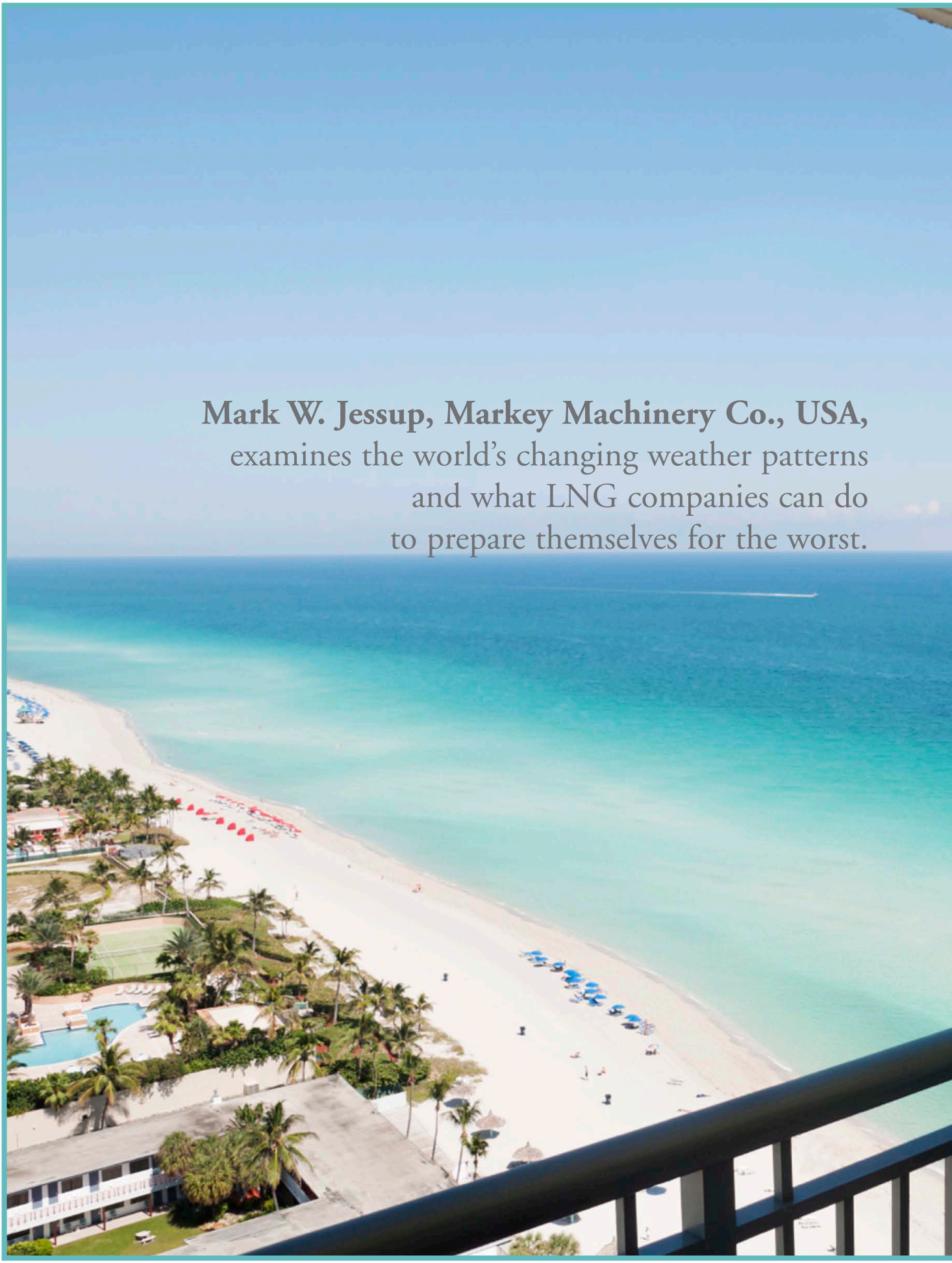

Mark W. Jessup, Markey Machinery Co., USA, examines the world's changing weather patterns and what LNG companies can do to prepare themselves for the worst.

IS ANYONE THINKING ABOUT THE WEATHER?

Over the past 50 years, various energy sectors have experienced tragic accidents, immediately placing themselves in the spotlight of public attention. In the USA, all one has to say is 'Exxon Valdez' or 'Deepwater Horizon' to conjure up the images of what occurred in those specific events. They have become etched in public consciousness around the world. Opponents of the affected energy sectors ensure these images are regularly reinforced; thus a worldwide population remains wary of what energy-related environmental disasters lurk on the horizon.

There is one notable exception. The global LNG industry continues to be perceived favourably, largely due to the continuing safe operation of shore-side terminals, and the LNG carriers that arrive and depart from their ports. One industry website cites an enviable safety record; over 128 million miles travelled, over 105 000 LNG carrier voyages made without significant accident or incident, in port or at sea. This relatively unblemished safety record has held for almost half a century.[1]

Keeping that record on track has become a greater challenge in recent years, even with significant progress in ship and terminal designs. The economic ebb tide has impacted port and channel maintenance just as larger LNG carriers are coming online. Increasing global energy needs are creating demand for increasing volumes of LNG crossing the seas between countries, resulting in more arrivals and departures. A combination of practical, environmental and safety concerns have pushed LNG sites into exposed remote locations. Optimal sites are out in the open with little buffering by surrounding terrain. As a result, weather conditions have a greater impact. Operations are already conducted in higher winds and sea states as a consequence of the exposed location.

The images of violent weather that have been recorded from around the world in recent years, along with the recognition that it will likely be with us for a while, does bring up a question. How prepared are terminal and port operators for operations in worsening weather? Specifically, can the existing fleet of tugs and crews attending to those arrivals and departures continue to ensure that they occur safely?

According to maritime superstition, talking about the weather can bring bad luck. But one ignores the weather at one's peril. A brief internet search produces hundreds of references to changing weather patterns and the debate about probable causes. But there isn't much dispute that the planet is experiencing weather events of an increasingly aggressive nature. Whatever fuels these events appears to have some staying power. A 2010 report regarding an increase in wave heights on the US Pacific Coast anticipates future extreme wave heights of 55 ft; dwarfing the 33 ft estimate made in 1996.[2] That's in Markey's 'backyard'. Coastal damage observed by this author over the last decade is certainly personal confirmation.

All of this will definitely have an impact on continued safe operations, particularly in the area of ship escort and berthing, as carriers move from port to port. Fortunately, there are ways to equip tugs and train crews to remain safe when operating in extreme weather. Issues of safe and efficient operation in exposed seas have been under study for some time. Two joint industry projects have examined this topic, along with a number of individuals from the ranks of captains, pilots and crews.

MARIN SafeTug I and II

It could be reasonably argued that where LNG facilities have been sited has triggered much of the development of Markey's high efficiency, high horsepower winch development, particularly in Asymmetric Render/Recover capable of bollard-strength pulls, and more. They have also been the berthing ground of a new generation of tugs such as Robert Allan's RAstar and Z-Tech series.

With similar activities occurring between different participants with competing interests, Maritime Research Institute Netherlands (MARIN) created a forum in 2005 for sharing knowledge gleaned from application and testing in real time conditions among all who would contribute. Focused around a website and process known as SAFETUG, a group consisting of 30 end-users, operators, designers, shipyards and equipment manufacturers participated in one or both of two sessions, focused on a variety of issues. Among the issues covered in the first session included a study of 'the performance and behaviour of tugs in waves while assisting at very slow speed (berthing), slow speed (escorting direct assist), or high speed (escorting indirect assist).'[3] The second study, which began in 2008, focused on tug design, deck machinery and towlines, along with operational training. One very significant deliverable was the creation of modelling and simulation software that allows companies to accurately predict the forces that tugs and winches will be subjected to, and the power needed to maintain control of the escorted vessel.

The view from the wheelhouse

Many of the issues addressed in the SAFETUG forums were initially identified through conversations with pilots, captains and crews of both escorting tugs and LNG carriers. A highly respected member of their ranks is Captain Greg Brooks, a long time ExxonMobil skipper. He now trains future tug crews around the world in the skills and techniques of ship assist via his company, Towing Solutions, Inc. In recent conversation with this author, he offered a 'view from the wheelhouse' perspective regarding the issues raised during the SAFETUG I and II process.

"The question of how the LNG industry might respond to higher average wind speed due to the warming of the atmosphere is an interesting one to ponder," notes Captain Brooks.

"First... [Ports] would initially accept some incremental delays to maintain their current environmental (operating) standards. However, over time these delays would start to affect the economic viability of the terminal and exceptions would probably start to be allowed to minimise these financial issues. As these exceptions are issued more frequently [they become] a new de facto environment [operating] limit."[4]

There is an added wrinkle. Contrary to what might be assumed, while all LNG terminals have formal environmental (wind and wave height) limits for operation, there is quite a bit of variance in these limitations by location. For example in Milford Haven, UK, LNG ships are allowed to transit to the terminals (there are two: South Hook LNG and Dragon LNG) with winds of 25 knots gusting to 30 from any direction except south (straight onto berth) then 20 gusting to 25, with no wave height limits. In contrast to this is Lake Charles, LA (again there are two terminals: Cameron LNG and Trunkline LNG). The wind limit is 20 knots of wind coupled with a maximum 2 m sea state (for safe pilot boarding).

Adding to this operational disparity are the physical limitations of the terminal, port and corresponding channels. Channel width, depth and length become critically important during operation in higher wind speeds and wave heights. In higher winds, an LNG carrier will occupy more of the channel width as it crabs it way up the channel, due to its windage. The only way to reduce this angle is to increase ship speed, which gives rise to other issues. "While a pilot might want to run the ship up the channel faster to minimise the ship's crab angle, this might not be physically possible due to squat issues and the amount of water that the ship would have to push ahead of it, which will accelerate bank erosion issues," said Brooks.

The term 'squat' refers to the reduction of a vessel's under-keel clearance caused by its relative forward movement. A vessel tends to squat when making way through seas or riding with the current. An extreme example is the 'bow up – stern down' stance of an accelerating speedboat.

This comment clarifies the need for deeper channels as well as increased channel maintenance. Looking at existing and future LNG facilities, one continuous challenge will certainly be maintaining clear channels while dealing with increasing accumulations of sediment brought by increased rain and coastal flooding. A 2009 United Nations report had predicted "Increased sediment mobility and changes in erosion/sedimentation patterns around harbours and access channels could also complicate operations and raise costs through the need for dredging. Beyond direct costs, damages caused by sea level rise, floods and inundations could lead to port shutdowns, disruption of service, delays and further economic losses."[5] Present day conditions in many of the world's ports and waterways ratify the accuracy of that prediction.

Attempting to increase passages through restricted channels could easily push terminal operators to increase channel speeds sooner rather than later. Such a decision could be made without due consideration of the capabilities of existing escort equipment. The consequences could be severe.

Just as there is variation in environmental 'speed limits' across locations, there is also a wide range of tug/horsepower/drive-type/deck equipment combinations servicing these locations. Will the assigned tugs have the capability to steer and stop the larger vessel? If operations are already at marginal safety levels, the answer is no.

At the very least a careful analysis should be conducted of each escort tug and its ability to affect a save on an LNG carrier, should the carrier suffer a serious mechanical failure during tethered escort. The most important factor to consider is that as the transit speed of the ship is increased, (to minimise the ship's crab angle), the kinetic energy that the escort tug must control is increasing with the velocity squared ($KE=\frac{1}{2}WxV^2$). This will substantially increase the escort tug's minimum performance requirements. Another consideration is the reduced reaction time crews will have in a crisis. As the escorted ship and attending tugs travel faster, the amount of time the pilot and escort tug have to save the ship before grounding is substantially reduced. Again, more tug (and winch) capability is required to safely bring the escorted vessel to a stop.

But increasing tug and winch horsepower and pulling capacity brings another set of issues. Operating in higher wind conditions also means operating in higher sea states. Operating in higher sea states will put severe strain on the connecting towlines and the assisted vessel's bits. Closed Loop Line Tension Control coupled with high speed variable frequency drives and electric motors is an excellent way to address this issue, but few tugs outside of the USA have this technology. Is the existing equipment up to the challenge? Since the ultimate goal is the safe escort of the LNG carrier in and out of the terminal, no single part of the system can be marginal in rating or performance.

Moving forward

At present no one is sure just how bad the weather may get, or how long extreme weather patterns may linger. We would suggest that the science and recurring weather patterns indicate a legitimate long term need for tugs and deck machinery that have more power and faster response rates. Render/Recover or some other form of heave compensation technology is a must. While it is doubtful that any agency will ever 'require' this level of technology, there is no doubt that it can greatly assist the captains and crews of escort tugs to execute the manoeuvres needed to escort and berth the larger LNG carriers of the present day.

To answer the original question; yes, someone has been thinking about the weather and its impact on operations, and safety. Yes, there are systems available that can safely deal with the wild variations of weather and sea states that can occur. Companies like Markey Machinery and Towing Solutions stand ready to equip the tugs, and train the crews to operate safely in extreme weather. The only remaining question now is will it take a tragic accident to move the industry forward? LNG

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