The Elmer A. Sperry Award

For the development of WindFloat,
a floating foundation for offshore wind turbines

Presentation of

The Elmer A. Sperry Award

For 2020

Given in recognition of a distinguished engineering contribution, which through application proven in actual service has advanced the art of transportation, whether by land, sea, air, or space.

PRESENTED TO

Dominique G. Roddier

Christian A. Cermelli

Alexia Aubault

BY

The Elmer A. Sperry Board of Award

REPRESENTED BY THE

American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
SAE International
Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics
American Society of Civil Engineers

For the development of WindFloat,
a floating foundation for offshore wind turbines

At the SNAME Maritime Convention 2020

The Elmer A. Sperry Award

2020 SPERRY AWARD Recipients, Alexia Aubault, Christian Cermelli and Dominique Roddier
Image courtesy of Principle Power

Dominique Roddier

Dominique G. Roddier, was born in Draguignan, in the south of France on November 30, 1969. He grew up in Nice, and developed early a passion for the ocean, swimming, spear fishing and sailing dinghies.

His parents, astronomers, moved their family to Arizona in 1984, where he completed high school and obtained his undergraduate degree in Aerospace Engineering, graduating from the University of Arizona cum laude and with honors. Dominique moved to Hawaii to study Ocean Engineering at the University of Hawaii where he completed his M.Sc. under Professor R.C. Ertekin. He then moved to Berkeley to pursue a Ph.D. in Naval Architecture and Offshore Engineering under Professor Ronald W. Yeung. This is where he met Christian Cermelli, not knowing yet how their careers would be so complementary. The topic of his dissertation was an experimental study of the flow around bilge keels, calculating the hydrodynamic loading of this highly separated flow, both in forced and free motions.

After graduation, Dominique moved with his wife, Wendy and 3-month old son to Houston, TX to work in the offshore division of ExxonMobil Upstream Research Company. There he worked on some of the most prominent offshore engineering problems: platform coupled motion analyses, Vortex Induced Motions (VIM), and LNG sloshing. He spent a summer in the offshore Innovation team of Dr. Roald Lokken looking at holistic ways to reduce the cost of oil and gas development. This experience marked him profoundly, as he understood then the difference between what makes a nice shelved feasibility study, and something that floats offshore. Looking holistically at the life cycle of a project and using economics as a matrix of feasibility potential and success never left him.

In 2003, he founded Marine Innovation and Technology (MI&T) with Christian, (who was working for Shell at the time) and they moved their family back close to their alma mater. Their first hire, in 2005, was Alexia Aubault. MI&T developed the MiniFloat hull, a small, three-legged semi-submersible for O&G marginal field development and did consulting work for the various maritime industries. MI&T's main clients were Shell and Chevron, for whom they performed a large variety of R&D and engineering projects. Additionally, the company did quite a bit of work in other areas. Dominique designed a gimbal system used in the Pirates of the Caribbean movies to rock the Black Pearl, and worked with many wave energy technology companies, including Finavera, where he met Principle Power's future CEO, Alla Weinstein. Another company MI&T worked for was AeroVironment, an aerospace company founded by Dr. Paul MacCready. AV has two very innovative planes in the Smithsonian Museum in Washington, DC. Dr. Tom Zambrano and Dr. Tyler McCready were two of the thinkers of the company and hired MI&T to work on an ocean energy buoy. They were also working on five-bladed wind turbines and wanted to see if MI&T could make them float on the MiniFloat… The WindFloat was born!

Alla Weinstein started Principle Power in 2007 with Jon Bonanno, a serial entrepreneur reborn sustainable investor post 9-11. After many business plan discussions with Dominique and Christian, both companies' businesses joined forces. Dominique became PPI Chief Technology Officer shortly thereafter and a director of the company once PPI bought the WindFloat IP rights.

Between 2008 to 2014, the two companies worked closely together, PPI focusing on business development and MI&T on the WindFloat design and engineering, with Dominique bridging the two. Funding was secured with EDP, a large Portuguese utility company and the prototype was fabricated and installed. The company also worked on projects in Oregon, funded by the US Department of Energy; in Japan, funded by NEDO; and in Scotland.

In 2014, the offshore industry looked very promising and Principle Power continued its growth through a merger between PPI and MI&T, and additional hiring to internalize many of the business development and engineering activities.

WindFloat Atlantic was the company's key project at that time, along with the Scottish KOWL project and the EFGL project in France. Five years after the merger, Dominique and Christian, joined by Alexia left PPI to create Ocergy, a new company whose mission is to develop sustainable offshore solutions. The company focuses on developing systems that can fast track offshore wind in the world; in particular, the OCG-Data, a smart, zero-emission buoy which combines a variety of instruments to acquire both environmental and ecological data.

Throughout his career, Dominique has been very active in various academic and society memberships. He has published extensively in the field of offshore engineering and is or has been an associate editor of the Journal of Offshore Mechanics and Arctic Engineering, the Journal of Waterway, Port, Coastal and Ocean Engineering and the Journal of Ocean Engineering and Marine Energy. He is a Fellow member of the Society of Naval Architects and Marine Engineers (SNAME) and continues to be active in the Northern California section, having chaired the section in 2008.

He was the Offshore Technology Symposium Coordinator of the ASME Conference on Ocean, Offshore and Arctic Engineering (OOAE) for ten years and a member of the division executive committee which he chaired in 2016. Along with Prof. Ronald W. Yeung, he was the chair of the OMAE 2014 conference in San Francisco, and the technical chair of OMAE 2017 in Trondheim. Under ASME, Dominique created the International Offshore Wind Technical Conference (IOWTC) with his friend Krish Sharman in 2018 and was the conference's first chair in 2018 in San Francisco. He currently serves on the ASME CleanTech Technical Advisory Panel and is a frequent speaker at many offshore wind events.

Dominique continues to be an avid sailor, winner in his class of many regattas, including the San Francisco Big Boat Series. His passion for the ocean is everlasting as he continues to swim, spearfish, and race his First 36.7 "Southern Star" very actively.

Alexia Aubault

One of Alexia Aubault's earliest naval memories was in an optimist boat on Etang d'Apigne, a small lake near her home-city of Rennes, France. During a beginner sailing day camp, 7-year-old Alexia was introduced to the thrill of racing on the water, while alone in an eggshell, trying to troubleshoot its deficient hardware. She was barely able to swim, but really enjoyed beating her fellow campers all the while trying to keep that tiller in its hinges.

Alexia was born and raised in Rennes. Although it stands as the capital of Brittany, a historic center of navigation with coasts on both the Atlantic Ocean and the English Channel, the city is landlocked, and Alexia spent more time reading about the ocean than experiencing it first-hand.

Still, as a teenager, she took every opportunity to set foot on a sailboat or to walk around ports. By age 15, as she started to consider engineering as a career path, she was looking up naval architecture programs.

After completing her high school and preparatory studies, she was accepted at ENSTA Paris. A member of ParisTech, the school offers one of the top engineering programs in France, and most importantly it has a strong and long-running offshore engineering and naval architecture program. The school was based in Paris, another beautiful, but landlocked, French city. There, Alexia tried out rowing, on a beautiful stretch of the Seine. For lack of good waves, she settled on rugby.

Throughout her studies at ENSTA, Alexia was exposed to both the theoretical principles of classical mechanics and the practical applications of engineering. She applied for internships in the maritime industry and spent a summer as an intern, on a Transatlantic CMA-CGM container ship. For a month, she split her time between the machinery room and the deck and enjoyed the natural beauty of the high seas and its wildlife.

For her final year of engineering studies, Alexia elected to pursue a double diploma. She arrived at UC Berkeley in August 2003, for her Master of Science in Ocean Engineering, eager to finally get some hands-on experience in the UC Berkeley towing facility. Her research advisor, Prof. Ronald W. Yeung had other plans: her analytical skills would be much better used in the computing lab. Through her research on interference resistance of multi-hull vessels, under Prof. Ronald W. Yeung's guidance, she learned the value of careful and systematic validation, a principle she continues to apply in her professional life.

By the end of her Master's degree, Alexia was eager to apply her hydrodynamic knowledge to the design of large scale floating structures. Dominique Roddier and Christian Cermelli had started their company, Marine Innovation & Technology. She joined as their first employee and immediately dove into the structural design of the MiniFloat. She also participated in many consulting projects for the oil and gas industry. She contributed to model tests campaigns on VIM and VIV; she performed numerical analysis of multi-body interactions and wave run-up. Working with some of the industry's experts, she was inspired by the mix of passion for their discipline and humility in the face of the large projects they contributed to. She brought that experience to her work in the renewable energy industry. Through consulting work, Alexia helped some wave energy companies better understand the constraints of operating in the ocean environment.

When the idea of putting a wind turbine on a MiniFloat emerged, Alexia went on to perform iterations of structural strength and fatigue design on the hull. As she gained understanding of the loading patterns, she started adjusting some of the initial design features of the MiniFloat to increase its structural resistance. Some of the improvements she suggested are still in use in the current WindFloat design.

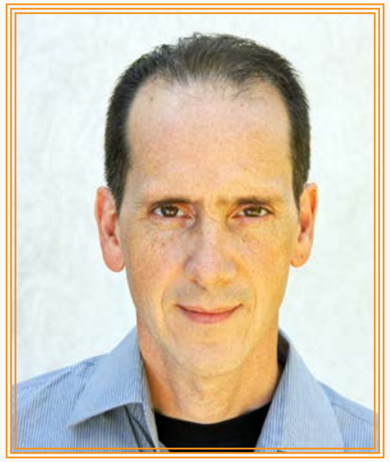
In 2010, the WindFloat I prototype project, led by Principle Power, took off. After running the load-structure interface during detailed design, Alexia went to Portugal to manage Principle Power's fabrication site team at the Lisnave Shipyard. Based on her detailed knowledge of the design, Alexia insisted on the quality of work necessary to ensure the robustness of the platform in the ocean environment.

By September 2011, as WindFloat I sailed away, she was ready to take her learnings back to the drawing table and started working on the next iteration of WindFloats. She kept a watchful eye on WindFloat I over the years, as she ran its integrity and inspection program, eventually using these early results as a basis for the retrofit plan in 2018, before the planned redeployment of the hull in Scotland. As head of engineering at PPI, Alexia used her experience of lifecycle design, fabrication, and operation of a floating wind turbine to ensure a holistic approach to the design of future WindFloats for upcoming projects.

As PPI's WindFloat first pre-commercial project WindFloat Atlantic approached completion in 2019, and the now established PPI engineering team was working towards the next projects, Alexia decided that it was time to look at new horizons and left the company in early October 2019. She took a short break to enjoy her family life with her husband Joe and their young son and twin daughters. Following a discussion with her now long-time friends and colleagues, Christian and Dominique, she decided to embark on another adventure, as a co-founder of Ocergy, to devise new floating solutions to fight climate change.

Alexia has published over 20 peer-reviewed papers in conferences and journals. She also contributed to two books on energy and offshore structures. In 2016, Alexia received the Offshore Energy Young Engineer Award for her role in the design, fabrication, and operation of WindFloat I.

Christian Cermelli



Christian A. Cermelli was born in Rio de Janeiro, Brazil on January 3, 1967. He grew up in France and developed a passion for power boats as a teenager. He spent his summers taking care of the 20ft family craft and particularly enjoyed the thrill of flying the boat in the heavy seas of the Mediterranean churned by the Mistral wind and occasionally rescuing drifting wind surfers and disabled boats. Expectedly, his first naval architecture task consisted of inserting structural reinforcement and patching the fiberglass and gelcoat of the cracked boat!

Combining his passion and studies, he joined the offshore engineering department at the Mediterranean Institute of Technology in Marseilles, France, and, for the final year project, he modelled numerically the planing of boats. Although not fully successful, it gave him an insight into the immense complexity of hydrodynamics and the fascinating forces of nature that make a boat rise above the water surface.

He graduated in 1989 and decided to further his understanding of hydrodynamics by joining the Naval Architecture and Offshore Engineering department at UC Berkeley for a Master of Science. His Master's thesis under the enlightening guidance of Prof. Ronald W. Yeung dealt with the transient hydrodynamics of vortex tubes in the presence of a free-surface.

He then performed his national service duty on a ship offshore Brazil for over one year, and one of his most memorable moments came only after a few days on the vessel, where he was in charge of retrieving an oceanographic instrument. A second of inattention by the winch operator resulted in the line snapping and Christian could do nothing but watch in horror the expensive instrument drop in a mile water depth. Fortunately, no one was injured, and the instrument and its precious data could be recovered a few weeks later with a remotely operated underwater vehicle.

Having learned the importance of good planning to keep offshore operations safe and successful, Christian returned to UC Berkeley in 1992 for doctorate studies. His doctoral thesis included an experimental study of a rolling plate near the free-surface to further the understanding of the performance of bilge keels on ships.

Having completed his Ph.D. in 1995, Christian went on to work for the engineering group Technip in Paris, France as a pipeline engineer. He then married his wife, Kaori, whom he had met a few years before at the UC Berkeley International House, bringing the Japanese culture into his family. They returned to the US in 1998 where Christian started a new job at Shell in the research arm of the deep-water division in Houston.

Christian had the opportunity to work on a variety of exciting projects involving different types of floating platforms, either already built and installed, in the design and engineering phases, as well as in the very early conceptual stages. Christian fondly remembers his days spent in various model testing facilities worldwide, mesmerized by the teachings of his mentor, Rick Mercier, a huge source of inspiration for the rest of his career.

In 2003, eager to expand his career objectives to the growing marine renewables field, he founded Marine Innovation & Technology (MI&T) in Berkeley, California, with his university friend Dominique Roddier. He dedicated much of his time to the development of a novel type of floater aimed at supporting minimum facilities. The concept, initially named Minifloat, consisted of a three-column semi-submersible platform with water-entrapment plates at the keel to improve hydrodynamic performance, and the ability to be fully integrated at a quayside, to reduce the amount and the complexity of offshore works.

The concept was well received by the offshore industry, but it did not get immediate traction because, during the long period of very high oil prices, oil and gas companies dedicated their resources mostly to large projects rather than minimal facilities. With Christian's strong background in theoretical hydrodynamics and his experience with offshore operations, he was instrumental in adapting the concept to support a multi-megawatt wind turbine, leading to a first patent filing in 2008 for the WindFloat technology.

Christian moved back to Europe in 2010 to become project manager for the design, fabrication, installation, and operation of the 2MW WindFloat 1 prototype in Portugal for Principle Power. He also oversaw the decommissioning and relocation of the prototype to Scottish waters between 2016 and 2018.

Christian started the French office of Principle Power in 2014 and acted as Chief Naval Architect for the growing company, overseeing technical development particularly in the area of station-keeping and offshore installation for Principle Power growing portfolio of projects worldwide.

With a strong desire to tackle new technological challenges, and with the goal to help improve the massive issues of the 21st century, such as climate change, biodiversity loss and collapse of fish stocks, Christian founded Ocergy in late 2019 with his long-time friends Dominique Roddier and Alexia Aubault.

The WindFloat

Principle Power's WindFloat is a floating platform supporting a large wind turbine. It is based on the semi-submersible architecture with several distinctive features:

- Water-entrapment plates (WEP) are horizontal plate extensions around the keels of the three columns, aimed at increasing the fluid inertia and viscous damping to minimize the platform motions. The WEP must remain sufficiently submerged for the improved performance and to prevent excessive wave loading.

- The turbine is supported directly atop one of the three columns. To balance the loads on the platform, an amount of seawater equal to the turbine weight is carried as ballast in the other two columns. The ballast is also required to reach the operating draft.

- Finally, an active ballast system keeps the platform trim close to horizontal in all operating conditions by shifting sea water ballast between the columns. This has beneficial effects compared to a traditional semi-submersible with the same architecture and no active heel compensation, which would have to be designed to heel only by a small angle when the turbine operates. With an active ballast system, the design heel angle can be much larger, allowing the platform to be smaller and softer. This, in turn, allows for better responses in waves and lower overall cost.

WindFloat 1 prototype ready for load-out at the Lisnave Shipyard in 2011. Picture shows the platform architecture including Water Entrapment Plates and the turbine sitting atop the right-most of the three columns
Image courtesy of Principle Power

With worldwide temperatures rising — and following most nations signing onto the Kyoto Protocol in 1997 — interest in carbon-free renewable energies has been increasing since the turn of the century.

Wind has become the fastest-growing source of renewable energy, with offshore wind farms offering huge potential due to the generally higher and steadier wind speed offshore, and the large areas available for commercial-scale wind power plants.

In many coastal regions, however, designation of the shallow water areas for fishing, recreation, or other activities — as well as visual impact from the shore — is pushing the sites available for offshore wind farms further off land and into deeper waters.

WindFloat 1 prototype operating with rated wind speed
Image courtesy of Principle Power

Traditionally, offshore wind turbines have been set on fixed foundations driven into the seabed, such as monopiles. In deeper areas, jackets can be used to support the wind turbines, such as in the Block Island wind farm off Rhode Island. Beyond depths of around 50 meters, the cost of fixed foundations increases drastically, and they are no longer economically viable.

Floating foundations for large wind turbines have therefore become a key component in enabling the installation of wind farms in offshore areas with depths of up to several hundred meters.

Early inroads into floating wind were made by the Norwegian company Equinor; the first multimegawatt floating wind turbine prototype, the Hywind spar, was installed successfully in 2009 off the southwest coast of Norway after several years of development. A number of concepts derived from oil & gas floating platforms were also adopted in the early 2000s to support wind turbines — including semi-submersible and tension-leg platforms.

Yet, an enormous challenge lay ahead in lowering the cost of such floating foundations to an acceptable level for mass production of electricity at commercial rate. This required a reduction of the installed cost per MW by a factor of approximately 10 from the earliest prototypes. Such economic improvement could only be achieved by taking a holistic approach and innovating on all aspects to reduce the cost curve. Major factors included advancements in technology, industrialization and scale-up of fabrication, and financing.

- **Technological advancements** have been developed by many manufacturers of floating wind turbine foundations. These included customized and novel floater architectures either to support the particular requirements of existing 3-bladed horizontal-axis upwind turbine technologies — or to support novel wind turbine architecture, such as vertical axis, downwind, two-bladed, counter-rotating pairs. Steel, concrete or hybrid (steel and reinforced concrete) structures were tested. Additionally, advancements in design methodologies were achieved using state-of-the-art modeling with modern software and supercomputing clusters to analyze the complex interactions between large wind turbines and their floating supports. Classification societies endeavored to adapt their rules and design guidelines to this nascent industry, relieving some of the constraints necessary for permanently manned platforms supporting hydrocarbon or other high-risk facilities.
- **Industrialization and scale-up** requires developing new, or using existing, infrastructure for mass fabrication and deployment. Given the cost and time required to develop new infrastructure, especially if it involves port facilities, the ability to assemble the foundations in existing facilities and transported to their operating site is preferable. Foundation designers almost always propose the integration of the turbine to the foundation to be performed at quayside or nearshore in protected waters, because, once the floater is hooked up to its mooring offshore, the heavy lift required to install a turbine on its foundation is almost impossible to achieve safely.

  A challenge with infrastructure development is the constant evolution of turbine size, which has been steadily growing. It is hard to determine years in advance what the available and optimum turbine size will be at onset of a floating wind farm development, in a given region. Therefore, defining infrastructure requirements and development plans can be challenging. Extensive use of the available infrastructure will take place during the wind farm construction phase, which is expected to last a couple years, but the need for the infrastructure for the operational phase, which is expected to last at least 20 years, should be sharply reduced, assuming that reliability targets are met for the foundations and turbines.

  Finally, developers must balance the suitability of existing infrastructure near their site and the cost of transporting the Floating Wind Turbines (FWT) from more distant facilities. Local content requirement is an important element in this equation.

Fabrication of WF1 in drydock
Image courtesy of Principle Power

- **Financing** is a key factor determining the economic feasibility of large-scale commercial floating wind farms. To achieve their financial targets, developers must have access to suitable financing conditions, which depend strongly on the risk assessment as well as expected returns. The Power Purchase Agreements typically provide some level of certainty on the income side, but the perception of risks, particularly on the operating side, has a strong impact on financing conditions. De-risking projects through prototype and pre-commercial developments is therefore necessary for improving financing conditions. The development of the WindFloat technology has tracked closely with the emergence of solutions to these challenges, sowing the seeds for some and benefiting from others.

Since 2003, Marine Innovation & Technology (MI&T), founded by Dominique Roddier and Christian Cermelli, had been refining a minimal floating structure based on three-column semi-submersible architecture with water-entrapment plates to support unmanned oil and gas facilities in deep water, such as water-injection or minimal processing equipment. With growing interest in offshore wind, the system was enhanced in 2006 to carry a large wind turbine, with two adaptations from its earlier version:

- All structural members were changed into circular cylinders, for enhanced hydrodynamic performance, but especially to allow mass fabrication of units, using industrial facilities equipped to build turbine towers and monopiles.
- An active ballast system was added to keep the platform even keel with change of wind speed and directions

Voila: The WindFloat was born.

Onboard cameras during a very large storm. Image courtesy of Principle Power

Early technological development:

The engineering team benefited from state-of-the-art modeling to tackle some of the early challenges. To drive down the cost of the system, every component of the platform had to be optimized. Numerical analysis was extensively used to model the complete system responses. The effort started with an advanced hydrodynamic model of the hull. Groundbreaking work by Professors J.W. Wehausen and J. N. Newman laid the fundamental theory of gravity waves interacting with floating vessels (the diffraction-radiation theory), which resulted in the development of the powerful WAMIT software, able to predict the pressure field around a vessel floating in waves. The TimeFloat software was developed by MI&T to compute motions and mooring tensions for a platform using WAMIT as a pre-processor.

A significant difference between Floating Wind Turbines (FWT) and Oil & Gas platforms is the influence that the turbine has on the floater motions because of the very large aerodynamic moment exerted at the base of the tower. Conversely, floater motions affect the turbine forces due to the apparent wind effect. The strong coupling between the two systems must be accounted for at the design stage to ensure proper performance.

Spartacus towing WF1 during decommissioning. Image courtesy of Principle Power

FAST is a public domain software developed by the National Renewable Energy Laboratory (NREL) to predict the performance of a turbine, including blade aerodynamics and turbine controller effects. FAST and TimeFloat were both written in FORTRAN computing language, with the source code available to Marine Innovation & Technology. Both WAMIT and FAST could then be efficiently coupled to enable a complete model of the floating wind

WindFloat 1 on its way to Scotland. Image courtesy of Principle Power

turbine performance. This allowed MI&T to progress with the optimization of its FOWT design.

Structural analysis was then conducted with state-of-the-art finite-element software to complete hull design optimizations.

The maturity of the system — which had undergone several scaled model-testing campaigns and extensive analysis — as well the holistic design aimed at reducing cost through the entire life cycle — including fabrication, installation, operation as well as decommissioning — provided the grounds for a successful demonstration project.

Principle Power licensed, then purchased, the WindFloat technology rights in 2007. Along with its investors A. Silva Matos, an early mover in fabrication of wind turbine towers, and Energias de Portugal (EdP), the largest utility in Portugal, it played a key role in advancing the technology to the next step. The tangible result was the fabrication and installation of a 2MW full-scale prototype in the open waters of the North Atlantic Ocean, five kilometers off Povoa de Varzim, on the northwestern coast of Portugal.

The demonstration project started in earnest in the last quarter of 2009 and the WindFloat 1 initiated production into the Portuguese grid in December 2011 after less than one year of fabrication, installation and offshore commissioning. This fast-track development was achieved by a consortium of companies joining their industrial and commercial strengths to progress this emerging industry.

The prototype operated successfully for five years, until the project completion. It was then decommissioned and mothballed in the Sines Port in Portugal, before finding a new life and relocating to Scotland in the summer 2018 as part of the Kincardine Offshore Wind Farm development. The entire life cycle of a Floating Wind Turbine was therefore tested at full-scale, which offered a unique view of the potential for developing a large industry — and what is required to achieve its maturation.

When the WindFloat 1 prototype was in its early operational stages, a pre-commercial phase was initiated to continue maturing the product. Principle Power's Windfloat Atlantic project, installed earlier this year, was designed to test all components of a large floating wind farm, but with a smaller number of units, e.g.:

- Integration of a commercial-size turbine
- Serial fabrication
- Serial offshore operations
- Certification
- Insurance
- Financing

WFA unit being loaded out in the water semi-submersible vessel. Image courtesy of Principle Power

WindFloat Atlantic floating wind farm. Image courtesy of Principle Power

WindFloat Atlantic is a 25MW floating wind farm about 20km off Viana de Castelo in Northern Portugal. It is composed of three identical units carrying MHI-Vestas V164-8.4MW turbines, a model which is now commonly installed on fixed wind farms.

The hulls were built in two different facilities to reduce the overall fabrication time, making inroads into fabrication of large-scale floating wind farms, which will probably require multiple facilities.

As the floating offshore wind sector begins to move from pre commercial to commercial stage, Principle Power's projects including the 50MW Kincardine OWF currently under construction and the recently announced 96MW Erebus development off Wales, will see the WindFloat make a significant contribution to the continued growth of the industry.

Elmer A. Sperry, 1860–1930

After graduating from the Cortland, N.Y. Normal School in 1880, Sperry had an association with Professor Anthony at Cornell, where he helped wire its first generator. From that experience he conceived his initial invention, an improved electrical generator and arc light. He then opened an electric company in Chicago and continued on to invent major improvements in electric mining equipment, locomotives, streetcars and an electric automobile. He developed gyroscopic stabilizers for ships and aircraft, a successful marine gyro-compass and gyro-controlled steering and fire control systems used on Allied warships during World War I. Sperry also developed an aircraft searchlight and the world's first guided missile. His gyroscopic work resulted in the automatic pilot in 1930. The Elmer A. Sperry Award was established in 1955 to encourage progress in transportation engineering.

The Elmer A. Sperry Award

To commemorate the life and achievements of Elmer Ambrose Sperry, whose genius and perseverance contributed so much to so many types of transportation, the Elmer A. Sperry Award was established by his daughter, Helen (Mrs. Robert Brooke Lea), and his son, Elmer A. Sperry, Jr., in January 1955, the year marking the 25th anniversary of their father's death. Additional gifts from interested individuals and corporations also contribute to the work of the board.

Elmer Sperry's inventions and his activities in many fields of engineering have benefited tremendously all forms of transportation. Land transportation has profited by his pioneer work with the storage battery, his development of one of the first electric automobiles (on which he introduced 4-wheel brakes and self-centering steering), his electric trolley car of improved design (features of its drive and electric braking system are still in use), and his rail flaw detector (which has added an important factor of safety to modern railroading). Sea transportation has been measurably advanced by his gyrocompass (which has freed humans from the uncertainties of the magnetic compass) and by such navigational aids as the course recorder and automatic steering for ships. Air transportation is indebted to him for the airplane gyro-pilot and the other air navigational instruments he and his son, Lawrence, developed together.

The donors of the Elmer A. Sperry Award have stated that its purpose is to encourage progress in the engineering of transportation. Initially, the donors specified that the award recipient should be chosen by a Board of Award representing the four engineering societies in which Elmer A. Sperry was most active:

American Society of Mechanical Engineers (of which he was the 48th president)
American Institute of Electrical Engineers (of which he was a founder member)
Society of Automotive Engineers
Society of Naval Architects and Marine Engineers

In 1960, the participating societies were augmented by the addition of the Institute of Aerospace Sciences. In 1962, upon merging with the Institute of Radio Engineers, the American Institute of Electrical Engineers became known as the Institute of Electrical and Electronics Engineers; and in 1963, the Institute of Aerospace Sciences, upon merger with the American Rocket Society, became the American Institute of Aeronautics and Astronautics. In 1990, the American Society of Civil Engineers became the sixth society to become a member of the Elmer A. Sperry Board of Award. In 2006, the Society of Automotive Engineers changed its name to SAE International.

Important discoveries and engineering advances are often the work of a group, and the donors have further specified that the Elmer A. Sperry Award honor the distinguished contributions of groups as well as individuals.

Since they are confident that future contributions will pave the way for changes in the art of transportation equal at least to those already achieved, the donors have requested that the board from time to time review past awards. This will enable the board in the future to be cognizant of new areas of achievement and to invite participation, if it seems desirable, of additional engineering groups representative of new aspects or modes of transportation.

The Sperry Secretariat

The donors have placed the Elmer A. Sperry Award fund in the custody of the American Society of Mechanical Engineers. This organization is empowered to administer the fund, which has been placed in an interest bearing account whose earnings are used to cover the expenses of the board. A secretariat is administered by the ASME, which has generously donated the time of its staff to assist the Sperry Board in its work.

The Elmer A. Sperry Board of Award welcomes suggestions from the transportation industry and the engineering profession for candidates for consideration for this award.

Previous Elmer A. Sperry Awards

1955 To ***William Francis Gibbs*** and his Associates for design of the S.S. United States.

1956 To ***Donald W. Douglas*** and his Associates for the DC series of air transport planes.

1957 To ***Harold L. Hamilton, Richard M. Dilworth*** and ***Eugene W. Kettering*** and Citation to their Associates for developing the diesel-electric locomotive.

1958 To ***Ferdinand Porsche*** (in memoriam) and ***Heinz Nordhoff*** and Citation to their Associates for development of the Volkswagen automobile.

1959 To ***Sir Geoffrey de Havilland, Major Frank B. Halford*** (in memoriam) and ***Charles C. Walker*** and Citation to their Associates for the first jet-powered passenger aircraft and engines.

1960 To ***Frederick Darcy Braddon*** and Citation to the Engineering Department of the Marine Division of the Sperry Gyroscope Company, for the three-axis gyroscopic navigational reference.

1961 To ***Robert Gilmore LeTourneau*** and Citation to the Research and Development Division, Firestone Tire and Rubber Company, for high speed, large capacity, earth moving equipment and giant size tires.

1962 To ***Lloyd J. Hibbard*** for applying the ignitron rectifier to railroad motive power.

1963 To ***Earl A. Thompson*** and Citations to ***Ralph F. Beck, William L. Carnegie, Walter B. Herndon, Oliver K. Kelley*** and ***Maurice S. Rosenberger*** for design and development of the first notably successful automatic automobile transmission.

1964 To ***Igor Sikorsky*** and ***Michael E. Gluhareff*** and Citation to the Engineering Department of the Sikorsky Aircraft Division, United Aircraft Corporation, for the invention and development of the high-lift helicopter leading to the Skycrane.

1965 To ***Maynard L. Pennell, Richard L. Rouzie, John E. Steiner, William H. Cook*** and ***Richard L. Loesch, Jr.*** and Citation to the Commercial Airplane Division, The Boeing Company, for the concept, design, development, production and practical application of the family of jet transports exemplified by the 707, 720 and 727.

1966 To ***Hideo Shima, Matsutaro Fuji*** and ***Shigenari Oishi*** and Citation to the Japanese National Railways for the design, development and construction of the New Tokaido Line with its many important advances in railroad transportation.

1967 To ***Edward R. Dye*** (in memoriam), ***Hugh DeHaven,*** and ***Robert A. Wolf*** for their contribution to automotive occupant safety and Citation to the research engineers of Cornell Aeronautical Laboratory and the staff of the Crash Injury Research projects of the Cornell University Medical College.

1968 To ***Christopher S. Cockerell*** and ***Richard Stanton-Jones*** and Citation to the men and women of the British Hovercraft Corporation for the design, construction and application of a family of commercially useful Hovercraft.

1969 To ***Douglas C. MacMillan, M. Nielsen*** and ***Edward L. Teale, Jr.*** and Citations to ***Wilbert C. Gumprich*** and the organizations of George G. Sharp, Inc., Babcock and Wilcox Company, and the New York Shipbuilding Corporation for the design and construction of the N.S. Savannah, the first nuclear ship with reactor, to be operated for commercial purposes.

1970 To ***Charles Stark Draper*** and Citations to the personnel of the MIT Instrumentation Laboratories, Delco Electronics Division, General Motors Corporation, and Aero Products Division, Litton Systems, for the successful application of inertial guidance systems to commercial air navigation.

1971 To ***Sedgwick N. Wight*** (in memoriam) and ***George W. Baughman*** and Citations to ***William D. Hailes, Lloyd V. Lewis, Clarence S. Snavely, Herbert A. Wallace,*** and the employees of General Railway Signal Company, and the Signal & Communications Division, Westinghouse Air Brake Company, for development of Centralized Traffic Control on railways.

1972 To ***Leonard S. Hobbs*** and ***Perry W. Pratt*** and the dedicated engineers of the Pratt & Whitney Aircraft Division of United Aircraft Corporation for the design and development of the JT-3 turbo jet engine.

1975 To ***Jerome L. Goldman, Frank A. Nemec*** and ***James J. Henry*** and Citations to the naval architects and marine engineers of Friede and Goldman, Inc. and Alfred W. Schwendtner for revolutionizing marine cargo transport through the design and development of barge carrying cargo vessels.

1977 To ***Clifford L. Eastburg*** and ***Harley J. Urbach*** and Citations to the Railroad Engineering Department of The Timken Company for the development, subsequent improvement, manufacture and application of tapered roller bearings for railroad and industrial uses.

1978 To ***Robert Puiseux*** and Citations to the employees of the Manufacture Française des Pneumatiques Michelin for the development of the radial tire.

1979 To ***Leslie J. Clark*** for his contributions to the conceptualization and initial development of the sea transport of liquefied natural gas.

1980 To ***William M. Allen, Malcolm T. Stamper, Joseph F. Sutter*** and ***Everette L. Webb*** and Citations to the employees of Boeing Commercial Airplane Company for their leadership in the development, successful introduction & acceptance of wide-body jet aircraft for commercial service.

1981 To ***Edward J. Wasp*** for his contributions toward the development and application of long distance pipeline slurry transport of coal and other finely divided solid materials.

1982 To ***Jörg Brenneisen, Ehrhard Futterlieb, Joachim Körber, Edmund Müller, G. Reiner Nill, Manfred Schulz, Herbert Stemmler*** and ***Werner Teich*** for their contributions to the development and application of solid state adjustable frequency induction motor transmission to diesel and electric motor locomotives in heavy freight and passenger service.

1983 To ***Sir George Edwards,*** OM, CBE, FRS; ***General Henri Ziegler,*** CBE, CVO, LM, CG; ***Sir Stanley Hooker,*** CBE, FRS (in memoriam); ***Sir Archibald Russell,*** CBE, FRS; and ***M. André Turcat***, L d'H, CG; commemorating their outstanding international contributions to the successful introduction and subsequent safe service of commercial supersonic aircraft exemplified by the Concorde.

1984 To ***Frederick Aronowitz, Joseph E. Killpatrick, Warren M. Macek*** and ***Theodore J. Podgorski*** for the conception of the principles and development of a ring laser gyroscopic system incorporated in a new series of commercial jet liners and other vehicles.

1985 To ***Richard K. Quinn, Carlton E. Tripp,*** and ***George H. Plude*** for the inclusion of numerous innovative design concepts and an unusual method of construction of the first 1,000-foot self-unloading Great Lakes vessel, the M/V Stewart J. Cort.

1986 To ***George W. Jeffs, Dr. William R. Lucas, Dr. George E. Mueller, George F. Page, Robert F. Thompson*** and ***John F. Yardley*** for significant personal and technical contributions to the concept and achievement of a reusable Space Transportation System.

1987 To ***Harry R. Wetenkamp*** for his contributions toward the development and application of curved plate railroad wheel designs.

1988 To ***J. A. Pierce*** for his pioneering work & technical achievements that led to the establishment of the OMEGA Navigation System, the world's first ground-based global navigation system.

1989 To ***Harold E. Froehlich, Charles B. Momsen, Jr.,*** and ***Allyn C. Vine*** for the invention, development and deployment of the deep-diving submarine, Alvin.

1990 To ***Claud M. Davis, Richard B. Hanrahan, John F. Keeley,*** and ***James H. Mollenauer*** for the conception, design, development and delivery of the Federal Aviation Administration enroute air traffic control system.

1991 To ***Malcom Purcell McLean*** for his pioneering work in revolutionizing cargo transportation through the introduction of intermodal containerization.

1992 To ***Daniel K. Ludwig*** (in memoriam) for the design, development and construction of the modern supertanker.

1993 To ***Heinz Leiber, Wolf-Dieter Jonner*** and ***Hans Jürgen Gerstenmeier*** and Citations to their colleagues in Robert Bosch GmbH for their conception, design and development of the Anti-lock Braking System for application in motor vehicles.

1994 To ***Russell G. Altherr*** for the conception, design and development of a slackfree connector for articulated railroad freight cars.

1996 To ***Thomas G. Butler*** (in memoriam) and ***Richard H. MacNeal*** for the development and mechanization of NASA Structural Analysis (NASTRAN) for widespread utilization as a working tool for finite element computation.

1998 To ***Bradford W. Parkinson*** for leading the concept development and early implementation of the Global Positioning System (GPS) as a breakthrough technology for the precise navigation and position determination of transportation vehicles.

2000 To those individuals who, working at the French National Railroad (SNCF) and ALSTOM between 1965 and 1981, played leading roles in conceiving and creating the initial TGV High Speed Rail System, which opened a new era in passenger rail transportation in France and beyond.

2002 To ***Raymond Pearlson*** for the invention, development and worldwide implementation of a new system for lifting ships out of the water for repair and for launching new ship construction. The simplicity of this concept has allowed both large and small nations to benefit by increasing the efficiency and reducing the cost of shipyard operations.

2004 To ***Josef Becker*** for the invention, development, and worldwide implementation of the Rudderpropeller, a combined propulsion and steering system, which converts engine power into optimum thrust. As the underwater components can be steered through 360 degrees, the full propulsive power can also be used for maneuvering and dynamic positioning of the ship.

2005 To ***Victor Wouk*** for his visionary approach to developing gasoline engine-electric motor hybrid-drive systems for automobiles and his distinguished engineering achievements in the related technologies of small, lightweight, and highly efficient electric power supplies and batteries.

2006 To ***Antony Jameson*** in recognition of his seminal and continuing contributions to the modern design of aircraft through his numerous algorithmic innovations and through the development of the FLO, SYN, and AIRPLANE series of computational fluid dynamics codes.

2007 To ***Robert Cook, Pam Phillips, James White,*** and ***Peter Mahal*** for their seminal work and continuing contributions to aviation through the development of the Engineered Material Arresting System (EMAS) and its installation at many airports.

2008 To ***Thomas P. Stafford, Glynn S. Lunney, Aleksei A. Leonov,*** and ***Konstantin D. Bushuyev*** as leaders of the Apollo-Soyuz mission and as representatives of the Apollo-Soyuz docking interface design team: in recognition of seminal work on spacecraft docking technology and international docking interface methodology.

2009 To ***Boris Popov*** for the development of the ballistic parachute system allowing the safe descent of disabled aircraft.

2010 To ***Takuma Yamaguchi*** for his invention of the ARTICOUPLE, a versatile scheme to connect tugs and barges to form an articulated tug and barge, AT/B, waterborne transportation system operational in rough seas. His initial design has led to the development of many different types of couplers that have resulted in the worldwide use of connected tug and barges for inland waterways, coastal waters and open ocean operation.

2011 To ***Zigmund Bluvband*** and ***Herbert Hecht*** for development and implementation of novel methods and tools for the advancement of dependability and safety in transportation.

2012 To ***John Ward Duckett*** for the development of the Quickchange Movable Barrier.

2013 To ***C. Don Bateman*** for the development of the ground proximity warning system for aircraft.

2014 To ***Bruce G. Collipp, Alden J. Laborde,*** and ***Alan C. McClure*** for the design and development of the semi-submersible platform.

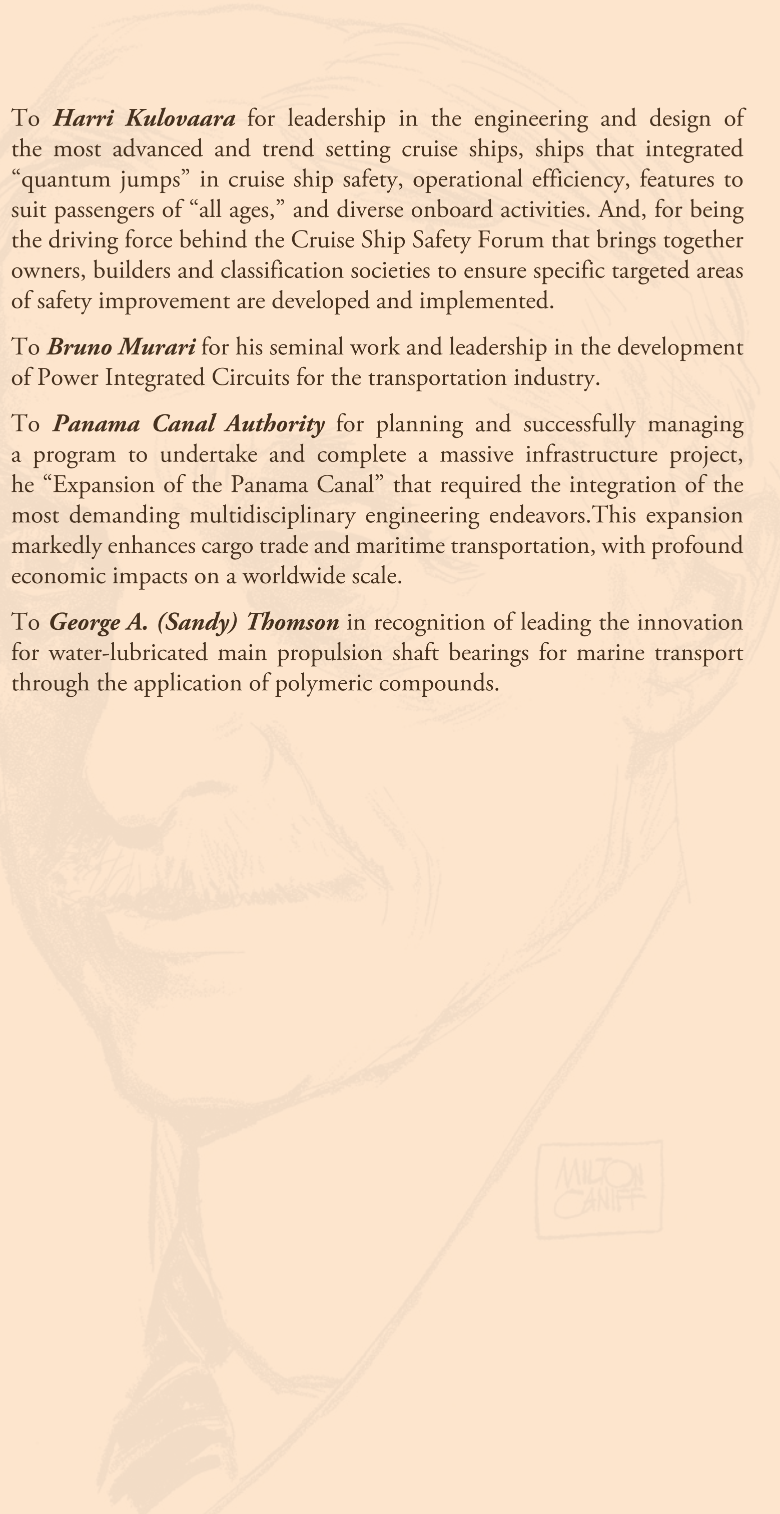
2015 To ***Michael K. Sinnett*** and the ***The Boeing Company 787-8 Development Team*** for pioneering engineering advances including lightweight composite wing and monolithic fuselage construction that have led to significant improvements in fuel efficiency, reduced carbon emission, reduced maintenance costs and increased passenger comfort.

2016 To ***Harri Kulovaara*** for leadership in the engineering and design of the most advanced and trend setting cruise ships, ships that integrated "quantum jumps" in cruise ship safety, operational efficiency, features to suit passengers of "all ages," and diverse onboard activities. And, for being the driving force behind the Cruise Ship Safety Forum that brings together owners, builders and classification societies to ensure specific targeted areas of safety improvement are developed and implemented.

2017 To ***Bruno Murari*** for his seminal work and leadership in the development of Power Integrated Circuits for the transportation industry.

2018 To ***Panama Canal Authority*** for planning and successfully managing a program to undertake and complete a massive infrastructure project, he "Expansion of the Panama Canal" that required the integration of the most demanding multidisciplinary engineering endeavors.This expansion markedly enhances cargo trade and maritime transportation, with profound economic impacts on a worldwide scale.

2019 To ***George A. (Sandy) Thomson*** in recognition of leading the innovation for water-lubricated main propulsion shaft bearings for marine transport through the application of polymeric compounds.



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The Sperry Award Board thanks SNAME Fellow Krisi Tikka for developing the nomination for the WindFloat. Ms. Tikka gave the presentation to the Board at the Board's March 25, 2020 meeting and the Board unanimously approved the award.

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