An advanced escort procedure

Capt Gregory Brooks* proposes a new method for escorting LNG carriers and tankers which employs tandem tugs and he calls T^2 Deployed

The knowledge of how to effectively use tugs of various types to assist ships transiting a port took on a more urgent purpose after several catastrophic tanker groundings involving large oil spills in the 1980s and 1990s. After these incidents shipowners, ports and pilot associations began to work together to develop procedures to make the escorting of tankers more effective. During the current decade, in tandem with the rapid expansion of the LNG industry and the need to ensure the highest levels of safety in the carriage of this cargo, LNG carriers have also come under the aegis of escort tug operations.

The author is aware of 10 fully instrumented live escort trials conducted in the US and Canada during the last 12 years, along with many other non-instrumented trials. These tests were designed to identify the various factors that contribute to the effectiveness of escort tug operations. Based on these trials, a number of critical interrelated factors that must be successfully balanced to achieve a successful escort have been identified. These can be summarised as follows.

Transit speed

As the kinetic energy of a ship rises geometrically with the transit speed ($KE=1/2W \times V^2$), minimising the transit speed of the ship significantly reduces the amount of energy that the escort vessel(s) will have to apply to maintain the ship in the available channel. Of course, the ship's pilot must balance the option of reducing the transit speed with those local environmental conditions that require a certain speed to be maintained.

Greg Brooks in a tug handling simulator

Channel width and bottom type

Channel width is another factor to be considered as this establishes how much time the escort tug(s) will have to 'save' the ship should an incident take place. The nature of the bottom of the channel on which the ship would ground if the escort was to be unsuccessful is also a factor. In particular, the principals need to weigh up whether their business or port could afford the potential damages, in physical, financial and/or adverse media coverage terms, associated with the consequences of a powered grounding.

Recognition/reaction time

The second critical element to a successful escort is the amount of time it takes for the pilot to recognise that the ship has suffered a failure; to decide what to do about it; to order the ship's engine be stopped and the tug(s) to work; and finally for the ship's engineers and tug operator(s) to react and start the ordered action to save the ship. Until this preventive action is finally applied, the ship will continue to react ever more quickly to the failed rudder or, with a blackout, to the elements.

Effective tug design

The third critical element of an effective escort is to employ tug(s) that can quickly and effectively apply the required steering and/or braking forces to the ship at the designed transit speeds selected by the terminal operator or pilot to save the ship. There are significant escort performance differences in the many azimuthing stern drive (ASD) 'tractor' tugs in use today.

Competency of the pilot and tug crews

The final critical element in this escorting puzzle is the competency and level of training that the pilot and tug crews receive, either in a simulator or using live drills where it is appropriate, to ensure that the people responsible for conducting the escort are capable of responding quickly

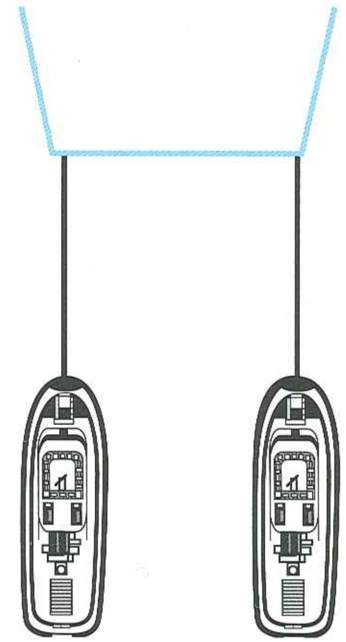

Figure 1. Tandem tractors, or T^2

and accurately to an incident.

In tackling these challenges the marine community has worked tirelessly in a number of areas to improve escort tug operations, including the critical equipment on board ships, the escort performance of the tugs, the strength of towlines, the capabilities of escort winches and the training of pilots and tug crews in sophisticated marine simulators. This article focuses on another area of escort tug performance that has also been improved over the past two decades, i.e. escorting procedures.

One of the steps taken in the late 1990s to improve the application of tug forces to a ship *in extremis* was to tether two 'normal-size' tractors at the transom of the ship being escorted. This approach doubles the power being applied to the ship and provides both tugs with the longest lever arm possible to the ship's pivot point. Furthermore, the two tugs can also apply their towing forces on two separate fairlead and bollard systems on the ship and the use of smaller tractor tugs, which are generally available in most ports, to conduct the escort is enabled. The term originally used for the technique, 'tandem tractors', can be abbreviated to 'T^2' (see Figure 1).

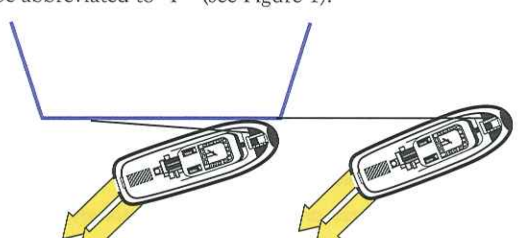

Figure 2. T^2 powered indirect to starboard

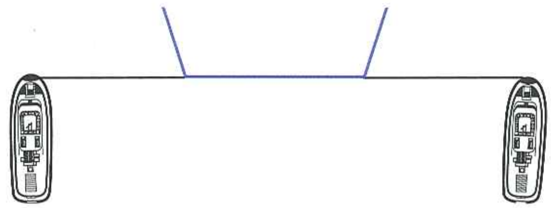

Figure 3. T^2 Deployed in the stop and hold position

As originally developed, the two tugs trailed behind the ship until ordered to conduct the 'powered indirect manoeuvre' at full power by the pilot by (as shown in Figure 2). However, as good as this system is, it carries an inherent delay of approximately 30 seconds, as the tugs have to move from the position trailing behind the ship to the 'powered indirect' position, at 90°, to respond to an incident.

To address this time delay, Towing Solutions Inc (TSI) developed a follow-on procedure to 'T^2' called 'T^2 Deployed'. T^2 Deployed seeks to minimise this response time by having the two tugs pre-deployed, one to either side of the ship's transom. In this 'stop and hold position' the two tugs run parallel to the ship with their towlines lightly loaded and ready to respond.

This pre-deployment allows one of the tractors to be in position to immediately roll into her towline and work at full power in the 'powered indirect' mode should an incident take place (see Figure 3). Meanwhile, the pilot will have stopped the ship's engine, to stop the water flow over the failed rudder, and ordered the second tug to also assist the first tug to double the steering forces being applied to the ship (see Figure 4).

Thus, the use of T^2 Deployed in the stop and hold position potentially removes 30 seconds in the response of the first tug. With this approach the ship barely gets swinging and the first tug, depending on its power, can at least keep the ship's swing from accelerating. When the second tug arrives, the two tugs can then very rapidly return the ship to its original heading and work the ship

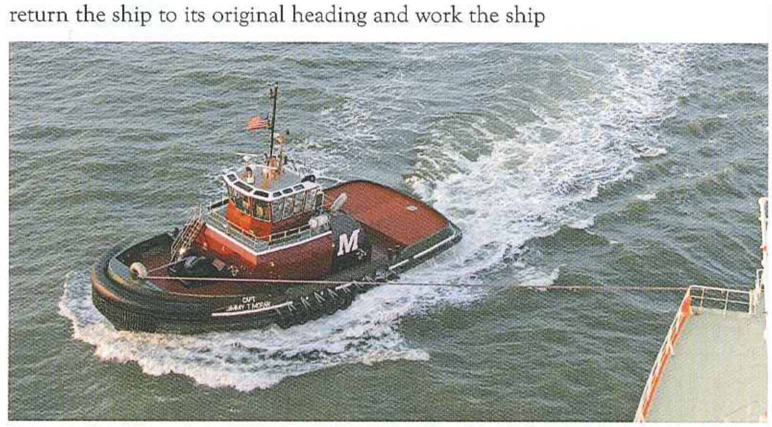

Figure 4. Escort tug in powered indirect manoeuvre

back to the centre of the channel. The Figure 5 photo shows how close the tugs *Jimmy T Moran* and *Shiney V Moran* work to each other in applying their steering force to the ship. By talking constantly to each other over their house channel, the tug captains ensure the necessary levels of safety while working in close proximity.

To evaluate the effectiveness of this new T^2 Deployed procedure, the British Columbia Coast Pilots have run two sets of live trials, one of which was fully instrumented. The first instrumented trial involved the tanker *Hellespont Tatina*, a vessel which displaces 96,935 tonnes at a draught of 13.5m, and two relatively small tractors, i.e. *Tiger Sun* with a bollard pull of 60 tonnes and *Falcon* with 40 tonnes of bollard pull.

During the trials *Hellespont Tatina* was easily controlled by the two tugs when addressing a hard-over rudder failure at 6 knots. Two pilots were on board the tanker, one conning and one observing the helmsman. A 10-second recognition/reaction delay was imposed before the first pilot was allowed to order the ship's engine stopped and the tugs to work at full power. With this combination of transit speed, 10-second delay and tug performance, the off-track distance for the ship was only 13.0m, despite the fact that the second tug never reached the desired 90° position. When a 20-second time delay was utilised for the ship travelling at the same speed, the off-track distance increased to 32.6m, illustrating the importance of minimising the recognition/reaction time.

The two Moran tugs pictured in Figure 5 were practising the T^2 Deployed escorting technique during the recent escort of a 155,000m^3 LNG ship into the new Cameron LNG Terminal in Lake Charles, Louisiana. The Lake Charles Pilots are currently also evaluating the performance of this escort system in simulation studies with 216,000m^3 Q-flex size LNGCs suffering a hard starboard rudder failure at 8 knots. Results of these tests have been very positive.

Figure 5. T^2 Deployed at 8 knots

In these simulation runs after an imposed 10-second delay in recognition/reaction time the pilot orders the ship's engines stopped and the two escorting tractor tugs, each rated at 75 tonnes of bollard pull, running with the ship in the T^2 Deployed mode to conduct the powered indirect manoeuvre to starboard at full power.

In the simulator the first tug, which is in position to starboard, is placed at full power after the 10-second delay and the second tug is brought to full power on the starboard side of the ship after a 45-second delay. This latter delay simulates the time it would take for the tug to change sides. Using this methodology the two tugs were able to quickly arrest the ship's swing and then gently return the vessel to its original heading with an off-track error of approximately one-half the ship's width within 6 minutes.

This escort tug approach yields an additional benefit. Generally in the shipping industry, if a ship has a problem, the pilot will stop and anchor the ship immediately. In practice, the chances that this failure location will turn out to be the best spot to anchor the vessel are very small. The simulation described shows that by using the two tugs to turn the ship to port and the ship's engine and failed rudder to turn to starboard, the ship can be controlled and in fact does not have to be stopped.

Both the British Columbia Coast Pilots and the Lake Charles Pilots have experimented with this ship handling technique and have found that with practice they can bring the ship further up their respective channels as if nothing had failed. Obviously, each pilot would have to assess the most appropriate course of action to take, depending on the conditions pertaining at the time. However, with the new T^2 Deployed steering methodology he now has another potential option to consider.

Development of the T^2 Deployed technique has shown that pilots and tug crews can be provided with new tools to control a ship suffering a mechanical failure during a port transit. It also illustrates that there is much more to learn about escort tug operations. LNG

***** Captain Gregory Brooks, the principal of Towing Solutions Inc, has been actively involved in the towing industry for 35 years. In addition to his expertise in escorting procedures and escort tug technology, he has been engaged in many projects in the marine simulation training arena.***