

Subject: **ACTION WHILE ENCOUNTERING TRS**

Ref : DMA/AIFI/98/C 1027

Date: 24/06/2019

Dear Captain
Good Day,

Recently one of the Company fleet container vessels encountered a Cyclone in Indian Ocean in her route to destination, although the movement and weather condition was under continuous monitoring by ship staff but due to underestimating/misjudgment of the storm behavior, vessel got too close to the center of the Cyclone and at a distance of 100 NM from center, she experienced very heavy confused swells and very strong winds. Due to severe rolling and pitching, some of the containers loaded on deck fell down on the adjacent empty row and one of the ship's crane was released from its locking arrangements and swung from center to Stbd side and hit the bridge and was severely bent and then by fortunately got stock on the Stbd wing bulwarks. Due to hitting of crane's wires, many of antennas on Monkey Island were also broken. DPA was contacted and Master was advised for evasive and controlling measures. Vessel was instructed to change her course to increase distance from center of storm in order to reduce rolling and pitching and to apply additional lashings on the crane. Although the main cause of crane's movement is still under investigation, but from what has been gathered so far, lack of proper lashing of the crane is considered as one of the main reasons.

In view of above and refer to Company's SMS, Ship's Manual, part II, section 6, prudent Masters are required to refresh their mind that Tropical Storms re-curve after following a particular track. It is therefore very important for Master to predict the location, magnitude and path of the storm, which is required to avoid affected regions or navigate with caution while in navigating these areas and in any case avoid the center of storm with as much distance as possible.

Followings are some precautions which Masters must follow while encountering tropical storms or navigating in areas of their frequent occurrence.

Use Available Information:

Tropical storms and depressions are formed by pressure and temperature variations. A mariner has access to information regarding seasonal areas and frequency of occurrence of such storms through Maritime Safety information via EGC, Admiralty Sailing Directions, Ocean Passages for the World, Weather Prediction Programs (such As Bridge) and several other means. Thus, if prior information is available regarding the legs of a voyage where the rough weather is expected, a sheltered passage or alternate route shall be carefully planned to divert vessel's course on time, if needed.

Study Weather Reports:

Often weather reports and weather faxes give warnings well in advance about unsettled weather conditions. Thus a careful selection of Nav Areas and type of weather reports



Ref. T1/2.04

MSC.1/Circ.1228
11 January 2007

**REVISED GUIDANCE TO THE MASTER FOR AVOIDING DANGEROUS
SITUATIONS IN ADVERSE WEATHER AND SEA CONDITIONS**

1 The Maritime Safety Committee, at its eighty-second session (29 November to 8 December 2006), approved the Revised Guidance to the master for avoiding dangerous situations in adverse weather and sea conditions, set out in the annex, with a view to providing masters with a basis for decision making on ship handling in adverse weather and sea conditions, thus assisting them to avoid dangerous phenomena that they may encounter in such circumstances.

2 Member Governments are invited to bring the annexed Revised Guidance to the attention of interested parties as they deem appropriate.

3 This Revised Guidance supersedes the Guidance to the master for avoiding dangerous situations in following and quartering seas (MSC/Circ.707).

ANNEX

**REVISED GUIDANCE TO THE MASTER FOR AVOIDING DANGEROUS
SITUATIONS IN ADVERSE WEATHER AND SEA CONDITIONS**

1 GENERAL

1.1 Adverse weather conditions, for the purpose of the following guidelines, include wind induced waves or heavy swell. Some combinations of wave length and wave height under certain operation conditions may lead to dangerous situations for ships complying with the IS Code. However, description of adverse weather conditions below shall not preclude a ship master from taking reasonable action in less severe conditions if it appears necessary.

1.2 When sailing in adverse weather conditions, a ship is likely to encounter various kinds of dangerous phenomena, which may lead to capsizing or severe roll motions causing damage to cargo, equipment and persons on board. The sensitivity of a ship to dangerous phenomena will depend on the actual stability parameters, hull geometry, ship size and ship speed. This implies that the vulnerability to dangerous responses, including capsizing, and its probability of occurrence in a particular sea state may differ for each ship.

1.3 On ships which are equipped with an on-board computer for stability evaluations, and which use specially developed software which takes into account the main particulars, actual stability and dynamic characteristics of the individual ship in the real voyage conditions, such software should be approved by the Administration. Results derived from such calculations should only be regarded as a supporting tool during the decision making process.

1.4 Waves should be observed regularly. In particular, the wave period T_w should be measured by means of a stop watch as the time span between the generation of a foam patch by a breaking wave and its reappearance after passing the wave trough. The wave length λ is determined either by visual observation in comparison with the ship length or by reading the mean distance between successive wave crests on the radar images of waves.

1.5 The wave period and the wave length λ are related as follows:

$$\lambda = 1.56 \cdot T_w^2 \text{ [m]} \text{ or } T_w = 0.8\sqrt{\lambda} \text{ [s]}$$

1.6 The period of encounter T_E could be either measured as the period of pitching by using stop watch or calculated by the formula:

$$T_E = \frac{3T_w^2}{3T_w + V\cos(\alpha)} \text{ [s]}$$

where V = ship's speed [knots]; and

α = angle between keel direction and wave direction ($\alpha = 0^\circ$ means head sea)

1.7 The diagram in figure 1 may as well be used for the determination of the period of encounter.

1.8 The height of significant waves should also be estimated.

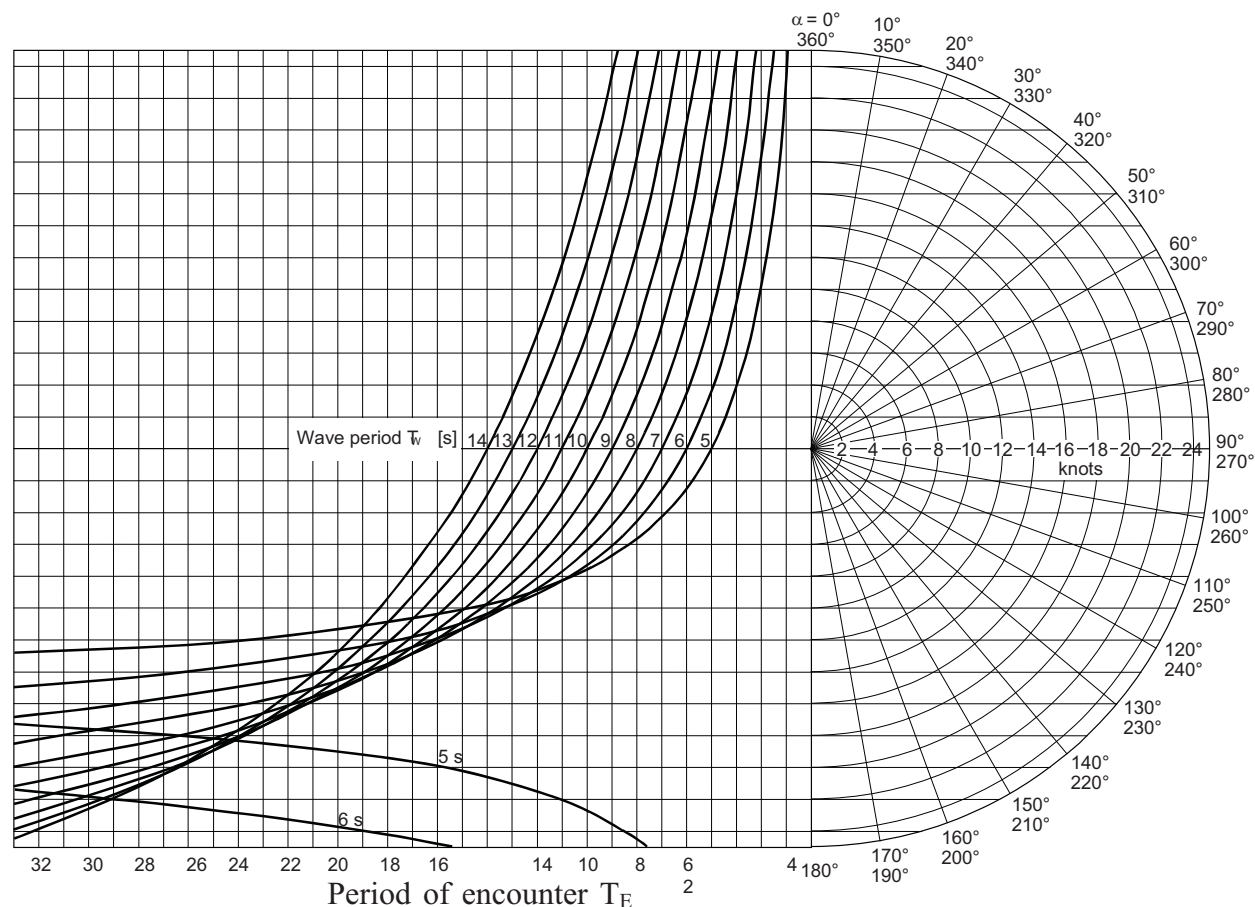


Figure 1: Determination of the period of encounter T_E

2 CAUTIONS

2.1 It should be noted that this guidance to the master has been designed to accommodate for all types of merchant ships. Therefore, being of a general nature, the guidance may be too restrictive for certain ships with more favourable dynamic properties, or too generous for certain other ships. A ship could be unsafe even outside the dangerous zones defined in this guidance if the stability of the ship is insufficient. Masters are requested to use this guidance with fair observation of the particular features of the ship and her behaviour in heavy weather.

2.2 It should further be noted that this guidance is restricted to hazards in adverse weather conditions that may cause capsizing of the vessel or heavy rolling with a risk of damage. Other hazards and risks in adverse weather conditions, like damage through slamming, longitudinal or torsional stresses, special effects of waves in shallow water or current, risk of collision or stranding, are not addressed in this guidance and must be additionally considered when deciding on an appropriate course and speed in adverse weather conditions.

2.3 The master should ascertain that his ship complies with the stability criteria specified in the IS Code or an equivalent thereto. Appropriate measures should be taken to assure the ship's watertight integrity. Securing of cargo and equipment should be re-checked. The ship's natural period of roll T_R should be estimated by observing roll motions in calm sea.

3 DANGEROUS PHENOMENA

3.1 Phenomena occurring in following and quartering seas

A ship sailing in following or stern quartering seas encounters the waves with a longer period than in beam, head or bow waves, and principal dangers caused in such situation are as follows:

3.1.1 Surf-riding and broaching-to

When a ship is situated on the steep forefront of a high wave in following or quartering sea conditions, the ship can be accelerated to ride on the wave. This is known as surf-riding. In this situation the so-called broaching-to phenomenon may occur, which endangers the ship to capsizing as a result of a sudden change of the ship's heading and unexpected large heeling.

3.1.2 Reduction of intact stability when riding a wave crest amidships

When a ship is riding on the wave crest, the intact stability can be decreased substantially according to changes of the submerged hull form. This stability reduction may become critical for wave lengths within the range of 0.6 L up to 2.3 L, where L is the ship's length in metres. Within this range the amount of stability reduction is nearly proportional to the wave height. This situation is particularly dangerous in following and quartering seas, because the duration of riding on the wave crest, which corresponds to the time interval of reduced stability, becomes longer.

3.2 Synchronous rolling motion

Large rolling motions may be excited when the natural rolling period of a ship coincides with the encounter wave period. In case of navigation in following and quartering seas this may happen when the transverse stability of the ship is marginal and therefore the natural roll period becomes longer.

3.3 Parametric roll motions

3.3.1 Parametric roll motions with large and dangerous roll amplitudes in waves are due to the variation of stability between the position on the wave crest and the position in the wave trough. Parametric rolling may occur in two different situations:

- .1 The stability varies with an encounter period T_E that is about equal to the roll period T_R of the ship (encounter ratio 1:1). The stability attains a minimum once during each roll period. This situation is characterized by asymmetric rolling, i.e. the amplitude with the wave crest amidships is much greater than the amplitude to the other side. Due to the tendency of retarded up-righting from the large amplitude, the roll period T_R may adapt to the encounter period to a certain extent, so that this kind of parametric rolling may occur with a wide bandwidth of encounter periods. In quartering seas a transition to harmonic resonance may become noticeable.
- .2 The stability varies with an encounter period T_E that is approximately equal to half the roll period T_R of the ship (encounter ratio 1:0.5). The stability attains a minimum twice during each roll period. In following or quartering seas, where the encounter period becomes larger than the wave period, this may only occur

with very large roll periods T_R , indicating a marginal intact stability. The result is symmetric rolling with large amplitudes, again with the tendency of adapting the ship response to the period of encounter due to reduction of stability on the wave crest. Parametric rolling with encounter ratio 1:0.5 may also occur in head and bow seas.

3.3.2 Other than in following or quartering seas, where the variation of stability is solely effected by the waves passing along the vessel, the frequently heavy heaving and/or pitching in head or bow seas may contribute to the magnitude of the stability variation, in particular due to the periodical immersion and emersion of the flared stern frames and bow flare of modern ships. This may lead to severe parametric roll motions even with small wave induced stability variations.

3.3.3 The ship's pitching and heaving periods usually equals the encounter period with the waves. How much the pitching motion contributes to the parametric roll motion depends on the timing (coupling) between the pitching and rolling motion.

3.4 Combination of various dangerous phenomena

The dynamic behaviour of a ship in following and quartering seas is very complex. Ship motion is three-dimensional and various detrimental factors or dangerous phenomena like additional heeling moments due to deck-edge submerging, water shipping and trapping on deck or cargo shift due to large roll motions may occur in combination with the above mentioned phenomena, simultaneously or consecutively. This may create extremely dangerous combinations, which may cause ship capsize.

4 OPERATIONAL GUIDANCE

The shipmaster is recommended to take the following procedures of ship handling to avoid the dangerous situations when navigating in severe weather conditions.

4.1 Ship condition

This guidance is applicable to all types of conventional ships navigating in rough seas, provided the stability criteria specified in resolution A.749(18), as amended by resolution MSC.75(69), are satisfied.

4.2 How to avoid dangerous conditions

4.2.1 For surf-riding and broaching-to

Surf-riding and broaching-to may occur when the angle of encounter is in the range $135^\circ < \alpha < 225^\circ$ and the ship speed is higher than $(1.8\sqrt{L})/\cos(180 - \alpha)$ (knots). To avoid surf riding, and possible broaching the ship speed, the course or both should be taken outside the dangerous region reported in figure 2.

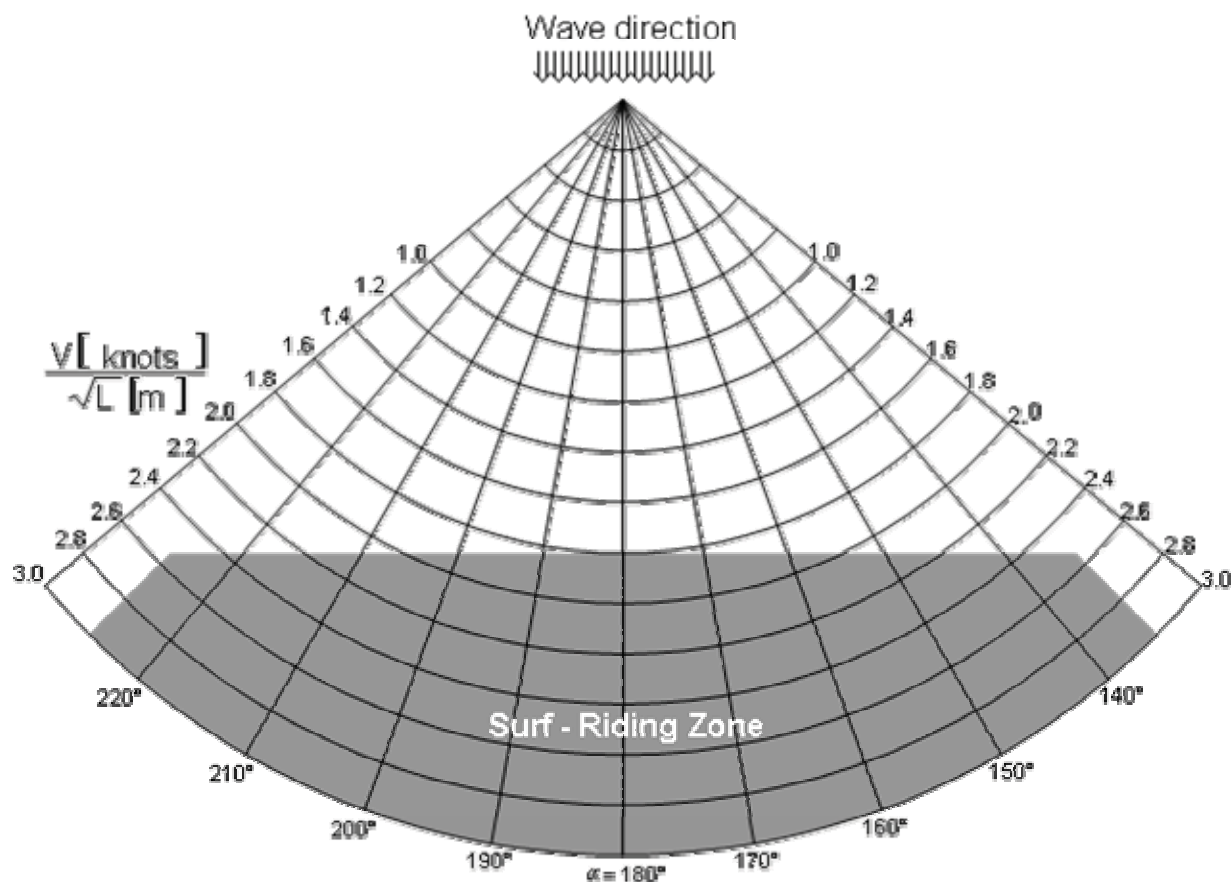


Figure 2: Risk of surf-riding in following or quartering seas

4.2.2 For successive high-wave attack

4.2.2.1 When the average wave length is larger than $0.8 L$ and the significant wave height is larger than $0.04 L$, and at the same time some indices of dangerous behaviour of the ship can be clearly seen, the master should pay attention not to enter in the dangerous zone as indicated in figure 3. When the ship is situated in this dangerous zone, the ship speed should be reduced or the ship course should be changed to prevent successive attack of high waves, which could induce the danger due to the reduction of intact stability, synchronous rolling motions, parametric rolling motions or combination of various phenomena.

4.2.2.2 The dangerous zone indicated in figure 3 corresponds to such conditions for which the encounter wave period (T_E) is nearly equal to double (i.e., about 1.8-3.0 times) of the wave period (T_W) (according to figure 1 or paragraph 1.4).

4.2.3 For synchronous rolling and parametric rolling motions

4.2.3.1 The master should prevent a synchronous rolling motion which will occur when the encounter wave period T_E is nearly equal to the natural rolling period of ship T_R .

4.2.3.2 For avoiding parametric rolling in following, quartering, head, bow or beam seas the course and speed of the ship should be selected in a way to avoid conditions for which the encounter period is close to the ship roll period ($T_E \approx T_R$) or the encounter period is close to one half of the ship roll period ($T_E \approx 0.5 \cdot T_R$).

4.2.3.3 The period of encounter T_E may be determined from figure 1 by entering with the ship's speed in knots, the encounter angle α and the wave period T_w .

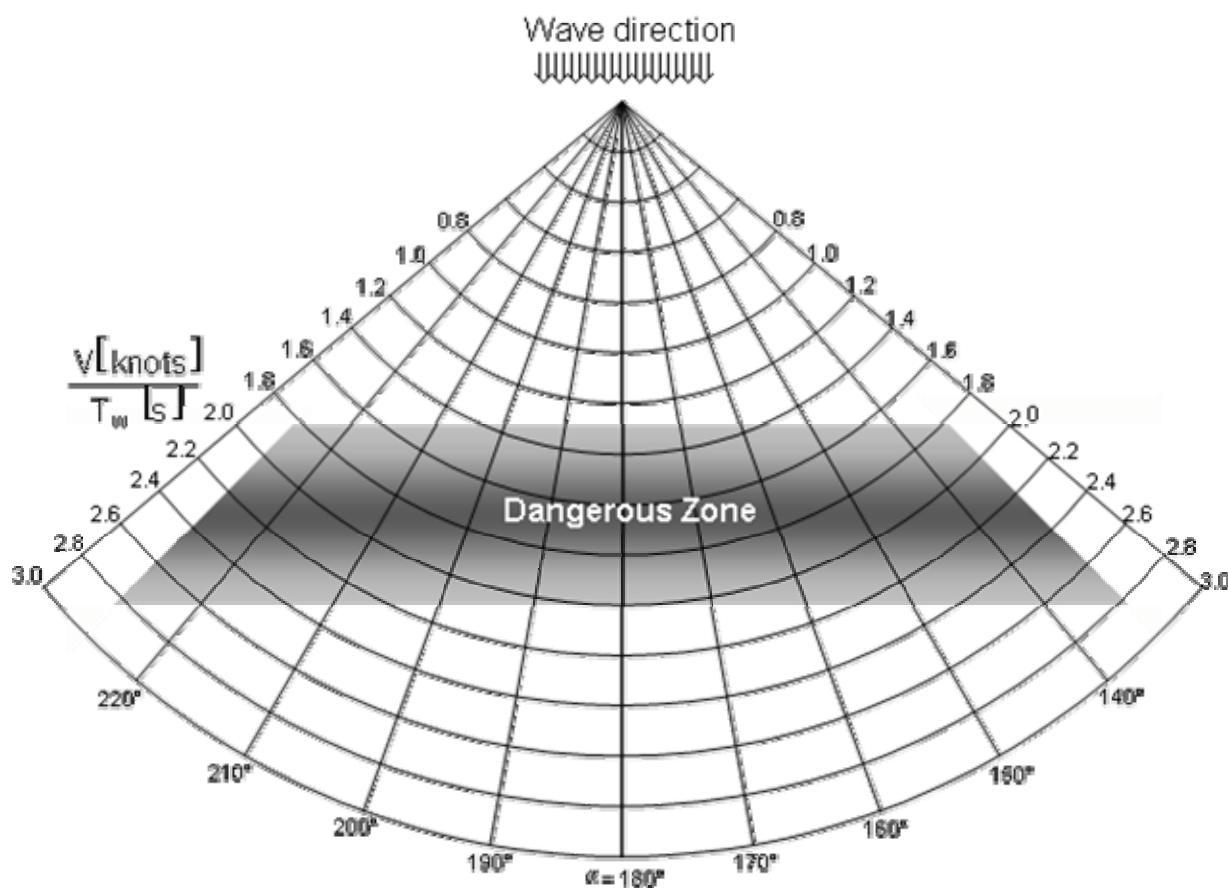


Figure 3: Risk of successive high wave attack in following and quartering seas

Abbreviations and symbols

Symbols	Explanation	Units
T_w	wave period	s
λ	wave length	m
T_E	encounter period with waves	s
α	angle of encounter ($\alpha = 0^\circ$ in head sea, $\alpha = 90^\circ$ for sea from starboard side)	degrees
V	ship's speed	knots
T_R	natural period of roll of ship	s
L	length of ship (between perpendiculars)	m

by the navigating officer can be instrumental in obtaining early warning about a storm. Frequent observations from various meteorological instruments and prevailing weather onboard can be used to confirm weather reports.

Keep Away from Centre of Storm:

Once the presence of a storm or depression is confirmed, it is vital to establish the distance of the vessel from it, the location of the eye of the storm, the centre of the depression, and storm's track and path. Buys Ballot's law states – Face the wind and centre of low pressure will be from 90 to 135 degrees on your right hand in N hemisphere and on your left hand in S hemisphere. It is advisable to keep at least 250 miles away from the center of a storm.

Check Stability of the Vessel:

A prudent check is required on the stability condition of the vessel and its compliance with intact stability criteria. Damage stability conditions to be evaluated carefully before the beginning of a voyage as it will assure compliance with damage stability requirements. A vessel can thus take heavy weather ballast while or before proceeding to rough weather areas. Heavy weather ballast provides additional stability to the vessel and by lowering the centre of gravity makes the vessel more stable as the GM* increases.

Use Ballast Tanks to Minimize Free Surface Effect:

As a part of good seamanship, all the ballast tanks which are slack can be pressed up to minimise the free surface effect which will also help to increase the GM. Well planned stowage of cargo, ballast or both can minimise the number of slack or partly filled tanks.

Be Careful While Changing Speed, Angle, and Direction:

Often waves associated with a storm or depression causes a reduction in intact stability of vessel with a threat of capsizing or rolling of the vessel to very large angles. IMO circular MSC 1228 (as attached) provides guidelines with respect to careful reduction of speed, changing the angle and direction of encounter and adjusting encounter period of waves to avoid parametric or synchronous rolling motions.

Secure Loose Equipment/Cargo on Deck:

For vessels with lesser freeboard, decks are washed frequently by seas with greater magnitudes. Thus securing of various loose equipment on deck, additional lashings to be taken to strengthen and prevent their loss being washed away into the sea. Safety lifelines can be rigged on vessels carrying cargoes on deck. Additional lashing must be taken to secure anchors, lifeboats, life buoys and life rafts.

Secure Weather and Water Tight Openings:

Various weathertight and watertight openings like side scuttles, hatch covers, portholes, doors, manholes to be securely closed to prevent any ingress of water. Leaking, damaged gaskets or inadequate securing for covers of such openings may affect the integrity of compartment they are protecting. Alarms and indicators for the closing of

remote watertight doors and openings are provided on Navigation bridge, their operational state to be confirmed prior the beginning of the voyage.

Secure Doors Forward of Collision Bulkhead:

Special emphasis to be made to secure the doors and openings forward of the collision bulkhead for e.g. forepeak store and hatches, vents and openings forward. These spaces often house forward mooring equipment and associated electrical or hydraulic machinery. Spurling pipe covers need to be cemented well in advance. Bilge alarms in such remote compartments should be tried out regularly to give an early warning of any ingress of water or flooding. Any openings in subdivisions of watertight compartments which can cause progressive flooding must be secured.

Drains and Scuppers Must Be Free:

All drains on deck and scuppers for drainage of water must be free to prevent any accumulation of water on deck.

Secure Aerials and Antennas:

Antennas, aerials, stay wire clamps and lashing to be inspected before the wind speed picks up. Winds of gale force and above can easily break and blow away aerials. Storms are associated with lightning and thundering thus all aerials and antennas to be earthed and any low insulation alarms to be investigated carefully.

Keep Check on RPM To Avoid Load Fluctuation on Main Engine:

Due to unsettled movement of the vessel often load fluctuations on the main engine are observed. A careful setting of RPM can help to keep the fluctuations on the main engine within permissible limits.

Inform All Departments:

All personnel in deck, engine and galley should be informed well in advance of any storm warning so that all the deck, engine and galley stores, hospitals, sick bays and work areas are lashed and secured. Any major overhaul jobs, working aloft or lifting of heavy machinery on deck and engine room using overhead or deck crane shall be postponed or avoided.

Morale of the Crew to Be Kept High:

The morale of the crew should be kept high as often heavy rolling and pitching causes giddiness, nausea and reduced appetite amongst crew members.

Adjust vessel's GM as safe as practicable.

Meanwhile, for more information, please find informative attached file.

You are requested to confirm receipt, discuss the contents in the next consolidated meeting on board & keep a copy in the file DA-11.

Best Regards