 Navigation in Adverse Weather	Revision Number: 0	Date Effective: 09 Apr 2021	Document: Bridge 150
	Prepared By: SSE Manager	Approved By: Director, Operations	Page: Page 1 of 5

**Master and Deck Officers shall follow this procedure.**

### Purpose of the document

This procedure describes the company requirements when navigating in adverse weather

### Scope of the document

This procedure applies to all company vessels.

### Definitions and abbreviations

**Adverse weather:** unfavorable weather conditions which can lead to endanger the crew, the vessel and the cargo.

**Atmospheric condition:** State of the atmosphere in terms of temperature, wind, clouds and precipitations.

**Encounter period (TE):** The time interval in seconds between the passages of two successive wave crests relative to a ship borne observer.

**FNSC:** Fleet Navigation and Support Center

**Oceanographic Condition:** Sea conditions (current, waves...)

**OOW:** Officer on Watch

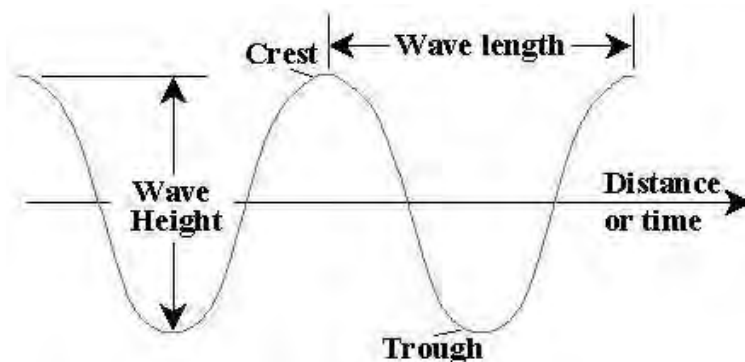
**Rolling period (TR):** The ship's natural rolling period when observing in calm sea.

**Significant waves (H1/3):** The height which is defined as the mean height (trough to crest) of the highest third of the waves.


**Wave height (H):** The vertical distance between any crest and succeeding trough which is determined visually.

**Wave length ( $\lambda$ ):** The horizontal distance between successive crests or troughs.

**Wave period (TW):** The time in seconds between successive wave crests as they pass a stationary point on the ocean surface.



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 <b>APL</b> Navigation in Adverse Weather	Revision Number: 0	Date Effective: 09 Apr 2021	Document: Bridge 150
	Prepared By: SSE Manager	Approved By: Director, Operations	Page: Page 2 of 5

## Navigation in Adverse Weather

### 1. General

Adverse weather or any dangerous phenomena can endanger the crew, the ship and the cargo.

The OOW shall:

- Monitor and assess the situation by considering the following factors (but not limited to):
  - Atmospheric and oceanographic conditions;
  - Heading compared to the sea and the wind direction;
  - Vessel's stability & lashing rules;
  - Ship's speed;
  - Under keel Clearance;
  - Any limitation due to the design and size of the Vessel;
  - Proximity of dangers.
- use the following information to assess the weather condition and to minimize consequences:
  - Weather forecast (Navtex, SafetyNet, VHF message).
  - Local observations (wind & sea condition, wave parameters, clouds, barometric pressure, air temperature).
  - Information received from shore-based services if available (facsimile...).
  - Advise received from FNSC, approved meteorological routing service or dedicated software.
  - Other relevant Nautical publications.
- Advise the Master of any significant or abnormal development in atmospheric and oceanographic conditions.

The Master or OOW shall assess the weather condition, at least, once a watch by using the dedicated software or the *IMS card "Dangerous Motion Criteria"*.

*Master shall be advised if result give a significative difference from master' standings orders.*


The Master shall:

- inform FNSC and Line Ops:
  - If any support needed in term of routing;
  - If the route shall be diverted;
  - When the passage plan has been updated in the dedicated software (V2PS).
- Send to FNSC objective observation, accurate measurement methods (wave photos, rolling records ...), calculations with official software, when passage plan shall be amended.

**Caution:** *When vessel is in coastal waters or alongside and receive Tsunami Alert, she shall proceed in deep sea with depth upper than 100 meters as soon as possible.*

### 2. Measures to be taken in adverse weather

As soon as adverse weather is announced, you shall apply IMS cards "Navigation in adverse weather Check-list" and "Engine safety measures for adverse weather".

 <b>APL</b> Navigation in Adverse Weather	Revision Number: 0	Date Effective: 09 Apr 2021	Document: Bridge 150
	Prepared By: SSE Manager	Approved By: Director, Operations	Page: Page 3 of 5

### 3. Dangerous phenomena

Adverse weather conditions include wind induced waves and heavy swell. Some combinations of wave length and wave height may lead to dangerous situations for ships.

The significant waves and the sea state can be determined with the following table:

Wind speed (Kts)	Sea state	Significant waves (Meters)	Significant Range of period (Sec)	Average period	Average Length of waves (meters)
0 - 4	0	<0.15	<0.5-1	0.5 - 1.0	0.45 – 0.60
5 – 8	1	0.15 – 0.40	1.0 – 4.0	2	2.90 – 4.80
9 – 13	2	0.40 – 1.00	1.5 – 6.0	3	6.10 – 13.0
14 – 17	3	1.00 – 1.80	2.0 – 7.5	4	14 – 20
18 – 20	4	1.80 – 2.40	3.0 – 9.5	5	24 – 30
21 – 25	5	2.40 – 4.0	3.5 – 12	6	30 – 50
25 – 36	6	4.0 – 7.0	4.0 - 15.5	8.5	56 – 80
37 – 45	7	7.0 – 12.50	5.5 – 22.0	11.5	100 – 160
46 – 57	8	12.50 – 18.50	7.5 – 26.5	14	180 – 240
58 - 73	9	18.50 – 30.50	9.0 – 34.5	18	280 - 400

In Yellow: Increase situational awareness for safe navigation

In Orange: Hazardous for safe navigation

In Red: Dangerous for safe navigation.

#### 3.1. Synchronous rolling motion

Synchronous rolling motion may occur in following and quartering seas.

**Note:** The synchronous rolling motion is a harmonic resonance effect leading to large rolling motion excited when the natural period of a ship coincides with the encounter wave period ( $TR \approx TE$ ).

Ship's rolling period  $TR$  is getting from MACS3 before sailing. This natural rolling period cannot be obtained by other means due to the size of the vessels.

**Caution:** *There is a danger when:  $0.8 TE < TR < 1.1 TE$*

#### 3.2. Parametric rolling motion

Parametric roll motion may occur in head or following seas.

The longitudinal waves (head and following seas) cause the most change in stability and, therefore, create maximum parametric excitation.

The parametric roll resonance develops when the natural period is nearly twice the encounter period ( $TR \approx 2TE$ ).

**Caution:** *There is a danger when:  $1.8 TE < TR < 2.1 TE$*

<b>APL</b> Navigation in Adverse Weather	Revision Number: 0	Date Effective: 09 Apr 2021	Document: Bridge 150
	Prepared By: SSE Manager	Approved By: Director, Operations	Page: Page 4 of 5

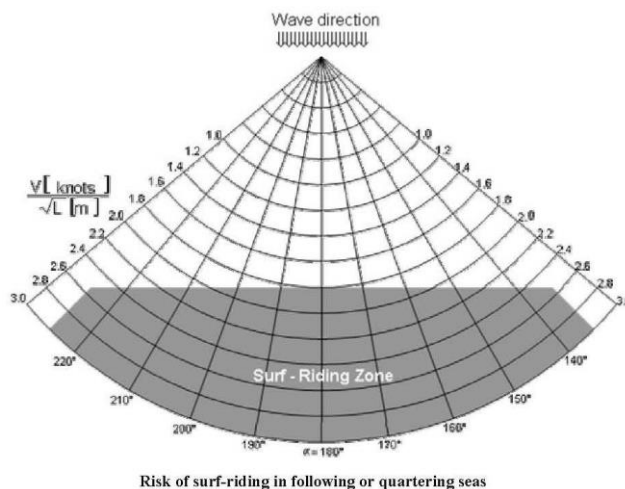
### 3.3. Surf riding

When the significant wave height is more than 6 meters, there is a risk of surf-riding and broaching-to.

The sea parameters are considered hazardous for following or quartering sea with significant wave height upper than 7 meters.

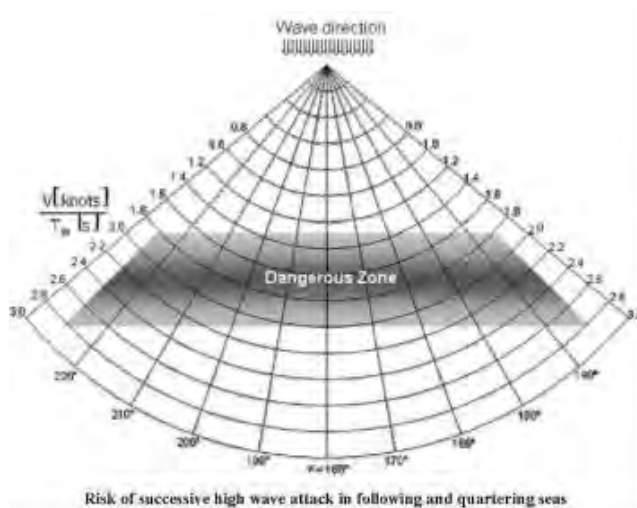
A ship sailing in following or stern quartering seas encounters the waves with a longer period than with beam, head or bow waves will suffer *surf-riding* condition.


In this situation, the broaching-to phenomenon may occur, which endangers the ship to sudden change of heading and unexpected large heeling.



### 3.4. Successive high-wave attack

This situation can happen in following or quartering sea conditions when the average wave length is larger than "0.80 L" and the significant wave height is larger than "0.04 L".



 <b>APL</b> Navigation in Adverse Weather	Revision Number: 0	Date Effective: 09 Apr 2021	Document: Bridge 150
	Prepared By: SSE Manager	Approved By: Director, Operations	Page: Page 5 of 5

#### 4. Navigation in negative temperature condition

In negative temperature condition, you shall apply IMS cards “all measures shall be taken as per IMS card “Navigation in adverse weather Check-list” and “Engine safety measure for negative temperature conditions”.

#### Appendices

Card n° Bridge-150A Navigation in adverse weather Check-list

Card n° Bridge-150B Dangerous motions criterion

#### References

IMO. Code on Intact Stability.

MSC.1/Circ.1228 Revised Guidance to the Master for avoiding dangerous situations in adverse weather and sea conditions.

Card n° Engine-040 Engine safety measure for negative temperature conditions

Card n° Engine-050 Engine safety measures for adverse weather

**Completed**