Excessive approaching velocity and approaching angle during vessel berthing in underway STS operations.

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STS SAFETY CIRCULAR

The aim of this circular is to address the issue of approaching velocity and angle for the attention of Masters and senior officers during the final maneuvering of vessels in underway STS operations. To aptly illustrate the facts, consider a case where the involved vessels are of same size with a berthing coefficient C [Table 9.1 of latest OCIMF STS Guidelines] equal to about 165000.

Attention is drawn by seafarers with respect to the approaching velocity which is directly linked to the approaching angle. In case the previously mentioned variables exceed the ones suggested by OCIMF, this may inevitably lead to damage or breakdown of fenders or steel to steel contact of both participating vessels. Furthermore, the risk is increased in case the maneuvering vessel is in laden condition due to the increased inertia effect and the energy exerted during the initial approach.

FIGURE 1 TANKERS PRIOR FINAL BERTHING POSITION

Turning back to our example with the same size vessels, it was observed that during the approaching phase, the velocity of the maneuvering vessel was excessively high. As has been recorded, the prevailing weather condition was calm and the weather forecast was accurate. However, the weather forecast alone, is not enough to estimate the approaching velocity. There are two more factors which are of equal importance. Those are, the relevant difference of the approaching speed and the approaching angle.

Although seafarers maintain practices and take into consideration the bearing of two vessels, because inevitably the vessel will have to end up in almost parallel contact, it is prudent to take into account the COG (Course Over Ground) of both vessels as well. Therefore, in order to estimate the COG, the ECDIS and the GPS data have to be taken into consideration.

Taking into account the above variables, what is the appropriate approaching velocity according to the latest OCIMF Guidelines?

From table 9.1 from Section 9.1.2 of the latest OCIMF STS guidelines, it is observed that the approaching velocity of the maneuvering tanker, should be 0.15 m/s (0.29 knots/s) as illustrated at below figure 2:

Berthing Coefficient (C) (Tonnes)	Approach Velocity (m/Sec)	Berthing Energy (Tonnes.m)	Suggested Fenders (Quantity)	Typical HP Pneumatic Fender (50kPa) (Metre)
1,000	0.30	002.4	3 or more	1.0 x 2.0
3,000	0.30	007.0	"	1.5 x 3.0
6,000	0.30	014.0	"	2.5 x 5.5
10,000	0.25	017.0	"	2.5 x 5.5
30,000	0.25	040.0	4 or more	3.3 x 6.5
50,000	0.20	048.0	"	3.3 x 6.5
100,000	0.15	054.0	"	3.3 x 6.5
150,000	0.15	071.0	5 or more	3.3 x 6.5
200,000	0.15	093.0	"	3.3 x 6.5
330,000	0.15	155.0	4 or more	4.5 x 9.0
500,000	0.15	231.0	"	4.5 x 9.0

FIGURE 2 TABLE 9.1 FROM LATEST OCIMF GUIDELINES

The approaching velocity is a limited to 0,15m/s since this is related to the forces exerted on the primary and secondary fenders during the berthing. The pressure exerted on fenders is associated with the berthing energy of the maneuvering vessel. Therefore, when the approaching velocity increases, the pressure on fenders is also increased. Exceeding the manufacturers' standards may enhance the risk, leading to fender breakdown or subsequently to steel to steel contact.

As per OCIMF Guidelines Appendix H, p. 137, the following is stated:

"The approach velocity of the ships can have a dramatic effect on the berthing energy absorption requirements of the fenders system. The allowance for velocity should take into consideration the effects of local weather, sea and swell conditions, tug or thruster availability and the physical size of the ships involved.

It is common to work within a range of about 0.1 to 0.3 m/s (0.2-0.6 knots) and it should be noted that an increase of about 0.02 (m/s) (0.04 knots) in velocity could result in approximately 28% increasing energy in energy absorption requirements, should a berthing speed be in the range of 0.15 (m/s), and 20% increase should the berthing speed be in the range of 0.20 (m/s). Also note that smaller ships tend to have higher berthing velocities."

FIGURE 3:TANKERS IN FINAL BERTHING POSITION

What needs to be done in order to prevent incidents during the final maneuvering of the vessel prior berthing?

One of the most efficient ways is to extract simplified procedures, enabling seafarers to estimate the approaching velocity of the maneuvering vessel a few minutes prior the final berthing. In this respect the following figure should be taken into consideration, as also included at latest OCIMF guidelines, paragraph 6.2:

For underway STS operations the procedures mentioned in paragraph 6.2 of OCIMF Guidelines are strongly recommended. It is essential for the maneuvering vessel to end up with parallel course to the one of the constant heading vessel, having both manifolds aligned.

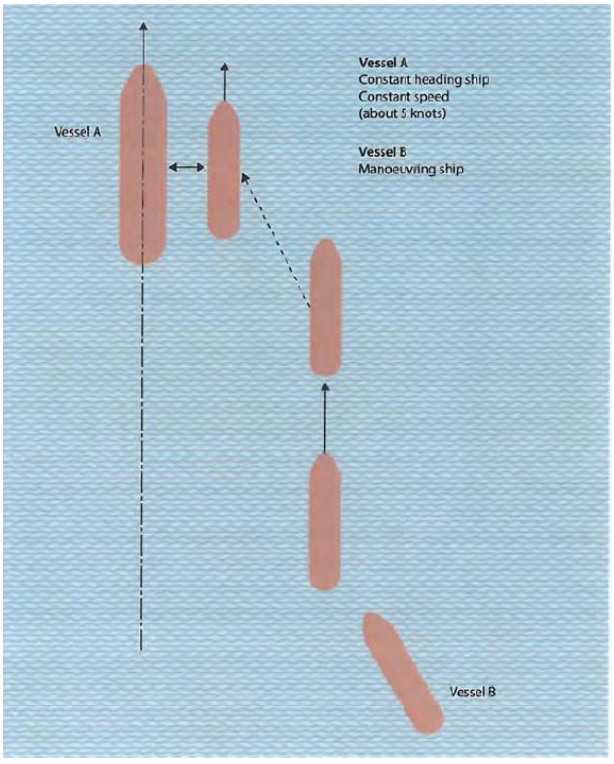


FIGURE 4 FIGURE 6.1 FROM LATEST OCIMF GUIDELINES

The final berthing velocity of the maneuvering vessel, after both vessels are parallel to each other, as shown at above figure, depends a great deal on her approaching angle and speed.

At this stage, the POAC and both Masters have to follow the agreed berthing plan, which was took place, during the Joint Plan agreement. The final berthing velocity as shown at table 9.1 of latest OCIMF guidelines is valid only for calm weather conditions and normal lightering operations. For adverse weather conditions, other than calm, guidelines from YOKOHAMA fender manufacturers include recommended approaching velocity as those shown at below table 1:

DWT	Calm Sea State:0-3 Wave Height (m):0-1.25	Moderate Sea State:4 Wave Height (m):1.25-2.5	Rough Sea State:5 Wave Height (m):2.5-4.0
Less than 10,000	0.30 m/s	0.40 m/s	0.50 m/s
10,000– 50,000	0.25 m/s	0.325 m/s	0.40 m/s
50,000–100,000	0.20 m/s	0.25 m/s	0.30 m/s
Over 100,000	0.15 m/s	0.20 m/s	0.25 m/s

TABLE 1 MAXIMUM ALLOWABLE APPROACHING VELOCITIES AS EXTRACTED BY YOKOHAMA PNEUMATIC FENDER GUIDELINES

The mentioned DWT is the DWT of the maneuvering vessel. Subject that the final berthing velocity has been agreed, manoeuvring vessel should follow an approaching pattern similar to the one depicted at below figure 5:

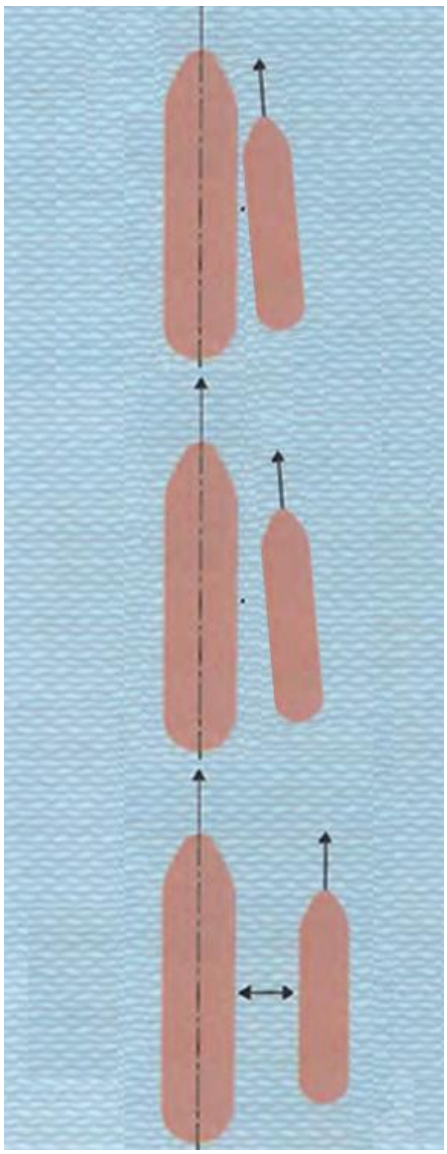
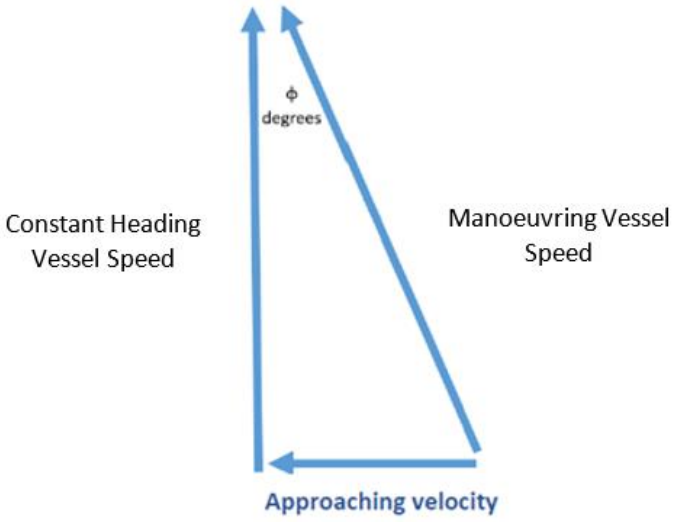


FIGURE 5 PROPOSED PATTERN FOR FINAL BERTHING

In order to estimate the approaching velocity, both Masters should consider the following diagram which depicts vessels speeds and approaching angle.



The approaching velocity is extracted from the following formula.

$$\boldsymbol{approaching\ velocity}\ [\frac{m}{s}] = \sin(\varphi) * (\boldsymbol{manoeuvering\ vessel\ Speed}\ [Kn]) * (\frac{1852}{3600})$$

The following table 2 depicts estimated figures of the maximum allowable approaching angle for various speeds of the maneuvering vessel as a result of the above formula.

All in all, it is essential for both Masters to discuss the final approaching pattern, both vessels speeds and approaching angle in order to maintain that the approaching velocity will be within the guided limits. If for any reason there is any doubt, this should be raised to the POAC and discussed prior to the vessel berthing.

Maximum Angles of approach for the Maneuvering Vessel (degrees)					
		Approaching Velocity			
		0.15	0.2	0.25	0.3
Manouvering Vessel Speed (knots)	4.5	3.7	5.0	6.2	7.4
	4.6	3.6	4.8	6.1	7.3
	4.7	3.6	4.7	5.9	7.1
	4.8	3.5	4.6	5.8	7.0
	4.9	3.4	4.6	5.7	6.8
	5.0	3.3	4.5	5.6	6.7
	5.1	3.3	4.4	5.5	6.6
	5.2	3.2	4.3	5.4	6.4
	5.3	3.2	4.2	5.3	6.3
	5.4	3.1	4.1	5.2	6.2
	5.5	3.0	4.1	5.1	6.1
	5.6	3.0	4.0	5.0	6.0
	5.7	2.9	3.9	4.9	5.9

Angle of approach is the difference from the COG (course over ground) from the two vessels.

Maneuvering Vessel Speed in Knots
Maximum allowable approaching velocity (OCIMF, table 9.1)
Maximum allowable angle of approach of the maneuvering vessel

TABLE 2 MAXIMUM APPROACHING ANGLES WITH RESPECT TO OCIMF PROPOSED APPROACHING VELOCITY LIMITS

All in all, it is essential for both Masters to discuss the final approaching pattern, both vessels speeds and approaching angle in order to maintain that the approaching velocity will be within the guided limits. If for any reason there is any doubt, this should be raised to the POAC and discussed prior to the vessel berthing.

Lessons learned

A higher lateral speed of the maneuvering vessel and/or an inappropriate angle during the approaching might result to a fender breakdown and eventually to steel to steel contact, given that all other crucial parameters/ elements (Primary and secondary fender positioning, adequate assessment of the JOINT PLAN, crew training and fatigue etc.) are satisfied.

As a guidance to the Master, onlineSTS.net is preparing, at the PART B of the Screening and Risk Assessment Service, an indication of the minimum time to final berthing, after the maneuvering vessel has reached the position indicated by table 6.2 of latest OCIMF guidelines. Thus the Master and senior officers will have a perception of the berthing velocity in conjunction with the berthing time.