EDWARD E. HORTON

1927–2015

Elected in 2002

"For innovative contributions to the development of systems and structures for oil drilling and production in very deep water."

BY J. RANDOLPH PAULLING

EDWARD EVERETT HORTON, one of the most creative and innovative engineers in the offshore oil and gas industry, died at the age of 87 on August 13, 2015, in Houston, Texas.

He was born November 13, 1927, in San Gabriel, California, to Winter David and Edith Kendall Horton. He received a BS degree in civil engineering from Yale University (1949) and a master's degree in petroleum engineering from the University of Southern California (1957). While at Yale he entered the Navy on the Holloway Plan[1] and was a decorated veteran of the Korean War, serving on the USS *Helena* and, as a qualified submariner, the USS *Sea Leopard*.

After his naval career, Ed moved into the new and growing field of ocean engineering, where his fertile imagination and expertise, combined with his Navy experience, afforded him the opportunity to fully develop his creative talents.

Some years earlier, a group of earth scientists had conceived the idea of drilling into the boundary between the Earth's crust and mantle to obtain a sample of the mantle material. Since the crust is substantially thinner under the deep ocean than under land, it would be expedient to conduct this drilling

[1] A post–World War II program to replace officers (mostly reserve) who left or would shortly leave the Navy.

in deep water from a floating platform. Ed was selected by the National Research Council as a principal engineer on this drilling effort, called the Mohole Project.[2]

In 1961 initial drilling was carried out from existing vessels, and construction was begun on a large semisubmersible platform to support the Mohole drilling. Unfortunately, before the project could achieve its goal, it was cancelled because of rapid cost escalation. It nevertheless generated much fundamental knowledge and engineering experience that finds use today in the design of floating platforms used for oil drilling and production in deep water.

As a result of his involvement and contributions, Ed became well acquainted with not only the technology but also many of the people and companies involved in engineering in the deep ocean. A small group of them, under the leadership of Ed's good friend Willard Bascom, formed a company, Ocean Science and Engineering, appointing Ed as a vice president and board member. OSE developed platforms, tools, and engineering concepts for offshore use in both deep and shallow water.

Within the framework of OSE, Ed formed his own subsidiary company, Deep Oil Technology (DOT), specializing in deepwater oil drilling and production. As head of DOT, Ed became one of the most recognized innovators in the offshore oil business, leading to his numerous patents on platforms, well controls, mooring systems, and other concepts.

Among his inventions are the surface platforms that support the drilling and production equipment and the wellhead that controls access to the well. DOT put substantial initial effort into the tension leg platform (TLP), a floating platform whose buoyancy exceeds its weight and is held in position by taut vertical anchor tendons. The tendons maintain vertical equilibrium under the excess of buoyancy over weight and, at the same time, suppress wave-induced vertical motion,

[2] Derived from the term for the boundary between Earth's crust and mantle, the Mohorovičić Discontinuity or Moho. The National Academy of Sciences observed the project's 50th anniversary in 2011 (https://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=04152011).

thus providing a stable base to support drilling and other operations.

Early in his development of the TLP, after much small-scale model testing and computer simulation, Ed convinced a consortium of 19 oil and offshore companies to fund a joint venture to build a large physical model, at about one-third scale, of a TLP. This model, to be tested at sea off the Southern California coast, was named the DOT X-1. It would be large enough to ensure that scale effects on hydrodynamic forces would be minimized yet small enough that the expected wave conditions in the area of testing would represent severe storm seas at full scale. It was equipped with instruments to record waves, platform motions, anchor tensions, and internal structural forces. The DOT X-1 was built and moored at sea as planned, where it provided about 3 years of experience data.

The TLP was only the beginning of a series of concepts for platforms to support drilling in the deep ocean. It was previously known that a simple vertical spar with small cross-sectional dimension (diameter) compared to its length (height) will have low wave-induced forces and motions if the dimensions are properly chosen in relation to the proportions of the waves. Ed conceived several variations on the simple spar, some consisting of multiple spar-like members of different diameter joined either coaxially or in an array of parallel members. He also invented a way to support marine risers in the spar, leading to spars in several configurations that have become some of the most successful new concepts for drilling and production platforms in deep water. Even today, TLPs and spars are the only platforms in deep water capable of supporting permanent vertical risers for drilling and production, allowing the well heads to be located at the surface rather than the sea floor for more economic operation. About half of the deepwater floating platforms that have been built in the past 2 decades are either TLPs or spars.

Later in life his interests included ocean monitoring and offshore wind, wave, and other sources of renewable energy from the ocean. And he was constantly studying new materials and construction methods for applications to old and new concepts.

In addition to his 2002 election to the NAE, Ed received numerous honors and awards for his contributions. The National Academy of Sciences awarded him the Gibbs Brothers Medal in 2001 for "visionary and innovative concept development and design of offshore platforms, mooring systems and related technology that have significantly influenced development of deepwater operations." Other major honors were the 1997 Offshore Technology Conference Distinguished Achievement Award for Individuals; 2004 Projects, Facilities, and Construction Award from the Society of Petroleum Engineers; and 2010 "Hall of Fame" award from ASCE for his 1970 paper on the tension leg platform.[3] He was also named an Offshore Pioneer by the Oilfield Energy Center (2008) and chosen as a Rhodes Petroleum Industry Leader by ASME (2005).

Ed served on numerous advisory boards and committees. He was a member of the American Bureau of Shipping Offshore Technical Committee, Marine Technology Society, American Concrete Institute, Yale Alumni Association, and Advancement Committee of the Civil and Environmental Engineering Department of Rice University.

Ed was as original and creative in his private life as in his business. He had a wonderful sense of humor, loved music and movies, and delighted in creating and reciting poems, especially for children. He was close to his three daughters—Winter Horton Hoffman, June Horton Van Nort, and Janet Horton—and six grandchildren, and was a guest in classrooms over the years. He was a devoted family man and a mentor and inspiration to many others.

Although Ed's principal business activity was in Houston, he maintained the home in California that had been his residence for many years. He and his beloved wife Anne Watts Horton were members of St. Martin's Episcopal Church, two

[3] Paulling JR, Horton EE. 1970. Analysis of the tension leg stable platform. Paper presented at the Offshore Technology Conference, April 21–23, Houston.

dance groups, and the Utopia Yacht Club of Lake George, New York, and also enjoyed traveling the world.

He was preceded in death by his first wife, Janet Durst Horton.