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Hurricane-Resistant Mooring System—Enabling Technology Through the Use of Synthetic Ropes

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Abstract

In the wake of the 2005 and 2006 hurricane seasons, many new technologies were developed to improve mooring systems for offshore rigs and drilling units. One new technology is the gravity-installed vertical-lift anchor system (VLA).

Proper deployment of the new anchor design would have been hampered by the use of traditional anchor chain in this application. The additional weight of chain affects the trajectory of the anchor causing insufficient embedment into the seabed.

We have designed and tested a synthetic mooring line coupled with an anchor retrieval/deployment line specifically for this system to be used for MODU installation in the Gulf of Mexico.

This paper discusses the design of the rope, the lessons learned from the first installations, and the effects of Hurricane Gustav on this system.

Background

Hurricanes Ivan, Katrina, and Rita proved the true power of Mother Nature. As these storms swept through the Gulf of Mexico, several platforms were either severely damaged, parted their moorings, or both, resulting in billions of dollars in damages and loss production. Since these storms, many new regulations have been adopted to minimize the risk associated with mooring during hurricane season. One of these revisions was that anchors must be approved by the Mineral Management Service (MMS) on locations where there is a high risk of mooring failure. Many of the anchors that became dislodged were traditional drag-embedded anchors. These anchors, once dislodged can drag on the sea floor damaging subsea structures in its path. With this added risk, traditional drag-embedment anchors are less likely to be approved in high subsea consequence areas during hurricane season.

The engineers at Delmar Systems created a unique anchor design that would not only provide the holding power for hurricane conditions, but would also be cost effective with regard to installation. This design, labeled the “OMNI-Max” anchor, incorporates several advantages over both traditional drag-embedment anchors and suction piles. These advantages are

1. precise positioning,
2. 360-degree loading,
3. size [eight anchors can be deployed by one average sized anchor-handling vessel (AHV)], and
4. efficient (anchors are “dropped” into place).

One critical component of the installation is the initial penetration of the anchor. The anchor is released using an acoustically activated quick-release hook, and requires full penetration before any side load can be applied. During the fall, the trajectory must remain true, to insure proper penetration. Heavy mooring chains and/or wire can cause the anchor to canter during the fall, hindering full penetration. To prevent this, a lightweight mooring system had to be created. This system would not only have to not interfere with the installation but also withstand the rigors of offshore moorings. These requirements lead to the creation of Samson’s “M-8 Mudline.” This rope construction is an application-specific product designed around the performance parameters required to work in conjunction with the “OMNI-Max” anchoring system designed by Delmar. The key design factors of the rope include strength, abrasion resistance, prevention of foreign-particle ingression, and the understanding of remotely operated-vehicle (ROV) connections at extreme depths.