time, the LR5 underwent significant enhancements, including the replacement of its GRP hulls with steel. Impressively, it has



completed over 1500 dives during its operational life. This paper focuses on the recent 5-Annual Special Survey conducted on the LR5, a vital component of its through-life Lloyd’s Register (LR) maintenance of Class certification. The LR Special Survey, governed by LR Rules for the Construction & Classification of Submersibles & Diving Systems, underscores the importance of meticulous planning and coordination. It encompasses a comprehensive assessment to ensure compliance with rules and address unique characteristics of the submersible's design and operational environment, crucial for maintaining LR certification and LR5's role in providing submarine rescue capabilities.

9:30 – 10:00 **Manned Submersibles x Uncrewed Underwater Vehicles - Crossover**

By: Stephen E. Armstrong
 Chief Technology Officer
 Submergence Group LLC
 USA



Submergence Group, M Subs, Promare, and MarineAI and their associated companies have been building and operating submersibles for over 30 years. This paper will trace the evolution of our vessels as they evolved from personal submarines to scientific research submersibles and drones, to diver lock-out submersibles, to large uncrewed submersibles and autonomous uncrewed surface and underwater vehicles. We'll briefly discuss the design, construction, operations, synergies, and challenges we've experienced.

10:00 – 10:30 **COFFEE BREAK**

10:30 – 12:00 **USCG Submarine Operations - Workshop Session**

Round Table on international jurisdiction for operations of submarines

By: James (Dan) Lawrence
 Coast Guard Offshore Engineer CG-OES-2
 Vessel & Facility Operating Standards
 US Coast Guard HQ
 Marine Safety Center
 USA



The Oceangate incident has left a lasting impact on public perception within the submarine industry. Recognizing the ongoing repercussions, the industry is committed to ensuring that regulatory agencies are well-informed about existing rules, regulations, and safety protocols. This round table workshop is to address the imperative of establishing more consistent global Submarine Operations Safety Standards. This workshop serves as a pivotal gathering, bringing together key stakeholders from the submarine industry, the US Coast Guard, international regulatory bodies, and a diverse array of experts. Participants include representatives from the US Coast Guard, Canadian Coast Guard, US Navy, NOAA, ISMERLO, NATO, and IMO representatives. Additionally, members of the industry from all sectors of operation, class societies, the international deep submergence leaders from the USA, France, Japan, India, and beyond will contribute their insights. The objective is clear: to foster collaboration, exchange ideas, and shape the future of global Submarine Operations Safety Standards. This workshop embodies the industry's commitment to ensuring safety excellence and operational integrity, underlining the importance of unity in a rapidly evolving landscape.

12:00 – 1:30

LUNCH BREAK

1:30 – 2:00

**Overview of the ABS Underwater Rule Change Proposals
(Annual Industry Meeting)**

By: Roy Thomas
Sr. Principal Engineer
American Bureau of Shipping
USA



The American Bureau of Shipping (ABS) Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities, commonly known as the “Underwater Rules”, are the primary ABS Rules for classification of underwater units. These underwater units include manned submersibles, lock-out submersibles, diving systems, atmospheric diving suits, remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and so forth that are used for commercial, scientific, and government applications. This industry meeting gives an overview of the annual ABS Underwater Rule change proposals and provides further insight into the rationale and basis for each proposed Rule change. Following this overview, the meeting includes a question-answer session and facilitates an open dialogue with the industry on current technical issues. All active designers, fabricators, owners and operators are invited to attend and provide feedback.

2:00 – 2:30

**Cost of Submarine Certification -Commercial Class, US NAVY P9290, and other
government certification**

By: Capt Gard Clark (USN Ret)
Principal
CPMQ Consulting LLC
USA



This session will revisit a topic that has been covered in this forum since at least 2008 when the philosophy behind the US Navy P9290 certification process was formally reviewed. The "costs" to be considered in any classification or certification process are not only economic but also may involve additional time to bring new technologies into service. We will discuss how this "cost" is perceived to impact development and innovation and how that sometimes exaggerated perception needs to be balanced with the significant safety benefit that a strong classification and certification process and culture provides. These benefits accrue especially rapidly to any organization that must operate with high reliability on a day-to-day basis. We will look at positive examples of this culture and process found in the US Navy Nuclear Propulsion and Deep Submergence programs as well as NASA. We will also review the potential and actual "costs" of not following a formal classification or certification protocol all the way through submarine and submarine support system operations.

2:30 – 3:00

DNV Classification Rules for design and testing of advanced underwater vehicles

By: Jonathan Struwe
 Dept Head - Underwater Systems
 DNV
 GERMANY

The objective of the presentation will be to provide the audience with an overview on the areas that need particular attention during submersible design and development. It will be based on DNV Rules for design and construction of manned submersibles and the Class systematics which can be applied to Newbuilding projects for ensuring that a systematic safety approach is applied over the whole lifetime of submersibles.



3:00 – 3:30

COFFEE BREAK

3:30 – 4:00

Design Considerations for Shallow Water Submarine Rescue

By: Bonnie Blackburn P.E.
 Senior Research Engineer
 Marine Structures & Engineering
 Southwest Research Institute
 USA



By: Andrew Hunt
 Engineering Program Manager
 Phoenix International Holdings, Inc.
 USA



Submarine rescue operations in a shallow water regime pose unique challenges. Southwest Research Institute and Phoenix International teamed up in 2019 to develop a solution for shallow water submarine rescue for the Australian Sub-Rescue Program. Project development ended before a solution could be fully realized, but the challenges of shallow water rescue remain. This presentation explores those challenges. When rescuing submarine sailors from a disabled submarine (DISSUB) in any environment, it is imperative to achieve a “safe mate” quickly and unequivocally between the Rescue Asset and the DISSUB, allow for rapid and safe transfer of personnel, and easily disengage to return to safety at the surface. These requirements can at times result in conflicting design characteristics which are exacerbated in shallow water.

4:00 – 4:30

Carbon Fiber: Qualification by Testing of Non-Standard Pressure Vessels for Human Occupancy

By: William Kohnen
President/CEO
HYDROSPACE Group Inc
USA



It is imperative to recognize that the engineering community possesses a well-established safety standard, one that has successfully safeguarded pressure vessels for decades. In the light of OceanGate, this enduring commitment to safety serves as a guiding light as we navigate uncharted frontiers, steadfastly dedicated to the pursuit of pressure vessel safety and excellence. This presentation is on pressure vessel design, a timeless human invention that has evolved dramatically during the industrial revolution's last two centuries. The submarine industry revolves around the design of pressure vessels for human occupancy. Today's cutting-edge submersibles owe a debt to the groundbreaking invention of acrylic plastic, which has evolved from humble flat windows to become integral pressure hull components. The knowledge from years of designing pressure vessels for human occupancy is preserved through the American Society of Mechanical Engineers (ASME) Safety Standards for Pressure Vessels for Human Occupancy (ASME-PVHO). This unique standard sets forth design and testing criteria for acrylic material and windows, based on half a century of comprehensive qualification testing on these non-linear materials. Non-Linear materials make design by analysis extremely complex, a challenge that extends to all new modern man-made materials. Yet, ASME PVHO offers a tried-and-true qualification testing process to validate the safe design of non-linear materials that defy full analytical comprehension. It is important to highlight the established procedures crafted by ASME PVHO for qualifying PVHO components and pressure vessels using non-metallic materials, such as carbon fiber hulls.

2023 ANNUAL SUBMARINE SYMPOSIUM

Day 3 - Room 252 - Friday, December 1

8:30 – 9:00 **Update on SNAME Book “Submersible Vehicle Systems Design”**

By: Roy Thomas
Chair, T&R Panel OC-6
SNAME
Society of Naval Architects & Marine Engineers
USA



SNAME T&R Panel OC-6 is in the process of updating and further developing the 1990 edition of the SNAME book “Submersible Vehicle Systems Design”. At present, a number of leading technical experts from around the world are participating in this effort and are assisting in drafting various chapters of this book. This presentation provides a brief update on the status of the ongoing work.

9:00 – 9:30 **Subsea Vehicle Endurance-Part 2:
Operating Li Ion Battery Electrical Power- Lessons Learned**

By: Leon Adams
VP, Sales & Marketing
Southwest Electronic Energy Group
USA



By: Brett Levins
NPD Engineering Manager
Southwest Electronic Energy Group
USA



According to the Secretary of the Navy in the Report on Autonomous Vehicle Requirements (AUV) for 2025, “Endurance (how far and how fast can the AUV go, and how many sensors need to be supported)” is one of the four core AUV capability characteristics for the future. Manned submarines have very similar endurance requirements. This presentation will provide insights from lessons learned regarding reliably operating lithium-ion battery based electrical power systems as used in submarines, AUVs, and subsea equipment. Topics covered will include dealing with inrush/outrush currents, inductive voltage kickback, battery system configuration, battery system design and operation including charging/discharging, and battery condition-based monitoring and communications. All of the information is derived from real world use case subsea battery system operating experiences across different applications.

9:30 – 10:00

VVUQ --The Pathway for Innovation In Submersibles
(Verification, Validation and Uncertainty Quantification)

By: Bart Kemper
Principal Engineer P.E., CPEng
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The safety record for the submersible industry is remarkable. No submersible that has been certified by a classification society has experienced a structural failure. It's equally true that many design features have a constrained range of design options within the existing codes and standards. For example, the engineering code for acrylic windows and hulls has remained almost unchanged from its initial design tables and requirements in the 1970's. Despite this, innovations can be developed as a number of manufacturers have demonstrated in recent years. Modern engineering simulations have been integral in these developments as they have been in other industries. A key enabler for the successful use of engineering simulation is a process called Verification, Validation, and Uncertainty Quantification (VVUQ). This is the method to prevent "Garbage In, Garbage Out" with simulations providing the right answers to the wrong questions. VVUQ is used in a wide variety of industries, including aerospace, medical devices, and nuclear power. This paper will address how the VVUQ process works, what references are available as a starting point, and how it applies to codes and standards such as ASME Pressure Vessels for Human Occupancy (PVHO) as well as the classification rules by ABS and DNV.

10:00 – 10:30

COFFEE BREAK

10:30 – 11:00

Benefits and Technical Details of Submarine Ventilation

By: Andrew Hunt
Engineering Program Manager
Phoenix International Holdings, Inc
USA



In any submarine rescue event, the condition of the disabled submarine (DISSUB) atmosphere is of critical importance. Buildup of CO₂, reduced O₂ levels, and presence of toxins can create acute danger for survivors even when the DISSUB is in a condition to support rescue. By refreshing the atmosphere from the surface, and ventilating to reduce CO₂ concentration, maintain an acceptable O₂ level, and vent toxins, a livable atmosphere is available for as long as required. A ventilation system can also be used to slowly decompress a pressurized DISSUB, creating less risk for those on the submarine, simplifying rescue operations, and reducing the complexity of operations required once rescues are onboard the VOO. The SEVDS provides a light weight, small footprint, mobile option at an acquisition and operational cost that is significantly less than a full rescue system. It extends the timeline for rescue and increases the probability that the correct rescue assets can be brought to bear.

11:00 – 11:30 Use of calcium hydroxide for carbon dioxide (CO₂) absorption in submarines

By: Tom Daley
Product Specialist
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USA



For over 100 years calcium hydroxide has been used for carbon dioxide (CO₂) absorption in lung powered and fan powered scrubbers. For the past 20 years a solid form of calcium hydroxide (in cubes and cartridges) has been used in scuba and submarine scrubbers. This paper will briefly discuss the chemistry of calcium hydroxide and the impediments to performance. The paper will report in detail: (1) The design and operation of a new fan powered scrubber for small submersibles that uses solid sheet absorbent. (2) The performance test results in scrubber chamber testing.

11:30 – 12:00 Innovative Ballast Systems for Full Depth Ocean Exploration

By: Jim Weir
President
Poseidon Deepsea Solutions
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The presentation explores the cutting-edge of ballast systems engineered to withstand the extreme pressures of up to 11,000 meters. Considering the current scarcity of readily available solutions, our design philosophy places a strong emphasis on redundancy and fail-safe mechanisms, ensuring proactive management of potential system failures. Recognizing that mission success and design integrity are of paramount importance, we discuss guarantee of operational reliability, unveil strategies for circuit separation, with a special focus on compressive gas ballast systems, through the lens of Failure Mode Effects and Criticality Analysis (FMECA). At the heart of this exploration lies valve technology, a pivotal element where simplicity and dependability reign supreme. We navigate the intricacies of valve selection, design principles, rigorous testing, and validation to meet stringent depth rating and reliability criteria. Our journey culminates in a comprehensive review of the current market landscape, showcasing the application of this transformative technology in the pursuit of full ocean depth-rated systems. We review present valve solutions, precisely crafted, and rigorously validated to meet exacting standards for reliability and depth ratings, heralding an exciting era of innovation in this dynamic field of marine technology.

BIOGRAPHIES – 2023 SPEAKERS



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Leon Adams is a Vice President at Southwest Electronic Energy. He has 10+ years' experience in Lithium and Lithium-Ion battery applications, product definition, and technical customer support and sales. Prior, Leon had 28 years' experience at Texas Instruments as a Systems Engineer, and managed applications, marketing, and business in DSP and embedded processing. Leon has authored/presented technical papers and articles on Lithium-Ion subsea battery technology and applications, DSP and embedded processing solutions, DSP power management, and software development tools. Leon is a member of MTS, SUT, AADE, and IEEE. Leon has an MBA and a BS in Engineering Physics.



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Steve Armstrong has been the CTO for Submergence Group LLC since 2014. Together Submergence Group and its UK subsidiary MSubs Ltd. design, build, and operate underwater vehicles and equipment for government and commercial clients. These include manned submersibles (mini-submarines), large unmanned underwater vehicles, and deep ocean systems. Prior to joining Submergence Group, Mr. Armstrong was a career civil servant with the Department of Defense for 25 years. He specialized in research, engineering, development, and acquisition of advanced naval systems and aircraft for use by Special Operations Forces (SOF). He led teams that developed and fielded numerous high-performance manned submersibles and combatant craft, including swimmer delivery vehicles, mini-submarines, high speed offshore craft, riverine craft, and other systems. Mr. Armstrong also served as a regular and reserve naval officer, retiring at the rank of Captain after 30 years of service. He served in nuclear submarines as an engineering and deck officer during the cold war and commanded Military Sealift Command offices in the Middle East and Pacific during various post-cold war conflicts. Mr. Armstrong and his wife Maria live in Tampa, Florida, USA.



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Bonnie Blackburn is a Senior Research Engineer for the Marine Structures and Engineering team at Southwest Research Institute (SwRI). She is a registered professional engineer with eleven years' experience working with pressurized equipment in various industries. At SwRI, she engages in engineering design, analysis, and fabrication support for pressure vessels and their associated structures and mechanisms. Ms. Blackburn supported design efforts for a submarine rescue system, including design of individual subcomponents, as well as system level operation concepts for subsea rescue. She has supported and led design efforts for complex pressure vessels including clamps, hatches, interlocks, and improved design for manufacture, for both subsea and surface applications.



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Currently, Captain Canfield is privileged to serve as the Program Manager of the Undersea Special Mission Systems Program Office (PMS390). A native of Damascus, Pennsylvania, Captain Burt Canfield graduated with honors from New York Maritime College in 1998, earning a Bachelor of Engineering in Electrical Engineering and a U.S. Coast Guard Third Mate's License. He earned a master's degree in aerospace engineering from the Naval Postgraduate School in 2005. Captain Canfield has served in the Atlantic and Pacific submarine fleets. His first assignment was aboard USS CONNECTICUT (SSN 22), where he completed two under-ice operations and a Northern Atlantic deployment. He served as Operations Officer on USS OHIO (SSGN 726) (GOLD) from June 2006 to January 2009. While serving aboard OHIO, he helped prepare and execute the United States' first OHIO-class SSGN for her inaugural deployment to the Western Pacific. Commander Canfield's Executive Officer assignment was on board USS LOUISVILLE (SSN 724), where he completed one Western Pacific deployment. He assumed command of USS JOHN WARNER (SSN 785) in September 2015, preparing and leading the ship through its first deployment including the first-ever combat launch of Tomahawk cruise missiles from a Virginia-class submarine. While CAPT Canfield led the Warner, the ship earned the Submarine Squadron SIX Battle Efficiency Award for 2018, and was nominated for the Battenberg Cup by Commander, Submarine Forces, Atlantic Fleet. Ashore, Captain Canfield has served on the staff of Commander U.S. Submarine Force, Pacific

Fleet as a Regional Employment Officer and later as Director for Special Operations, and at US Fleet Forces Command as Senior Member of the Nuclear Propulsion Examining Board (NPEB), the Program Manager for the Compatibility Test Facility at the Philadelphia Navy Yard, and Test and Evaluation Director and MK 48 MOD 9 Program Manager for PMS 404. Captain Canfield has been awarded the Legion of Merit, Meritorious Service Medal, and various other awards.



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Captain Clark is a seasoned submariner with 31 years of experience in the United States Navy, including commanding the USS DALLAS (SSN-700) where he led operations with special forces utilizing the Seal Delivery Vehicle (SDV) during Middle East and Indian Ocean deployments. Retiring from the Navy in 2012, he joined Teledyne Brown Engineering, Inc. recently retiring from there as Senior Vice President, overseeing the Energy and Environment Business Unit and Teledyne Energy Systems, Inc. Teledyne Brown Engineering is known for designing and building the US Navy Shallow Water Combat Submersible and also managing the Teledyne Slocum Glider program. Captain Clark is co-chair of the Marine Technology Society's Submarine Committee. His career spans leadership roles in submarine operations, undersea mobility, and marine technology.



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Dr Gregory B. Cotten graduated from the United States Naval Academy in 1987 with a B.S. in Systems Engineering. He completed 5 strategic deterrent patrols on USS JAMES MADISON (SSBN-627), ultimately as Strategic Weapons Officer. He completed his M.E. and Ph.D. in Chemical Engineering from the University of Idaho in 2000 and then served as Associate Chair and Assistant Professor of the Chemistry Department at USNA; as EXECUTIVE OFFICER, Deep Submergence Unit; DEPUTY COMMANDER for Combat Development, Naval Special Warfare Group 3; and retired in 2014 as DEPUTY COMMANDER for Undersea Rescue at Commander Submarine Squadron 11. Since 2014, he has been involved with global Submarine Escape and Rescue Systems (SERS) at JFD Ltd., in leadership positions for offshore operations, training and competence, and through-life engineering design, maintenance and certification. He is currently the SERS Technical and Operational Authority and holds a Master Mariner's Credential from the United States Coast Guard.



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Mr. Cunningham is the Undersea Special Mission Systems Assistant Program Manager for Submarine Escape and Rescue Global Rescue responsible for international rescue, international rescue seat certification, and foreign military sales. Mr. Cunningham has received various awards, including the Navy Meritorious Civilian Service Award, Naval Sea Systems Command Team Submarine Excellence Award.



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Mr. Tom Daley's background is in life support systems in closed environments. He had a 30 plus year career with the US Navy as the technical specialist in submarine atmosphere control. In addition to design, development, qualification, and fielding of atmosphere control equipment on nuclear powered submarines, He was able to work on small submersibles and rescue submarines. During his time with the Navy, he was on loan to the US Air Force, US Army and NASA. After the Navy he was employed by Micropore as a product specialist. He currently supports Micropore's submarine, submersible and aerospace customers with carbon dioxide control products.



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General (Engr) Christian DUGUÉ belongs to the armament corps of military engineers, working at DGA (Direction Générale de l'Armement), the MoD service in charge with procurement for army, navy and air force. Christian Dugué dedicated most of his career to the navy and more specially to submarine forces, from hydrodynamics, nuclear propulsion to weapon launch safety and special ops. He began his career developing silent propulsors until being proposed to join industry (Naval Group) mid 2001 as chief architect of the new Suffren class nuclear attack submarine. He held this position for almost eight years, from early technical studies and contract negotiations to the production line. Back to administration in 2009, he spent three years settling state-to-state relationships for submarine export programs, then became in 2011 technical authority for naval systems for both navy ships building and their maintenance. In 2018, he was responsible for supervising deterrence programs and since 2020, he is inspector for naval building and inspector for nuclear safety. Since 2015, IFREMER, the French Research Institute for Exploitation of the Sea, entrusts him as president of the Nautilie safety committee. Nautilie is a native 6000-meter depth crewed submersible in service since 1984, with now more than 2000 dives.



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Andy Hunt boasts a distinguished 20-year career in the US Navy, where he served as a ship operator and maintainer. His educational background spans mechanical and naval engineering, providing a solid foundation for his versatile roles as an engineer and program manager. Over the past six years, Andy has applied his extensive experience at Phoenix International, a company specializing in undersea projects. His work primarily focuses on rescue vehicle design, ventilation system design, and shallow water rescue operations. Andy's hands-on experience and leadership skills acquired during his naval service have been instrumental in addressing complex challenges within the maritime industry. Whether it's designing innovative rescue vehicles or optimizing ventilation systems for enhanced safety, he continues to make significant contributions to undersea technology and safety. Andy Hunt's career reflects a commitment to excellence and a dedication to advancing maritime operations.



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Daniel Hurd is a Professional Engineer (P.Eng) and Operations Manager for Atlantis Submarines, which operates 9 tourist submarines at seven sites in the Caribbean and Pacific. Daniel joined Atlantis Submarines Cayman in 2007 and spent many years piloting and maintaining the Atlantis class submersibles. He is now responsible for the operation of the global fleet of Atlantis submersibles. Founded in 1986, Atlantis Submarines is the world's first commercial passenger submarine tour company and has carried over 17 million passengers and completed over 550,000 dives. Daniel is a member of the ASME Codes and Standards Committee for Pressure Vessels for Human Occupancy and the ABS Special Committee on Underwater Systems & Vehicles.



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Mr. Itaru Kawama is the Director of Fleet Maintenance and Engineering at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), boasting over 15 years of expertise in marine exploration and technology. Beginning as a deep submersible pilot, he accumulated a decade and a half of experience in submersible operations, assuming the role of Chief Mechanic along the way, enhancing his grasp of underwater systems intricacies. Subsequently, he dedicated five years to overseeing maintenance and engineering for JAMSTEC's underwater vehicles. His extensive perspective on marine exploration led to a 12-year tenure focused on research fleet maintenance and engineering. Currently, as Group Leader of the Underwater System Maintenance and Engineering Group, he continues to drive advancements in underwater systems. Mr. Kawama's journey underscores his commitment to propelling marine exploration and technology forward in the domain of underwater research and engineering at JAMSTEC.



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Bart Kemper, P.E. is the principal engineer for Kemper Engineering Services. He is a Fellow of the American Society of Mechanical Engineers (ASME) and the National Society of Professional Engineers (NSPE), plus is a licensed engineer in the US and Australia. He is a long-time member of the ASME PVHO Codes and Standards committee, serving as Chair for the Viewports subcommittee and Design By Analysis task group. He is also on the ASME committees for Mobile Uncrewed Systems (MUS), which includes AUVs, several committees within ASME VVUQ, and the MTS subcommittees for Submarines and Diving. Kemper over 30 years of engineering experience with over 50 professional papers and patents.



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Ofer Ketter is the President of Submerge, a leading organization in Costa Rica dedicated to underwater exploration and adventure. With a passion for the ocean and its mysteries, Ofer has played a pivotal role in promoting marine education and conservation efforts in the region. Under his leadership, SubMerge has become a renowned hub for diving enthusiasts, researchers, and adventure seekers. Ofer's commitment to sustainable and responsible diving practices has not only enriched the underwater experience for visitors but also contributed to the preservation of Costa Rica's remarkable marine ecosystems. Ofer Ketter's dedication to marine conservation and exploration has garnered him recognition as a visionary leader in the field of underwater adventure tourism. While working as a dive instructor at Cocos Island, Costa Rica, Ofer took a chance opportunity to complete his SEAmagine Deep Submersible Pilot (Triumph 3-man 1500ft) Certification (he went on to complete piloting certifications for two other submersible models in 2011 and 2018 and, to date, has logged over 300 hours as a pilot. This opened up a world of opportunities, from circumnavigating the globe on-board a superyacht as an expedition planner and leader and solo piloting the first ever deep submersible into an active crater of a volcano in the Galapagos to working as a documentary filmmaker and helicopter aerial cinematographer. Mr. Ketter is an explorer, submersible pilot, diving instructor, certified tour guide, photographer and videographer, he is in charge of business development expedition design and management.



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Charles Kohnen serves as the co-founder and Chairman of SEAmagine Hydroospace Corporation, a distinguished California-based manufacturer specializing in ABS-classed manned submersibles. His extensive career in the submersible industry was initiated in 1995 when he co-founded SEAmagine, following several years dedicated to the offshore oil service sector with Schlumberger International. Mr. Kohnen brings a wealth of expertise to the field, underpinned by his academic foundation. He holds a bachelor's degree in electrical engineering and business Administration, from McGill University in Canada. His leadership and strategic vision have been instrumental in driving the development and production of ABS-classed manned submersibles at SEAmagine, making notable contributions to the advancement of underwater exploration. Mr. Kohnen's professional journey exemplifies his commitment to excellence in the submersible technology domain.



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William Kohnen is president and CEO of HYDROSPACE Group Inc., a California company expert in manned submersibles and pressure vessels for human occupancy. Mr. Kohnen has 30 years of engineering experience combining expertise in electrical and mechanical engineering serving the aerospace, medical and subsea industries with a primary mission as a center of excellence for the design, manufacture, testing and certification advanced subsea systems in support of the exploration and management of world oceans and its infrastructure worldwide. Mr. Kohnen is chairman of the Marine Technology Society (MTS) Submarines committee for the past 20 years and was made MTS Fellow in 2014. He has published many papers and articles on the state of the MUV industry and is chairman of the Annual Submarine Symposium. Mr. Kohnen is a member of the ASME PVHO Safety Standards Committee, a member of the ABS Special Committee on Rules for Underwater Vehicles, Industry representative for DNVGL Underwater Technology Rules review, member of the Undersea and Hyperbaric Medical Society (UHMS), the Aerospace Medical Society and was member of the Deep Submersible Pilot association. Mr. Kohnen is Co-Founder of SEAmagine Hydroospace Corp which

designs and produces manned submersibles since 1995. He was born in Germany. He completed a bachelor's and master's degree in electrical engineering at McGill University, in Montreal, Canada.



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Patrick Lahey is the co-founder and CEO of Triton Submarines, a company with manufacturing facilities in both Sebastian, Florida and Barcelona, Spain. Patrick was Born in Ottawa, Canada and started diving in 1975. Patrick is a fully qualified air, mixed-gas, and bell saturation diver with a background in electronics and instrumentation. Patrick began work as a commercial diver in 1982. During his 41-year long career in the underwater business, Patrick has participated in the design, manufacture, testing and operation of numerous underwater vehicles and diving systems including more than 60 human occupied submersibles. In his role at Triton Submarines, Patrick has overseen the development of their entire range of products, including the Triton 36000/2, which is the first and only full ocean depth capable submersible to be fully accredited by an internationally recognized third party classification society (DNV) with an unlimited diving depth noted on the certificate. This remarkable craft is intended for daily use in the most extreme and least understood area of our ocean, the hadal zone, which lies between 6,000 and 11,000 meters (20,000 – 36,000 feet). Patrick has made five dives in the Mariana Trench, including a certification dive in 2019 with DNV surveyor Jonathan Struwe, during which they successfully completed the world's deepest ever salvage operation at a depth of 35,865 feet (10,932 meters). In 2021, Patrick completed three additional dives in the Mariana Trench accompanied by fellow explorer and astronaut (Axiom 1 Civilian Mission Commander) Larry Connor. Patrick is an ardent ocean advocate and passionate supporter of all initiatives aimed at furthering our knowledge and understanding of his favorite place on Earth, the Ocean.



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Dan Lawrence joined the U. S. Coast Guard in 1974. He completed 29 years of active-duty service. His first 16 years serving in various engineering and surface operations billets, and then his final 13 years serving in marine safety and occupational health, including a tour, as the senior inspector, at the Coast Guard Inspection and Investigations School. Upon retirement from active-duty Dan joined the civilian staff, at the Coast Guard Headquarters Office of Design and Engineering Standards, serving as the small vessel, environmental, submersible, and special projects engineer. He currently serves as the Coast Guard Offshore Engineer and leads the Offshore Branch of the Coast Guard Headquarters Vessel and Facility Operating Standards Division. He is a member of several professional engineering associations including ASME PVHO and ASTM. He also serves on the ABS Special Committees for Mobile Offshore Units and Underwater Systems and Vehicle.



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Brett Levins is the Lead Engineer and Manager for New Product Development at Southwest Electronic Energy. He has 10+ years' experience designing and testing Lithium-ion batteries and associated battery protection products. After design, Mr. Levins has guided products through various industry performance testing and certifications such as ABS Type Approval, MIL-PRF and IEC 60601 medical. He has supported customers in high-power battery system design and troubleshooting. Mr. Levins graduated with a Bachelor's and Master's degree in Electrical and Computer Engineering from Baylor University.



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Tim MacDonald is one of the originals, helping build, test and commission the Triton 36,000/2 (LF) that made the record dives to the Marianna Trench and around the globe. He grew up in Nelson Bay, north of Newcastle in NSW, where a job at a local dive shop as a young teen launched an obsession with the deep. After school, he decided he could blend a passion for scuba and an aptitude for designing and fixing things at the Australian Maritime College in Launceston. His degree was in marine systems engineering. An Officer Of the Watch, a technical diver, a keen fisherman, free diver, surfer and sailor, Tim finally found his way to submersibles working from design engineer, swimmer, sub tech, pilot and now sub team leader.



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A Desert Storm veteran and former Royal Air Force Intelligence and Electronic Warfare Officer, Alasdair Murrie has spent 20 years in the commercial subsea sector in various senior business development and project roles, delivering UUV & robotic vehicle, acoustic/optical sensor, smart tooling and software solutions for defense & security, offshore energy and scientific clients, globally.



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Dr Jan Opderbecke is head of the Unit for Underwater Systems at IFREMER. Electrical engineer with a PhD in physics, he has specialized in underwater vehicle navigation as well as autonomous acoustic and optical seabed mapping. The underwater systems unit develops remote operated and autonomous vehicle systems for scientific use within the French Oceanographic Fleet infrastructure. The unit's major projects in 2023 are the development of the 6000m AUV ULYX, the refit of the ROV Victor 6000, and the preliminary design of the refit of the manned submersible Nautile. The team runs R&D projects on key topics in order to provide vehicles with cutting edge performances, functional capabilities, and payloads.



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Bill Orr, Commander, U. S. Navy Retired was born in Oakhurst, New Jersey. He attended the Georgia Institute of Technology where he received a Bachelor of Science Degree in Industrial Management and has a Master's degree in Public Administration from Auburn University. Served as a U.S. Navy Special Operations Officer, Diving and Salvage from September 1983 to January 2004. He served in USS SHREVEPORT (LPD-12) as Weapons Officer and Assistant Operations Officer, and USS GRASP (ARS-51) as First Lieutenant and Salvage Officer. He was assigned as Director of Training at the Naval Diving and Salvage Training Center, Panama City, Florida. He served as Executive Officer, USS GRAPPLE (ARS-53). While serving as Commanding Officer of USS GRASP (ARS-51) his ship conducted various operations in the Mediterranean and the Atlantic including a lead role in the TWA Flight 800 recovery operations. Following his principal sea tours he completed the Air Command and Staff College course, Maxwell AFB, AL. He then served for six years on the Chief of Naval Operations staff as the Deputy Director, Deep Submergence Systems, responsible for current and future Unmanned Undersea Vehicles (UUV), submarine rescue and diving programs including diving and submarine rescue biomedical development and the Submarine Arctic Program. He served as the

Head of the U.S. Delegation to NATO for the Submarine Escape and Rescue Working Group and Underwater Diving Working Group where he also served as Chairman. Following military retirement in 2004, he has served as a Navy Civilian as U.S. Submarine Force Escape and Rescue Officer and developed the International Submarine Escape and Rescue Liaison Office (ISMERLO) including leading the development of its novel web based global rescue coordination system. He currently serves as the Director, U.S. Submarine Survivability, Escape and Rescue on Commander, Submarine Force Pacific Fleet and technical advisor and coordinator to NATO MARCOM ISMERLO..



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Roy Thomas works as a Senior Principal Engineer with the American Bureau of Shipping (ABS) and is based in Houston, TX. He has worked with ABS for the past 20 years. In his current role, he serves as the ABS engineering liaison to the U.S. Coast Guard, as well as the ISO/TC8 - U.S Technical Advisory Group. He also serves as the Americas technical lead for rule development, engineering equivalencies and interpretations. He has formerly served as the Manager of the Corporate Chief Engineer’s Office and Managing Principal of the Underwater Systems and Lifting Appliances Group. Mr. Thomas has extensive experience with the certification of underwater vehicles, systems, and hyperbaric facilities for commercial and military applications. He has served as the lead design review engineer at ABS 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. Mr. Thomas is actively involved with various industry committees and currently serves as the Chair of the ASME PVHO - Subcommittee on Diving Systems, as well as the Subcommittee on Submersibles. He also currently serves as the Chair of the SNAME T&R Panel OC-6 and is coordinating the efforts to update the SNAME textbook “Submersible Vehicle Systems Design”. Mr. Thomas holds a master’s degree in Ocean and Naval Architectural Engineering from Memorial University of Newfoundland, Canada with a specialization in underwater vehicles and systems. He also holds a Bachelor’s degree in Marine Engineering from Marine Engineering and Research Institute, India.



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Matt Thigpen is a Design Engineer with over 8 years of firsthand experience designing manned submersibles and support systems for shallow, intermediate, and full ocean depth vessels, with a focus on custom equipment integration, electrical and mechanical design, and after sales support. Currently employed with the Inkfish group supporting continuous Full Ocean Depth research and development with the Bakunawa platform operating off RV-Dagon.



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Jim Weir is a 20-year veteran of Oil and Gas drilling equipment, with experience at both Major OEMs and startups. He was raised in Beaumont, Texas and at a young age was disassembling everything, gaining a core appreciation for practical engineering. Later he would attend LAMAR University for a Mechanical Engineering Degree. He would go on to receive a Master's in Technology Commercialization from the University of Texas McCombs School of Business. It is an appreciation of simple machines that provides a foundation for everything Jim designs. The years of field experience and support of offshore drilling equipment solidify every decision. Coupled with a deep understanding of business operations, Jim brings solutions to the most volatile markets and continues to innovate in an environment driven by comfort in historical solutions.

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