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Current Positions

President, John Halkyard & Associates, Consulting Offshore Engineers, Houston, Texas USA

Visiting Professor of Maritime Technology, National University of Singapore, 2010 - 2014

Date/Place of Birth: 30 Mar 1945, Syracuse, NY

Citizen of US

Education

B.S., Engineering Science, Purdue University, 1966
M.S., Massachusetts Institute of Technology, 1969
Sc.D., Ocean Engineering, Massachusetts Institute of Technology, 1972

Registered Engineer: M.E., California (since 1983)

Principal Professional Memberships and Activities

Current

Life Fellow, American Society of Mechanical Engineers (ASME)
ASME-International Petroleum Technology Institute, Member of the Board of Directors, 2008 – 2013
Associate Editor, Journal of Offshore Mechanics and Arctic Engineering
Chair, International Professional Advisory Panel, University of Hawaii, Department of Ocean and Resources Engineering

Previous

Guest Professor, Harbin Engineering University, China, 2007 – 2010
Chairman 2005-2006, Executive Committee, Offshore, Ocean and Arctic Engineering Division, ASME
Chairman, OMAE 2007 Conference

Past Chairman, Houston Technical Chapter, OMAE, ASME
Member, Society of Naval Architects and Marine Engineers
Section Chair, Marine Technology Society, San Diego
Marine Board of the National Research Council, National Academy of Engineering
Marine Board Review Committee: Ocean Thermal Energy Conversion Technology
Visiting Committee Member, Massachusetts Institute of Technology, Department of Ocean Engineering
Visiting Committee Member, U.S. Naval Academy, Ocean Engineering Department
Visiting Committee Member, University of Hawaii

Record of Professional Work Experience

2007 – Present, President, John Halkyard & Associates

Dr. Halkyard is presently serving as Integrated Project Team Lead for Platforms and Mooring for a major development of an offshore Ocean Thermal Energy Conversion Project. His client is Lockheed Martin Corporation and the work is funded by Lockheed Martin and the U.S. Navy. The project is planning on installing a 5 MW pilot plant off the coast of Oahu in 2013. Dr. Halkyard is also consulting on an offshore wind energy project. He is under contract with Petronas (Malaysian National Oil Company) to assist in Technical Professional Career Progression related to offshore engineering. This involves establishing a technical inventory and ruler for measuring competency of engineers, and preparing and teaching primary and advanced courses on offshore engineering topics, especially related to floating platforms.

2010 – 2014, Visiting Professor of maritime technology, National University of Singapore

Conducting courses on Floating Platform Design, Moorings and Risers and supervising Ph D student research in hydrodynamics.

2006 – 2010, Visiting Sr. Fellow, National University of Singapore

2008 -2010, Guest Professor, Harbin Engineering University, China

Visiting lecturer.

2004, Visiting Professor, University of Western Australia, 2004

Visiting Lecturer

2003 – 2007, Technip USA, Inc.

Chief Technical Advisor, Floating and Fixed Facilities Product Group. Provide technical advise and support for projects and R&D efforts, particularly in the areas of hydrodynamics, model

testing and systems global analysis. Spearheaded application of Computational Fluid Dynamics to the problems of spar and riser vortex induced vibrations.

2000 – 2003, Aker Engineering, Inc. and Subsequent acquiring companies (CSO and Technip)

Vice President, Product Technology and Deepwater R&D. Plan and implement an $3MM/annum R&D program in a large contractor organization which had no previous R&D department. Hired a staff and lead development of several new products. Presently Chief Technical Advisor for the Floaters Products Division of Technip Offshore, Inc.

1989 – 2000, Deep Oil Technology, Inc.

Consultant and later Technical Director, responsible for analysis and testing of Spar Floating Production Systems. Plan, organize and conduct experiments and develop computer programs for spar and riser analysis. Prepare and analyze novel designs for new applications, especially North Atlantic and Norwegian Sea projects. Manage R&D projects with industry participation.

1984 – 1988, Vice President, Arctec Offshore Corporation

Market and manage hydrodynamic and structural testing related to naval and offshore projects. Managed numerous test programs for offshore structures, ships and submarines in the AOC model basin in Escondido, California. Principle among these was a comprehensive series of tests for the first floating production system in the Gulf of Mexico, The Placid GC29 Semi-submersible.

1980 – 1984, Founder and President, Ocean Engineering Consultant, Inc.

Started and managed has own consulting company working on projects ranging from ocean mining, offshore structures and high performance pumping applications. Prepared studies for mining methods of cobalt rich oceanic crusts and ocean sulfides. Assisted in the design of tendons for Tension Leg Platforms, especially the analysis and testing of the tendons for fatigue and fracture. Initiated major research program on the Inspectibility of TLP Tendons. Also prepared business plan and helped develop an energy efficient system for desalination using reverse osmosis and a patented energy recovery pumping system (Varipump Corp.).

1971 – 1980, Sr. Ocean Engineer and Director, Ocean Mining Laboratory, Kennecott Exploration, Inc.

Responsible for developing equipment and systems for mining of Manganese Nodules for the sea floor in 15000 ft water depths. Responsible for planning and executing basic and applied R&D which lead to successful testing prototype equipment. Work involved developing laboratory facilities which several unique testing fixtures, planning and supervising lengthy ocean expeditions to collect data and to test equipment. This included hiring and supervising a highly skilled, multidisciplinary technical team.

1967 – 1970, Summer Engineer, Chicago Bridge and Iron Company, also Research Assistant at the Massachusetts Institute of Technology

As summer worker and as part of funded research while a graduate student, responsible for hydrodynamic analysis and testing of large oil storage tanks and other offshore structures. Developed computer program used by CBI for analysis of forces and pressures on large submerged structures in waves. Helped design and specify wave tank for testing of offshore structures. Contributed to business planning of CBI's offshore business.

1967 – 1970, Research Assistant, Massachusetts Institute of Technology
Developed the first numerical boundary element code for diffraction analysis of large bodies in waves.

1966, Jr. Geophysicist, Geophysical Services, Inc.

Helped process seismic data at GSI Data Center as summer employment.

Professional Achievements

Numerical Hydrodynamics: As part of Graduate School and early employment at Chicago Bridge & Iron, Dr. Halkyard developed one of the first numerical programs using Green's Theorem to solve ideal fluid equations for wave interactions with large objects in the sea. This program was used to develop pressure loads on large oil storage platforms installed offshore in the Persian Gulf in the early '70s[1].

Ocean Mining

From 1972 to 1980 Dr. Halkyard led the Ocean Mining Research and Development activities for an International Consortium operated by Kennecott Copper Corporation. He was responsible for hiring a highly skilled technical staff and planning and organizing applied research activities which resulted in the successful prototype scale testing of mining equipment for the recovery of Manganese Nodules from the sea bed in 15,000 ft water depths. He was directly responsible for supervising a technical staff of over 50 engineers, scientists and contractors in this large R&D effort. This required the invention and implementation of numerous new technologies, for example:

A nodule collector (dredge) had to be designed without access to the sea bed for extensive testing. The unusual properties of the pelagic marine sediments (high sensitivity) had to be quantified and replicated in a laboratory. This required design of unique instruments for

[1] Halkyard, J.E., "Forces Induced on a Bottom Mounted Semi-Sphere by a Plane Progressive Gravity Wave", S.M. Thesis, M.I.T., June, 1969; Milgram, J.H. and Halkyard, J.E., "Wave Forces on Large Objects in the Sea", *J. Ship Research*, Vol. 15, 1971; Halkyard, J.E., "Wave Forces on a Submerged Object", Sc. D. Thesis, M.I.T., Oct. 1971

measuring the appropriate engineering properties of the sea bed and the translation of these measurements into a laboratory procedure for testing collectors[2].

A prototype nodule collector was successfully tested in a Pacific Ocean mine site in 1974-5. Dr. Halkyard was the Technical Director of this effort and served as Chief Scientist on the test cruises[3].

The system for lifting the slurry of manganese nodules from the sea bed to a surface vessel also required development of new technologies. The commercial design called for raising 3 million tons/year, or 15,000 tons per day of nodules in a slurry from 15,000 ft. Designs were made and tested for both submersible electric pump systems and air lift systems for these requirements. New analysis methods were developed and experimentally verified for the two and three phase flow in a near vertical pipe.

The overall mining system design required development of analytical methods for the coupled analysis of the dynamics of a ship, pipe and sea bed collector in ultra deep waters. Customized software for this purpose was developed under Halkyard's direction in the 1970s which rivals much of the software in use today by the offshore industry. Wave, current and soil/machine interactions were successfully modeled. The results were verified by the prototype tests[4].

The mining operations required towing large pipe (18") through the 15,000 ft water column at speeds up to 2 kts. This required the evaluation and mitigation of vortex induced vibrations. New experimental methods for obtaining VIV data at supercritical Reynold's numbers were utilized[5].

From 1978 – 1980 Dr. Halkyard served as Secretary on the coordinating committee for the Mining Consortium and was chief planner of all activities which included mining, transportation and processing and an overall technical and economic feasibility assessment of the project.

In the early '80s, while managing his own consulting firm, Dr. Halkyard served as a consultant and prepared a report for the State of Hawaii on the mining of cobalt rich manganese crusts in the EEZ[6] Separately he performed a feasibility study for a major mining company on the mining of massive sulfide deposits on the sea bed.

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[2] Halkyard, J.E. "Soil Mechanics Considerations in the Design of Deep Ocean Mining Equipment":, Proceedings – Deep Sea Sediments: Physical and Mechanical Properties, A.L. Interbitzen, ed., Arlie House, VA April, 1973

[3] Heine, O.R., "An Experimental Nodule Collection Vehicle Design and Testing", Proceedings – Offshore Technology Conference, Houston, TX, Paper 78-3138, 1978

[4] Halkyard, J.E. "Deep Ocean Mining for Manganese Nodules", *Physics in Technology*, The Institute of Physics, UK, V. 10, 1979

[5] Grote P. and Halkyard, J., "Vortex-Induced Response of a Pipe at Supercritical Reynold's Numbers", Proceedings – Offshore Technology Conference, Paper 87-5520, Houston, TX 1987

[6] "Mining Development Scenario for Cobalt Rich Manganese Crusts in the Exclusive Economic Zone of the Hawaiian Archipelago and Johnston Island", Report, Hawaii Department of Planning and Economic Development, Business and Industrial Development Division, Ocean Resources Branch, Honolulu, 1987

Offshore Structures R&D

Structural Design

From 1982 – 1984 Dr. Halkyard initiated and carried out a research program on the Inspectibility of Tension Leg Platform Tendons. The tendons are the primary mooring and stabilizing elements for the TLP concept for oil production in deep water. The Minerals Management Service and three oil companies funded this work. The objective was to determine an appropriate specification for field deployable non-destructive testing devices. Two questions had to be answered.

- What was the state of the art for NDT machines' ability to detect fatigue cracks in steel tendons, and
- What was the relationship between the minimum detectable crack size and the frequency of inspection.

The research involved acquiring prototype NDT components based on ultrasonic methods and running numerous tests on different crack configurations. Some specimens were produced by welding to appropriate standards and generating fatigue cracks through cyclic bending tests. This yielded an algorithm for determining the sensitivity of ultrasonic NDT instruments as a function of the sensor properties and orientation.

A parallel effort was also conducted to perform a fracture mechanics assessment of the tendons for various designs and environments which lead to another algorithm for determining frequency of inspection for a particular inspection scheme. This research led directly to MMS specifications for inspection tools used on the first TLP installed in the Gulf of Mexico.

Model Testing

From 1984 – 1988, Dr. Halkyard served as Vice President, Arctec Offshore Corporation in Escondido, California where he was in charge of testing floating offshore platforms. In 1985 he supervised the multi-faceted testing of the first Floating Production System designed for the Gulf of Mexico. This program included investigation of floater and riser behavior in waves and current. It involved the first model test to attempt to model the coupling of mooring and vessel response in deep water[7]. Dr. Halkyard also conducted numerous tests on other offshore platforms as well as towing tests for resistance, propulsion and maneuvering of floating and submerged vehicles.

Floater Development

In 1996, Oryx Energy Company and Consolidated Natural Gas Company installed the world's first Oil Production Spar Buoy in 2000 ft of water in the Gulf of Mexico. This concept for a

[7] Halkyard, J. E. *et al*, "A Summary of a Multi-Faceted Physical Model Test Program of a Floating Drilling and Production System", Offshore Technology Conference, Paper 88-5674, Houston, 1988

stable floating production vessel was the invention of Ed Horton, founder of Deep Oil Technology. Dr. Halkyard served as Mr. Horton's chief technical advisor since 1989 and was responsible for proving the Spar concept and demonstrating its effectiveness. Dr. Halkyard organized and led several Joint Industry Projects, including, among other things, conducting of hydrodynamic model tests and correlation with theoretical estimates of the Spar's performance in ocean waves and currents, developing software for the integrated structural and hydrodynamic design of the Spar production system, and development and verification of mathematical models for the Vortex Induced responses of the spar in currents[8]. A numerical program was developed to predict the Vortex Induced Vibrations and drag on a spar in a variable current and with the spar partially covered with helical strakes[9].

Dr. Halkyard was involved in the design and development of several of the critical components necessary for the spar concept to function as an oil production platform. For example, he received a patent for the a stress relieving joint for the production riser pipes which allowed the pipes to pass through the keel of the spar where they would be subject to bending and wear from the relative motions of the spar in waves[10].

As Technical Director of DOT and subsequently as manager of R&D for Aker Engineering, Inc. after Aker acquired DOT, Dr. Halkyard has been responsible for the development of several additional deep water concepts and methods, some of which have resulted in additional patents.

Publications - Journals

Dr. Halkyard is author of numerous publications in journals, conferences and magazines, come cited above and others including:

Milgram, J.H. and Halkyard, J.E., "Wave Forces on Large Objects in the Sea", *J. Ship Research*, Vol. 15, 1971

Halkyard, J.E. "Deep Ocean Mining for Manganese Nodules", *Physics in Technology*, The Institute for Physics, UK, V. 10, 1979

Halkyard, J.E., "Innovation in Crust Mining Technology", *Materials and Society*, Vol. 14, No. ¾, 1990 (expanded version in "Mining Development Scenario for Cobalt Rich Manganese Crusts in the Exclusive Economic Zone of the Hawaiian Archipelago and Johnston Island", Hawaii Department of Planning and Economic Development, Business and Industrial Development Division, Ocean Resources Branch, Honolulu, 1987)

[8] Halkyard, J.E., "Evolution Of The Spar Floating Drilling, Production And Storage System", Sname (Texas) Annual Meeting, Offshore Technology: Evolution And Innovation", Feb., 2001, Houston, TX

[9] Halkyard, J.E., "Vortex Induced Motions of Large Floating Bluff Bodies", Proceedings – Offshore Technology Conference, Houston, TX, 1991

[10] U.S. Patent "Stress Relieving Joint for Pipe and Method", 1998

Publications - Conference Proceedings (Sample)

Halkyard, J.E., "Evolution Of The Spar Floating Drilling, Production And Storage System", Sname (Texas) Annual Meeting, Offshore Technology: Evolution And Innovation", Feb., 2001, Houston, TX

Halkyard, J.E., "Vortex Induced Motions of Large Floating Bluff Bodies", Proceedings – Offshore Technology Conference, Houston, TX, 1991

Halkyard, J. E., "Ore Handling and Transfer at Sea", Marine Technology Society, Annual Conference and Exhibition, Washington, 1980

Tahar, Arcandra and Halkyard, John, "Full Scale Data Comparison for the Horn Mountain Spar during Hurricane Isidore, Time Domain versus Frequency Domain Analysis", The 25th International Conference on Offshore Mechanics And Artic Engineering, OMAE-2006-92137, Hamburg, Germany, 4 – 9 June, 2006

Atluri, Sampath, Halkyard, John and Sirnivas, Senu, "Cfd Simulation Of Truss Spar Vortex-Induced Motion", The 25th International Conference on Offshore Mechanics And Artic Engineering, OMAE-2006-92400, Hamburg, Germany, 4 – 9 June, 2006

Ji, Chun Qin and Halkyard, John, "Spar Deck Float-Over Feasibility Study For West Africa Environment Condition", The 25th International Conference on OFFSHORE MECHANICS AND ARTIC ENGINEERING, OMAE-2006-92157, Hamburg, Germany, 4 – 9 June, 2006

Halkyard, John, Atluri, Sampath and Sirnivas, Senu, "Truss Spar Vortex Induced Motions: Benchmarking of CFD and Model Tests", The 25th International Conference on Offshore Mechanics And Artic Engineering, OMAE-2006-92673, Hamburg, Germany, 4 – 9 June, 2006

Publications – Books and Monographs

"Structural Analysis of Tension Leg Platforms", monograph included in *Tension Leg Platforms – A State of the Art Review*, American Society of Civil Engineers, 1990

Contributing author to Handbook of Offshore Engineering, Chakrabarti, ed., Elsevier, 2005 (Chapters on Floating Offshore Platform Design and Risers)

Dynamics of Floating Offshore Structures, authored by the late Subrata Chakrabarti, the chapters on floating offshore structure design are being edited by Dr. Halkyard.

Principles of Naval Architecture, to be published by the Society of Naval Architects and Marine Engineers. Dr. Halkyard wrote the chapter of floating structure responses.

Author and Publisher, *99 Days to Panama*, Brindle Press, 2005 (non-technical)

Patents Issued

U.S. Patent 6,652,192, “Heave suppressed offshore drilling and production platform and method of installation”, Nov. 2003

U.S. Patent 6,299,383, “Method for deck installations on offshore substructure”, Oct. 2001

U.S. Patent 6,206,614, “Floating offshore drilling/producing structure”, Mar. 2001

U.S. Patent 5,924,822, “Method for deck installation on an offshore substructure”, July, 1999

U.S. Patent 5,683,205, “Stress relieving joint for pipe and method”, Nov. 1997