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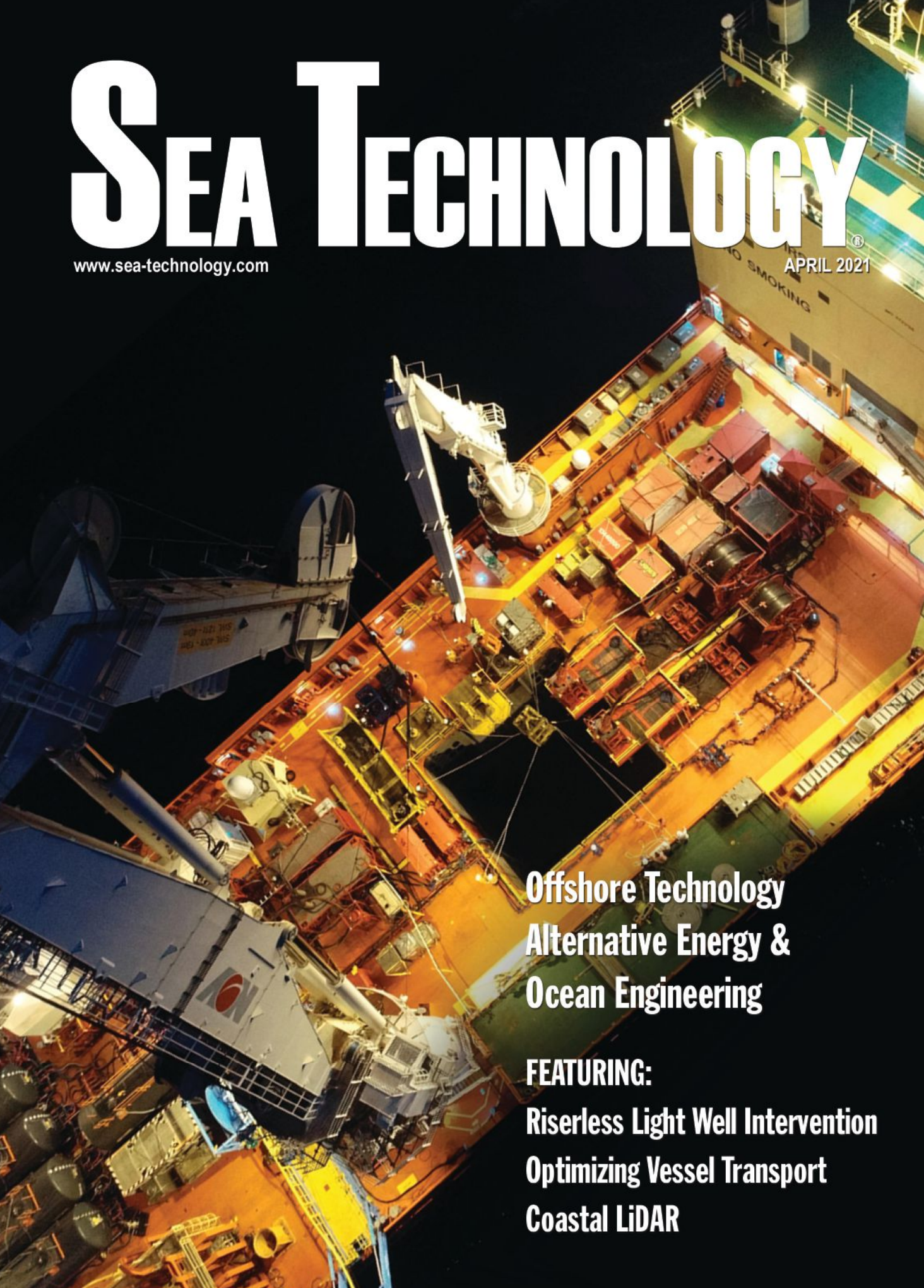

Offshore Technology
Alternative Energy &
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FEATURING:

Riserless Light Well Intervention

Optimizing Vessel Transport

Coastal LiDAR

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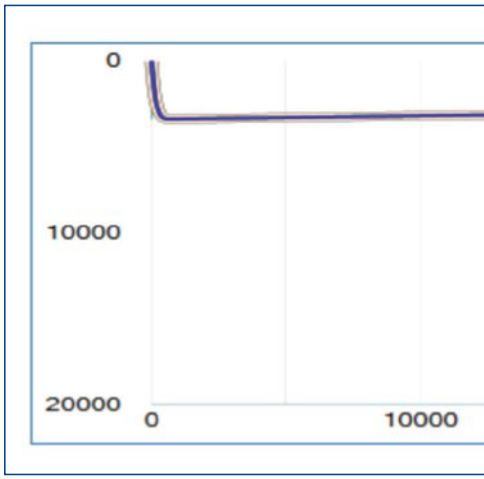

DEPARTMENTS

COVER IMAGE
C-I's flagship Gulf of Mexico assets include the offshore construction and light well intervention vessels *Island Venture* and *Island Performer*, the only RLWI vessels operating in the GOM.

NEXT MONTH
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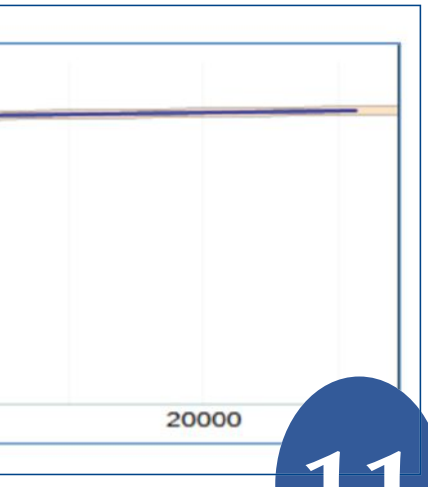

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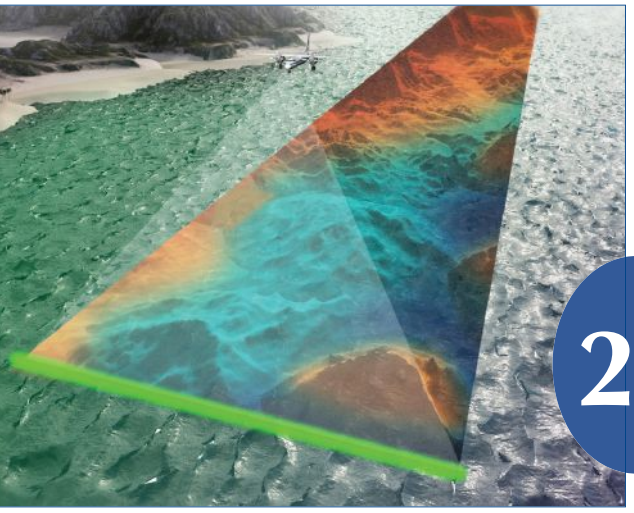

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Record Pipeline Cleanout

Snubbing/Hydraulic Workover Unit Facilitates Pipe Decommissioning

By Bobby Bray • Charles Overstreet

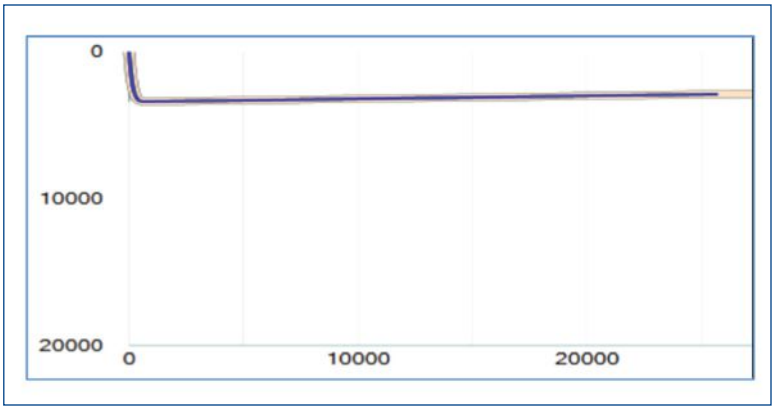
As field assets in the deepwater Gulf of Mexico (GOM) mature, there will be continuing decommissioning needs, including pipeline decommissioning, which is part of a larger decommissioning program.

Two typical types of pipeline decommissioning are: retrieving, cutting, cleaning and disposing of the pipeline on land; and flushing, cleaning, capping, burying, covering, surveying and leaving pipeline in situ on the seafloor.

In the case of leaving the pipeline on the seafloor, a pigging program may be used if it is possible to circulate the pipeline from one end to the other.

If circulation is not possible, then other means of meeting the regulatory requirements must be used. One proven technique is using a snubbing/hydraulic workover (HWO) unit and a DP3 semisubmersible well intervention and construction vessel.

In the fourth quarter of 2020, SBS Energy Services (SBS) successfully completed a multi-phase project to decommission approximately 29,000 ft. of 10-by-6-in. concentric insulated pipeline in the deepwater Gulf of Mexico (3,281-ft. water depth) in partnership with Helix Energy Solutions Group, setting a new offshore snubbing/HWO unit world record. The project was completed successfully in 22 days, ahead of schedule and under budget.



Pipeline trajectory, side view. The trajectory illustrates the short vertical depth (3,281 ft.) compared to the horizontal lateral (25,069 ft.) for a 7.8:1 ratio and the lateral up-dip. Total work string depth was 28,789 ft.

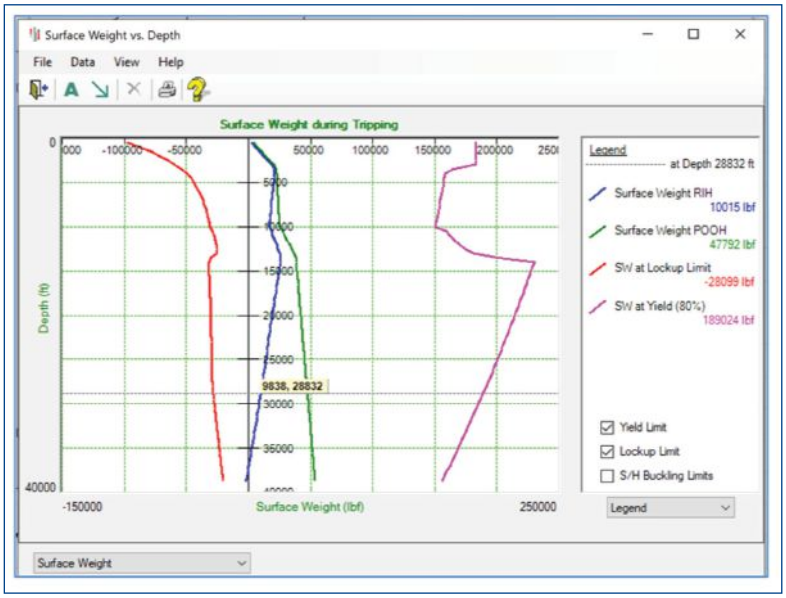
Project Overview

The operator had a four-part objective to meet the federal regulations for decommissioning the pipeline section and ancillary components. This article will expound on phase two operations, which involved using a 340K snubbing/HWO unit to rig up and intervene inside the pipeline with an optimized drill pipe string to perform washing/flushing operations until reaching the second pipeline end termination. Phase two entailed: building a bridge between operational aspects using previous successes/and lessons learned; using a multi-faceted approach combining offshore, snubbing and coiled tubing experience; performing multiple torque and drag iterations to balance practicality, supply chain availability and optimal work string design; keeping the bottom hole assembly (BHA) as simple as possible; provide enough hydraulic horsepower to circulate at high enough flow rates to effectively clean the pipeline of debris; determine the best pre-plan trip schedule of the optimum depth to trip/snub/rotate/snub rotate; and convey the information to operations prior to deployment.

SBS realized that the most efficient operation was to adopt a one-trip-in/one-trip-out philosophy.

Pre-Job Planning

Pre-job planning started six months prior to commencing the work. The operator employed project man-



Force modeling: rotate, pipe heavy, pipe on pipe, est. 0.2 friction factor. Successful prediction of tripping to 28,789 ft. at 10,015 lb. pipe heavy. The execution required snubbing while rotating in tight areas.

agement techniques such as completing the overall task matrix and HAZID. The customer group also used the combined experience and institutional knowledge, along with pre-job modeling, collaboration and process design.

This project required the use of a semisubmersible well intervention and construction vessel. The combination of the vessel platform along with the snubbing/HWO equipment and ancillary equipment allowed for maintaining control while cleaning out the pipeline.

The pipeline's analog data needed to be evaluated and converted to survey data. This was achieved by coordinating with the vessel's pipe lay survey coupled with the pipeline layout on the seafloor.

Then, the force calculations were run. Using the intuitional knowledge, coupled with the available work-string supply, numerous iterations were performed to determine the best overall fit and design of the 2.875-in. OD work string to be successfully tripped in the inner 6-in. nominal pipeline with adequate margin. After completing the force modeling, the best pre-plan trip schedule was produced using the optimum depth to trip/snub/rotate/snub and rotate for the most time-efficient trip.

An endurance fatigue graph (S-N curve) was developed in collaboration with the operator's drilling engineer. The calculations determined that with the inputs the work string could rotate with infinite cycle life due to stresses and not exceed the endurance limit.

A rotary torque schedule was used to prevent overtorquing the work string, depending where the depth was relative to the pipeline. The hydraulic circuit was reset at periodic intervals.

Fluid circulation calculations were performed to determine the proper flow rate and horsepower range to adequately remove the pipeline debris. The fluid circulation calculations estimated 3.5 bpm and less than 5,000 psi, 428 hhp.

Nozzle-sizing sensitivity was performed by balancing the number of nozzles and diameters with adequate pressure drop, jet velocity, impact force and hydraulic horsepower.

Since the snubbing/HWO unit and drill pipe work-string option provided more than enough probability of success to reach the target depth, there was no need to add extra BHA components. However, extra BHA components can be used as needed in future applications.

The project group chose to use a custom junk mill/jet nozzle assembly. This heavy-duty BHA approach reduced the probability of BHA failure, maximized fluid circulation horsepower availability, and reduced the need to trip out of the pipeline to repair or replace the BHA.

Operational Execution

The highlight of the operation was to successfully trip in one time and trip out the work string to the 28,789-ft. actual pipe measurement (3,281-ft. water depth; 25,069 ft. lateral) and flush the pipeline.

The high-level procedure follows: the pipeline was hung off at the drill floor of the semisubmersible; a 340K snubbing/HWO unit system and purpose-configured blowout preventer stack was rigged up directly on the end of the exposed 10-by-6-in. pipeline prepared with a welded flange; a custom 2.875-in. drill pipe and 2.875-in. tubing work string was tripped in the pipeline; the BHA consisted of a nipple and a custom-built junk mill/jet nozzle; and treated calcium chloride fluid and pipe-on-pipe additive were heated and circulated to clean out the debris and mitigate hydrate formation.

Managing the fluid circulation system was one of the challenging parts of the operation. The pipeline was filled with seawater and capped. The snubbing/HWO unit was tripped in as far as possible, then snubbed/pushed until the predetermined maximum allowable snub force was reached. During this time, the pipe-on-pipe additive was introduced into the circulation system as needed. When the snubbing limit was reached, the rotary torque was engaged, and the work string continued to be tripped in. When the work string would not trip with its own weight, the snubbing/HWO unit rotated while pushing to the objective depth. The pipeline was circulated as per the customer's procedure, and the work string was tripped out of the pipeline.

The work string tripped in over 1 mi. (5,280 ft.) farther than the best multi-trip attempt by coiled tubing in a side-by-side comparison. The snubbing/HWO system is capable of even greater distances than those on this project.

Unique Project Features

This project relied on the snubbing/HWO unit's abili-

ty to snub/push/rotate and allows for the ability to reach nearly 5 mi. of extended lateral or a 7.8:1 lateral/vertical ratio.

Another characteristic that makes this unique is that the pipeline lay on the seafloor has a short vertical section (3,281-ft. water depth) compared to a conventional well profile (10,000 ft. vertical). In a simplified case, the weight of the tubular in the vertical is slacked off, and the weight is transferred to the horizontal path and pushes the tubing in front of it along said horizontal to the objective depth.

This concept works until the horizontal buckling and subsequent lockup occur due to frictional forces between the tubing and the casing, or until the vertical section helically buckles and locks up. The operational hurdle is that the vertical depth is short in comparison to the above example. Thus, other techniques need to be employed. Typical techniques considered were using a coiled tubing unit/advanced BHA, a drilling rig or a snubbing/HWO unit. A coiled tubing unit can push and pull, but not rotate; a drilling rig can rotate and pull, but not push. The snubbing/HWO unit can push, pull, rotate, and simultaneously push and rotate; advanced BHAs can be attached to each if needed.

A thermal reactive water heater system was used on this project. Even though thermal reactive water heater systems are established in the industry, consideration was taken to ensure that enough capacity with redundancy was available on the semisubmersible vessel deck so as not to impede the circulation rates pumped. This technique was employed to further assist in softening the hydrocarbon deposits in the pipeline and assist in cleaning out the pipeline.

The pipe-on-pipe friction reducer additive was used to increase the trip depth and lower the trip forces. This technique is typically used in coiled tubing operation. Pumping the chemical intermittently, or as a batch treatment, was effective.

The new torque lock system was designed, engineered and manufactured to store, transfer and maintain residual torque energy while washing and rotating. The system consists of a compact hydraulic traveling torque lock clamp device and a lower stationary torque lock clamp device working in conjunction. The torque lock system has both safety and operational efficiency in design. It saved measurable time, controlled project costs and created a safer work environment.

When drilling long laterals, drilling rigs use a backup tong on the drill string prior to breaking out joints to prevent backlash and maintain torque. However, since a drilling rig uses a power swivel or top drive instead of a traveling head, there is no torque transfer as when using a snubbing/HWO unit.

The system maintains internal residual downhole torque through each stroke and while making up or breaking out joints. The system also mitigates torsional and axial shock loads to increase trip speed and operational efficiency without having to release the system torsion on each stroke. So, over a 28,789-ft. trip in operation, the torque lock device will be used over 2,300 times, resulting in a time savings of up to three days.

Another technology was to incorporate a heavy-duty hydraulic bypass swivel. The bypass swivel increases the efficiency during tripping by eliminating the need to manually attach and detach hoses for the traveling torque lock device. This piece of equipment is designed to hold the design push/pull axial loads while providing a pressurized flow path from a stationary spool to an upper rotational spool. The swivel increased project safety by not requiring personnel to climb and attach hydraulic hoses.

This project demonstrated that the snubbing/HWO unit and vessel configuration approach is an environmentally safe and cost-efficient option for pipeline cleanouts.

Acknowledgments

SBS Energy Services and OPC would like to give thanks to the GOM operator; Helix Energy Solutions Group and the Q4000 vessel and crew; and SBS's support staff and crew for their dedication, professionalism, teamwork culture and safety practices. **ST**

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