Chapter 3: Situational Awareness for Junior Officer

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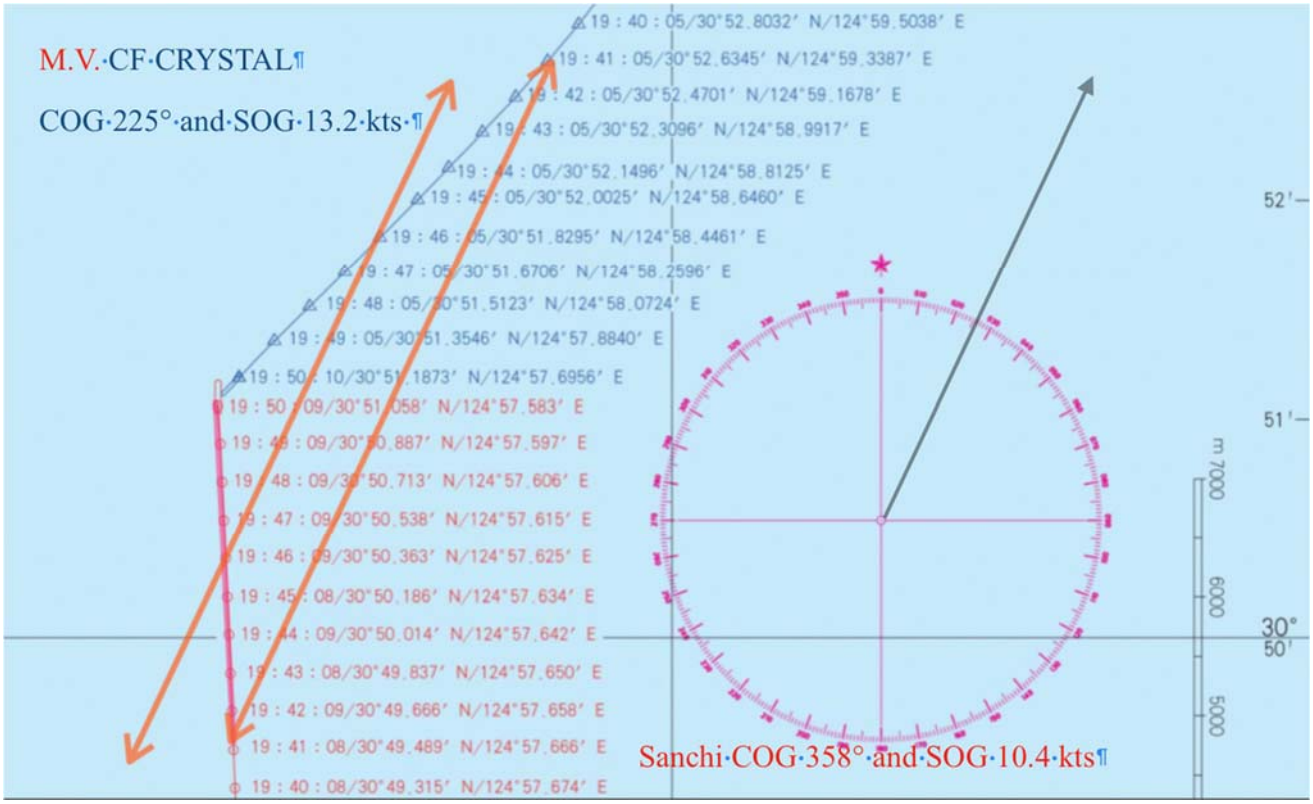


Figure 3-01 Diagram of navigational track of SANCHI and CF CRYSTAL
圖形 3－01 桑吉輪與長峰水晶輪航跡圖

3-01 雷達瞭望的基礎：碰撞點線面

3-01 他們不知道如何做雷達瞭望

所以這又是桑吉輪的案件，只是這一次，我們會在雷達螢幕上，去發現三副看到了些什麼？這兩條目標船的位置在 1941 時，長峰水晶輪羅經方位是 026 度，從桑吉輪來觀測。在圖形 3-01 上面是黑線。長峰水晶輪相對方位是 028 度，在桑吉輪的右舷。長峰水晶輪的距離，從桑吉輪量起是 3.5 海浬。不管是羅經或是相對方位，從這個時間 1941 時開始，到碰撞發生時都沒變，這是一個特殊的案例。因為兩條船從頭到尾，完全沒有採取任何有效的避碰行動，從這時到最後 1 分鐘。在最後一分鐘，想要去改變航向，是無效的。一定是有什麼事情，在值班過程中被疏忽了？桑吉輪的三副被一條小漁船所分心，這條小船持續的在 VHF 特高頻無線電上呼叫桑吉輪。而且在 1948 時與桑吉輪有碰撞危機，就在與長峰水晶輪發生碰撞的前兩分鐘。與此同時，在 1948 時，長峰水晶輪的船副與瞭望，都沒看到桑吉輪，在發生碰撞的前兩分鐘，這是調查的口錄。過了兩分鐘後，桑吉輪與長峰水晶輪在 1950 時發生碰撞，兩條船都感覺到有些不對勁，因為雷達與 AIS 自動識別儀的資料，在碰撞前都不太對勁，可是這兩條船都沒有做視覺的接觸，也就是沒有目視確認雷達的目標，即使是在碰撞前兩分鐘。沒有目視瞭望的技術，這是一個缺陷，但並不致命，如果他們

知道如何做雷達瞭望，可惜的是他們也不知道怎麼做雷達瞭望。當阿帕的資料不可靠的時候，不會使用雷達瞭望，這個才是一個致命的缺失。

3-01 Radar lookout basic: collision point, line and area.

3-01 They don't know how to do radar lookout.

So, it's Sanchi case again. Only this time we will look into the Radar see what 3/O had seen. Measuring bearing of target vessels' position at 1941 hours, M.V. CF Crystal was at compass bearing 026 degrees from M.V. Sanchi (black line in figure 3-01). M.V. CF Crystal relative bearing is 028 degrees starboard side from Sanchi. The distance of CF CRYSTAL is 3.5 nm from Sanchi. The bearing whether compass or relative remain almost the same until collision happened. This is a rare case where no effective avoidance actions been taken by both vessels from the beginning till last minute. Last minute course change is useless. Something must have missed during their watch. Sanchi 3/O distracted by a small fishing boat ZHEDAIYU 03187 which kept calling SANCHI on VHF radio and had a collision risk at 1948 hours, 2 minutes before CF Crystal collision. At the same time 1948 hours, M.V. CF Crystal Duty officer and lookout haven't seen Sanchi yet, 2 minutes before Sanchi collision. (as per investigation interviews). After 2 minutes Sanchi collided with CF Crystal at 1950 hours. Both vessels have sensed something wrong in RADAR or AIS data before collision but no visual contact (or positive identification of radar target) had established two minutes before collision. No visual lookout skill is a deficiency but not fatal if they know how to do radar lookout. **They don't know how to do radar lookout without usage of ARPA.** This is a fatal deficiency when ARPA data are not available. From **Figure 3-01 Diagram of navigational track of SANCHI and CF CRYSTAL**, we can see relative bearing (orange line 026/206 degree) of both vessels are all most remained unchanged till collision happened. By visual, collision risk is there always although OOW did not have the knowledge and skill.

3-02 雷達瞭望的基礎：碰撞點線面

請參考圖形 3-02 這兩條船有碰撞航向，具有速度向量線的顯示。這兩條船的速度向量線是沿著他的航向，實際上，速度向量線就是他們航線的一部分，如果兩條船使用穩定的航向航速前進，那他們的速度向量線就是他們的航線的一部分，這個碰撞點是這兩條船航線的交點。兩條船也許可能會，有不少這樣的航線交點，但並不會發生碰撞。兩條船也許在航線上只有一個交點，碰撞卻發生了。就像圖形 3-02，這個差別就是這兩條船的到達時間不同。

雷達螢幕上的速度向量線，另外一個維度，除了方向跟速度，也就是他的時間。兩條船的速度向量線，也許具有同樣的型態或是形狀(同向同速)，但是在雷達螢幕上，速度向量線的起點(本船的位置)是隨著時間在改變，會發生碰撞的情況，就是像圖形 2-02 兩條船的速度向量線終點位置，就在他們的交點上，速度向量線結束的位置，就是本船航行經過預設的時間間隔之後的位置，我們預測碰撞的時間，就是利用速度向量線所設定的長度來估計，速度向量線的長度是跟他顯示碰撞危機的時間長短成正比。一般 6 分鐘是最經常使用的時間設定，3 分鐘的速度向量，現在很少在 6 海浬和 12 海裡的探測距離裡面使用，因為它顯示的長度太短了，在螢幕上的比例太小，桑吉輪的案件，速度向量線的長度設定是 9 分鐘，這是資淺船副的設定，因為他的技術水準，就是 9 分鐘前該讓路。速度向量線的起點在圖形 3-02 是 2215 時，這兩條船的速度向量線終點相交，如果速度向量線的設定是 6 分鐘那這個碰撞的時間，就是 2215+0006=2221 時，如果速度向量線的設定是 9 分鐘，那這個碰撞時間就是 2215+0009=2224 時，如果這速度向量線的設定是 3 分鐘，碰撞時間就是 2215+0003=22 18 時

如果我們想要知道碰撞的時間，我們必須知道本船速度向量線的時間設定，從本船的雷達螢幕上去確認。當兩條船在同樣的時間，通過同一個位置，碰撞就會發生。我們可以避免本船跟他船的航線相交，我們就能減低很多的碰撞危機，這個就是航行計畫的安全概念。碰撞不單是要有碰撞位置，在不好的時機，還同時到達碰撞位置。如果兩條船在不同的時間通過同一位置，碰撞就不

會發生，那我們又怎麼知道，通過的時間是好還是不好？這取決於兩條船到達碰撞點的時間，是否相同。

3-02 Radar lookout basic: collision point, line and area.

Please refer to figure 3- 02 two vessels in collision course with speed vectors display. These two vessels' speed vectors are sailed along their course line. Actually, speed vector is part of their course line. If both vessels sailed with steady course and speed their speed vector is part of their course line. The collision point is where two vessel's course line intersected. Two vessels may have same course line but no collision happened because they sailed in different time. Two vessels may have only one course line intersected point but collision happened like figure 3-02 because they arrived at same time. The reason of this is the difference in arriving timing of these two vessels. The speed vector on Radar screen has carried another dimension beside course and speed, the timing. The speed vector may have same shape on the screen (many same type fishing vessel sailed at same time) but the starting point of speed vector varied as time changed. The collision situation is like figure 2-02 two vessels speed vectors finish position meet in the intersection point. Speed vectors finish position is the position ownship had travelled after preset time interval. We predict collision time by the segment portion in speed vector. The length on speed vector is proportional to its display time setting. Usually 6 minutes are most commonly used time setting for speed vector on board. 3 minutes speed vector is rarely used in 6 NM or 12 NM detection range because the display length is too short on screen. In Sanchi's case the speed vector is set to 9 minutes. At 2215 hours, speed vectors show on figure 3- 02. have two vessels speed vector meet in the end,

If the speed vector setting is 6 minutes the collision time will be 2215 + 0006 = 2221 hours.
If the speed vector setting is 9 minutes the collision time will be 2215 + 0009 = 2224 hours.
If the speed vector setting is 3 minutes the collision time will be 2215 + 0003 = 2218 hours.

If we want to know collision time we need to know time setting of speed vector on radar. When two vessels arrive one position at same time collision will happen. If we can avoid ownship's course line to intersect other vessel's course line we can avoid collision risk. This is a safety concept in voyage planning. Collision not only has collision position it also has timing. In bad timing we will have collision. If two vessels have different time passing same position, collision will not happen. How can we know the timing is good or not? It depends on two vessel's arriving time at collision position.

如果兩條船在同一時間到達碰撞位置，碰撞就會發生。如果兩條船到達碰撞位置，是一個接一個，碰撞可能不會立刻發生，因為船隻具有龐大的體積，它具有地表上最大人造機械的尺寸，一條船也許已經通過碰撞位置，但是只通過一半的時候，另外一條船才到達碰撞位置，雖然他們通過的時間相差了半分鐘或 1 分鐘，但是碰撞還是發生，船隻還必須考慮到遲緩的回轉半徑，回轉需要 3 分鐘的時間，才能完成。如果兩條船通過碰撞位置的時間少於 3 分鐘，就很可能發生碰撞，就像第二章圖形 2-25 太空船一樣。

我們使用速度向量線來預測碰撞危機，這個線我們叫做碰撞線，在圖形 2-15 速度向量線的最後 3 分鐘，是我們的太空船。我們可以把這些太空船推到 6 分鐘遠，或是更遠的向量線長度位置，以檢查是否跟其他船隻速度向量線有交點，檢查是否有碰撞。

如果這兩條船速度向量線的最後 3 分鐘裡面，就像圖形 2-14 綠色跟紅色的船，再 6 分鐘後有碰撞危機，**這個速度向量線最後 3 分鐘的部分，就是我們的碰撞區域**，這個碰撞區域的大小，就是本船速度跑 3 分鐘的距離。

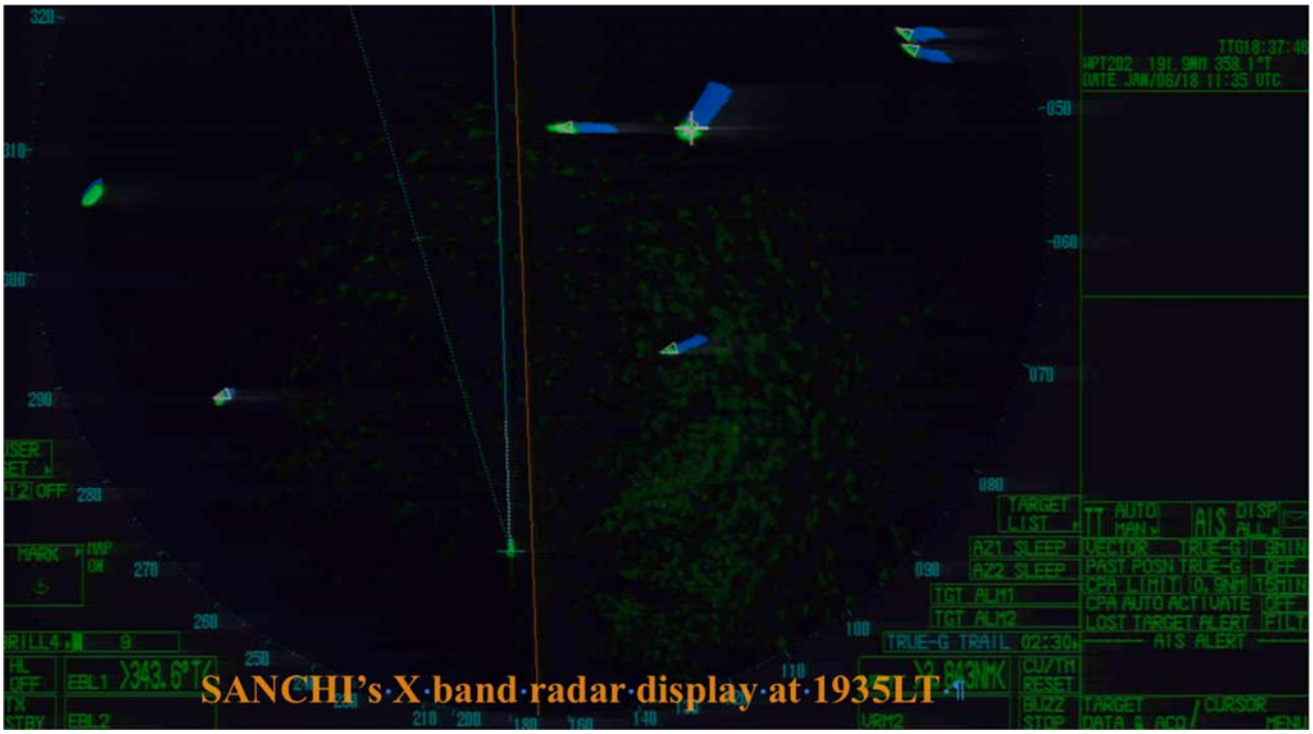
在圖形 3-02 兩條船在碰撞航向上，具有速度向量線的顯示。這兩條船經過同樣的碰撞位置，在同樣的時間，引起碰撞。利用這個圖形 2-02，我們還不知道經過多少分鐘？他們會碰撞。必須需利用其他的資源去核對，如電子海圖和阿帕。圖形 3-02 兩條船在碰撞航向上，同時具有速度向量線的顯示。圖形 3-03 要確認碰撞危機，需要利用兩條速度向量線的交點。圖形 3-03 雷達的螢幕，只有目標尾跡的說明。

If both vessels arrive collision position at same time collision will happen. If two vessels arrive collision position one by one the collision may not happen immediately as vessel has massive volume and largest dimensions than any other artificial machinery on Earth. One vessel may had passed collision position half way or other vessel arrive same collision position one or half minute later while collision still happened. Also, we have to take vessel's sluggish turning 3 minutes time into consideration. If time difference of two vessels passing collision position less than three minutes the collision is very likely to happen as chapter 2 FIGURE 2-25: SPACE SHIP's requirement.

The speed vector we used to detect collision risk is called collision line. In figure 2-15, last 3 minutes in True motion speed vector is our space ship. We may enlarge these space vector to 6 minutes or longer length (time) to check any intersection point (collision point) with another vessel. If two vessel's speed vectors are crossed in its last three minutes as figure 2-14, green and red vessel will have collision risk after 6 minutes.

The last 3 minutes part of speed vector is collision area (= last 3 minutes distance run of current speed). In figure 3-02, two vessels in collision course with speed vectors display. They pass same collision position at same time cause the collision. By this figure 2-02 we don't know after how many minutes they will collide we have to check their speed vector time setting. Identify collision risk by intersected point of two speed vectors.

圖形 3-02 兩條船在碰撞航向上，同時具有速度向量線的顯示



圖形 3-03 要確認碰撞危機，需要利用兩條速度向量線的交點

3-03 確認碰撞危機，利用兩條速度向量線的交點。

在 1935 時，在圖形 3-03 雷達螢幕有很多目標的回跡，而且速度向量線的設定是在 9 分鐘，本船的速度 10.4 節，航向是 358 度，本船的速度向量線是在我們的船艏輝線上。

本船速度向量線長度是 10.4 節乘上 9 分鐘等於 1.56 海浬，速度向量線的距離是 1.56 海浬。目標在雷達螢幕上，都沒有速度向量線的顯示，所以呢本船就沒有碰撞線，可以幫我們探測碰撞危機。雷達尾跡長度的設定，也就是目標在雷達螢幕上，過去位置的顯示，是真運動且對地穩定，尾跡的長度是 2.5 分鐘，顯示在螢幕上。

3-03 Identify collision risk by intersected point of two speed vectors.

In Figure 3-03, *at 1935 hours, Sanchi radar screen has many target echoes and speed vector setting at 9 minutes with ownship speed 10.4 knots, heading 358^0 degrees, ownship's speed vector is on our heading mark.*

Ownship speed vector length is 10.4 knots x 9 minutes =1.56 nm = 9 minutes speed vector distance

No speed vector display on target from ARPA or AIS, target vessel have no collision line to help detecting collision risk.

Setting of trails (target's past position on radar) is true motion and ground stabilized, trail length is 2.5 minute. True motion trail represents target's true position based on their past 2.5 minutes (as set) radar echo.

3-04 目標的尾跡有兩個好處，

1.使得目標的回跡變大，在螢幕上看起來更為清楚明顯，就像一個 RACON 的浮標，在海面上有較長的回跡，另外一個好處是對目標船的速度跟航向，有一個大約的概念，第三對於目標船隻的船型與大小，借由比較他尾跡的長短跟方向，會有一些概念（遠洋船行進方向是路過港口，漁船沒在抓魚是時，行進方向是進出港口），所以應該說是有三個好處，第三個就是對於他的船型，有一點大概的瞭解，有時候目標的尾跡，是我們的唯一線索，這可以從雷達螢幕上，尤其是當來往船隻眾多，或是在惡劣天氣（回跡時有時無），這個可以參考圖形 2 之 19，我們要知道如何利用

這些尾跡的性質，是非常重要的。回到桑吉輪的螢幕，在 1935 時，借由尾跡，桑吉輪的三副的想要瞭解一條大船回跡的方位跟距離，（暗示是一個大船），在圖形 3-03 的雷達螢幕上，顯示這個目標的資料，借由游標的量取，這是長峰水晶輪在雷達螢幕上面的顯示，我們得到的方位是 023 度，距離是 5.4 海浬。10 分鐘以後。三副已經忘了，他曾經在雷達螢幕上看過這一個目標，023 度與 5.4 海浬，這些都是數位的資料。所以三副在 1946 時，拒絕採取避碰行動，他已經忘記他在 1935 時，在阿帕螢幕上，看到的東西，在方位 023 距離 5.4 海浬的雷達回跡是一條大船，三副：他是一條小船對吧？這不是因為三副愚蠢，這是

3-04 Target's trail can have two advantages:

first is to make target echo size more prominent on screen like Racon. Second is to give rough picture of target vessel's speed and course and type by comparing her trail length and direction and size. Sometimes target trail is the only help we can get from radar screen especially when traffic is heavy or in rough (see figure 2-19). It is very important we know how to use trails properly.

Back to Sanchi's scene at 1935 hours, with the help of trail Sanchi 3/O tried to get the bearing and distance of a big echo (implied it's a big vessel) shown on radar screen figure 3-03. This target marked by cursor which is CF CRYSTAL shown on ARPA as bearing 023^0 degrees and distance 5.4 nm. After ten minutes 3/O forget what he had seen in radar screen (023^0 x 5.4) about this target's because it's all digital data.

At 1946 hours, 3/O refuse to take action. *3/O: Starboard? Why?* He had forgotten what he had seen at 1935 hours ARPA's screen (big echo in bearing 023^0 x 5.4 nm). *3/O: ...It's a small vessel, right?* It is not 3/O foolish. It is our human limitation in our short-term memory.

3-05 這是我們人類短期記憶的限制

這樣的麻煩，就是我們借由這本書，做一些補償的訓練，作為一個適任的三副，目標的距離 5.4 海浬，就是採取行動的一個信號，至少也要評估碰撞危機。如果 3 副在稍早的時候，沒有採取適當的瞭望， 5.4 海浬的距離，是避碰的第一階段，在圖形 2-22 上。如果不是三副要採取行動的距離，也是 3 副應該要評估目標雷達方位變化的距離，這是避碰規則 7：跑船應該使用所有可能的方法，對當時的情況與環境，適當的評估，以決定是否碰撞危機存在。如果三副決定轉向，在 1935 時目標的方位，代表本船應該轉向的度數，由 358 度的航向，轉到 023 度目標的船尾方位，向右轉讓路，就像圖形 2-10 的標準操作，也是避碰規則 8：避碰行動應該明確，而且考慮到遵守優良船藝。

3-05 It is our human limitation in our short-term memory.

This kind of trouble is what we try to compensate in this book. As a competent 3/O, target distance 5.4 nm is a signal to take actions to access collision risk if 3/O had not taken proper lookout earlier. 5.4 nm distance is first stage in Figure 2-22: vessels obligations in collision avoidance varied by distance. If it is not 3/O action distance to alter course it must be 3/O evaluation distance to check targets compass bearing as COLREG rule 7: *Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists*. If 3/O decide to alter course now 1935 hours the bearing of cursor means ownship should alter course 25 degrees (from 358^0 to 023^0) to starboard side to give way as in Figure 2-10: SOP for collision avoidance as COLREG rule 8: *Any action to avoid collision shall be positive, made in ample time and with due regard to the observance of good seamanship*.

好啦，是還有另外的一條船在雷達螢幕上，現在大約是方位 038 度，距離 3 海浬，這個是一個較小的雷達回跡，他的尾跡長度也比較短，是較小較慢的船隻回跡， 在這個雷達螢幕上，每一條船看起來，在這一階段都是無害的，因為三副設的 AIS 自動識別儀的碰撞警報，CPA 是在 0.9 海浬，警報時間是 15 分鐘，1935 時剛好是在實際碰撞前的 15 分鐘，即使碰撞危機是真實的，阿帕

也不會有任何碰撞的警報，當值船副設定警報時間的理由是，因為 CPA 警報 0.9 海浬，是為遠洋大船所設定的，不是為了小型船隻設定，太多小船在這個區域，設定的 CPA 如果是大於 0.9 海浬，將會有太多碰撞警報，三副也沒有辦法處理。

But there is another vessel ZHEDAIYU 03187 on the radar screen now, about bearing 038^0 degrees distance 3 nm away which was in smaller trail echo and shorter trail length (smaller and slower vessel's echo). On this radar screen, everything seems harmless at this moment because 3/O set the AIS alarm of CPA at 0.9 nm and 15 minutes. 1935 hours is exactly 15 minutes before actual collision time. Even collision risk is real OOW will have no collision alarm. The reason OOW set alarm time so long is because CPA alarm setting 0.9 nm is for ocean going big vessel not small vessel. Too many small vessels in this area with CPA setting of 0.9 nm will trig too many collision alarms if alarm time setting is shorter.

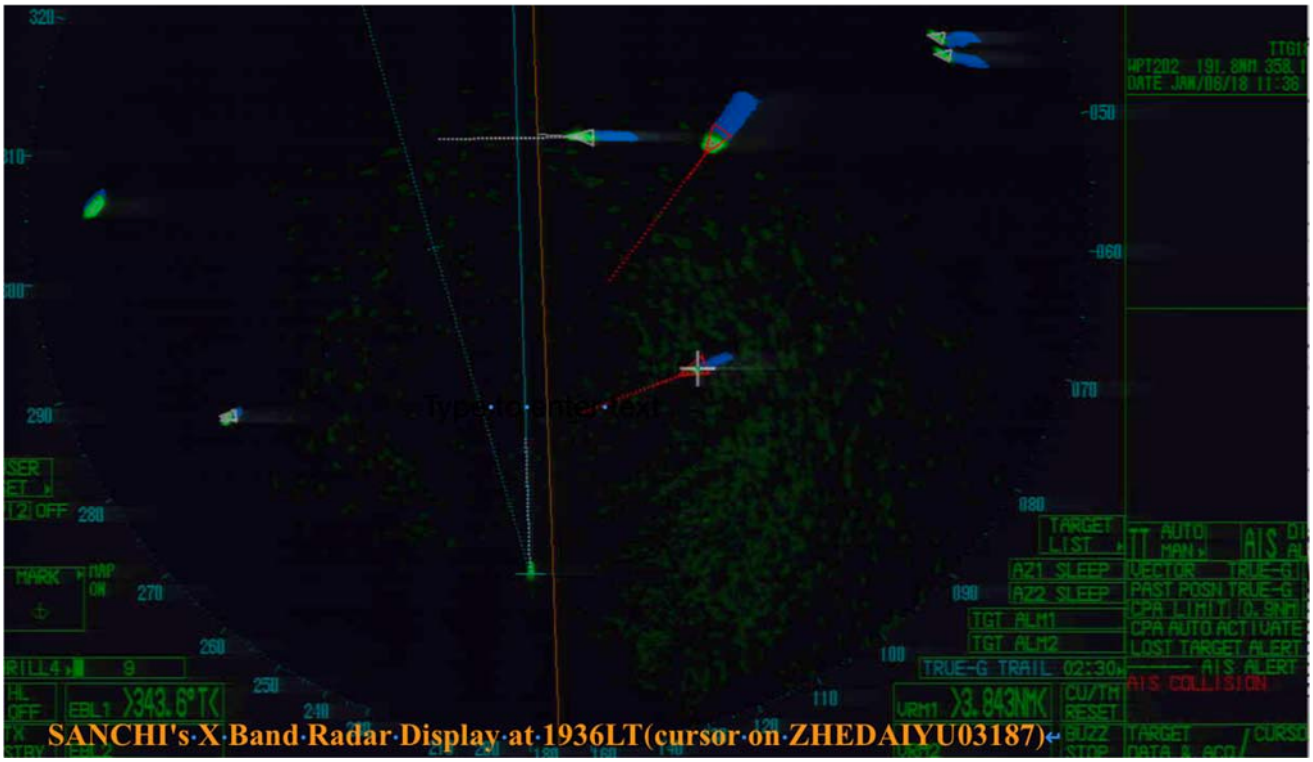
3-06 處境感知:我們能夠得到更多的幫助

- 三副並沒有設定固定距離圈，來說明確認目標的距離，如果有開啟固定距離圈，可以立刻得到目標距離的資訊，這表示三副並不關心目標的距離，因為本船的速度並不高，只有 10.4 節，3 海浬的目標，如果有 20 節的相對速度，還有 9 分鐘的時間，可以去處理這個情況，這是一個慢速船的實務。
- 我們會都在某些時刻，疏忽一些東西，因為我們的短期記憶，老是在忘記資料，不論這些資料是多麼重要，要幫助我們的短期記憶，我們需要更多的線索來互動，以加強我們的印象，像是固定距離圈，如果有開啟，那我們對目標的距離，就會產生一個立即的圖形印象。
- 在右舷，桑吉輪有五個目標，沒有被阿帕擷取，沒有阿帕的速度向量線顯示，或是 AIS 的資料，如果沒有速度向量線在螢幕上顯示，要探測碰撞危機，只是單純的利用目標的尾跡，就不是那麼簡單，在 1935 時，碰撞的前 10 分鐘。

圖形 3-04，長峰水晶輪與鄭大嶼漁船的速度向量線顯示在雷達螢幕

3-06 some more help we can get for situational awareness.

- 3/O did not set fixed range ring to help reading target distance immediately. This means 3/O did not care about target distance due to ownship has slow speed 10.4 knots. For a 3 nm target with 20 knots relative speed ownship still has 9 minutes time to handle the situation. This is a slow-paced practice.
- We all will overlook some items sometimes due to our short-term memory always overflow and forget data no matter it is important or not. To help our short-term memory we need more clues to interact to stimulate our attention, like setting fixed range rings.
-in the starboard side of SANCHI, there are 5 targets without acquired by ARPA. No speed vector displayed by ARPA or AIS. If no speed vector in the screen it is hard to detect collision risks by target trails only at this time 1935 hours.



圖形 3-04，長峰水晶輪與鄭大嶼漁船的速度向量線顯示在雷達螢幕

在 1936 時，桑吉輪的航向 358 度，對地的航速 10.4 節，由自動識別 AIS 所產生的 9 分鐘速度向量線，有碰撞警報，阿帕螢幕上面，在圖形 3-04 所顯示的漁船鄭大嶼在方位 039 度，距離是 3 海浬，長峰水晶輪的距離是 5.3 海浬。鄭大嶼的當職人員開始在 VHF 特高頻上呼叫桑吉輪，他可能沒有桑吉輪的船名，就在此時在 3 公分雷達上面，三副將游標移到鄭大嶼的回跡上，過了一陣子 AIS 的警報信號響起，長峰水晶輪跟鄭大嶼都顯示在桑吉輪的雷達螢幕上，這三角形的符號，對這兩條船都變成紅色的“AIS collision “AIS 碰撞警報是在雷達螢幕的右下角亮起。
這是桑吉輪開始頭痛的時候，他有三條速度向量線，以及一個 VHF 的呼叫需要處理，在 1 分鐘之前，所有事情都還 ok，都很好，過了 1 分鐘，就有四樣事情同時發生，兩個危險目標。如果三副具有圖形 3-02 雷達瞭望的知識，這兩個目標顯示的是紅色三角形，跟紅色的速度向量線，（標誌危險）

At 1936 hours, M.V. Sanchi COG 358° and SOG 10.4 kts. The 9 minutes speed vector generated from AIS collision alert show on ARPA display as figure 3-04 above. Fishing boat ZHEDAIYU 03187 is on bearing 039^0 degrees (T) x dist. 3 nm, and CF Crystal at a range of 5.3 nm. The watchkeeper of ZHEDAIYU 03187 started calling SANCHI on VHF channel 16. At this time, the cursor of X-band radar was shifted to ZHEDAIYU 03187 and shortly afterwards visual AIS warning signals of CF CRYSTAL and ZHEDAIYU 03187 were displayed on SANCHI's X band radar. The triangle symbols of both targets turned red and red message "AIS COLLISION" appeared in the right lower corner of radar display.
This is the time Sanchi headache begins: three speed vectors and one VHF calling to take care. One minutes ago, everything is fine. After one minute four things happened at once. Two targets are dangereous if 3/O had the knowledge of collision risk as figure 3-02 above. These two targets are shown as red triangle and speed vectors (danger sign) at same time.

3-07 兩個紅色三角形跟兩個紅色速度向量線

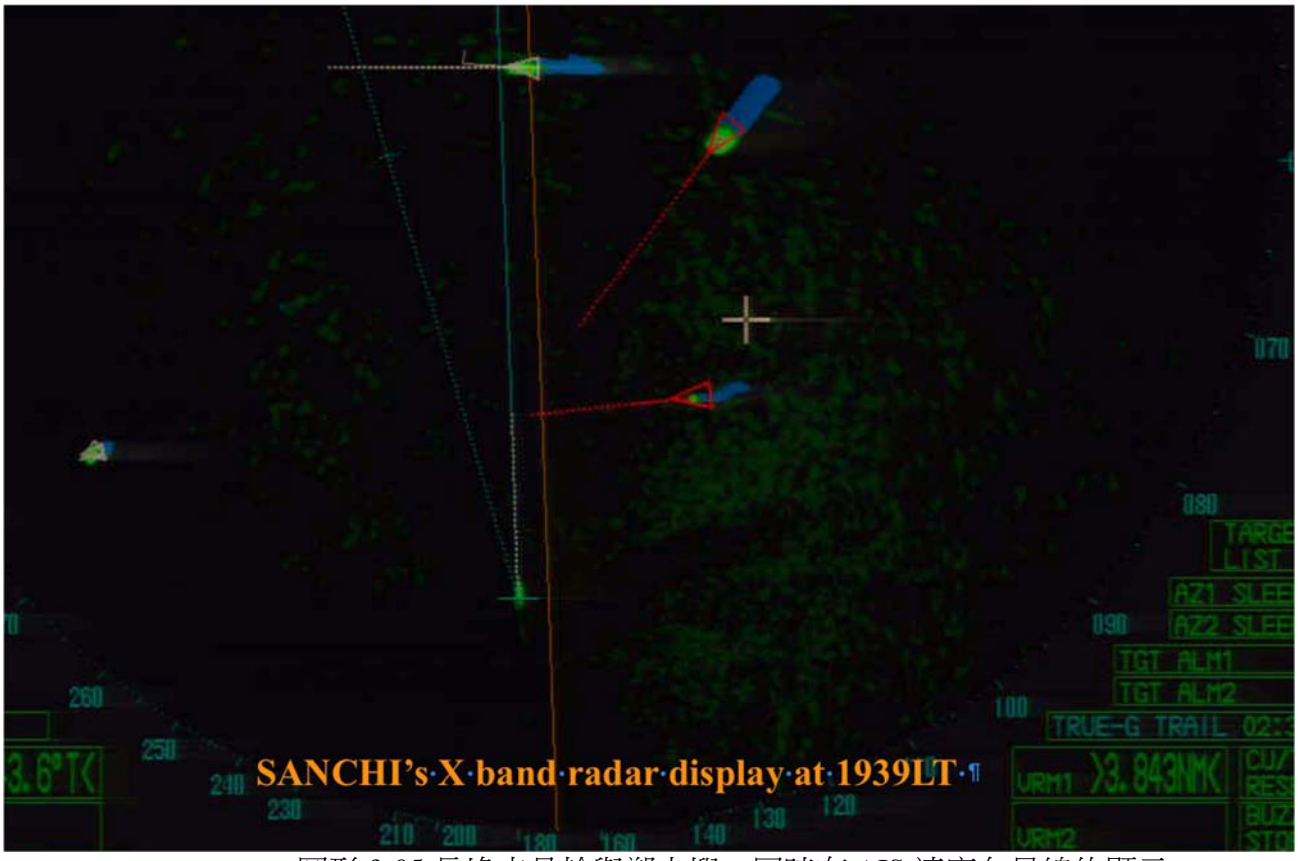
- 桑吉輪三副並不知道現在的碰撞時間是何時？是否對漁船是再 9 分鐘之後碰撞？漁船的速度向量線交點是 9 分鐘後，如果本船保持航向 358 度，航速 10.4 節來估計，本船將會比漁船先到達，這一個交叉點，也就是碰撞點。

- 跟長風水晶輪的碰撞時間是什麼時候？我們現在也沒有線索，現行 9 分鐘的速度向量線，並沒有給我們清楚的畫面，它們的交點在那裡？兩條速度向量線點的交點在哪裡？去找出交點的方法之一，就是放大速度向量線的長度，使用 9 分鐘時間設定不行，就用 15 分鐘的長度來試試看，有沒有交點，有交點，我們就可以估計碰撞時間，沒有交點，我們知道 15 分鐘之內，都沒有碰撞的問題。
- 船頭船隻的白色速度向量線是無害的。它會通過本船船頭，在 4 分鐘以後，這是由他的速度向量已經在碰撞點上判斷，本船同樣會在 27 分鐘之後通過，（碰撞點，在本船前面的距離，是我們現在速度向量線的 3 倍距離），所以通過的時間就會有 23 分鐘的差別。
- 碰撞危機：CPA 太小的時間設定，可以比 15 分鐘更久，用來避免工作的負荷太集中，當小型船隻已經在 3 海浬遠的距離。

圖形 3-05 長峰水晶輪與鄭大嶼，同時有 AIS 速度向量線的顯示

3-07 two red triangles and two red speed vectors.

- Sanchi 3/O did not know what is collision time now? Is it after 9 minutes for fishing boat? The intersected point of fishing boat ZHEDAIYU 03187 and ownship is about 9 minutes estimated by ownship's COG 358° and SOG 10.4 kts speed vector. Ownship will ahead of this fishing boat at intersection point.
- What is collision time with CF Crystal? We don't have a clue because 9 minutes speed vector did not give us a clear picture of where is their intersection point now. One way to find out intersection point is to enlarge speed vector length with longer time setting more than 9 minutes now.
- The white speed vector of vessel ahead is harmless. This vessel will pass ownship's bow after 4 minutes judging from her speed vector already on intersection point now. Ownship will pass same intersection point after 27 minutes (the distance ahead ownship now is 3 times of our COG 358° and SOG 10.4 kts speed vector). Passing time difference is 23 minutes.
- The CPA collision risk critirea can set longer than 15 minutes to avoid workload when small target come together at once and already in 3 miles distance away.



圖形 3-05 長峰水晶輪與鄭大嶼，同時有 AIS 速度向量線的顯示

在 1939 時，桑吉輪航向 358 航速 10.4 節，9 分鐘的速度向量線，是由 AIS 碰撞警報所產生的，在雷達螢幕上顯示，如同圖形 3-05。漁船鄭大嶼在方位 040 度，距離 2 海浬，而長峰水晶輪是在方位 026 度，距離是 4 海浬。

- 在 1936 時，本船將會先到鄭大嶼的船頭之前，位於交叉點上，現在我們可以看到漁船的 AIS 速度向量線在螢幕上的顯示，他的尾跡現在並不一致，因為他有轉向的動作。

At 1939 hours, *M.V. Sanchi COG 358° and SOG 10.4 kts. The 9 minutes speed vector generated from AIS collision alert show on ARPA display as figure 3-05 above. Fishing boat ZHEDAIYU 03187 is on bearing 040° degrees (T) x dist. 2 nm, and CF Crystal is on bearing 026° degrees (T) x dist. 4 nm.*

- At 1936 hours, Ownship will ahead of this fishing boat at intersection point. Now fishing boat speed vector from its AIS data on screen is not consistant with her trail on Radar because she had alter course to starboardside in hope that Sanchi will give way to her.

3-08 雷達瞭望的第一個警覺，碰撞的位置

桑吉輪跟漁船鄭大嶼的碰撞位置，是位於桑吉輪 9 分鐘速度向量線的終點，桑吉輪通過碰撞點早於漁船，因為桑吉輪的速度向量線終點，比漁船鄭大嶼速度向量線終點早到碰撞點，碰撞的時間是 1939 時+ 9 分鐘＝1948 時，我們知道碰撞的時間，長峰水晶輪跟桑吉輪是在 1950 時，這是正式調查報告上面顯示的碰撞時間。漁船鄭大嶼的碰撞危機是在 1948 時，只比長峰水晶輪真正的碰撞時間 1950 時，早了兩分鐘。如果這兩位當值船副會使用不同的速度向量時間設定來判讀碰撞點，就像我們在圖形 3-02 所討論的，他們就能夠利用交叉點來判斷碰撞的時間，這是我們在做雷達瞭望時，當值船副需要的第一個警覺，從速度向量線上，找出碰撞點的可能位置。

3-08 First awareness in radar lookout: Collision Position.

The collision Position of Sanchi and fishing boat ZHEDAIYU 03187 (intersection point of these two vessel's course line) located exactly at the end of Sanchi 9 minutes speed vector. Sanchi will pass collision position

earlier than fishing boat because Sanchi speed vector reach this intersected point earlier than ZHEDAIYU 03187. The collision time is 1939 hours + 9 minutes= 1948 hours. We know the collision time of CF CRYSTAL and SANCHI is at 1950 hours in formal investigation report. Fishing boat ZHEDAIYU 03187 had a collision risk with Sanchi at 1948 hours, 2 minutes before CF Crystal actual collision Time 1950 hours. If both OOW can read collision risk by different speed vector time setting as we discussed before in figure 3-02, they can identify collision time by intersected (or collision) point. This is first awareness needed in radar lookout for OOW: Judging collision position from both vessels speed vectors.

3-09 雷達瞭望的第二個警覺：碰撞的時間

一旦我們有了碰撞的感覺，因為速度向量線有交點，船副應該檢查本船距離碰撞位置的時間有多少？我們要檢查本船距離碰撞點的時間，因為避碰規則在不同的目標距離下，會有不同的義務，如同圖形 2-22，雖然在避碰規則。他並沒有提到任何具體的距離數字。第二個理由要檢查碰撞距離，是要設定避碰行動的優先順序，在本船與多目標的速度向量線，有航線交叉點的時候，雖然碰撞點距離的估計，對船副很重要，要確認雷達螢幕上的距離，利用游標 ／速度向量線或是固定距離圈，碰撞時間比碰撞距離更方便，用來確認目標的優先性。在圖形 3-05 上面，船副可以看到本船跟漁船的碰撞點，是在本船現在速度向量線的終點，9 分鐘後，本船跟長峰水晶輪的碰撞位置，是比鄭大嶼漁船還要遠一點，當值船副對本船速度向量線的時間設定，如果沒有概念，借由這兩條船在本船速度向量線上的交點，鄭大嶼比長峰水晶輪近，就能夠立刻知道漁船是避碰的第一優先，因為碰撞時間比長峰水晶輪早了兩分鐘，避碰直覺是來自於兩件事情的知識，瞭解交叉點就是碰撞點，本船越接近的碰撞點，代表越危險。

3-09 Second Awareness of radar lookout: TTC Time To Collision

Once we have the feeling of collision by speed vector intersected then navigator should check Distance of ownship To Collision position (DTC). The reason for distance checking is because COLREG applied in different stages by distance to target as figure 2-22 although in COLREG they did not say anything about the distance. Second reason for collision distance checking is set priority of collision avoidance actions to target when ownship have many targets speed vectors intersected ownship's course line at the same time. Although the Distance To Collision DTC is important OOW can verify the distance displayed on Radar by many ways like cursor, speed vector or fixed range rings. Time To Collision TTC is more convenient for OOW to verify the priority of Target if OOW knows ownship's maneuvering characteristics, i.e. how many minutes ownship need to make necessary degrees of course alternation. As figure 3-05 above, OOW can see collision point with fishing boat is at the end of ownship speed vector (9 minutes) and collision point with CF CRYTRAL is not so clear as ZHEDAIYU 03187. Maybe OOW have no idea of what time setting of ownship speed vector is, but the intersected point of SANCHI and ZHEDAIYU 03187 is more likely closer than SANCHI and CF CRYTRAL (CF CRYTRAL at relative bearing 025 degrees, her position after 9 minutes speed vector is far away than small vessel ZHEDAIYU 03187). OOW can have instant feeling that fishing boat ZHEDAIYU 03187 is the first priority now. This kind of instinct is coming from knowing two things: 1. Intersected point is collision point 2. Closer to collision point means more dangerous because Time To Collision TTC is lesser.

3-10 判斷從本船到碰撞點的距離 DTC 與時間 TTC

碰撞時間 TTC 與碰撞距離 DTC，這些呢都可以很容易地從速度向量線的交叉點判讀出來，本船的速度向量線，是從本船從現在的位置，一直到速度向量線的終點。碰撞位置在速度向量線的一半位置時，碰撞的時間 TTC time to collision 就是速度向量線設定時間的一半。碰撞距離 DTC distant to collision 就是現在速度向量線的長度距離的一半。對一個 20 節速度的船隻來講。如果他的速度向量線設定是 6 分鐘，這個 6 分鐘的速度向量線在雷達螢幕上顯示的距離，就是 2 海浬，因為是

20 節的速度，6 分鐘是他的十分之一。碰撞位置是速度向量線的一半位置時，碰撞的時間就是 3 分鐘以後，是 6 分鐘的一半，等於 3 分鐘。碰撞的距離 DTC 就是 1 海浬，6 分鐘可以跑 2 海浬，那一半的長度就是 1 海浬 。這個就是我們在雷達瞭望上的第二個警覺，碰撞時間 TTC time to collection。

3-10 Judging Distance To Collision DTC and Time To Collision TTC.

The DTC and TTC can be easily read from speed vectors' intersection point on Radar. Our speed vector moves ownship from present position to the end of the vector. If collision position is at half length of speed vector the collision time TTC is half time of speed vector setting and the distance to collision DTC is half distance run of current speed vector. For a 20 knots vessel, if the speed vector setting is 6 minutes (this 6 minute speed vector length displayed on Radar is 2 nm) and one collision position locate at half way from ownship's speed vector then collision time TTC is three minutes to go (6/2=3 minutes) and distance to collision DTC is 1 nm (half distance of 6 minutes run of 20 knots vessel). This is second awareness of radar lookout: Time To Collision TTC.

3-11 注意他尾跡的方向速度跟大小，如果有速度向量線時

鄭大嶼的速度向量線在雷達的顯示，跟他的尾跡顯示不一致。長峰水晶輪的尾跡，看起來就是一條很穩定的線條，接續在他的速度向量線之後，因為小船的雷達回跡，會因為海浪雜斑消失，或是被雜斑抑制所遮蔽，不論是在自動測繪模式或是人工調整海浪回跡的抑制，在桑吉輪的案件，我們看到海浪回跡的雜斑抑制，是設定在 40%，這是人工設定的雷達螢幕畫面。這一個海浪回跡的雜斑抑制設定，是雷達的使用者手冊所建議的：海浪回跡抑制的設定，應該在雷達螢幕上，可以看到少許海浪雜斑，仍然在螢幕上可見，不能把海浪雜斑完全抑制掉，這樣子可能會設定得太高，讓小船的回跡沒辦法顯示在雷達螢幕上，所以桑吉輪的雷達，海浪回跡的抑制設定，是合乎標準的。至於這條小漁船的尾跡顯示，可能是有向右轉，在過去的 2.5 分鐘內，當它還在 VHF 呼叫桑吉輪的時候。

3-11 Beware of her trail's course, speed and size when speed vector is available.

Speed vector from ZHEDAIYU 03187 is not consistent with her trail on Radar in Figure 3 - 05. Speed vector consistent with her trail is CF CRYTRAL there are in a steady line parallel with her speed vector. However, radar echo of fishing boat may lose due to sea clutter depressed by system in automatic mode or manually depressed the receiving gain too much. In this case, sea clutter setting is 40 manually (seeing in figure 3 – 05). By the picture of Radar screen this sea clutter setting is good as what Radar's user manual had recommended: keep some sea clutters visible on the screen to make sure Sea Clutter setting is not too much. The trail of this small vessel show she may have altered course to starboard side in past 2.5 minutes while she calling in VHF to Sanchi.

- 在 1939 時，圖形 3-05，情境感知如同下列：
  - 漁船鄭大嶼是在方位 040 度，距離 2 海浬，
  - 對於碰撞的感覺是，它與本船的 9 分鐘速度向量線終點處相交，所以 9 分鐘以後，會發生碰撞，這是我們的第二個直覺，由速度向量線上面的交叉點，讀出碰撞時間 TTC 。
  - 碰撞時間是 1948 時＝1939 時＋9 分鐘。當我們需要碰撞時間時，要做一些心算，
  - 碰撞距離是 9 分鐘本船速度向量線的長度，也就是 10.4 節乘上 0.15 小時等於 1.56 海浬。碰撞的距離是我們瞭解本船 9 分鐘速度向量線長度後，得到的第一個直覺。
  - 當值船副的情境感知是 1.56 海浬的距離，本船會有跟漁船發生碰撞的情形，但是我們還有另外一艘目標船速度向量線是紅色的，這是怎麼回事？
- 長峰水晶輪的雷達回跡在方位 026 度，距離四海浬：

- 可能會與本船有碰撞危機，但是交叉點現在看不到？他的回跡尺寸有比較大一點。
- 碰撞時間大於 9 分鐘，因為我們的速度向量線設了 9 分鐘，他的碰撞時間晚於漁船的 1948 時，
- 碰撞距離大於本船 9 分鐘的速度向量線長度 1.56 海浬，所以當值船副就現在的畫面，得到的感知是在 9 分鐘後，本船也許跟這一條大船，會有問題，其他還不知道。

-In 1939 hours in figure 3-05, situational awareness is as follow:

- Fishing boat ZHEDAIYU 03187 is on bearing 040^0 degrees (T) x dist. 2 nm (instinct for experienced OOW which had to cultivate certain time)
- *Sense of collision*, both vessels' 9 minutes speed vector crossed at end.
- *Time To Collision* = 9 minutes from now (our second instinct, read TTC with intersected point on speed vector).
- collision time is at 1948 hours = 1939 + 9 minutes (Collision time needs some mental calculation)
- Distance To Collision = 9 minutes Ownship speed vector length =10.4 x 0.15 = 1.56 nm (OOW should always remember how many distance shown in his speed vector setting for his instinct cultivation)
- OOW situational awareness now is "After 9 minutes or 1.56 nm distance ahead, ownship will have a collision case with fishing boat". But, we have another target's speed vector in red?

- CF Crystal is on bearing 026^0 degrees (T) x dist. 4 nm who

- *May have collision risk with ownship?* Intersection point is unknown.
- But her echo size is big. This is a big vessel.
- time to collision TTC > 9 minutes from now and Collision later than fishing boat 1948 hours
- distance to collision DTC > 9 minutes and Ownship speed vector length 1.56 nm
- OOW situational awareness is "After 9 minutes, ownship may have problem with this big vessel?".

3-12 告訴我，如何瞭解長峰水晶輪在目前迷霧下的碰撞警示

回答：本船必須使用到較長的速度向量線時間設定，來確認碰撞危機，也就是大於 9 分鐘。

回到碰撞現場，在 1939 時鄭大嶼在 VHF 無線電上呼叫桑吉輪，
三副說道"它在跟別人講話，你知道，永遠不要回答這些呼叫"，
三副說道"他在跟別人呼叫或是講話"，是在找一個藉口，不去做任何事情。
"你知道，永遠不要回答這些呼叫"，因為呢，我有為什麼不回應的一套理論。
三副也許是對的，MCA 英國海岸防衛隊也曾經警告過"使用 VHF 特高頻無線電，我們會有麻煩，因為不知如何確認我們正在交談的的物件？"
在公海上，當值船副也不會知道誰在 VHF 上面呼叫？除非有 AIS 資料的幫忙，也有可能是另外一條船，使用第三條船的名字來跟我們聯絡，其動機可能是惡意，或者只是單純的開玩笑。
避免不必要的 VHF 通訊，如果我們不能確定，本輪是在跟誰對話。
行經港口 河道 湖泊與內陸水道與海相通水域時，當地的航行規則，可能會強迫當值船副保持無線電執更，定點向 VTIS 船隻通航資訊服務，通報報告點，並使用特定的 VHF 頻道。
在美國的水域，他們有強烈的傾向要保持 VHF 通訊的連續性，要不斷的向港務台通報經過的地點，這是非常重要的，可以避免來自海岸防衛隊的罰款。
所以三副說："永遠不要回答這些呼叫"不是永遠對的，也許是他的船，跑美國的機會不多。

3-12 Tell me how to understand CF CRYSTAL collision situation in current mystery?

ANS: Ownship have to use more (than 9 minutes) speed vector time setting to verify collision risk with CF CRYSTAL.

Back to collision scene at 1939 hours: ZHEDAIYU 03187 kept calling SANCHI on VHF radio.
3/O said: *Oh, he's talking to another one. You know, never answer these calls.*

- *Oh, he's talking to another one.* Find an excuse to do nothing.

- *You know, never answer these calls.* Because 3/O has a theory why he is responded like this .
- Maybe 3/O is right? MCA also had warned "*Using VHF, we will have problem to identify the party we are talking to*". In open sea no OOW can know who is calling in VHF unless he identifies himself with Call Sign or his ship's name. Even calling vessel had included his ship's name we don't know it is really come from the party is calling. It is also possible another vessel used third vessel's name to communicate out of malice or joking.
- Avoid unnecessary VHF communication if we cannot make sure who we are talking to.
- In roadsteads, harbors, rivers, lakes or inland waterways connected with the high seas where the operation of local rules may enforce OOW to keep radio watch and report to VTIS Vessel Traffic Information Service in specified VHF channel when passing reporting point.
- In US and China in-land waterways, there are strong tendency that keep VHF communication continuously with port authorities specified channel is very important to avoid penalty from Coast Guard.
- It is not always right "*never answer these calls*" as 3/O said.

3.02 由不確定引起的恐懼

3-13 "如果你回答，他會認為……他已與你確認他的行動"

三副說到"*因為你如果不回答，他就不 OK 去行動，但是如果你回答，他會認為……他已經與你確認他的行動*"。

- *因為你如果不回答，他就不 OK 去行動*：三副認為漁船會想，大船沒有收到我特高頻的呼叫，漁船就不會採取任何行動去擋到你的路。三副也許是對的，但這也是對避碰規則第 18 條的違背，避碰規則 18 條（a）：動力船舶在航行中，必須讓路給從事捕魚的船隻。
- 一條從事捕魚的船隻：不是一條正在捕魚的船隻，只要他的船隻性質是漁業的，動力船隻就要讓路，這個定義包括以前補過魚的船隻。
- "*但是如果你回答，他會認為已經跟你確認了他的行動*"，三副擔心，如果他回答漁船，就是暗示他同意，不管漁船做的任何提議，也不管三副的回答是好？還是不好？三副也許是對的，但三副的說法，違背了避碰規則第 18 條（a）。

三副說道，"*如果他採取行動，不管他在無線電裡面說了什麼？你根本就聽他不懂？*"但是如果你回答他的無線電呼叫，裡面講了什麼？你也搞不懂，他就會跟著採取行動。

- "*如果我回答他們的 VHF 呼叫，他就認為跟你確認了他的行動*"，不管他在無線電裡說了什麼？而且你還搞不清楚？
- 三副說的很有道理，但是並不是每一個人都同意他的看法？尤其是在本船以外的單位，這個並非是海員常規，就像規則 2 規定的，我們需要特別的注意。
- 實際的海上，這是最危險的事情，為你自己的壞習慣，發展出一套你自己的理論，貓一套，狗一套，每個人都有一套。
- 成功的溝通，包括四個部分 1.他心裡面所想的到 2.他嘴巴裡面所說的 3.然後是你耳朵所聽到的 4.最後是你腦子裡面想的是什麼？在這裡呢，三副提到了另外兩種障礙，在船跟船之間的溝通，那就是在無線電裡面說了些什麼外國語言？跟你在無線電裡面聽到的外國語言？也就是對方說的，跟你聽的都不是你的母語，所以溝通有六重的障礙。

3-02 Fear comes from uncertainty

3-13 But if you answer, he seems … he confirms with you about his action.

3/O said: *Because if you don't answer, it is not OK to action. But if you answer, he seems … he confirms with you about his action.*

- *If you don't answer, it is not OK to action.* 3/O assumes that fishing boat will think big vessel did not receive his call then she will not take any action to block your way. 3/O may be right but it is a

violation of COLREG rule 18: (a). *A power-driven vessel underway shall keep out of the way of: a vessel engaged in fishing*. A vessel **engaged** in fishing not a vessel engaging in fishing. This definition includes a vessel had engaged fishing before, even not now.

Also violation of rule 5: keep proper lookout including hearing to ascertain collision risk.

- *But if you answer, he seems ... he confirms with you about his action.* 3/O worried if he answered the fishing boat it will imply that he has agreed whatever fishing boat had proposed whether 3/O's reply is yes or not. 3/O may be right but it still is a violation of own ship's responsibility by COLREG rule 18(a). *shall keep out of the way of a vessel engaged in fishing.*

3/O said: *So he takes action, whatever he said in the radio and you don't understand.*

- *If you answered whatever he said in the radio and you don't understand.* Ownship will be in danger that **fishing boat will take actions by what he had just said but ownship don't understand.**
- *If you don't answer, it is not OK to action.* Out of fear that ownship will not take action to avoid collision.
- No reply to their VHF calling he *is not ok to action.*
- Reply to their VHF calling *he seems ... he confirms with you about his action, whatever he said in the radio and you don't understand.*
- What 3/O said make sense to himself although not everyone agrees with him especially outside parties. It is not *the ordinary practice of seamen* (COLREG rule 2).
- In real sea, **it is most dangerous thing to have your own theory about your bad habit.**
- Successful communication consist of four parts: what he thinks in mind -> what he said in mouth -> what you hear in ear -> what you think in mind. Here 3/O mentioned **two more obstacles in ship board communication. 1. What he said in the radio and 2. what you heard in foreign language.** or 1. Radio hearing capability and 2. English verbal communication.

3-14 因為你不回答，他就被迫採取行動來讓路

三副說到：“*如果你不回答，他將被迫採取行動，讓他能夠清爽通過，瞭解嗎？*”

- 但是如果你不回答，這個通訊煉就破裂了，沒有程式或是沒有協定可以達成，沒有瞭解可以建立。
- 他將被迫採取行動，這並不是以這樣的邏輯，來發展的。
- 漁船溝通的目的，也許不是要求做任何的安排。
- 他也許只是希望警告桑吉輪，他們在桑吉輪的右舷，並且有碰撞危機。
- 最終的目的是要求桑吉輪給漁船讓路，因為兩條船有碰撞危機，並且可以符合避碰規則的要求。
- **漁船並不希望你的無線電答覆，他們希望你立刻讓路**。
- 桑吉輪無須回答無線電，但是必須立刻轉向讓路。
- 桑吉輪三副不想讓路給漁船，從一開始就是這樣，如果從 1 9 3 9 時桑吉輪在漁船呼叫的時候，就讓路給漁船，最後結果如何？沒有人能夠確定。因為漁船的相對方位大於長峰水晶輪，先讓路的結果，就是一次 OK。

三副把他對避碰的主導性，交給沒有受過 STCW 訓練的外籍漁船，如果這條漁船沒有採取有效的避讓行動，沒有人知道會發生什麼事？所以 3 副是賭上他的事業跟工作，把它交到外國漁船的船長手上。

- 他必須去採取行動，讓他可以清爽通過。
- 漁船也許可以採取行動去避免碰撞，在第一時間使用避碰規則 17 a 第 2 項，“也許，不論如何，採取行動去避免碰撞，使用他自己單獨的運轉船隻，當讓路船沒有採取適當的行動去符合本規則”，這個是在讓路船跟直航船**會遇的第二階段**，避碰的義務

-**漁船可以採取行動**，以避免碰撞，從碰撞前的 9 分鐘，從 1939 時（沒收到無線電回答，但是有看到桑吉輪發的摩斯信號燈的燈光），到 1948 時（速度向量線顯示的碰撞時間），如果桑吉輪沒有採取適當的行動，以避免發生碰撞。

漁船應該採取行動避免碰撞，在最後的時刻，這是避碰規則 17（b）“他將採取這樣的行動，以最好的幫助避免碰撞”，當直航船需要保持航向航速，“發現本船太接近它船，碰撞無法由讓路船單獨的行動，而加以避免。”**這是兩條船在會遇的第三階**段，兩條船都要有讓路的義務。

- **漁船應該採取行動**，去避免碰撞，在 1945 時之前，碰撞前 3 分鐘的時間，碰撞時間是 1948 時，如果碰撞沒辦法，由桑吉輪單獨行動所避免。
- 桑吉輪並沒有採取行動，避免與漁船的碰撞，只有維持原航向航速，將避碰的主導權，他自己的安全交給漁船船長。
- 在 1939 時，漁船可能預備向左轉向，通過桑吉輪船尾，然後在 VHF 上面呼叫，可能只是要通知桑吉輪確認，桑吉輪並沒有在 VHF 特高頻無線電上，回答漁船對他的呼叫。
- 經過失敗的無線電呼叫兩分鐘之後，在 1941 時，漁船開始改變他的航向到左邊，當漁船開始讓路，另外一條船桑吉輪應該保持航向航速，這是避碰規則 17（a）（i）。桑吉輪要保持航向航速，在 1941 時開始，去避免跟漁船的碰撞，漁船已經向左舷轉向。
- 這個情形，綁住桑吉輪的動向，無法對長峰水晶輪做避碰的動作，桑吉輪浪費了從 1941 時到 1946 時，不能做任何動作，1946 時是真正碰撞前 4 分鐘的時間。

3-14 Because if you don't answer, he shall be forced to take action to make himself clear.

3/O said: *But if you don't answer, he shall be forced to take action to make himself clear, understand?*

- *But if you don't answer:* the communication chain is broken. No arrangement or agreement will be made. No understanding will be established.
- *he shall be forced to take action:* It is not in this logic.
    - *he shall be forced to take action* is to save the collision risk but Fishing boat has no obligation to give way by COLREG.
    - The communication purpose of fishing boat may not ask for any arrangement to be made.
    - It may only want to warn Sanchi their present at her starboard side and collision risk.
    - The ultimate purpose of communication is to ask Sanchi give way to fishing boat to avoid collision risk and COLREG compliance.
    - Fishing boat don't want your radio answer. They want you to give way immediately even Sanch did not answer in VHF.
    - Sanchi don't need to answer the radio but to alter course immediately.
- Sanchi 3/O don't want to give way to fishing vessel from the beginning. What will happen from 1939 hours (the moment Sanchi 3/O refused to reply) no one can tell.
    - 3/O give up his initiative to avoid collision risk to an unqualified foreign fishing boat. What happen if this fishing boat did not take effective avoidance actions. 3/O bet his career and job on the hands of a foreign fishing boat skipper.
- *he shall be forced to take action to make himself clear:*
    - fishing boat may (is allowed to) take action to avoid the collision in the first instance by COLREG **rule 17(a)(ii)** *"may however take action to avoid collision by her manoeuvre alone" when "the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules."* This is second stage obligations between give-way and stand-on vessel.
    - Fishing boat may take action to avoid the collision from 9 minutes time before collision from 1939 hours (no radio reply from Sanchi but receive ALDIS signal) to 1948 hours (collision time as speed vector shown) if Sanchi not taking appropriate action.

- fishing boat shall (have to) take action to avoid the collision in last minutes by COLREG **rule 17(b)** "*she shall take such action as will best aid to avoid collision" when "the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone.*" This is third stage obligations both vessels have to give-way.
- Fishing boat shall take action to avoid the collision at least before 1945 hours (3 minutes before collision time 1948 hours) if collision cannot be avoided by the action of Sanchi alone.
- Sanchi had not taken action to avoid collision with fishing boat but stand-on in second stage and give her initiative to avoid collision (her own safety) to fishing boat.
- At 1939 hours, fishing boat may have alter course to starboardside to help SANCHI to pass her astern and called in VHF for confirmation without SANCHI's reply in VHF.
- After two minutes of failed radio contact, at 1941 hours, *fishing boat started altering its course to port side.*
- When fishing boat *is to keep out of the way the other* (Sanchi) *shall keep her course and speed by* **rule 17(a)(i)**. Sanchi has to keep her course and speed from 1941 hours to avoid the collision with fishing boat. Fishing boat alter course to starboard at 1941 hours.
- This situation binds Sanchi's movement to avoid the collision risk with CF CRYSTAL from 1941 hours to 1946 hours (4 minutes before actual collision). This is most dangerous part of this case.
- This situation also blocked Sanchi's attention (or lookout) to avoid the collision risk with CF CRYSTAL from 1941 hours to 1946 hours.

3-15 AB 說道:然而這並不符合規則，我被強迫要…

只因為我們不懂他們的語言

- 三副並沒有讓路給右舷的船隻，不符合避碰規則 15 條橫越的相遇：船隻見他的右舷有其他船隻，應該讓路。這個規則規定讓路義務是由相對位置，在他本身的右舷有船隻，就有讓路義務。
- 本船見有其他船隻在其右舷的時候，有兩種情形，橫越或是追越。這兩種情形，本船都必須讓路。規則 13（b）是當本船在其他船隻正橫後面 22.5 度之後接近，視為追越。
- 規則 15 並沒有規定，用語言問題來規範義務，只有兩條船隻相互之間的視角，來規定船隻的讓路義務。
- 桑吉輪這條船，看見在右舷有漁船，就應該讓路，不論漁船在無線電裡面說的是什麼？就算你也聽不懂？

三副並沒有回答 A B 的說法

- **三副可以改變速度向量線的時間設定為 12 分鐘，以評估長峰水晶輪的碰撞危機**

3-15 AB: And this is not complying to the rules that I must oblige……

Because we don't understand their language.

- 3/O did not give way to starboard side vessel is not complying with COLREG rule 15 crossing situation: *the vessel which has the other on her own starboard side shall keep out of the way.* This rule regulated *keep out of way obligations* by relative position: *on her own starboard side.*
- Ownship which has the other on her own starboard side has two situations: crossing or overtaking. Both situations, ownship has to give way. (**Rule 13(b)** *overtaking is when ownship coming up with another vessel from a direction more than 22.5 degrees abaft her beam.*)
- Rule 15 did not regulate the obligation by language problem but only by aspect of each other.

- Sanchi (*the vessel) which has* fishing boat *[the other] on her own starboard side shall keep out of the way whatever fishing boat said in the radio and you don't understand.*

3/O did not reply AB's comments.

- 3/O can change RADAR speed vector setting to 12 minutes to evaluate the collision situation with CF CRYSTAL because it is not clear in 9 minutes speed vector time setting.

3-16 漁船開始向左邊轉向

在大約 1 941 時，航向 358 度，航速 10.4 節，漁船鄭大嶼在 1.8 海浬之外。三副要求瞭望去發摩斯訊號燈給鄭大嶼，當值船副也注意到漁船開始向左舷轉向。

- 鄭大嶼速度大約是 8 到 9 節，這是我們檢查漁船速度向量線，在雷達上面的長度與本船桑吉輪 10.4 節速度向量線的長度，比較長度得出來的概念，鄭大嶼的速度是 8 到 9 節。我們可以利用一個分規，量取速度向量線的長度，跟本船的速度向量線做一個比較，來估計它的速度。
- 三副要求瞭望發摩斯訊號給漁船，實際上，這是不允許的，本船對外界的通訊，應該由有執照的當值船副來監督進行，誰知道 AB 會發出什麼樣的信號?
- 三副對其他船隻所採取的避碰，是否有足夠的行動？懷有疑問，此時我們應該對有懷疑的船隻，如何表示本船的這種疑問？
- 因為這是在駕駛台的實務，AB 可能知道正確的信號，是至少連續的五閃光，避碰規則 34 條第 1 項的規定。
- 三副並不關心他讓路的義務，是對右舷的船隻，向右舷轉向。反而表示他的疑問？對方船隻有沒有避碰的行動？用摩斯信號燈來表示他的疑問，這只是一個懷疑的表示，不是一個要求漁船去行動的訊號。同樣的理由，表示疑問，漁船鄭大嶼當值人員開始在 VHF 頻道 16 上呼叫桑吉輪，是從 1936 時開始的。
- 摩斯信號燈光，在當下，並不是正確的答案，但是他給漁船一些確認，就是桑吉輪已經注意到他的存在。
- 調查報告並沒有提到，桑吉輪的 AB 發射什麼信號摩斯信號給漁船鄭大嶼。
- 當漁船接收到桑吉輪發出來的摩斯信號燈光，漁船鄭大嶼採取行動向左轉向，而桑吉輪的當值船副注意到了，所以漁船鄭大嶼的特高頻呼叫，至少達到一個目的，就是讓桑吉輪注意到他的存在，能夠讓漁船向左轉向，不會讓桑吉輪同時向右轉向，引起後續碰撞
- 從 1941 時到 1946 時，避碰規則 17 條桑吉輪就是直航船，相對于鄭大嶼這條漁船，原來是直航船，現在正在向左轉向，以讓路給桑吉輪。

3-16 the fishing boat started altering its course to port side.

At about 1941LT, SANCHI's, COG 358° and SOG 10.4 kts. ZHEDAIYU 03187 was around 1.8 nm away. *The 3/O asked lookout to give ALDIS signal to ZHEDAIYU 03187. The OOW noticed that the fishing boat started altering its course to port side.*

- ZHEDAIYU 03187 speed is about 8 to 9 knots. This is visual check on fishing boat speed vector length with ownship SANCHI SOG 10.4 Kts speed vector length can be verified by using a divider to take speed vector length of fishing boat to compare with ownship's length. (knowledge and skill in target vessel's speed estimation)
- 3/O asked lookout to give ALDIS signal to fishing boat. Actually, this is not allowed. Any communications outside ownship shall carry out by licensed OOW. Who knows what signal AB will send through ALDIS signal which could mistook as other meaning like overtaking or crossing?
- 3/O *is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by at least 5 short blast in whistle or 5 quick flashes* ALDIS signal light*?*

- Because this is common practice in bridge ask AB to do the job for 3/O, AB might know or not the correct signal is "*a light signal of at least five short and rapid flashes*" **Rule 34(d)**.
- 3/O did not care of his obligation to give way to starboard side vessel but express his doubt *whether sufficient action is being taken by the other to avoid collision* by ALDIS signal. This is an expression of doubt not a request to ask fishing boat to act. It is the same reason (expression of doubt) *the watchkeeper of ZHEDAIYU 03187 started calling SANCHI on VHF channel 16* at 1936 hours.
- ALDIS signal is not right answer for this moment but it can give fishing boat some confirmation that SANCHI had seen her.
- Investigation report did not mention what signal SANCHI AB sent to ZHEDAIYU 03187.
- By receiving this ALDIS signal, ZHEDAIYU 03187 begin to take action to alter course to port side as SANCHI OOW had noticed.
- From this moment 1941 hours to 1946 hours, from **COLREG rules 17,** SNCHI is stand-on vessel to ZHEDAIYU 03187 who originally is a give-way vessel.

3-17 避碰規則的義務改變：直航船原來是一條讓路船

規則 17 17 (a)(i) *當兩條船之一正要讓路，另外一條應該保持其航向航速。*

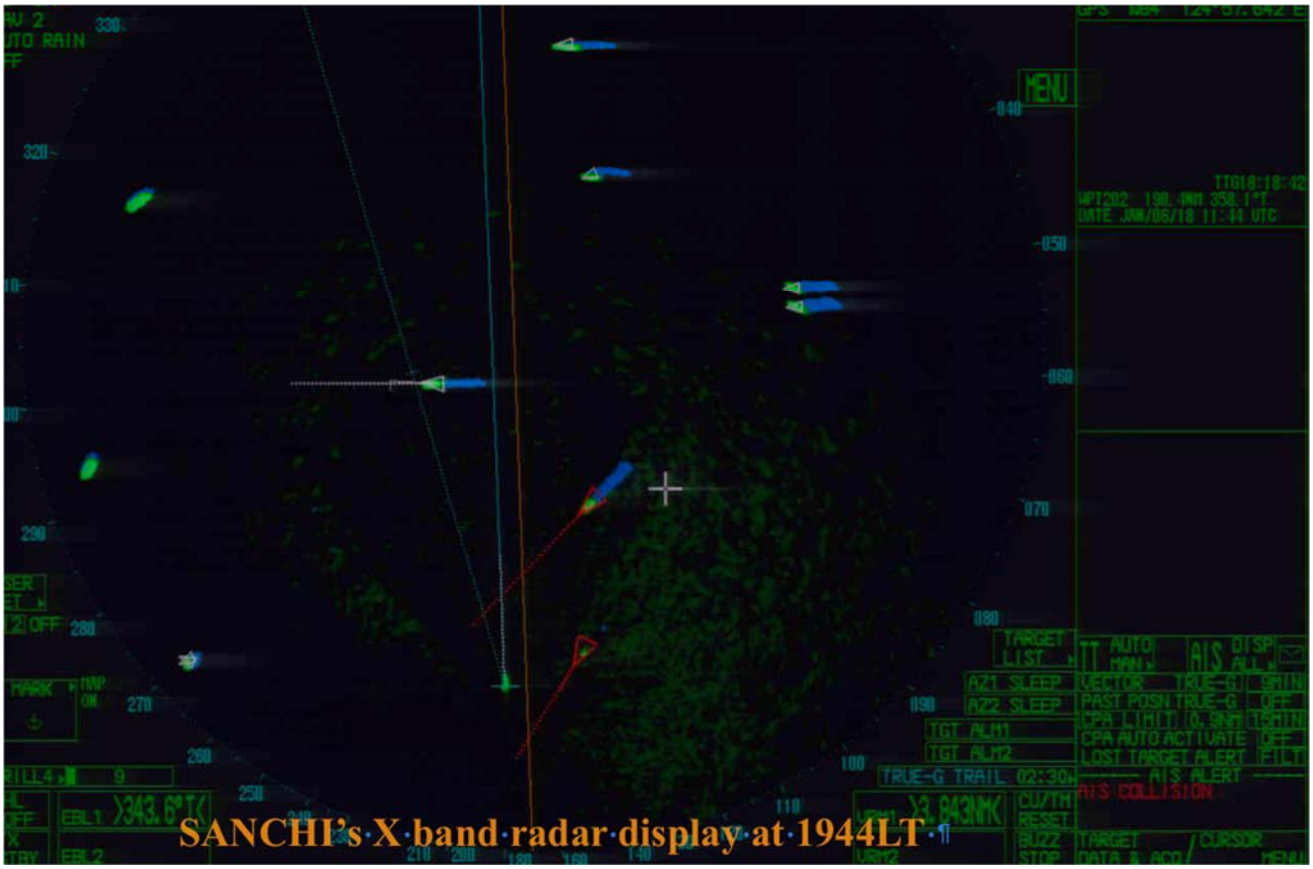
- *兩條船其中一條：很可能在開始的時候，沒有要讓路的義務，那就是說這一條正要讓路的船，原來是一條直航船。*
- *一旦某船正要開始讓路，他船應該保持它的航向航速，不管開始的時候，誰是直航船。*
- *讓路船失去他的主動性，去轉向或減速，一旦直航船開始讓路。*

圖形 3-06 長峰水晶輪與鄭大嶼具有 AIS 速度向量線顯示

3-17 COLREG obligation changed: stand-on vessel who originally was a give-way vessel

rules 17 (a)(i). *Where one of two vessels is to keep out of the way the other shall keep her course and speed*.

- - *one vessel is to keep out of the way*: "*is to* " in English grammar is future tense which means : Before this vessel take action to keep out of the way, the other shall keep her course and speed.
- - *one of two vessels*: This one may not be directed to keep out of the way originally. That is to say the one is to keep out the way maybe a stand-on vessel originally.
- - *Once a vessel is to keep out of the way, the other shall keep her course and speed*, no matter who is the stand-on vessel in the first place.
- Give-way vessel lost its initiative to alter course or speed once stand-on vessel take action first.



圖形 3-06 長峰水晶輪與鄭大嶼具有 AIS 速度向量線顯示

在 1944 時，上圖桑吉輪 GPS 位置不變，航向 358 度，航速 10.5 節，三副說到：這是一個困難的情況

- 讓路船失去改變航向航速的主動性，一旦直航船採取行動。桑吉輪的三副發現，是在這種困難的情況下。如何是解決這種困難的雷達瞭望？

At about 1944LT, in Figure 3-06 both CF CRYSTAL and Fishing Boat have Speed Vector displayed, SANCHI's GPS position was 30°50'.0N/124°57'.6 E, COG 358° and SOG 10.5 kts. *The 3/O commented that it was a hard situation.*

- Give-way vessel lost its initiative to alter course or change speed once stand-on vessel take action. SANCHI 3/O found himself in this hard situation because he is binding by stand-on vessel obligation. How to solve this hard situation of multiple target by radar lookout?

3-2 在多目標雷達瞭望下的情勢感知：

有技術與目地的讀取雷達畫面

3-18 兩個目標相對之間的距離

1.如何知道兩個目標相互之間的距離？漁船跟長鋒水晶輪距離是 1.5 海浬，這又是如何知道的？我們可以使用分規，或是我們手指頭的跨距來量出，本船速度向量線的長度，這個我們前面已經計算過很多次，本船現在在雷達畫面上，速度向量線長度是 1.5 海浬。本船速度 10.4 節跑 9 分鐘的距離，利用本船速度向量線現在的長度，可以估計兩條船之間的距離，我們需要這一個資訊的理由，是去估計從這兩條船之間，本船是否具有足夠的海域去穿越，也就是安全距離是否足夠。

3-2 Situational Awareness in multiple targets Radar lookout.

Read RADAR picture with certain skill and purposes.

3-18 Knowing two target's distance to each other

Knowing two target's distance to each other? Does there have safe distance between these two targets could be used by ownship to keep safe distance to avoid collision. ZHEDAIYU 03187 and CF CRYSTAL are 1.5 nm apart and how do we know?

By using divider or your fingers span to take out ownship's speed vector distance 1.5 nm (we know it by ownship speed 10.4 knots and speed vector time setting is 9 minutes) to compare with these two vessel's echoes space on radar screen.

The reason why we need this information is to estimate the possibility to pass between these two targets when ownship have to take action. (situation awareness from radar picture)

3-19 要在兩條船之間穿越，這個距離是否足夠？

2. 這個 1.5 海裡的距離，對本船是否足夠穿越？我們是怎麼知道的？

如果本船讓路給長鋒水晶輪，我們必須向 026 度轉向，鄭大嶼的方位，現在是 065 度，這兩條船之間，有 41 度的分隔，我們可以從中開過去，一個 AB 能夠做這樣子的操船，這是沒有問題的，在其他的情況下，船隻之間的距離，需要本船的 6 倍船長，才足夠完成一個成功的航向改變，桑吉輪的全長是 274 公尺，274 乘 6=1644 公尺，這還不到一海浬。現在兩條船隻的距離有 1.5 海浬，就像我們從本船速度向量線長度得到的估計，是足夠本船從中穿越航行。

3-19 Is this distance enough for ownship to pass in-between

Is this 1.5 nm enough for ownship to pass between these two vessels and how do we know?

If ownship give way to CF CRYSTAL we have to alter course to 026^0 (T), this is CF CRYSTAL's true bearing. ZHEDAIYU 03187 bearing is 065^0 degrees now, there are 41 degrees gap ownship can steer to. An AB can do this maneuvering without any problem. In general, **the distance between two targets needs 6 times of ownship's length for a success course change.** In Sanchi case, her length over all is 274 meters. 274 x 6 = 1644 meters. 1.5 nm as we estimate it from comparing the length of ownship's speed vector which is enough for ownship to maneuver to pass in-between these two targets.

3-20 本船需要改變到什麼航向？來避免碰撞

3. 只需要避免本船的速度向量線跟長峰水晶輪產生交點，我們就會免於碰撞。

4.在實際海上，3 副必須改變本船的航向到長峰水晶輪的船尾，即使三副不知道長鋒水晶輪的方位是多少？反正就是對著來船的船尾轉向，尤其是在近距離，難以估計到底還有多少海浬遠。

5.在雷達螢幕裡，避免長峰水晶輪速度向量線的圖形解答。是利用 EBL electric bearing line 電子方位線，這也代表本船的船首線，是從本船的中心點轉到我們的右舷，經過長鋒水晶輪的速度向量線，以及他在雷達上的回跡，也就是把長峰水晶輪的速度向量線當做一條太空船，直接小心的轉向，讓本船的太空船不會與他的太空船，產生交叉點。

6. 在 1944 時，本船隻需要轉向到 026 度，這是長峰水晶輪的方位，我們的電子方位線就會清爽長峰水晶輪速度向量線，避免碰撞危機的所有交點。

圖形 3-07 太空船：本船使用 10 度舵角的進距

3-20 What course ownship need to change to avoid collision?

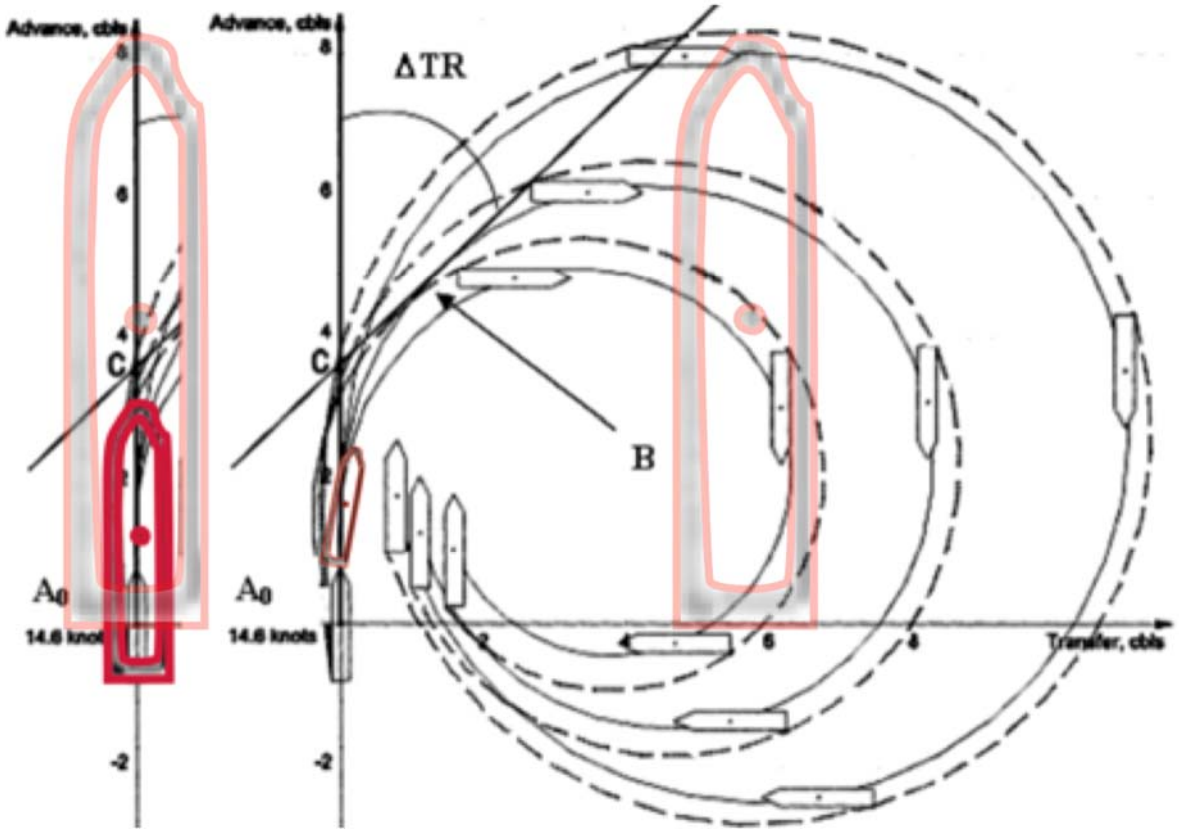
Ownship only need to avoid ownship's speed vector intersect with CF CRYSTAL we will be free of collision. (no collision point)

In visual lookout, 3/O need to alter ownship's course to CF CRYSTAL's stern even 3/O doesn't know CF CRYSTAL's bearing reading.

In Radar lookout, the graphic solution is to avoid CF CRYSTAL's speed vector at all by using EBL (electric bearing line which represent heading of ownship) originate from center to rotate to starboard

side till passed CF CRYSTAL's speed vector and echo on screen. Reader can find out that new bearing to steer to target's stern both in visual and radar lookout are the same.

1. In 1944 hours, Ownship only need to alter course to 026^0 degrees (T) (where is the bearing of CF CRYSTAL in radar) our EBL will clear of any intersect point with CF CRYSTAL's speed vector and echo.



圖形 3-07 太空船：本船使用 10 度舵角的進距

3-3 多目標目視瞭望的情境感知

3-21 除非失去控制，否則不會碰撞

- 避碰規則的每一條，都是為了避免碰撞，沒有碰撞危機，就沒有綁定的義務，各船是可以自己的需求去自由運轉。
- 漁船鄭大嶼已經通過本船，但是沒有清爽，這是在 1944 時。如果桑吉輪的三副可以控制船隻的回轉，不要讓船首向跟漁船的速度向量線有交點，桑吉輪可以在漁船鄭大嶼跟長峰水晶輪之間航行通過，只要桑吉輪不對 065 度方位轉向，這個是漁船鄭大嶼的位置，他就會從碰撞危機中解除，長鋒水晶輪的方位是 026 度。
- 當漁船鄭大嶼開始向左舷轉向，碰撞位置就跟著轉移到桑吉輪的船尾，現在鄭大嶼沒有碰撞危機，如果桑吉輪不轉向到 065 度。
- 即使桑吉輪想要轉向到 065 度，他也需要 3 分鐘的時間去轉到 065 度。需要的回轉速率是每分鐘 20 度，在這 3 分鐘的時間，漁船鄭大嶼也不會在原地等待，3 分鐘之後，在 1947 時，漁船的方位會是在 090 度，也就是桑吉輪現在正橫的位置，就變成桑吉輪向右轉向，撞不到 065 度的漁船鄭大嶼。
- 在這 1944 的時候，往鄭大嶼的方位轉向，他的方位是 065 度，等桑吉輪轉向 3 分鐘以後，他的方位又變成 0 9 0 度，還要多轉近 25 度，顯然現在要轉向，是已經太晚了。難道回轉速率不會提高到每分鐘 30 度，是可以，下一次船長還是領港在轉向時，注意一下他用的回轉速率是多少？這在以後船長級的時候，會再討論。現在只能說，回轉速率每分鐘 30 度會失控，航向會壓不住。

- 真實的海上，桑吉輪可能永遠撞不到鄭大嶼，如果本船沒有發生機械故障，（如舵機故障），在這 1944 時，三副說到：這是困難的情況，事實上，現在要讓路給長鋒水晶輪，已經不是問題，有問題的是桑吉輪的知識不足。

3-3 Situational Awareness in multiple targets Visual lookout.

3-21 No collision unless lost control at this moment

- Every rule in COLREG is for collision avoidance. There is no binding obligation if no collision risk involved, every vessel is free to move as they need.
- ZHEDAIYU 03187 had passed but not clear yet in 1944 hours. If SANCHI 3/O can control the turn properly with the help of AB to starboard side without speed vector intersected with fishing boat's speed vector SANCHI can sail between ZHEDAIYU 03187 and CF CRYSTAL with no collision risk. If SANCHI can avoid alter course to bearing 065^0 degrees (where ZHEDAIYU 03187 echo is) she will be safe from collision risk.
- One of important feature in Radar lookout is judging collision point in Radar monitor. By alter course to avoid ownship's speed vector crossed other vessel will clear collision risk with other vessel.
- When ZHEDAIYU 03187 started altering its course to port side the collision position also started to shift from ahead of SANCHI's to her stern. There is no collision risk with ZHEDAIYU 03187 if SANCHI keep her original course.
- Even SANCHI alter course to 065^0 degrees now, there will need 3 minutes time to arrive 065^0 degrees if the rate of turn is 20 degrees per minutes. ZHEDAIYU 03187 won't be there waiting. After 3 minutes at 1947 hours, ZHEDAIYU 03187 will be at bearing about 090^0 degrees (SANCHI abeam bearing).
- In real sea, SANCHI probably never collide with ZHEDAIYU 03187 if ownship had not lost control (due to steering gears failure) at this moment 1944 hours. *3/O commented that it was a hard situation* is not the truth.

3-22 恐懼來自於不確定

- 魔鬼就是植根於我們的恐懼，並不是事實，**你的恐懼來自於對生命的不確定**，這些不確定是植根于我們對雷達瞭望的訓練不足。
- 我們現在已經把，是否能向右舷轉向的不確定性討論清楚，如果我們向右舷轉向，就像是避碰規則的要求，我們最好的希望是，長鋒水晶輪，會保持他的航向航速，依照規則 17。
- 如果長峰水晶輪向左舷轉向，會怎樣？依照規則 17(a)(i)：當兩條船隻之一正要讓路，另外一條船，應該保持它的航向航速。

3-22 Fear comes from uncertainty : Human Element

- The devil is rooted in our fear, not reality. Human's fear comes from uncertainty of life. The uncertainty is rooted in our incompetent of radar lookout, lack of radar and Visual lookout knowledge and skill. Competence is coming from our knowledge, skill and instinct.
- We now clear the uncertainty of course altering to starboard side. If we alter course to starboard side as directed by COLREG our best wish is CF CRYSTAL will keep her present course and speed as rule 17.
- What happen if CF CRYSTAL alter the course to port side against **COLREG rule 17(a)(i)** (Where one of two vessels is to keep out of the way the other shall keep her course and speed)?

3-03 橫越船適用的避碰規則

3-23 見他船在其左舷，這有 4 種情況與三種階段

右舷的船隻，長鋒水晶輪向左舷轉向，是有三個距離階段

1.兩條船距離非常遠的**第一階段**，碰撞危機還不相關，6-9 海浬，在圖形 2-22 裡，是兩條船是自由運轉的階段。

2.在 3 到 6 海浬的距離，是**第二階段**規則 17(a)(i)兩條船其中之一要讓路，另外一條船應該保持它的航向航速。左舷船隻桑吉輪依照規則 15 應該要讓路，船隻見他船在其右舷，應該讓路，這是避碰的第二階段。

3. 在距離 3 到 6 海浬是**第三階段**，第二階段時有另外一種情況，依照規則 17(a)(ii) 後者長鋒水晶輪可以採取單獨行動去避免碰撞，只要情況變得明顯，讓路的船隻並沒有採取適當的行動，以符合本規則。就是說在第二階段直航船可以採取行動，只要讓路船還沒有開始讓路。

4. 在非常近距離的 0 到 3 海浬，規則 17b 當不論任何理由，船隻需要保持航向航速的，發現本船已經太接近，碰撞無法由讓路船的單獨行動，加以避免，他應該採取可以最佳避免碰撞的行動。所以這是有 4 種情況與 3 個距離階段。

是的，這是正確的，在第二階段三到六海浬，讓路船或直航船的角色，是隨時互換的，這就是為什麼避碰行動，應該及時明確，而且遵守優良船藝的規定，在規則 8（a）要求避碰行動要大到，可以立即被其他船隻明顯的觀察到，不論是在雷達或是在目視，這是規則 8(b)

在這個時刻 1944 時，長峰水晶輪是允許行動的，可以自行採取行動去避免碰撞。只要應該要讓路的船隻，沒有採取適當的行動，以符合避碰規則 17(a)(i)的規定讓路。

3-03 Crossing vessel's COLREG situations

3-23 CF CRYSTAL: Vessel has the other on her port side include four situations in three stages

If Starboard side vessel CF CRYSTAL need to alter course to port side there will be three stages:

1. Two vessels are very far away **in first stage** where no collision risk involved, like 6-9 nm in figure 2-22. Both vessels are free to move.
2. It is not free to move in 3-6 nm range **in second stage**: **rule 17(a)(i)** *Where one of two vessels is to keep out of the way the other shall keep her course and speed.* Port side vessel SANCHI is under **rule 15** to keep out of the way (*the vessel which has the other on her own starboard side shall keep out of the way).*
3. It **may be allowed** to move in 3-6 nm range **(second stage)**: **rule 17(a)(ii)** *The latter vessel (*CF CRYSTAL *) may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.*
4. It is allowed to move in 0-3 nm very close range **in third stage**. **rule 17(b)** *When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.*

These are four situations in three stages. First stage and second stage's obligation remained unchanged. But, **in second stage 3-6 nm, give way vessel or stand on vessel's role may change any time.** That's why our avoidance actions should "*be positive, made in ample time and with due regard to the observance of good seamanship*" **rule 8(a) and "***be large enough to be readily apparent to another vessel observing visually or by radar"* **as rule 8(b).**

It is allowed in this moment 1944 hours, as long as CF CRYSTAL *may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules*. **(rule 17 (a)(ii))**

3-24 船隻見他船在其右舷，其實有兩條規則與三種情況，在第二階段

左舷橫越船桑吉輪的三副

1. 兩船在距離非常遠的第一階段，當沒有碰撞危機時，像 6 到 9 海浬是自由運轉階段。
2. 第二階段規則 **15** 應該讓路，如環境許可，避免橫越他船的船頭。（本船讓路）
3. 在第二階段規則是 **17(a)(ii)** 後者長峰水晶輪，單獨採取行動去避免碰撞，使用他的行動。這時是桑吉輪需要保持它的航向航速，但並沒有採取適當的行動，以符合這些規則。（他船讓路）
4. 使用摩斯信號燈光顯示懷疑，在第二階段依照規則 34 的號燈，對是否有足夠的讓路行動，已經被他船採取，使用燈光信號，五短且快速的閃光來表示。
5. 在第二階段有規則 **17(a)(i)**的情形，應該保持它的航向航速，因為其他船隻正在讓路。（本船直航）
6. 在第三階段規則 **17（b）**，要採取這樣的行動，將最佳幫助避碰。

3-24 SANCHI : Vessel has the other on her own starboard side: two rules and two situations in second stage

Port side crossing vessel SANCHI 3/O

1. Two vessels are very far away **in first stage** where no collision risk involved, like 6-9 nm in figure 2-22. Both vessels are free to move.
2. **In second stage** SANCHI had taken avoidance action by **rule 15: ...** *shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel*.
3. **In second stage** SANCHI had not taken avoidance action by **rule 17(a)(ii)** *The latter vessel (*CF CRYSTAL *) may however take action to avoid collision by her manoeuvre alone, the vessel (*SANCHI*) required to keep out of the way is not taking appropriate action in compliance with these Rules. And by* **rule 17(a)(i)** *(*SANCHI*)…shall keep her course and speed (other vessels is to keep out of the way now***).**
4. In third stage: **rule 17(b)** *take such action as will best aid to avoid collision.*

Both vessels In second stage may use ALDIS signal light to show his doubt **by rule 34(d)** in *doubt whether sufficient action is being taken by the other to avoid collision, a light signal of at least five short and rapid flashes*. This is third situations in second stage.

3-25 3 種情況在第二階段，沒有被注意到，

桑吉輪的三副有三種情況，在第二階段，只是他沒有注意到

1.規則 15 該讓路
2.規則 17(a)(ii)沒有採取適當行動以符合本規則
3.規則 17(a)(i)應該保持航向航速

桑吉輪的三副會怎樣回應？來自於他的判斷，判斷來自於他瞭解的知識，知道在他右舷的橫越船是一條大船，如果他沒有看到，長鋒水晶輪在其右舷橫越，他就不知道這個情況。
這是他對瞭望的感知，如果對此情況沒有知識，會根據錯誤的知識來下決策，不論桑吉輪的三副知覺的瞭望是對或是錯？這近接的情況都會繼續的發展，會讓桑吉輪的三副最終都需要讓路，不管桑吉輪的三副，是否有採取適當的行動？或是桑吉輪應該遵守規則 17(a)(i)應該保持航向航速，因為對方已經在讓路，桑吉輪的三副會產生知識不足的突然決策，在最後的階段，依照規則 17（b），當三副發現已經太接近他船，碰撞無法由讓路船的單獨行動，加以避免，本船應該採取最佳的避免碰撞行動。

3-25 Three situations in second stages without his awareness will have jump-out decision

Sanchi 3/O have three rules to obey in second stages without his awareness:

1. **rule 15** *shall keep out of the way*,
2. **rule 17(a)(ii)** *is not taking appropriate action in compliance with these Rules* **and**
3. **rule 17(a)(i)** *shall keep her course and speed*.

What response Sanchi 3/O will take depends on her judgement? Her judgement comes from her knowledge of current situation (does he knows one big vessel at her starboard side crossing). If he has not seen CF CRYSTAL crossing from starboard side he did not know the situation. This is his awareness in lookout. If no knowledge of current situation she will have wrong decision based on wrong awareness. Whether Sanchi 3/O awareness is right or wrong the situation will develop anyway from **rule 15** Sanchi 3/O *shall keep out of the way* to **rule 17(a)(ii)** Sanchi 3/O *is not taking appropriate action* to **rule 17(a)(i)** Sanchi 3/O *shall keep her course and speed if other vessel had taken action*. Sanchi 3/O will easily have jump-out decision in third (last) stage by **rule 17(b)** Sanchi 3/O *finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.*

3-26 練習去更熟悉雷達瞭望

我們能否比他更瞭解這個情況？我們並不能夠確認，我們只能練習去更熟悉雷達瞭望。

- 跟長峰水晶輪碰撞的時間是 6 分鐘以後，1944 加 6 等於 1950 時，如果你不懂如何從 3-06 的圖形，讀出以上的訊息，你需要從頭再讀第三章。
- 碰撞時間是 6 分鐘，需要轉向的時間是 3 分鐘，這是以後才會討論，6 減 3 等於 3。這 3 分鐘就是我們的安全期限。
- 我們應該在這個時刻轉向，也就是 1944 時，當漁船已經向左轉向，這就是我們第一個採取行動的機會。
- 本船應該在 1947 時之前轉向，碰撞前 3 分鐘，這是我們採取行動的最後機會，考慮到船隻的情況與其回轉距離的需求。
- 碰撞距離是 1 海浬，從現在的位置 1940 時。採取避碰行動有一海浬是 ok 的，因為足夠轉向所需要的前進距離，也就是 6 倍本船的長度。
- 碰撞距離是半海浬，這是 1947 時的位置。這樣要採取避碰行動，就會很危險，因為半海浬是不夠轉向所需要的前進距離。
- 如果我們熟悉本船的速度向量線設定，我們可以讀出碰撞距離 Distance to collision DTC（從速度向量線的交叉點），就像我們讀出碰撞時間一樣的簡單，求出碰撞距離是與求出碰撞時間一樣的。
- 我們熟悉本船的速度向量線長度，在 9 分鐘是 1.56 海浬，10.5*0.15=1.56 海浬 。

現在長峰水晶輪的速度向量線與本船的速度向量線有交點，在 3 分之 2 位置，從桑吉輪的速度向量線長度，我們對情況的認知是這樣的：

1. 碰撞距離是 1.56 海浬的 3 分之 2 = 1.04 海浬。
2. 碰撞的時間是 9 分鐘的 3 分之 2 ＝ 6 分鐘。

碰撞距離當我們要做什麼樣的選擇？用來做避碰的行動。碰撞距離是一個很重要的因素。

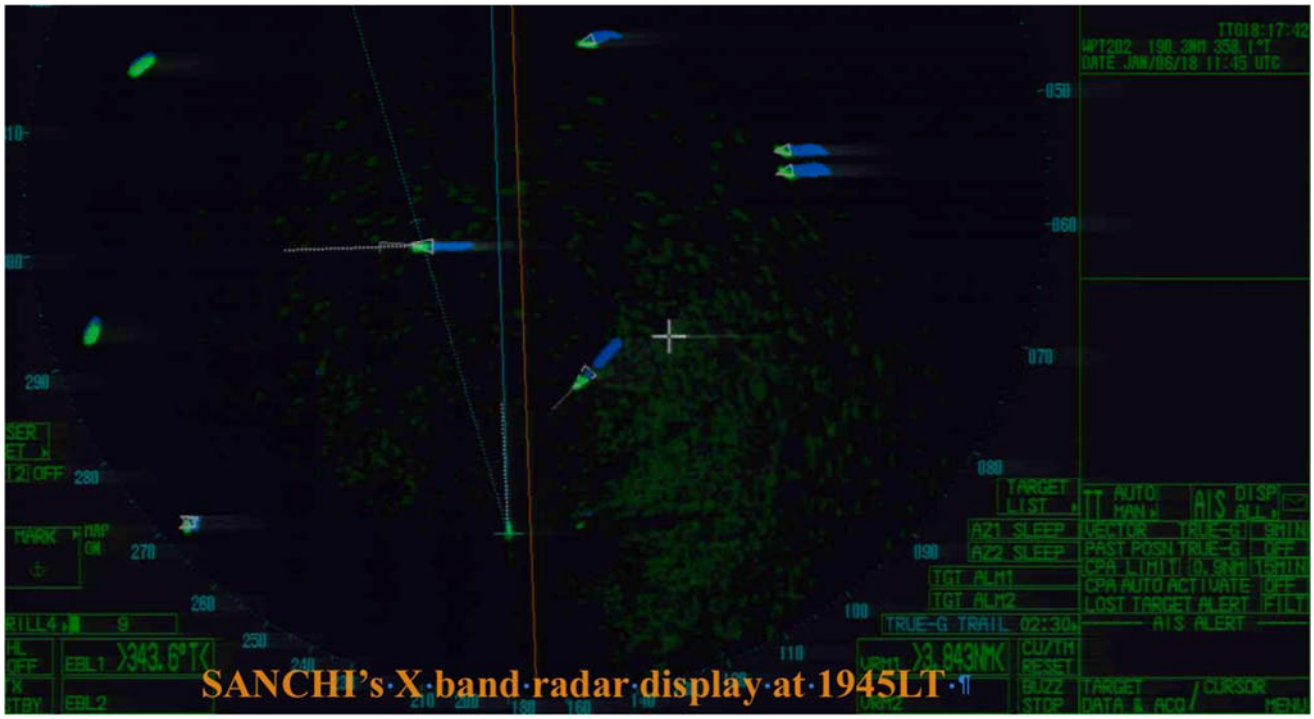
圖形 3-08 長鋒水晶輪失去速度向量線，鄭大嶼失去了目標的回跡

3-26 Practice to familiar radar lookout better

Can we know the situations better than him? We don't know exactly. We can only practice to familiar radar lookout better. In Figure 3-06

- the collision time with CF CRYSTAL is 6 minutes away, 1944 + 6 = 1950 hours. If you don't know how to read it from figure 3-06 above. You should read this chapter from the beginning.
- Time to collision is 6 minutes. Time needed to alter course is 3 minutes (discuss later). 6-3=3. These 3 minutes are our safety window.
- Ownship should alter course from this moment 1944 hours when fishing boat had altered course to port side as our first chance to take action.
- Ownship should alter course before this moment 1947 hours as our last chance to take avoidance action without fail considering the space ship status we had. (in Figure 3-07)

- Distance to collision DTC is one nautical mile from present position at 1944 hours. It is OK to take avoidance action because it is enough for one course change advance distance (6 times ownship's length).
- Distance to collision is half nautical mile from position at 1947 hours. It is dangerous to take avoidance action because half nm is not enough for course change which need advance distance is 6 times ownship's length.
- If we familiar with ownship's speed vector setting we can read the distance to collision DTC from speed vector intersected point also easily get time to collision TTC. DTC judgment is as easy as TTC.
- Our familiar of ownship speed vector length in 9 minutes are 1.56 nm= 10.4 x 0.15.
- Now CF CRYSTAL speed vector has intersected point with ownship at two third position from starting point of Sanchi's speed vector. Our situational awareness are 1. Collision distance 2/3 of 1.56 nm = 1.04 nm and 2. Time to collision is 2/3 of 9 minutes = 6 minutes.
- The DTC distance is important when we have to decide what options we had in avoidance action. (how many minutes left and how much rudder angle we need)



圖形 3-08 長鋒水晶輪失去速度向量線，鄭大嶼失去了目標的回跡

在 1945 時，*桑吉輪航向 028 度，航速 10.5 節，鄭大嶼在桑吉輪右舷的正橫，（失去漁船的回跡），桑吉輪的當值船副要求 AB，發日間型號燈號給長峰水晶輪（該船的碰撞距離大約 1 海浬）。圖形 3-08。*

桑吉輪三副對瞭望說道：我們有船隻在我們的右舷，我們應該採取行動，我能採取什麼樣的行動，在這個狀況，右舷已經滿了。

- 在 1944 時，我們看到兩條紅色的速度向量線，以及兩個紅色的三角形，與在 AIS 資料區的碰撞警報顯示。

At about 1945LT, SANCHI's SOG 10.5 kts. ZHEDAIYU 03187 *was almost abeam SANCHI's starboard (almost lost echo of it). The OOW of SANCHI asked AB to give ALDIS signal to CF CRYSTAL (the vessel which DTC is about 1 nm). (in Figure 3-08)*

Sanchi 3/O *He spoke to the lookout. ...we have this one on our starboard side. We should take action. But what action can I take in this situation? Starboard side is full.*

- In 1944 hours, we see two red speed vector and two red triangle and collision alert in AIS alert data area.

3-27 現在所有紅色的危險標誌已經從雷達螢幕上消失

⇒ 鄭大嶼失去目標的回跡，速度向量線以及碰撞警報字樣，就像從來不曾存在過。
⇒ 長峰水晶輪失去紅色速度向量線，與沒有碰撞警報字樣。
⇒ 長峰水晶輪白色速度向量線變短了，像是減過速，所以沒有碰撞警報。
⇒ 所有這三個錯誤，並沒有被認為是雷達不好，正式的調查報告並沒有抗議這些錯誤，可能對當值船副或是 AB 造成誤導。航運界只是把這一次的碰撞，認為是一個獨立的事件，沒有嘗試要去改進這些缺失，為了海員，這是他們性命所依賴的儀器。
⇒ 航運界把這些當做是當值船副的錯，沒有採取早期避碰的措施，對碰撞的早期評估與早期行動。
⇒ 如果你是一個船長，被三副叫到駕駛台，看到這樣的雷達螢幕，會是什麼樣的情形？ 即使船長已經對讀取雷達的碰撞危機，有良好的訓練，可以從速度向量線判斷碰撞情勢。但是在失去速度向量線的情況之下，也是很難立刻就可以進入狀況。在這種情形（在 1945 的時間），船長得不到速度向量線的說明，來做他的雷達瞭望的判讀 。
⇒ 警急的瞭望，必須依賴目視，因為目視，才能幫助直覺，在一眨眼的功夫，看出端倪。
⇒ 這些缺失對雷達瞭望，是一件壞事。如果你不懂得如何去調整雷達的雨雪雜斑，跟增益的設定。
⇒ 在非常惡劣的海象，需要減少雷達的海浪雜斑抑制的程度，來看到鄭大嶼的回跡，試著去平衡雷達增益跟海浪回跡抑制之間的設定。
⇒ 我們應該擔心這一世代的雷達使用者，可能沒有分辨目標船與海浪雜斑的技術，他們可能在海浪回跡抑制的選項上面，太過依賴雜斑自動抑制功能。
⇒ 遺失的阿帕或是 AIS 資料。像是紅色的速度向量線，或是紅色的三角形，或是紅色的 AIS 碰撞警報字樣，本船是無能為力，也沒有時間去確認，它們在這麼關鍵的時刻，發生遺失的真正原因。
⇒ 這是因為在無線電接收的回波遺失？或是運算軟體的混淆？當值船副只有能力做硬體設定的調整，增加或是減少回跡增益的設定，海浪回跡抑制的調整檢查。
⇒ 在這個時刻，我們第一優先是對碰撞危機的警覺，離碰撞時間還有 5 分鐘。沒有人有時間去試著或是嘗試錯誤，如何使雷達目標回跡與海浪回跡的設定，能夠達到我們的要求。

3-27 Now all red danger sign had disappeared in Radar lookout in figure 3-08.

⇒ ZHEDAIYU 03187 lost target echo, speed vector and collision alert at all like it is not exist.
⇒ CF CRYSTAL lost red speed vector looks like no collision alert.
⇒ CF CRYSTAL white speed vector is shortened looks like reduce speed, so no collision alert.
⇒ All these three mistakes are not regarded as RADAR trouble. Formal Investigation Report did not complain of this misleading to OOW or AB. Shipping industrial just treat this collision as one isolated case. No attempt had made to improve these radar mistakes for seaman where their lives depend on it.
⇒ These Radar mistakes are contributed to OOW's fault for no early avoidance actions (or collision assessment had taken).
⇒ What happen if you are a Master who had called to bridge by 3/O at night? Even Master has very good training in Reading collision risk from speed vector will not be able to handle these radar mistakes at once.
⇒ In this case, master will have no speed vector to help his radar lookout skill in 1945 hours now. In Emergency, lookout has to use Visual where our instinct can help us by feel of the movement of targets.
⇒ These radar deficiencies are bad things for radar lookout if you don't know how to properly adjust radar sea/rain clutter and gain setting.
⇒ Radar echo depressed by sea clutter will cause danger signs be missed in close range.

⇒ Unless in very rough sea state, we can reduce RADAR sea clutter depress level to see ZHEDAIYU 03187's echo again by trying to balance the Gain and Sea clutter setting.

⇒ We should worry this generation Radar user may not have this skill to distinguish target vessel's echo from sea clutter due to over reliance of auto depress function of sea clutter knob.

⇒ Missing ARPA or AIS data like red speed vector or red triangle or AIS alert, ownship can do nothing about it and have no time to verify its real cause at this critical moment.

⇒ Whether it is radio received echo missing or confused in software algorithm, OOW only has the ability to do hardware adjustment, increase/reduce the gain setting of echo or reduce/increase sea clutter.

⇒ At this moment our top priority is collision risk awareness, five minutes to collision TTC. No one has the time to try and error How is the correct RADAR setting of Gain and Sea clutter should be?

3-28 現在當值船副瞭望的優先順序是什麼？

- 如果瞭望是使用目視瞭望，當值船副會行動的更有信心。

⇒ 這兩條目標船的水準方位之間，間隔有 65 度，從眼睛來看。

⇒ 長峰水晶輪接近方位，沒有改變。

⇒ 長峰水晶輪距離本船現在是 1.5 海浬，應該足夠用來改變航向避碰，這是比較本船的速度向量線長度得知，也就是比較本船的太空船長度。

⇒ 長峰水晶輪的水準夾角，對他 225 米的全長，在距離 1.5 海浬，現在是 4.6 度（1852 x1.5 sin(Ø)= 225 m, (Ø)= 4.6 度）。

⇒ 要對 1.5 海浬的目標船，轉向 25 度向右舷是 ok 的，就像圖形 2-10 可以轉向到目標船的船尾。

⇒ 如果是 1.5 海浬的目標船，只要向右舷轉向 15 度就夠了，這是標準的操作需求，是對資深船副來說，那這個我們會在圖形 6-13 時，再做討論。距離多遠，需要轉向幾度？ 225 米的船隻，如果是在 1.5 海浬遠的話，至少要轉向 15 度，到那時我們會仔細的討論。

現在讓我們看看，他們在駕駛台做了些什麼？桑吉輪的當值船副要求 AB，向長峰水晶輪發射摩斯信號燈號。

⇒ 我猜，最少需要 5 短閃光組成的燈光信號， 他對瞭望說道：有這一條船在我們的右舷，我們應該採取行動，但是在這種情況下，我能採取什麼行動，右舷是滿的。一個跳耀式的結論，因為心裡的壓力，跟雷達聊望的不適任，底氣不足。

利用雷達雷達瞭望

1.這兩條船之間，還有 1.5 海浬距離之遠。

2.本船可以轉向到 026 度，這是長峰水晶輪船尾的雷達方位，從 1935 時開始，就沒有改變過。或是轉向到鄭大嶼的方位之前

3. 090 度（鄭大嶼現在的雷達方位），就是轉向到 026-090 度之間的航向，都沒問題，不會發生碰撞。

利用目視瞭望，我們可以得到的資訊是

1.我們知道這兩條船有 65 度的水準角度，本船新的航向可以是從 026 度到 090 度之間。

2.長峰水晶輪總長 225 公尺，距離 1.5 海浬，水準夾角大約是 4.6 度。

3. 長峰水晶輪的水準夾角，是由目視估計的，雷達並沒有辦法得到這樣的資訊，也就是目標的水準夾角。（這是新一代雷達要克服的困難）

4. 是本船必須轉向 026 度加上 4.6 度的水準夾角，去清爽通過長峰水晶輪船尾，從本船現在的船頭方位到他的床尾方位，這樣就是需要轉向 026 度加 5 度等於 31 度，是對資淺船副而言

3-28 What OOW priority in lookout should be now? five minutes to collision

- If the lookout is conducted by visual OOW will more confidence in his actions to take.

⇒ The horizontal angle of these two targets are 65 degrees open to eyes. (from relative bearing 025 to 090 degrees)

⇒ CF CRYSTAL approaching bearing had no changed.

⇒ CF CRYSTAL distance is 1.5 nm now which should be enough to alter course by comparing speed vector of ownship.

⇒ The horizontal angle of CF CRYSTAL LOA 225 meters is about 4.6 degrees (1852x1.5 sin(Ø)= 225 m, (Ø)= 4.6 degrees).

⇒ It is OK to alter course 25 degrees to Starboard side for 1.5 nm target as FIGURE 2-10 alter course to target vessel's stern.

⇒ It is OK to alter course 15 degrees to Starboard side for 1.5 nm target. To avoid the collision point for senior OOW skill (1852x1.5 sin(15)= 719 m abeam distance, discussed later in Figure 6-13).

Now let's see what they doing are at bridge? The OOW of SANCHI asked AB to give ALDIS signal to CF CRYSTAL.

⇒ - "a light signal of at least five short and rapid flashes", I guess.

He spoke to the lookout: ...*we have this one on our starboard side. We should take action. But what action can I take in this situation? Starboard side is full.* This is a jump out conclusion because the mental pressure and incompetent in radar lookout.

⇒ By radar lookout,

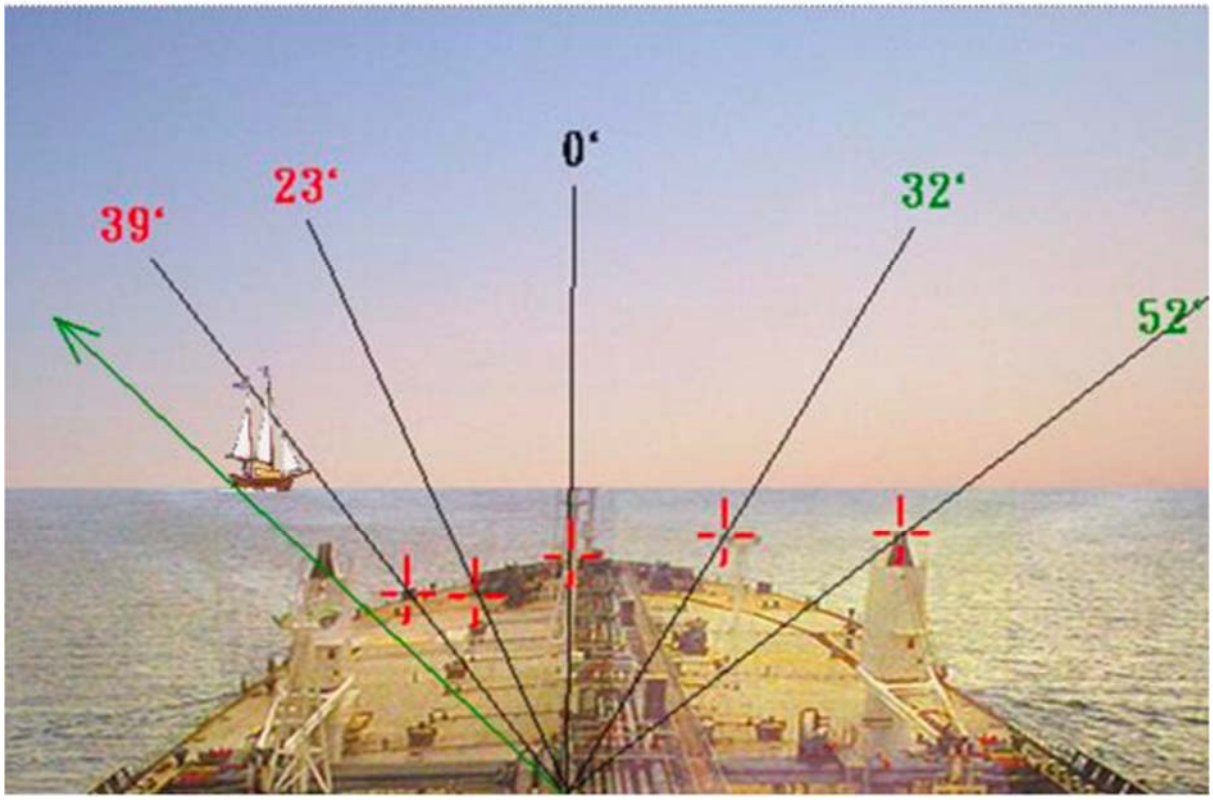
1. we know these two vessels have 1.5 nm distance apart.

2. Ownship can alter course to 026^0 degrees (CF CRYSTAL's radar bearing now, unchanged from 1935 hours) or alter course more degrees up to

3. 090^0 degrees (ZHEDAIYU 03187's radar bearing now, changed from 040^0 degrees to 090^0 degrees) without any problem.

⇒ By visual lookout,

1. we know these two vessels have 65 horizontal degrees open to our bare eyes.
2. The horizontal angle of CF CRYSTAL LOA 225 meters is about 4.6 degrees.
3. The horizontal angle of CF CRYSTAL is only available by visual estimation, Radar cannot get this kind of information: horizontal angle of target and no blossom effect estimation.
4. Ownship have to alter course to 026^0 degrees plus 4.6 degrees to clear CF CRYSTAL from ship's bow bearing to her stern bearing which make it $026^0 + 5^0 = 031^0$ degrees for a competent junior OOW.



Picture 1-07: use tanker fixed deck fittings as reference mark for bearing checking

3-04 雷達瞭望跟目視瞭望的比較

3-29 雷達瞭望與目視瞭望警覺性的不同

雷達瞭望的警覺，對當值船副而言：

⇒ 距離的警覺：雷達瞭望要在 2， 3 吋的速度向量線上工作，這長度可能代表 1.5 海浬的距離，在雷達上面要獲得距離的警覺，經常要先確定雷達的距離設定，避免產生混淆，無法一目了然，一步到位。

⇒ 水準方位的警覺：雷達的方位無法讀出，或看出目標的水準夾角，作為轉向的參考，在近距離的時候，經常發生失去雷達回跡，當方位資料，對我們的避碰行動，非常重要的時候。

⇒ 相對方位的警覺，沒有永久相對方位的參考點，只有數位化的讀數，可以記憶目標的相對方位。

⇒ 船尾方位的警覺：雷達的方位是轉向目標的船體方位，而不是他的船尾方位，可以用來避免碰撞。

⇒ 安全方位範圍的警覺：安全方位的範圍，是在兩條目標船方位之間，並不是立即可見，安全方位範圍，是從第一個目標的方位 026 度，到下一個目標，090 度之間，64 度的方位，可供安全轉向避碰。

3-04 Comparison of radar and visual lookout

3-29 Radar and visual lookout awareness difference

RADAR lookout awareness, OOW

⇒ Distance Awareness: Working at two- or three-inches length of speed vector (represent 1.5 nm) to get distance awareness on RADAR screen and often confused with other range detection setting.

⇒ Horizontal Bearing Awareness: Radar Bearing cannot read target horizontal angle for reference and lost radar echo at close range is often when the echo is vital to our collision avoidance.

⇒ Relative Bearing Awareness: No permanent relative bearing reference, only digital reading to remember.

⇒ Stern Bearing Awareness: Alter course by target's body bearing, not her stern bearing to avoid collision.

⇒ Safety Window Awareness: Safety bearing window between two target's bearing to steer is not immediately visible to us. Safety bearing window is from first target 026^0 to next target 090^0 degrees.

目視瞭望的警覺，對當機當值船副而言：

⇒ 距離的警覺：對 1.5 海浬距離遠的目標，在駕駛台目視後的警覺，可以由下列方法取得：

1. 由目標船體的水線，比較我們在船頭的視線限制線來檢查。
2. 是否有任何航跡流，或是船頭的船頭浪？
3. 檢查目標船是否有任何住艙或甲板燈光可以參考？
4. 檢查有無任何水面反光的產生？
5. 檢查駕駛台玻璃上，目標船航行燈余暉的長度。

經過適當的訓練，這比雷達好用。

⇒ 相對方位的警覺：可以找出甲板上永久方位參考點，如右舷 30 度的目標船，可以由甲板舾裝來決定，這個都是可以事先準備好，請看圖形 1-07 上的圖例。例如，我們有一 32 度的標記在右舷。

⇒ 水準方位的警覺：因為有永久方位參考點在甲板上，所以本船立刻可以知道目標的方位改變大概有多少度？是否需要去讓路，對接近的目標長鋒水晶輪，或是他的船尾讓路，即使我們不知道他船尾的方位讀數。

⇒ 安全方位的警覺：可以安全航行的方位範圍，在駕駛台的玻璃上看，是比雷達螢幕顯示的清晰。

⇒ 船尾方位的警覺：向目標船尾轉向，利用目視加上目標水準夾角大約 5 度，將會比向雷達目標的方位轉向，會有更多的安全容許值。

對目標的船尾轉向，是自動調整的，不論目標現在的距離？也不論目標的花開效應有多少？

現在我們知道為什麼當值船副比 AB 更焦慮，不是因為他的薪水比 AB 高，而是因為雷達螢幕的限制，跟人為因素在我們短期記憶的影響，人們容易忘記數位化的資料，當值船副必須重複核對，一再讀取起那些遺忘的資料，一遍又一遍用他的良好當值習慣，直到他能夠做出合理的決策。這些雷達跟人為因素的缺失，可能永遠無法由我們的決心跟努力跟優良船藝來克服，我們只能做出最好的利用，雖然浪費了我們的寶貴時間跟努力，去重複同樣的程式，但是最終還是可能失望。

Visual lookout awareness, OOW

⇒ Distance Awareness: Aware 1.5 nm distance target at bridge,

1. To compare with our visibility line at bow,
2. To check any wake current or bow wave in target ship's hull
3. To see any accommodation or deck working lights on her ship's hull,
4. To check any reflection lights on water or
5. To check lights glare length on bridge window.

⇒ Relative Bearing Awareness: Permanent bearing reference for 30 degrees to starboard side can be pre-determined by deck fittings immediately. See figure 1-6 above, for example We can easily indentify 32 degrees mark on starboard side.

⇒ Horizontal Bearing Awareness: Permanent bearing reference is there so ownship knows immediately how many degrees course change is needed to give-way to approaching target CF CRYSTAL and her astern even we don't know target's bearing reading exactly.

⇒ Safety Window Awareness: Safety bearing range is wide open at bridge window than RADAR screen displayed.

⇒ Stern Bearing Awareness: Alter course to target's stern visually plus target body horizontal angle (5 degrees) has more safety margin than by radar target's body bearing only.

⇒ Alter course to target's stern is automatically adjust from any distance regardless blossom effect of target (the horizontal angle enlarged in closer distance).

Now we know why OOW are always more anxious than AB. It is because the limitations in radar screen and human elements in our short-term memory to forget digital information often. OOW have to double check and pick up all loose ends over and over again by his rituals before he can make a reasonable decision. **These drawbacks of radar and human elements can never be overcome by our determination or diligent or prudent seamanship.** We can just make the best use of it, wasting our valuable time and efforts to repeat same rituals and disappoint.

3-05 碰撞位置因本船的行動而改變

3-30 碰撞位置改變的安全警覺

他對瞭望說道："*在右舷有這條船，我們應該採取行動，但是在這情況下，我能採取什麼樣的行動？右舷已經滿了。*"

右舷並沒有滿？右舷只有從 000 到 025 度，不能轉向，因為會橫越其他船隻的船頭，從 025 度到 090 度之間，有 64 度是開放的。

轉向或是停車，船隻就會立刻改變碰撞的位置。

1. 碰撞位置會隨著目標船的速度向量線而改變，當本船轉向時，碰撞位置永遠都會在本船的船頭，如果本船可以轉向，來避免目標船的速度向量線，就不會有碰撞危機。核對圖形 3-09，想想為什麼？（如果我們是小船，由 020 轉向到 325 度，會怎樣？）
2. 當本船停車，碰撞位置就會從本船位置移到本船的船頭前方去。
3. 當目標船停車，碰撞位置會由本船的位置，移動到到本船的船尾位置，就是在本船的船尾之後。
4. 碰撞不是不可避免，如果我們能夠在碰撞最後 3 分鐘前，改變碰撞的位置。

三副的主要問題，是沒有目視瞭望的訓練，如果三副知道如何去做目視瞭望，然後改變碰撞位置，他就不會感到疑惑。圖形 3-09 轉向的圖解 會改變碰撞位置

3-05 Collision position changed by ownship's action

3-30 Safety Awareness of collision position change

He spoke to the lookout: *...we have this one on our starboard side. We should take action. But what action can I take in this situation? Starboard side is full.*

⇒ *Starboard side is not full*: Starboard side is full from 000^0 to 025^0 degrees (Don't cross another vessel's bow). Open up from 025^0 to 090^0 degrees.

⇒ **Alter course or stop engine of ownship will change collision position immediately.**

1. Collision position will change along target vessel's speed vector when ownship altering course, but always on ownship's bow. **If ownship can alter course to avoid target vessel's speed vector there will be no collision risk.** Check on figure 3-09 below and figure out why? (Imaging we are the small vessel alter course from 020^0 degrees to 325^0 degrees in right picture.)
2. When ownship stop engine collision position will moving from ownship position to forward of ownship bow, moving ahead ownship. Ownship will arrive collision position later than target vessel.
3. When target vessel stop engine collision position will moving from ownship position to aft of ownship stern, falling behind ownship.
4. Collision is not inevitable if we can change collision position before last three minutes , either by altering course or speed.

The major problem of 3/O is he has no visual lookout training. If 3/O knows how to do visual lookout and change collision position, he will not confuse in current situation.

圖形 3-09 轉向會改變碰撞位置的圖解

3-31 浪費避碰的安全時間

在大約 1946 時，*桑吉輪航向 358 度，航速 10.4 節，漁船通過了桑吉輪的船尾，桑吉輪發射摩斯信號燈號給長鋒水晶輪，五快閃光以吸引其注意力。*

AB 說到：*查理已經過去了，對嗎？右邊一點。*

三副：*為什麼？*

AB：*CPA 是多少？CPA 是……零，零。*

⇒ 在 1946 時，漁船清爽了桑吉輪的船尾，這不是事實，我們知道漁船原來的碰撞時間是 1948 時，他現在是在桑吉輪的右船尾，還沒有通過。

⇒ 桑吉輪發燈號給長鋒水晶輪 5 閃光，使用日間信號燈來吸引其注意。

⇒ 在 1.5 海浬距離遠時，三副應該使用雷達瞭望的技巧，使用速度向量線去確認碰撞的情勢，他也沒有目視的技巧，來分辨碰撞危機，1 分鐘的時間，被這樣的行動（使用日間信號燈）所浪費掉。

⇒ 使用日間信號燈，只能吸引長鋒水晶輪的注意，使用五閃光，只能表示疑問？這並不是要求長峰水晶輪去轉向，或要求他停車，對避碰行動完全沒有幫助。

⇒ 桑吉輪三副希望長鋒水晶輪去採取什麼樣的行動？當長鋒水晶輪接收到這五短閃光的信號，是要溝通，評估或是行動？這三個選項其中之一，都會浪費避碰的時間，離碰撞只有 4 分鐘了，這是當值船副最大的盲目，不知道自己還有多少時間會碰撞？三副並不瞭解，他只有 1 分鐘的時間去採取避碰行動，以拯救他自己的生命。

⇒ 如果桑吉輪是要引起長鋒水晶輪的注意，使用 VHF 特高頻的呼叫，也許還比較有用，因為 VHF 的聲波可以滲透到駕駛台每一個角落，而日間信號燈的光束，只能在駕駛台某些特定的位置，才能夠看到。

⇒ 對方船副呢，可能只有眼睛看著雷達螢幕，根本就沒看到外面的信號燈光。

⇒ 長鋒水晶輪還需要一些時間來評估碰撞的情勢，而且要判斷桑吉輪的意向？他是是一條讓路船，要到什麼時候？長鋒水晶論才能夠瞭解，左舷的這一條橫越船，並沒有要讓路，依照規則 15 的要求。

圖形 3-10 長鋒水晶輪失去速度向量線 鄭大嶼失去回跡

3-31 Wasting Safety window time of collision avoidance in Figure 3-10 CF CRYSTAL lost speed vector and fishing vessel lost echo

At about 1946LT, SANCHI COG was 358° and SOG 10.4 kts. *Fishing vessel cleared from SANCHI's stern. Signals to CF Crystal (5 short flashes by ALDIS Lamp) to attract attention.*
AB: Charlie is passed, right? A little to starboard? 3/O: Starboard? Why?
AB: What's the CPA? CPA is ... zero, zero.

⇒ Fishing vessel cleared from SANCHI's stern at 1946 LT: this is not true. We know collision time with her is 1948 LT. Now is only 1946 LT, She is in ownship's starboard quarter now, not cleared our astern.

⇒ Signals to CF Crystal (5 short flashes by ALDIS Lamp) to attract attention.: at 1.5 nm distance away OOW should using radar lookout techniques with speed vector to verify the situation if he has no visual skill to distinguish the collision risk. One minutes time had wasted by this action.

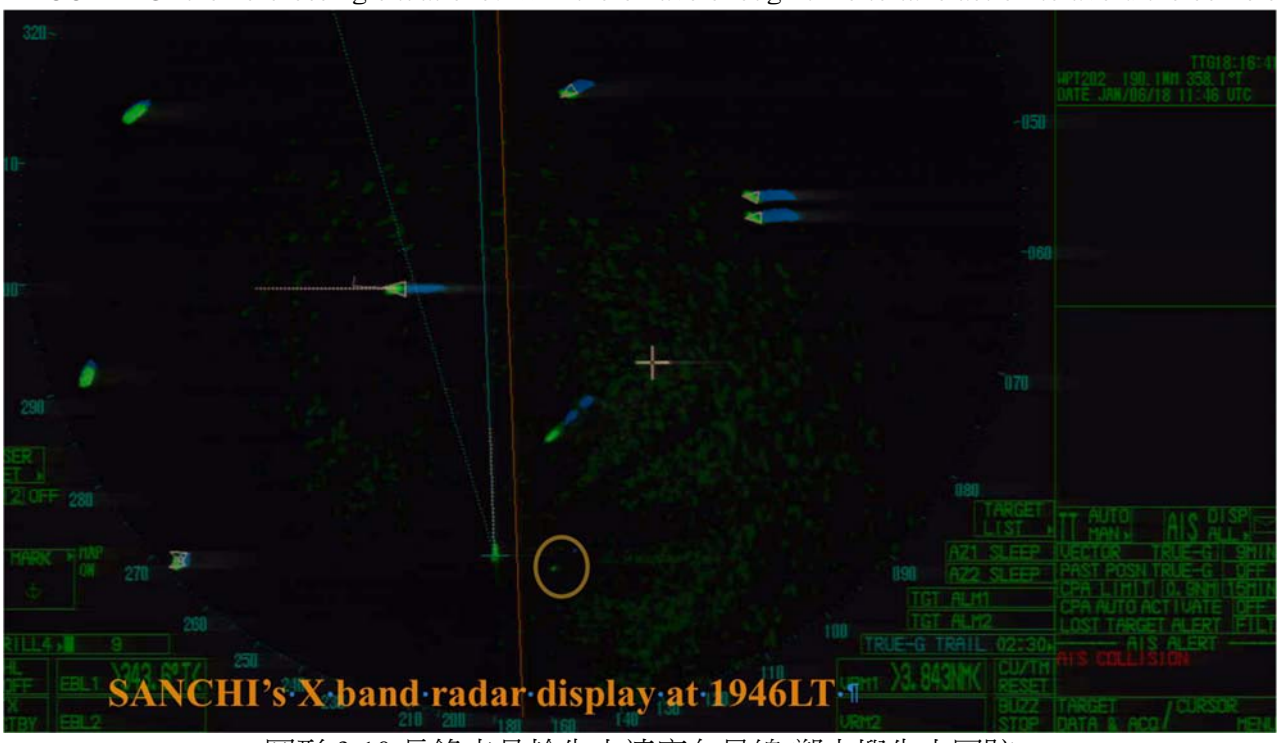
⇒ to attract attention of CF Crystal by 5 short flashes on ALDIS Lamp: this is not a request to ask CF Crystal to alter course or give way by stop engine.

⇒ What action SANCHI 3/O expect CF Crystal to take after received this signal of 5 short flashes? Communication or evaluation or action? Any one of these three options will waste time to avoid collision, only 4 minutes before collision. 3/O did not know he has only one minute to take avoidance action to save his own life.

⇒ If SANCHI try to raise the attention of CF Crystal using VHF calling may be more effective. The sound wave of VHF can penetrate to every corner of Bridge, light beam of ALDIS lamp can only see at certain position in certain bearing at bridge.

⇒ CF Crystal needs some time to evaluate collision situation and to judge SANCHI's intention who is a give-way vessel

⇒ What time CF Crystal can understand port side crossing vessel will not give way as required by COLREG rule 17 crossing situations? Will there have enough time to take action to avoid the collision?



圖形 3-10 長鋒水晶輪失去速度向量線 鄭大嶼失去回跡

3-32 向右舷轉向，會轉移碰撞點到右舷

AB:查理已經過去，對吧?向右一點。查理是共產黨或是中國人的簡稱，已經通過正橫位置。

⇒ 向右一點：AB 過去曾經看過其他資深船副，向右轉向一點來讓路。

⇒ 向右一點：如果向右一點代表是向右轉向 5 度，在 1.5 海浬的距離的 DTC，將會創造正橫距離大約 242 公尺，（1852x1.5 sin (50) = 242 m）

⇒ 242 公尺正橫距離，也許對避讓一條大型船隻，並不足夠，但是是一個好的開始，讓桑吉輪做一些事情，來避免這危險。

⇒ 在圖形 3-09 轉向可以轉移碰撞位置，我們一定要記得碰撞點是速度向量線的交叉點，其中一條船向左轉向，這碰撞點對他來講，也是轉到左邊，小船向左舷轉向，綠色的船艏線到紅色的船艏線，對他而言，碰撞點是向大船的船尾方向移動。

⇒ 在桑吉輪的案件，如果他向右舷轉向 5 度，我們可以估計桑吉輪的碰撞位置會跟著改變，由長峰水晶輪 225 米的長度的船頭，轉移到長峰水晶輪的船尾位置。

⇒ 向右一點，不是最佳的建議，但是對於避碰是一個良好的開始，

三副回答：向右，為什麼？

⇒ 三副沒有進入狀況，他被他的焦慮而消耗，而這些焦慮，又因為他不斷的講話而釋放，

AB： ＣＰＡ是多少？ＣＰＡ ……是零，是零。

⇒ 我們不知道 AB 是從哪裡得知這項訊息，這並沒有顯示在雷達的螢幕上，但他是對的，他仍然記得從 1944 時，兩分鐘前所得到的資訊。

⇒ AB 使用疑問句，然後自己在同一時間回答了兩次，這是一個強烈的提示，要提高三副瞭解現在碰撞的情形，除了已經在正橫的第一條船，還有在船頭的第二條船。

⇒ 三副的注意力被漁船所分散了，他並不記得長峰水晶輪的碰撞警報，在 7 分鐘之前，1939 時。

⇒ 讓我們再次看著雷達螢幕，雷達現在並不能給當值船副任何有用的 CPA 線索，或是碰撞點的資訊，我們已經失去長鋒水晶輪的速度向量線，在這關鍵的 1946 時，這是一個重大的缺失，當瞭望最需要這一項資料的時候。

3-32 Alter course to starboard side will shift Collision point to starboard side

AB: Charlie is passed, right? A little to starboard?

⇒ *Charlie is passed, right?:* Charlie is Communist or Chinese had passed abeam.

⇒ *A little to starboard*? AB may have seen other senior OOW alter course *A little to starboard* to give way before.

⇒ If a little to starboard course altering is 5 degrees to starboard side at distance of 1.5 nm (DTC) will create abeam distance of 242 meters (1852x1.5 sin (5^0) = 242 m)

⇒ 242 meters abeam distance may not be enough to avoid the collision for a big vessel with length over all 225 meters but it is a good beginning. At least Sanchi has doing something to avoid the danger.

⇒ In figure 3-09 **illustration of alter course shifted the collision position**, we must remember collision point is intersection point of two speed vectors. If one vessel alter course to port side the collision point to her is alter to port side too. The small vessel alter course to port side from green heading line to red heading line. Collision point to her is moving to big vessel's stern direction.

⇒ In SANCHI's case, if she alter course to starboard side with 5 degrees we may estimate SANCHI's collision position changed from CF Crystal (225 meters in length) bow to his stern position.

⇒ *A little to starboard*? Is not the best suggestion but a good start to collision avoidance?

3/O: Starboard? Why?

- 3/O is not in the situation. Consumed by his anxiety and relaxed by talking to himself and AB.

AB: What's the CPA? CPA is ... zero, zero.

⇒ We don't know where AB had this information, it is not shown on radar screen. But he is right about this. He still remembers from 1944 hours, 2 minutes ago.

⇒ AB used question and answer at the same time. This is a strong reminder to raise 3/O's alert in collision situation of second vessel beside the fishing vessel abeam.

⇒ 3/O's attention is distracted by fishing boat. He did not remember the collision alert of CF Crystal in the past 1939 hours, 7 minutes ago.

⇒ But looking at Radar screen now cannot give OOW any useful clues of CPA or collision point. We lost speed vector of CF Crystal in Radar screen in this critical hours of 1946 LT, 4 minutes before collision. This is a major deficiency when lookout need the information most.

3-33 碰撞危機的三大要素：碰撞位置，時間跟距離

⇒ **在大約 1947 時**，桑吉輪航向 358 度，航速 10.4 節,沒有採取任何行動。

三副：它是一條小船，對吧？

⇒ 再一次，三副不知道他面對的是什麼樣的目標？因為雷達螢幕上，看不清楚。

瞭望：*不，大船*。

⇒ 也許 AB 眼睛看到了長鋒水晶輪，可是這一條船在雷達螢幕上，現在我們看不出來。

三副說道：為什麼他要採取這樣子的行動？

⇒ 這是對他自己在說話，是用來舒緩他的焦慮，長鋒水晶論並沒有轉向，或是回應桑吉輪的疑問燈光信號。

事實真相是，長鋒水晶輪並沒有看到桑吉輪，在碰撞前 3 分鐘，桑吉輪三副的心裡面，並沒有這樣子的想法，對方會沒有看到自己的船隻。更不知道對方正在交接班，又交代不清。

⇒ 三副把他的頭腦集中在他自己的思想上 ，他在駕駛台的瞭望程式，有錯誤的優先順序。

⇒ 所以三副並不知道瞭望的三大要素：碰撞位置就在正船頭，離碰撞時間只剩下 3 分鐘，碰撞距離已經少於一海浬。1 分鐘寶貴的時間又被三副自言自語的浪費掉了。

圖形 3-11 長峰水晶輪速度向量線與鄭大嶼回跡又再出現

3-33 Three important elements of collision risk: collision position, time and distance

At about 1947LT, SANCHI's COG was 358° and SOG 10.4 kts. (no actions been taken)

3/O: *...It's a small vessel, right?*

- Once again, 3/O did not know what target he is facing from Radar screen.

Lookout: No, big vessel.

- maybe AB saw CF Crystal by eyes?

3/O: *So why is she intending to take action like this?*

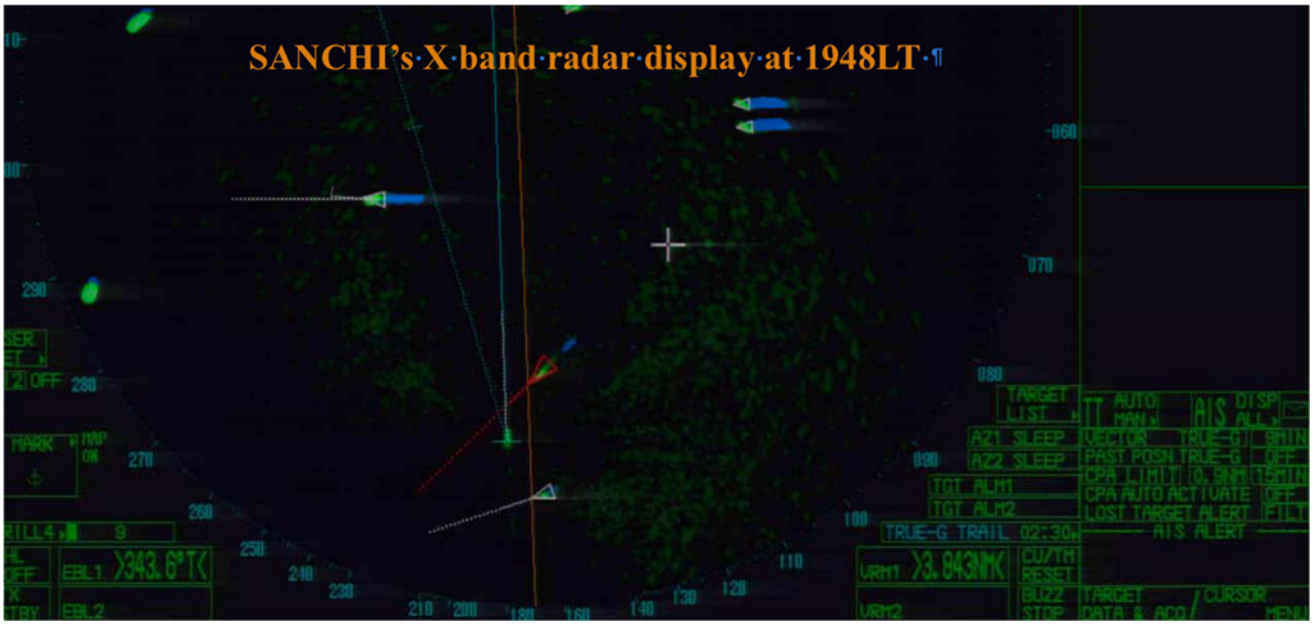
- 3/O is saying to himself for relief. CF Crystal did not alter course and response to SANCHI.

**The truth is CF Crystal have not seen SANCHI up to this moment.* ** Has this thought come to 3/O awareness?*

- 3/O keeps his head to his thought only, he has wrong priority in bridge procedures.

- 3/O does not notice three important elements of collision risk: Collision position is dead ahead; Collision time is 3 minutes and distance to collision is less than one nm.

- One minute time had wasted by this reassure talking to himself.



圖形 3-11 長峰水晶輪速度向量線與鄭大嶼回跡又再出現

3-05 桑吉輪雷達瞭望的最後一海浬

3-34 兩分鐘警報：要右轉也已經太晚

在 1948 時，*桑吉輪的航向 358 度，航速 10.5 節，三副打電話給船長並且說道：“在我們又右舷有一目標，CPA 是零，距離非常近，他是一條大船。”*

長峰水晶輪紅色速度向量又再出現，我們從雷達瞭望又能夠得到什麼？

1. 碰撞位置是這兩條真運動速度向量線的交叉點
2. 碰撞距離應該立刻決定，如果三副警覺到速度向量線上的碰撞點。
3. 如果三副沒有對碰撞點的警覺，那三副從雷達螢幕上讀出，目標的方位跟距離，只是單純的數字而已，如果沒能產生危險的感覺。

這是為什麼當三副呼叫船長時，他說道右舷有一目標，CPA 是零，距離非常短（這三項是從雷達螢幕上讀出的資料），他是條大船（這是瞭望告訴他的，但是他在雷達螢幕上沒有辦法確認）。

碰撞時間：桑吉輪三副是沒有辦法從雷達螢幕讀出來的，依照他現在的技術水準，如果有了雷達瞭望的技術來幫忙，就像我們所提到的，我們能夠估計碰撞時間（用心算），桑吉輪的三副對此卻是無知的。

碰撞時間大約是在 4 分之 1 桑吉輪的速度向量線長度的位置上，1.5 海浬乘上 4 分之 1 等於 3.75 CABLE，這是對桑吉輪的碰撞距離而言。

長峰水晶輪的碰撞點，在速度向量線的 4 分之一，13.5 節乘上 0.15 乘上 4 分之 1 等於 5.06 CABLE，這是長峰水晶輪的碰撞距離。

雖然碰撞距離不一樣，但是碰撞時間幾乎相同，碰撞時間是 9 分鐘速度向量線的 4 分之 1 等於 2.25 分鐘。

實際碰撞時間是 1950 時，等於 1948 時（現在的時間）加上兩分鐘，這兩分鐘就是本船到碰撞的時間。

實際碰撞的時間，也是由船隻的大小尺寸來決定，在這案子，桑吉輪的船頭已經通過碰撞點，通過了碰撞位置，然後長峰水晶輪船頭才到達碰撞位置。長峰水晶輪的船頭，撞上桑吉輪右舷船體第二艙與第三壓水艙之間，使得右旋第二艙第三艙之間的貨艙壁板破裂，或油艙壁的破裂。雷達瞭望的技術在決策的過程，已證明了他的價值，當值船副應該知道，如何去使用雷達瞭望，三副的生命就會被拯救。中國人說：千金難買早知道。

3-05 Last mile in Sanchi radar lookout

3-34 Two minutes warning: too late to go starboard side only

At about 1948LT, SANCHI's COG was 358° and SOG 10.5 kts.

The 3/O called the Master and said: … *We get a target on starboard side and CPA is zero. Distance is very short. It's a big vessel.*

- CF CRYSTAL red speed vector had appeared again.

What we can get from radar lookout?

⇒ collision position: is the cross point of these two vessels' s true motion speed vector.

⇒ collision distance: should be immediately determined if 3/O had acknowledged collision point on his speed vector.

- If 3/O had not acknowledged collision point, what OOW can read from radar screen is target's distance and bearing only.
- That's why when 3/O called Master he said "*We get a target on starboard side and CPA is zero. Distance is very short.* (these three are read from Radar screen) *It's a big vessel.* (this was told by lookout but he cannot make sure of it from Radar screen).

⇒ collision time: is something SANCHI 3/O cannot read from Radar screen by his knowledge level now. With the help of Radar lookout skills we discussed, we can estimate distance to collision DTC mentally which is not known to Sanchi 3/O.

- it's about one fourth length of SANCHI's speed vector. 1.5 nm x 1 / 4 = 3.75 cables (DTC to SANCHI)
- it's about one fourth length of CF Crystal's speed vector. 13.5 knots x 9 min. x 1 / 4 = 5.06 cables (DTC to CF Crystal)

⇒ Although the distance to collision is different but the time to collision is almost the same as

- **collision time: 9 min speed vector / one fourth length 9/4 = 2.25 minutes.**

⇒ Actual collision time is 1950 hours = 1948 hours (current time) + 2 minutes (time to collision)

⇒ Actual collision time also decided by vessel's dimension and which one is passing collision point first. In this case, Sanchi's bow passed collision point first then CF Crystal's bow arrived later.

> "*The bow of CF CRYSTAL collided with the starboard side hull between No.2 and No.3 ballast tanks, breaching the boundary of the No.2 and No. 3 starboard cargo tanks of SANCHI.*

Radar lookout techniques prove its value in decision making process. If OOW knows how to use Radar lookout the life of 3/O will be saved. Chinese saying "Thousands of golden coins cannot buy earlier knowledge."

視覺瞭望有什麼好處？

長鋒水晶輪的水準夾角在 1948 時，距離是 3.75 CABLE，3.75 cables x sin (Ø) = 225 meters。（225 meters：這是他的船隻長度），長峰水晶輪的水準夾角在 0.375 海浬的時候是 18.9 度。

長峰水晶輪的雷達方位右舷 25 度，如果桑吉輪向右舷轉向，需要旋轉 25 度加上 9.4 度（也就是他水準夾角 18.9 度的一半），34.4 度才能夠清爽的離開長峰水晶輪的船尾。

請看圖形 2-08 前進距離，34 度航向的改變，需要 0.4 海浬的前進距離來完成 34 度的轉向。桑吉輪的碰撞距離只有 0.375 海浬，不夠。在 1948 時，碰撞距離的長度，已經不夠用來改變 34 度的航向到右舷。

35 度的航向改變，需要 2.28 分鐘，使用現在的速度（0.375/10.5 節 ，這是 0.375 海裡除上 10.5 節的速度，需要 2.28 分鐘），所以兩分鐘的時間，對轉向 35 度所需要的時間，也是不夠。離碰撞的時間只有 2.25 分鐘，從速度向量線上的估計，而轉向需要的時間是 2.28 分鐘，到碰撞的時間已經不夠，用來轉向 35 度來避免碰撞。

我們並沒有把本船的全長 274 公尺，加入估計，274 公尺等於 0.148 海浬，必須列入考慮。0.148 海浬的進距，需要 0.85 分鐘，以 10.5 節的船速，所以本來需要 2.28 分鐘清爽通過長峰水晶輪的船尾（考慮到長峰水晶輪的船長），又需要 0.85 分鐘的時間，這是要避開桑吉輪船身長度前進的時間（考慮到桑吉輪的船長），這需要的全部時間是 3.12 分鐘，才能夠完全清爽長峰水晶輪的船尾。

這是為什麼要用 3 分鐘的速度向量線，來設立可能的碰撞區域。讀者可以使用自己的計算去決定，多少分鐘的速度向量線長度，才是你的船隻可以用來作為碰撞區域的估計值。

碰撞區域就是我們操船避碰所需要的區域，最少也是 4.5 倍船長（IMO 的回轉進距要求）加上 0.5 倍的船身長度（駕駛台到船頭的距離），將近 5 倍船長的距離，這是在操船避讓所需要的最短距離（滿舵操船，以後會講），少於這 5 倍本船的船隻長度，就必然會碰撞。

長峰水晶輪的距離我們並不確定，必須由當值船副的經驗來估計，（我估計的是 0.75 海浬，這是用本船 1.5 海浬的速度向量線，在雷達螢幕上的長度來做的估計）。

如果碰撞距離或是碰撞時間已經不夠，作為緊急轉向（單一轉向）的需求，使用滿舵或是停車，到車，應該同時加以嘗試，去避免碰撞。

Visually, what is good in visual lookout?

⇒ horizontal angle of CF Crystal at 1948 hours? DTC to SANCHI = 3.75 cables, 3.75 cables x sin (Ø) = 225 meters, Horizontal angle of CF Crystal Ø = 18.9 degrees.

⇒ CF Crystal radar bearing is 025 degrees starboard side.

⇒ if SANCHI alter course to starboard side needs to alter 025 degrees + 9.4 degrees = 34.4 degrees to clear CF Crystal's stern.

⇒ see figure 2-08 DISTANCE OF ADVANCE, 34 degrees course change will need about 4 cables advance distance to finish the turn. Sanchi DTC is 3.75 cables only in 1948 hours which is not enough now.

The DTC is not enough to alter course to 034° degrees to starboard side.

⇒ 35 degrees course change will need 2.28 minutes by current speed (4 cables / 10.5 knots = 2.28 minutes)

⇒ TTC time to collision is 2.25 minutes from speed vector estimation and alter course time needs 2.28 minutes.

The TTC is not enough to alter course to 034° degrees to avoid the collision.

⇒ we have not taken ownship's length over all 274 meters (1.48 cables) into consideration.
  - 1.48 cables advance needs 0.85 minutes by current speed 10.5 knots.
  - 2.28 minute (including clear CF horizontal angle time) + 0.85 minutes (SANCHI longitudinal advance time) = 3.12 minutes:

This is why 3 minutes speed vector should be used to represent possible collision area.

⇒ Reader can make your own calculation to determine how many minutes speed vector is useful to your ship in same manner.

⇒ Distance to CF Crystal in radar is unknow which can be estimated by experience of OOW. (my guess is 0.75 nm with ownship's 1.5 nm speed vector length on screen)

⇒ If DTC or TTC is not enough to alter course emergency maneuvering hard over rudder or stop/reverse engine should be tried at same time as "best aid to avoid collision".

3-35 碰撞前兩分鐘 最佳的避碰行動

碰撞的情勢：兩分鐘後碰撞，碰撞已經在我們想像的碰撞區域裡面發生了，已經太慢了，不能採取回轉單一的行動來避免碰撞，兩條船現在都進入太空船的狀態，兩條船所採取的措施，應該只是用來減輕碰撞的力道，從撞擊之中，利用舵角，或是調整碰撞的角度，相互之間利用滿舵來推動他們的船尾，如何準備碰撞，是下一章資深船副，所要討論的知識。

三副呼叫船長並且說道，*我們右舷有一目標，CPA 是零，距離非常近，它是一條大船。*

三副呼叫船長，並且說了四樣事情：

1.右舷有一目標，這是他自己的觀測。

2.CPA 是零，這是 AB 在 1946 時提醒他的。

3.距離非常近，三副並不知道，到底還有多遠？會發生碰撞。因為他沒有固定距離圈的顯示在螢幕上，他也不會使用目視瞭望的技術，來估計目標的距離，對距離的第一個直覺是目視瞭望。目標的距離大約是 0.75 海浬，如果使用速度向量線在雷達螢幕上的長度來做估計，但這也不是他雷達瞭望技術的一部分。他第二個雷達瞭望的直覺，也不具備。

4.他是一條大船：這是 AB 在 1947 時提醒他的。雷達螢幕上，並不能告訴他，AB 說的是對還是錯？

三副對還有多久時間，會發生碰撞，並無概念，如果他知道碰撞的時間，只有兩分鐘，他就會自己採取行動，不會等待船長的到來。

圖形 3-12 水晶輪紅色速度向量線鄭大嶼的目標回跡又再出現

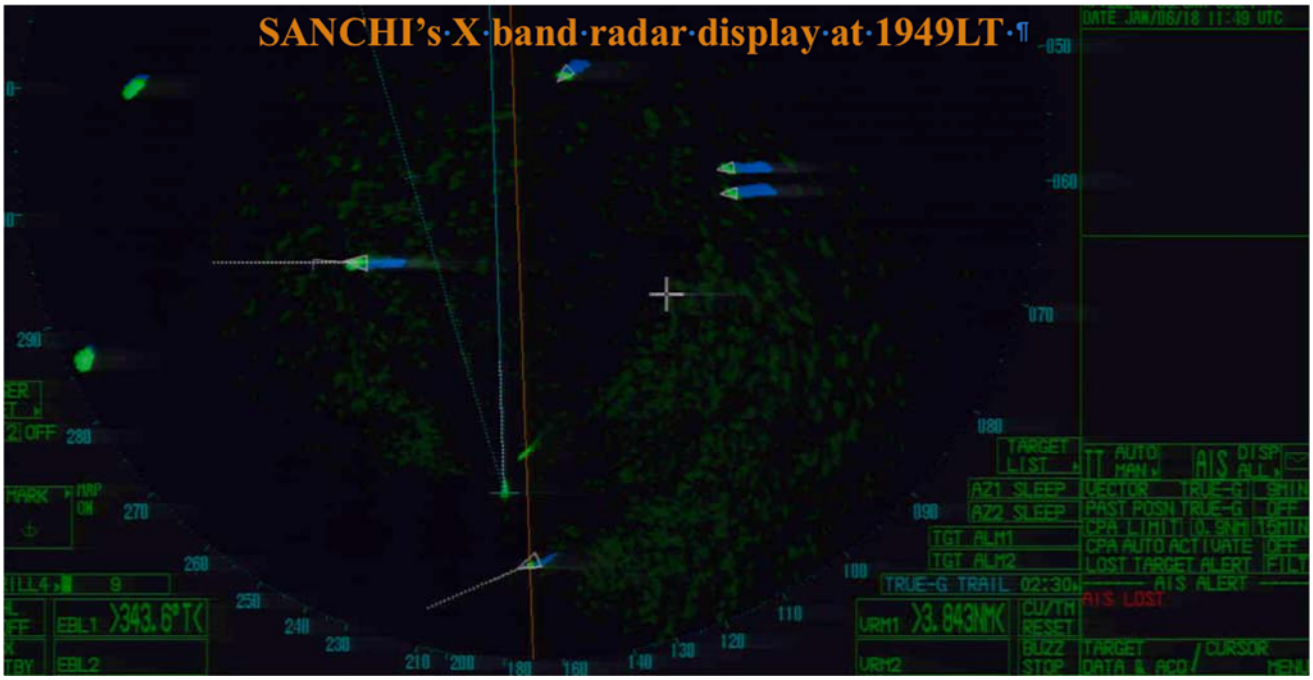
3-35 Two minutes before collision: best aid to avoid collision

Situational Awareness of collision:

2 minutes before collision: Collision already happened in imaginary collision area. It is too late to take one action only to avoid collision. Two vessels are now inside collision area (space ship status). The actions taken by these two vessels are to mitigate the collision impact from crush by using astern engine or adjust collision aspect by hard over rudder angle applied. How to prepare to collision is Senior OOW knowledge for next chapter.

The 3/O called the Master and said: … *We get a target on starboard side and CPA is zero. Distance is very short. It's a big vessel.*

- 3/O called master and told four things:
  1. *We get a target on starboard side*: his own observation.
  2. *CPA is zero:* AB remind him in 1946 hours
  3. *Distance is very short:*
     3/O don't know exactly distance for no fixed range ring on screen (not available from his visual lookout skill of target distance, his first instinct of distance in visual lookout). It's about 0.75 nm by speed vector length (not available from his radar lookout skill, his second instinct of distance in Radar lookout).
  4. *It's a big vessel.*: AB remind him in 1947 hours but radar screen cannot tell him this is correct or not?
- 3/O have no knowledge and skill of how many times to collision TTC now. If he knew TTC he will take action by himself along without waiting Master.



圖形 3-12 水晶輪紅色速度向量線鄭大嶼的目標回跡又再出現

在 1949 時，桑吉輪航向 358 度，航速 10.5 節，

三副：為什麼他不做任何事？天啊！他要撞到了！

三副：向左邊，全速向左，天啊，全速向右，全速向右，全速，全速，拜託。

船長來到駕駛台，19 時 49 分 28 秒的當地時間。

三副：船長，她沒有採取任何行動。

船長：右滿舵，右滿舵。

3-36 碰撞前 1 分鐘，碰撞已是無可避免的。

這是最絕望的時刻，減速或是回轉船隻對著來船接近的方向，是這情況的唯一方法，在雷達螢幕裡，我們現在沒有線索，哪一條船會先通過碰撞位置，因為長峰水晶輪的速度向量線，再一次又不見了。

⇒ 如果本船先通過碰撞點，本船桑吉輪的右舷就會被撞到，這實在是一個令人絕望的情況，對本船來說，貨艙的破裂，很可能會使得本船沉沒。

⇒ 如果目標船先通過碰撞位置，本船的船頭，會撞擊到目標船的船舷。

⇒ 如果本船警急到俥，如果目標船先通過碰撞位置，可以減輕碰撞的力道。

⇒ 如果本船先通過碰撞位置，全速到車也許並不好，因為本船的減速，沒有辦法立即生效，而且本船可能留在碰撞點，時間比我們期望的更久。我們也可能需要俥葉流，在我們的舵板來改變船艏向。

3-06 碰撞到俥的情境感知

3-37 碰撞到俥,停俥的神秘性

碰撞到俥並不是一個單獨的程式，他有三個程式化的主機控制，來產生倒退的船速。在駕駛台的控制台上，有一個加了封蓋的紅色按鈕，（crash astern ）。

IMO 在 1993 年 11 月 4 號所接受的決議案 A.751(18)，船舶操控性的中期標準

停車能力：在全速停車的航跡裡前進的距離，不應該超過 15 倍船長。無論如何這個數值可以由主管官署修正，如果船隻具有太大的排水量，使得這項標準，不切實際。船旗國有權修正這項標準。

碰撞停車或是碰撞到車，主要是主機功能的一個測試，螺旋槳倒車能力的標準。比較由船隻沖止距的能力，相較於船隻排水量與主機動力所產生的直接結果。

柴油機倒車的能力，只有 85%進車的力量。然而對於蒸汽機來講，倒車的能力，可能只能達到進車的 40%。

對於沖止距的表示，以直線的航跡，幾倍的本船長度來表示，可以寫成下面的格式，（由 IMO 決議案 MSC 137（76））：

S = A log e (1+ B) + C , S : is the stopping distance, in ship lengths

S ： 停車距離是以本船長度的倍數來表示。

A：係數，由船隻的品質除上他的阻力係數而決定。

B：係數，由船隻的阻力在停車前立即的阻力，比上他倒車的推力，當船隻靜止于水中。

C： 係數，取決於獲得到車推力的時間與本船的初始速度。

以白話來說，停止距離的長度是以本船船長為單位的表示式，是由船隻的品質，阻力係數，到車推力，以及或者到達預定到車推力的時間，跟船隻的初始速度等等而決定。

At about 1949LT, SANCHI's COG was 358° and SOG 10.5 kts.

3/O: *Oh, why is she not doing anything? Oh man, he's touching*

3/O: *Go to port side, full port side. Oh, man! Full starboard side, full starboard side. Full, full, please.*

Captain comes to bridge at 19:49:28LT

3/O: *Captain, she did not take any action.*

Cap: *Hard to starboard, hard to starboard.*

3-36 One minutes before collision: collision is inevitable

The collision is inevitable now. This is most desperate moment. Reduce engine and turn vessel into approaching vessel's direction is the only way to handle this situation. In Radar screen, we have no clue now which vessel will passing the collision position first as CF Crystal have no speed vector again.

- ⇒ If ownship passing collision position first, ownship will be collided in our starboard side which is sure a devastating situation to ownship. Breaching the cargo hold side wall is very likely to sink ownship.
- ⇒ If target vessel passing collision position first, ownship bow will hit target vessel's side.
- ⇒ Ownship crash astern is good for target vessel passing collision position first to mitigate the impact.
- ⇒ It may be not good for ownship to go crash astern if ownship passing collision position first as
  - Ownship speed reduction may not be effective immediately within one minute and
  - Ownship may stay at collision point longer which have more collision chance.
  - Ownship may need the engine propulsion current acted on our rudder plate to change heading.

3-06 Situational awareness of Crash Astern

3-37 Crash Astern, the mystery of Stopping ability

Crash astern is not a single process. It consists of three programmed procedures in engine control computer with one covered red button on bridge control console. In IMO RESOLUTION A.751(18) adopted on 4 November 1993 INTERIM STANDARDS FOR SHIP MANOEUVRABILITY

Stopping ability

The track reach in the full astern stopping test should not exceed 15 ship lengths. However, this value may be modified by the Administration where ships of large displacement make this criterion impracticable.

- ⇒ The "crash-stop" or "crash -astern " manoeuvre is mainly a test of engine functioning and propeller reversal.
- ⇒ The stopping distance is a direct result of the ratio of astern power to ship displacement.
- ⇒ With diesel engine, the astern power available is usually about 85% of the ahead power, whereas - With steam turbine this figure could be as low as 40%.
- ⇒ An expression for the stopping distance along a straight track, in ship lengths, can be written in the form (copied from IMO resolution MSC.137(76)):

S = A log e (1+ B) + C , S : is the stopping distance, in ship lengths

where:

A : is a coefficient dependent upon the mass of the ship divided by its resistance coefficient.

B : is a coefficient dependent on the ratio of the ship resistance immediately before the stopping manoeuvre, to the astern thrust when the ship is dead in the water.

C : is a coefficient dependent upon the product of the time taken to achieve the astern thrust and the initial speed of the ship.

In plain words, **stopping distance (in ship lengths) is determined by mass of the ship, resistance coefficient in water, astern thrust of main engine, the time taken to achieve the astern thrust and initial speed of the ship.**

3-38 汽缸裡面的動作，當警急停車的按鈕按下，

船隻的初速是海上的全速或是在公海上的巡航速度，在桑吉輪的是 10.5 節。緊急倒車按鈕（碰撞倒車按鈕）在駕駛台的儀錶板上，經常會有一蓋板以避免被意外觸及。

1. 當緊急倒車按鈕的蓋子被打開，而且紅色按鈕被按下，主機會切斷對汽缸燃油的供應，船隻會失去主機的出力，但是會繼續向前移動，因為船隻巨大品質所產生的慣性。
2. 船隻沿著他原始的航向向前滑行，會繼續直 5 到 6 倍船身長度的距離，這是對內燃機，柴油引擎的估計，船隻在這段距離，就是等他的轉數下降。
3. 螺旋槳轉速要掉到他最大連續出力的 40%的時候，在主機全速前進的 40%左右的轉速，或是當主機的轉速，是在慢速進車 Dead slow ahead 的範圍，在壓縮空氣櫃裡面的壓縮空氣會注入汽缸頭，去將主機的轉速歸零。
4. 主機的轉速歸零之後，因為壓縮空氣的制動，船體仍然有向前移動的慣性，船體的速度可能還有微進車，前進的速度。
5. 壓縮空氣注入汽缸，去建立反轉的轉速。
6. 汽缸內壓縮空氣，推著船隻的螺旋槳產生反向的轉速，超過微倒車的轉速，燃油才會注入，開始點火內燃機。

此時會有兩個情況，點火成功：倒車的轉速會超過微倒車的轉速，然後慢慢增加到最大的到車出力，最大的到車推力只能達到進車推力的 85%，這是對內燃機來說。

如果倒車轉速的點火失敗，倒車的轉速無法建立，轉速就會再次跌落到零轉。

7. 不論點火是否成功，當值船副必須看著轉速表來仔細的核對，到俥轉速是否成功建立。
8. 壓縮空氣必須再一次注入氣缸，如果倒車轉速點火失敗，去推動倒車的轉速，（當值船副可能需要重搖車鐘一次，也就是先把俥鐘的搖杆，推回停車的位置，然後再次拉到倒車的位置，以重新點火），這個主要是看主機的程式設計，每條船，重置倒車轉數的情況不一樣。
8. 汽缸內壓縮空氣推動船隻的螺旋槳轉速，轉速超過微倒車的轉速，燃油會注入汽缸，再次點火。

幸運的是當值船副不必監督這些過程，這都是由主機的控制軟體，或是機艙當值的人員來處理，這些程式就是一個固定螺距螺旋槳經常會產生的缺點，單螺旋槳船隻使用固定螺距，正俥時葉片是向向右轉，到車操作的時候，船首向會偏向右舷，因為船尾的螺旋槳在到車時，是向左轉。

3-38 Inside the cylinder after crash astern button is pushed

The initial speed is Full Sea Speed or service speed in open sea for testing vessel which is 10.5 knots in Sanchi case. Crash Astern button usually has a cover to avoid accidently pushed by OOW.

1. When Crash Astern button cover is opened and pushed, engine will cut fuel oil supply to cylinder. Vessel lost engine output but still moving ahead due to the inertia of ship's mass.
2. Vessel sliding along her original course will last about 5 or 6 ship's length (estimated for diesel engine).

3. As soon as the RPM of the engine drops below 40 % of the Maximum Continuous Rating or MCR, 40% rpm of engine full speed rpm or when engine RPM dropped to about "maneuvering slow ahead" range compress air in air pressure reserve tank will inject into cylinders to stop the RPM.
4. After engine RPM is stopped by compress air (RPM = 0 now) ship still has her inertia to move ahead with the speed of "Dead Slow Ahead".
5. Compressed air injected into cylinder again to establish reversal RPM.
6. When compress air pushing ship's propeller with reversal RPM over the "Dead Slow Astern" RPM fuel oil will inject to cylinders to ignite diesel engine.
    a. If ignition is success reverse RPM will stay over dead slow astern RPM then increase slowly to its maximum output or thrust, 85% of the ahead power for diesel engine.
    b. If the ignition of reverse RPM is failed, the reverse RPM dropped to zero once again.
    c. After few seconds, compress air will eject to cylinder again to start the reverse RPM again.
    d. If ignition is success reverse RPM will stay over dead slow astern with fuel oil inject into cylinder to carry on astern RPM. If not, repeat above procedures once again.
    e. Whether ignition is success or not, OOW have to look at RPM meter to check carefully.
7. Compress air will have to inject into cylinder again if reverse RPM ignition failed to push the propeller to move in astern rotation. (OOW may need to ring astern engine telegraph once more.)
8. When compress air pushing ship's propeller with reverse RPM over the "Dead Slow Astern" RPM fuel oil will inject to cylinder ignite again.

Compress air is part of RPM control's requirement. After 7-10 times injected into cylinder the pressure reserved (22-35 kg/cm^2) for this purpose may drop below necessary pressure. The main engine will be a dead meat with no means to start the RPM, just like a car dead without battery power to start. OOW in charge of the Main Engine order on bridge have to **monitor the compress air pressure all the times during berthing operation.** Luckily, OOW don't need to supervise these processes. It's all in main engine controlling software or manually by engine officer to take care. These procedures are the drawbacks of a fixed pitch propeller. Single-screw ships with propellers turning right heading will turn to starboard in a stopping or astern manoeuvre.

3-39 可變螺距螺旋槳 CPP 倒車，反轉推力的程式

依據國際避碰規則的操作，避碰應該最好是向右逃逸，所以螺旋槳船隻俥葉的轉向，固定螺距螺旋槳船隻在進俥時，是向左轉。如果本船是可變螺距螺旋槳，在倒車的時候，不必反轉主機的大軸，倒車的出力是借由改變螺旋槳的葉片角度來建立，改變螺旋槳的葉片角度是使用油壓動力，可變螺距螺旋槳的到俥程式來的快速，可變螺距螺旋槳 CPP，可以讓本船在 6 倍的船長之內停車，他的一般毛病，跟其他的油壓系統一樣，就是油壓的活塞頭經常會卡在油壓缸裡，就像我們的舵機系統會卡舵是一樣的，使得螺旋槳的角度。沒有辦法改變。倒車的動力在可變螺距船上沒辦法建立，會沒辦法停車，減車，一直卡在全速前進葉片的位置或角度，這個是經常發生的事，油壓缸的油壓油洩露，也有可能發生卡住俥葉。

3-39 controllable pitch propeller CPP reverse output or thrust procedure

According to COLREG, collision avoidance manoeuvre should be executed with starboard evasion, single-screw ships should be equipped with right-turning fixed-pitch propellers or left-turning propeller shaft for CPPs. By this different arrangement in FPR and CPP, each time vessel use STERN engine vessel will have the tendency FOR HIS BOW going to starboard side. If ownship has a controllable pitch propeller CPP the reverse output or thrust don't need to reverse the main shaft of main engine. Reverse thrust is established by changing the pitch of propeller by hydraulic power which can reverse more quickly than Fixed pitch propeller's main shaft turning direction. Controllable pitch propeller CPP can stop ownship within 6 times of ship's length compared with fixed pitch propeller need 12-15 times ship's length advance. It has the common problem as any hydraulic system had. The hydraulic pistons sometimes stuck in its cylinders like our steering gear system

which make the pitch angle unchangeable (the reverse power of CPP vessel cannot establish or vessel cannot reduce speed due to pitch stuck). If the pitch angle is stuck vessel speed may not be able to reduce or increase by CPP propeller.

3-40 壓縮空氣在主機點火時的壓力

船隻主機經常會有多個氣缸，11 個或者 12 個汽缸，對一條大船來講，都是常見的。這些汽缸的燃油注入，要依照次序輪流注入氣缸，產生爆炸，推動曲枴軸，再推動大軸，才會帶動主機螺旋槳葉片轉動，產生一定轉速來產生推力。燃油注入的時機，時間點是非常重要的，這樣才會使得大軸的能夠平順轉動，每當有汽缸在從事保養工作之後，保養他的缸套或是活塞環之後，機艙會測試主機的啟動，點火順序是否正常？當值船副在駕駛台的控制台旁待命，搖進俥與倒車來測試點火順序，是否正常，在這種時候，當值船副應該研究主機轉速計指標的動作，以瞭解點火是否成功？

3-40 Compress air pressure in engine ignition

Vessel usually has more than one cylinder. 7 or 9 cylinders is common in big vessels main engine. All these cylinders inject fuel oil in turn to carry on the RPM needed for thrust. The injection timing is very important to make the main shaft turning smoothly. Each time one of the cylinders had maintenance works done on his main engine liner or piston ring. After assembly, Engineer will test the ignition timing of Main Engine. OOW will help in bridge control console to ring the telegraph to “dead slow ahead” and “dead slow astern” to test ignition procedures. This is the time OOW should study the RPM indicator needle behavior to understand ignition is success or not.

3-41 需要的主機轉速是否已建立？

在進港之前要測試倒車，是一個例行的工作。當值船副會在車鐘旁待命，執行船長或是領港的車令，當車鐘搖杆推或拉到需要的車令位置，會有一些人工的鈴聲，提醒船長注意，你在車中搖杆上的動作。我們可以看到主機轉速的指標，當壓縮空氣注入的時候，在轉速表裡面的移動。

如果當值船副測試主機的點火，轉速計指標會開始快速的移動到微進車所設定的轉速，因為這是由壓縮空氣所推動的，在轉速超過了微進車或微倒車的轉速時候，燃油會注入汽缸，用來點火。如果點火成功，轉速的指標，就會停在我們所需要的轉速，如果點火沒有成功，轉速指標就會又掉到零。

螺旋槳的轉速在第一次點火失敗以後，在第二次就很可能成功。失敗的原因在第一次很可能是因為大軸跟螺旋槳的慣性太大，所以即使燃油注入，也沒有辦法順利啟動反轉的轉數，經過第一次壓縮空氣的制動後，再第二次點火的時候，反轉的轉數建立，就輕鬆一點。也有可能壓縮空氣在空氣壓力櫃裡面，存量已經不夠啦，無法去點火主機，或改變轉數，也就是主機沒有足夠的空氣壓力啟動操作，就會變成廢物。沒有改變進倒車的功能，就像可變螺距螺旋槳葉片角度卡住一樣，不能改變車速，要解決這個問題，駕駛台的每一個人，必須等待壓縮空氣打到空氣壓力櫃裡面，建立了足夠的空氣壓力，主機才能再次作動，改變成其他的車速。

大船內燃機的空氣壓力櫃設計的壓力，是可以啟動主機七次，在靠碼頭時，太頻繁使用車令之後，空氣壓力可能會消耗太快，以至於緊急的關頭，無法有足夠的空氣壓力來建立倒車的轉速，所以當值船副在負責車鐘的作業時，就有另外一個任務，要關注壓縮空氣的壓力，還有多少？現代化的船隻空氣壓力連續使用 7 次，很可能就會低於他能夠作動，降低轉速的水準，此時主機就不受駕駛台的控制，船副應該警告船長或是領港，當空氣櫃裡面的壓力，已經/或是壓力已經快速的下降。在緊急倒車的時候，尤其是要啟動倒車轉數的時候，這是啟動失敗，最經常的原因。

當值船副必須對船長大聲提醒：船長！壓縮空氣快不夠了。

3-41 Required RPM of propeller is established or not?

To test astern engine before port entry or docking is a routine operation. OOW will attend the telegraph to carry out Engine order of Captain or Mr. pilot while docking. When telegraph handle push or pull to the slot of speed order there will accompany with some artificial sound to make the Captain aware of your movement on telegraph. We can see then RPM needle in RPM indicator moving while compressed air injected. If OOW is testing engine ignition, RPM will be started to move rapidly from zero over Dead slow ahead setting rpm while compress air injected into cylinder. After RPM pushed over certain RPM by compress air the fuel will inject into the cylinder in correct timing to keep the Main Engine RPM going which we call ignitition. If the ignition is success RPM needle will stay on required RPM. If not, RPM needle drop to zero again. Usually, propeller RPM can be established in second time by compress air pushing. There is a possibility that compress air reserved in air pressure tank is not enough to ignite main engine. Main engine cannot ignite without enough air pressure. Main engine RPM will be dead without compress air. No RPM fuel oil injection after RPM is established by compress air vessel cannot to keep main engine shaft turning To solve this problem of compress air pressure is too low, everybody has to wait for air compressor to pump enough air pressure into air pressure tank. So, OOW in charge of telegraph operation has another mission to watch over compress air reserve pressure. Usually engineer in engine control room will monitor air pressure reserved in compress air tank. EOOW engine officer of watch will start any other compress air compressor to speed up the pressure reserved procedures. It is also a prudent OOW job on bridge to monitor the same so as knowing any possibility that telegraph order might not be able to carry out as required and remind captain the situation of main engine. In modern ship, if compress air injected into cylinder more than 7 times in short interval compress air pressure will drop below working level, engine telegraph will not response to telehraph order. OOW should warn Captain and Pilot when air pressure remained in tank is not enough or pressure drop low very quickly in crash astern. This is common cause of engine starting failure especially in astern RPM. Shout to Captain, Captain, Compress AIR is out.

3-07 操船的不可抗力

3-42 碰撞前，船長只有 30 秒去回應挑戰

在這個案子，

三副說道：為什麼他不做任何事？天啊！他要碰到了。

- 三副希望直航船去做一些事情，而忘了作為一個讓路船，他應該去讓路。
- 在碰撞前 1 分鐘，要改變更任何事情，都已經太晚。
- 但是在法庭的判決裡，碰撞前做任何事情，都會認為是必要的，作為一個好的瞭望，或是優良船藝，或者是最佳的避碰措施。雖然實際上，已經於事無補。

在這等待的時間裡，三副並沒有要求瞭望，要改成手操舵，或把舵機改成手操舵。

三副說到道：“去向左邊，全部左邊，天啊！全速右邊，全速右邊，全速，全速，請（拜託）。”

- “去向左邊，左邊全速”，這不是海上的用語，這是三副心裡面的思想，他說的是他心裡面想的東西，但不是給瞭望應該有的舵令。這邊我們看到典型的溝通障礙。
- “左滿舵”的舵令，應該就足夠了。
- “向左全速，向左”，這是希望碰撞能夠借由船首向平行以避免，這是他心裡面的第一個想法，轉到左邊與來船平行。

“向右全速，向右轉”，這是知道本船船頭先通過碰撞位置，希望碰撞點能移往本船的船頭，以避免碰撞時，插入船中。

- “全速，全速，拜託。”這個最後的請求，表示出他心裡脆弱的一面。

3-07 Force Majeure in shiphandling

3-42 Captain only has 30 seconds to response before collision

In this case, 3/O: *Oh, why is she not doing anything? Oh man, he's touching*

- 3/O expect stand on vessel to do anything and forget to do anything is both vessel obligation in this 3 stage.
- one minute before collision already too late to change anything (course or speed).
- In the court verdict, anything before collision will be deemed necessary as **good lookout or good seamanship or best aid to avoid collision** even it is useless in reality.
- In this waiting, 3/O had not asked lookout to change steering to hand steering which is part of requirement as collision avoidance preparation procedure.

3/O: *Go to port side, full port side. Oh, man! Full starboard side, full starboard side. Full, full, please.*

- "*Go to port side, full port side*". This is not sea language, it is 3/O's thought in his mind. "Rudder hard port" is correct order.
- He is saying what he thought in mind not giving rudder order to lookout.
- "*Hard Port*" will be enough.
- *full port side*: is in hope that collision will be avoided by parallel to coming vessel's course but it is too late now.
- *Full starboard side, full starboard side:* is knowing ownship pass collision position first and hope collision spot will move from backward to ownship's bow direction.
- *Full, full, please.* In the hope vessel will be safe.

船長在 1949 分 28 秒來到駕駛台，船長在碰撞前只有 30 秒，來回應現場狀況。

三副說道，"船長，他並沒有採取任何行動"。

- "船長，本船在 30 秒前，也沒有採取任何行動"，這一點，他也沒有告訴船長。
- 本船並無任何回轉速率來避碰，這是在下一階段資深船副要討論的事項。

船長：Hard to Starboard 右滿舵，右滿舵。

船長接到電話後 1 分鐘，來到駕駛台，在電話裡面聽到的資訊，充滿壓力。

- 船長知道有一條大船，在非常近的距離，CPA 是零，在右舷。
- 船長聽到三副下的舵令，全速向右，全速，全速，請。
- 船長接過指揮權，沒有時間去詢問三副，就直接下令：右滿舵，右滿舵。船長看到右舷船隻，但是他可能不知道本船的船頭，已經通過了目標船的船頭。
- 當碰撞發生時，長峰水晶輪航向 226 度，桑吉輪 358 度，這兩個船首像，自始至終都沒有改變。

Captain comes to bridge at 19:49:28LT.

- Captain only has 30 seconds to response before collision

3/O: *Captain, she did not take any action.*

- Captain, ownship did not take any action before either.
- There is no rate of turn yet. Rate of turn will be discuss in senior OOW chapter.

Cap: *Hard to starboard, hard to starboard.*

- Captain came to bridge within one minute with stressful information heard in telephone.
- Captain knew one big vessel CPA is zero at starboard side in very close distance.
- Captain heard 3/O giving rudder order " *full starboard side. Full, full, please."*
- Captain took over the command with no time to ask 3/O anything.
- "*Hard to starboard, hard to starboard*"
- Captain saw starboard side vessel in close range but he may not know ownship's bow has passed target vessel's bow. He have to adopt to night vision.

When the collision occurred, CF CRYSTAL was heading 226°, and SANCHI 358°." No nothing had done in both vessels' OOW by their knowledge, skill or instinct. We know that awareness of danger is the first priority as they don't have in the beginning. So, no other job had done to prevent collision.

3-43 船員生命的悲傷時刻

大約 1950 時，長鋒水晶輪的船頭撞到桑吉輪的右舷，在第二與第三右舷的壓水艙位置，深入貨油艙，造成燃淅油的洩漏，而接著就是火災與爆炸。桑吉輪的船長下令要求，打開所有甲板燈光，下令舵工操作左滿舵，然後他要求啟動遇難信號系統的警報。

- 左滿舵並不是一個非常好的選擇，當在右舷發生碰撞時。
- 當兩條船的船體因碰撞而合在一起，要拉開這兩條船，會造成破裂的貨艙，快速的大量進水，嚴重影響到它的穩定性。
- 如果這是要減輕碰撞的力道，舵角對船體沒有立即的影響，最多只能做動到船尾。
- 如果船隻向左舷轉動，這破裂的貨油艙，會讓海水的進入，也許會嚴重的損害他的穩定性。
- 這時最好停車，減慢進水的速度，因為船隻前進的時候，進水的壓力比較高。
- 風向是東北風，4 到 5 級風力，從桑吉輪的右船頭來的。
- 風向風力是情勢感知的第一個要素，因為這些是不論在任何情況下，都會持續作用在船體。
- 船長向左舷轉向，也許可以幫助爆炸的船頭，轉移到下風的方向。

桑吉輪船長，要求打開所有甲板燈光。

- 船長沒有下令停車，但是要求打開所有甲板燈光，在駕駛台觀察碰撞的情事。
- 在 1951 時，船長指示啟動滅火幫浦，而且 GMDSS 環球海事遇難信號系統。
- 船長並沒有施放通用警報聲，以警告在睡覺的船副船員，召集他們立刻到集合地點集結。
- 船長並沒有使用廣播系統，來廣播碰撞的發生。

3-43 Sad moment of seaman's life

At about 1950LT, *CF CRYSTAL's bow hit SANCHI's starboard side between No.2 and No.3 starboard ballast tanks and breached her cargo tanks, resulting in the leakage of condensate oil and a consequent fire and explosion. The Sanchi captain requested to switch on all deck lights and ordered helmsman to steer "hard to port". Then he asked to send distress message.*

- *hard to port:* is not a very good choice when collision happened at starboard bow.
  - ⇒ Two vessels' body may puncture each other now. Breaking two vessels apart will ingress seawater into broken cargo hold very quickly.
  - ⇒ If it is to mitigate collision impact rudder angle has no immediate effect on ship's hull direction.
  - ⇒ If vessel do swing to port side the breached cargo hold will expose to sea water ingression which may severely damage her stability and sinking afterward.
- It is better to stop engine first to slow down water ingression into the cargo hold from bow direction.
- The wind is northeast wind Beaufort force was 4 to 5 from Sanchi starboard bow. Sanchi is heading North in the beginning. So, turning to portside will bring the bow to downwind direction which is better to avoid the fire and smoke come down from bow direction.
- Beware of wind and current direction and force are first rule in situational awareness before anything else in bridge watching keeping because these are Force Majeures in any circumstance.
- Captain Alter course to port side may help fired and explosive bow into downwind direction.

The Sanchi captain requested to switch on all deck lights.

- Captain had not ordered to stop engine (may be forgot) but to switch all deck lights to figure out collision situation by his eyes.

At about 1951LT, *Captain instructed fire pumps to be started and GMDSS activated.*

- Captain had not sounded the General Alarm to warn the crew in sleep and summon muster station at once.

- 3/O had not use public address system to broadcast the collision and fire, engine room had not informed of the situation.

3-44 爆炸與火災吞噬了駕駛台與住艙

在大約 1 952 時，火災吞噬了駕駛台與住艙，接下來是窒息的聲音。
在 1953 時，GMDSS 的信號中斷了，環球海事遇難信號系統的求救信號就中斷。
就人力資源的角度來看，這情形就是：

⇒ - 船長花了 1 分鐘的時間來到駕駛台。
⇒ - 到了駕駛台以後，船長只有 30 秒的時間，來處理即將發生的碰撞情況。
⇒ - 船長與所有的船員，只有 3 分鐘的時間，在碰撞之後，可以用來求生存，也沒有多餘的人力，可以叫到駕駛台來協助碰撞危機。
⇒ 雖然我們並不是火災專家，有些事後的想法，可以提醒所有人員在將來類似案件發生時，可以採取的對策，做一事前的演練。
⇒ 貨油的蒸氣跟空氣的混合，並不一定是在可燃的範圍，除非貨油與空氣的混合比例，在爆炸或起火範圍。這就是最低的可燃比例限制，跟最高的可燃比例限制。
⇒ 因為貨物很容易發生火災跟爆炸，一般的注意事項，應該是
⇒ 火災三要素要被排除同時存在，燃燒物質，點火源跟氧氣。氧氣跟貨物的蒸氣，很容易在貨油管路系統內發現，要知道這些混合氣體比例，是否在一個安全的範圍內？或是系統裡面，可能接觸的點火源，必須使用正確的操作實務，來加以排除。
⇒ 當點火源跟氧氣的產生。不可避免時，例如在住艙的範圍，引擎跟鍋爐間，廚房等等，應該儘量想辦法，來排除可燃氣體或是可燃蒸氣的集結。
⇒ 如果在機場跟貨油系統之間，可能會有洩漏的地方，特殊的警覺是必須的，要特別注意。
⇒ 火災跟爆炸發生在碰撞之後，此時應該採取的措施：
⇒ 所有貨艙的泄壓閥應該開啟，雖然增加了點火的可能，但是比起爆炸要好一點。
⇒ 所有裸露的燈光，都應該避免啟動。
⇒ 防爆型甲板燈光的罩子，可能因碰撞，已經破裂，容易起火。
⇒ 甲板燈光開啟，可能會引起燈泡的火花。
⇒ 向下風轉向，以避免火勢與爆炸進入駕駛台，啟動通用警報器以叫醒所有船員應變。
⇒ 救火幫浦應該啟動，GMDSS 也應該作動，如同船長的指示，啟動環球海事遇難信號系統。

3-44 Explosion and fire engulfed bridge & accommodation

At about 1952LT, *explosion and fire engulfed bridge & accommodation, followed by suffocation sounds.* **At about 1953LT**, *GMDSS signaling stopped.*
In human resource aspect, the situation is

- Captain has only one minute to come to bridge.
- Captain has only 30 seconds to handle the collision.
- Captain and all crews have only 3 minutes time after collision to survive.
- No extra man power had summoned to help.

In all these limitations as summarized we can understand now “why our skill have to be trained from conscious knowledge level to subconscious skill level and finally into unconscious “instinct” lever. Too many cases as writer analyzed shown one rule “ **Captain has only one minute to handle the collision or grounding**” .
Although we are not fire expert some after thought of total lives lost should be exercised for future reference. A mixture of cargo vapour and air cannot cause a fire unless the proportions of vapour and air lie between two

concentrations known as the Lower Flammable Limit (LFL) and the Upper Flammable Limit (UFL). By reference fire and explosive nature of cargo, general precautions should be:

- Check wind direction to alter course to avoid the fire and smoke get into bridge.
- Sound general alarm to wake up all crews.
- Fire pumps to be started and GMDSS activated as Captain instructed.
- Fire is prevented by ensuring that at least one of these three elements is excluded: Flammable substance, sources of ignition or oxygen.
- Oxygen and cargo vapor mixture cannot be controlled to a safe level within the cargo system in a short time by ship's personal.
- Otherwise, sources of ignition will be only element available to be excluded in fire control practices.
- Where sources of ignition and oxygen are likely to be present, such as in accommodation, engine and boiler rooms, galley, motor rooms etc., it is vital to exclude flammable vapour.
- Particular care is necessary if there is a direct connection between the engine room and oil cargo space if leakage had started now.
- Fire and explosion might happen immediately after collision.
- All pressure relief valve of cargo hold should be opened to avoid over pressure by heat.
- No naked light should be present.
- The explosion proof deck light cover may break already because of collision.
- Turn on Deck light will send electricity to deck and trig spark in broken bulb.

3-45 在火災與爆炸現場的不可抗力

在意外發生的時間，天氣是多雲，良好的能見度，東北風風力 4 到 5 級，海象是小浪。

⇒ 氣候的狀況是不可抗力，沒有辦法去改變，只能做最佳的利用。
⇒ 船長向下風轉向，向左舷轉向是正確的，可以避免火光與煙霧，進入駕駛台與住艙。
⇒ 向左舷轉向，破壞了碰撞區的連結，可能引起貨油與可燃蒸氣洩漏的更快。
⇒ 也許船長維持原來 358 度的航向，而不是試著要與長鋒水晶輪分開，才不會造成可燃性的貨物油大量注入火災現場。

3-45 Force Majeure at explosion and fire scene

At the time of the accident, the weather was cloudy with good visibility, the northeast wind Beaufort force was 4 to 5, and the sea state was slight.

- the weather condition is Force Majeure which we have no means to change but to make best use of it.
- Captain alter course to downwind (port side) is correct to avoid the fire and smoke get into bridge.
- Alter course to port side break the punched area of collision from CF CRYSTAL which may cause oil cargo and vapour leakage more quickly.
- Maybe Captain remains in original 338 course and not to part from CF Crystal is better to avoid gushing of flammable cargo into the fire.

3-08 觸動他潛意識的軟肋：主張

3-46 影響他人的領導能力

桑吉輪的航行紀錄器 VDR，錄下了碰撞與爆燃的音響，與在駕駛台 1950 分的聲音，反映出當值瞭望情緒的激烈變化。在 3 公分雷達的影像上，（航行資料記錄儀每 15 秒所擷取的雷達影像），顯示船首向從 358 度在 1949 時，改變到 338 度在 1951 時），碰撞引起船首向改變了 20 度，同時船隻的速度，由 10.4 節降低到 6.5 節。

- 當值瞭望在駕駛台，在 1950 時有強烈的情緒改變。
- 我們不知道當值 AB 是對他自己感到憤怒，或對三副感到憤怒。
- **我們是否應該堅持，我們認為對的事情去做**？

由維琪百科上面來看，主張就是自我確認，有信心，而不會有攻擊性，就是有品質的自信，而不會對別人產生攻擊性。這是一個可以（應該）學習的技術與溝通的方式，
多納醫藥字典裡面，定義的主張是：
這樣的一種行為的形式，可以歸類為有信心的宣告，或是對於敘述的肯定，不必另加證明：這個肯定了這個人的權利，或是他的觀點，不必威脅到他人權益，（也就是不會產生一支配性的地位），或是順服他人的被動性，讓自己的權益或者是觀點被忽略。
主張不是攻擊，也不是臣服，以中文來說，就是不卑不亢，這就是我們人際關係中的領導能力，跟別人相處的時候，不論我們是低階或是高階的職務。
這是英國“人為因素領導統禦”訓練教材裡面的一個面向，這是說的比做的容易，這是因為英文裡，他們也有同樣的觀念，只是對我們來講，有些文化的差異，所以就是簡單的單字，我們不能產生以上的聯想，現在讓我們看看：瞭望能否對他觀測的事物加以主張？

在 1939 時，瞭望說道“這並不符合規則，就是我們必須……”
在 1946 時，瞭望說道“查理已經過去了，對吧？向右邊一點，CPA 是多少？CPA 是零，是零”
在 1974 時，瞭望說道“不！是大船”過後，瞭望就沒有再出聲音。
三副對自己說到：“所以，為什麼他要這樣子做？”AB 沒有回答
在 1948 時，三副再次說道：“噢！為什麼他沒有做任何事，喂！他要撞上了。”AB 也沒有回答。

航行資料記錄器記錄當值瞭望，AB 在駕駛台是，1950 時反映出強烈情緒改變，只是不曉得是悲傷？還是憤怒？
瞭望在 1939 時，想要說出來的意見，一再忍耐 11 分鐘後，以碰撞 1950 時，爆發的情緒收場。

3-08 Touch soft spot of his subconscious: Assertiveness

3-46 Leadership in our relationship with others

The VDR of SANCHI recorded the sound of collision and deflagration, as well as the voice of duty crew in bridge at 1950 LT, which reflected the dramatic emotional changes. The image of X-Band Radar extracted from the VDR (one capture every 15 seconds) showed that the heading changed from 358° at 1949 LT to 338° at 1951LT, meanwhile, the vessel speed dropped from 10.4 to 6.5 knot.

- the voice of **duty crew in bridge at 1950 LT, which reflected the dramatic emotional changes**.
- We don't know duty AB is angry about himself or 3/O?
- Shall we insist on something we think is rightful to do?

Assertiveness: from Wikipedia, the free encyclopedia
Assertiveness is the quality of being self-assured and confident without being aggressive. **It is a learnable skill and mode of communication.**
Dorland's Medical Dictionary defines assertiveness as:

A form of behavior characterized by a confident declaration or affirmation of a statement without need of proof; this affirms the person's rights or point of view without either aggressively threatening the rights of another (assuming a position of dominance) or submissively permitting another to ignore or deny one's rights or point of view.

Assertiveness is not ***aggressive*** or ***submissive.*** It is a leadership in our relationship with others whether we are lower or upper in hierarchy. This is part of British Human Element Leadership and Management (HELM) training objective. It is easier to say than to do. Can duty crew assert on his observation?

- at 1939 hours: *And this is not complying to the rules that I must oblige……*
- at 1946 hours: *Charlie is passed, right? A little to starboard? What's the CPA? CPA is ... zero, zero.*
- at 1947 hours: *No-, big vessel.* after that time duty AB remain silent.

- 3/O said to himself: *So why is she intending to take action like this?* No answer from duty AB.
- at 1948 hours, 3/O said to himself again: *Oh, why is she not doing anything? Oh man, he's touching.* No answer from duty AB.

VDR recorded the voice of duty crew in bridge at 1950 LT, which reflected the dramatic emotional changes.

3-47 如何主張你的觀點

- 要表現出你的情緒。
- 人們沒辦法對抗情緒，我們所擁有的所有知識跟訓練，以及經驗，只能有一個目的，就是服膺我們潛意識的感覺，這就是主張的重點，服務我們的目的，而不會引起他人的攻擊性。

“真實的領導能力需要偉大的人或女人，來帶出我們的勇敢 堅強 堅忍 或他們所有的決心。” 這是錯誤的主張。

領導能力並不是來自主管或是部屬，在一個團隊每一個成員都有權利來表達他的關切（這就是主張）。

在這案件裡，第一是要引起三副的情緒，瞭望應該說，

在 1939 時，“三副，我恐怕這個船將會碰撞”，如果你是這個三副，當值 AB 這樣說了以後，你會怎樣回答？

⇒ 三副會感覺到害怕的情緒，雖然害怕是來自於 AB，聽到這個字“害怕”的時候。

⇒ 三副又聽到了碰撞這個關鍵字，碰撞，引起所有三副潛意識的回憶，在避碰規則的訓練都被記起，

⇒ 此時，三副只能證明他自己的正確性，或是三副需要當值 AB 來說明，他害怕碰撞的理由？

第二是要加入一些簡單事實，有了情緒之後，再加入一些簡單的事實，他沒有辦法否認，

在 1946 時，A B 可以說到：“三副，我害怕將會有一碰撞發生，和一條大船，CPA 是零，是零。”

⇒ 如果你是三副，你會怎麼做？當你聽到當值 AB 這樣子說，現在 1946 時，離 1939 時又過了 7 分鐘，對避碰的內心思考應該已經完成，碰撞即將發生，

⇒ 在 1946 時，三副感覺到當值 AB 的害怕，又一次三副再度聽到碰撞，這個關鍵字，如果避碰規則還沒有在他的意識層面，所有不採取避碰行動的藉口，將會被關閉，因為 AB 提到對方是一條大船，並且 CPA 是零，三副是否應該，

⇒ 1.現在調整他的心態？2.再度猶豫？3.立刻採取行動？

第三點是要將你的指令，加在句子裡面，因為沒時間去浪費了，沒時間讓他自己去，想起來讓路船的義務，所以你的話語，做主張的言詞，

應該在 1946 時，是有如下述，“我害怕這條大船會發生碰撞，CPA 是零，現在我們應該向右舷轉向。”

⇒ 經常我們的命令，會混在事實裡面，也許有些是我們個人的希望，你必須把你的情緒，加到情況裡面，這樣會比我們只有簡單的說出事實，或我們的希望，更為有力量。

⇒ 你希望什麼？對他毫無意義，說出你的感覺，就會在他的心裡留下一些疑問？

⇒ 當他懷疑你的感覺的時候，潛意識就會被喚起。

⇒ 當他的潛意識開始作用，會更容易記得他還有其他的選項。

⇒ 有了更多的事實，我們可以確認我們的指令是正確的，讓他確實的遵守。

3-47 How to assert on your point? This is also a topic Captrain assert to a pilot

- Show your emotion first. This is first stage.

People cannot fight with emotion. All knowledge and training and experience we have only served one purpose to “obey our feeling from subconscious”. This is the key point in assertiveness without offence to other.

"Because true leadership requires great men and women to bring all the courage, boldness, toughness, determination and audacity they can summon." These are wrong. Assertiveness is leadership either from the leader or from the follower. In a team every member has the right to express his concern (assertiveness). In this case, duty AB should say:

At 1939 hours, "3/O, I am afraid there will be a collision".

What will you say if you are the 3/O in duty when AB said that?

This send the **afraid** into 3/O subconscious when he heard the word AB said.

3/O heard the key word of "**Collision**" also. All subconscious of COLREG training is aroused.

3/O will have to **justify himself**. Or

3/O will have to **ask Duty AB to justify** his reasons of collision.

When AB bring out two key words "afraid in subconscious" and " collision in conscious".

- **Second, to include simple fact he cannot deny**. This is second stage because collision time is closing.

I am afraid a collision with this big vessel, CPA is ... zero, zero, ...".

What will you do if you are the 3/O after duty AB said that?

7 minutes had passed, 3/O had not mental adjusted to collision avoidance.

Collision is imminent in this time, 1946 hours C-4 minutes.

3/O feel afraid of duty AB's afraid once again.

3/O heard "**Collision**" and COLREG will come to conscious level now.

All excuse of no avoidance actions been shut out by duty AB.

Should 3/O have to **justify himself now? or hesitation again? or**

Take action immediately.

- **Third, embed your command inside in third stage. Wasting no time.** At 1946 hours,

"3/O, I am afraid there will be a collision with this big vessel, CPA is ... zero. alter course to starboard side now. "

- usually, our comments mixed with facts and our wish inside. You need to add your feeling to these situations which will make it more powerful than just saying what you want.
- "What you want" means nothing to him. Saying "what you feel" will leave some doubt in his mind.
- When he suspects of "what you felt" his subconscious will arise.
- When his subconscious arises, he will more easily remember other options he can have.
- Together with more facts we are assuring him our commends is correct.

These assertions can be separated into three stages:

1. I am afraid of a collision case. Emotional.
2. Big vessel, CPA is zero. Two simple truths. Rational.
3. Alter course to starboard side. Embedded command. SOP or best practice.

3-48 對你的意見練習主張，加上你的感覺

讓我們回到現場，使用主張的新技術。

在 1939 時，"我恐怕將會碰撞，如果我們不，趕快符合避碰規則的義務" 。（我的感覺 + （如果我們不）一個疑問 + 命令）

在 1946 時，"查理已經過去了，我恐怕 CPA 是零，向右邊一點。"（第一個事實 + 我的感覺 + 第二個事實 + 我的命令）

在 1947 時，"我恐怕這是條大船，我們需要採取行動" 。（同樣的感覺再次強調 + 第三個事實 + 同樣的命令）

除非三副是一個石頭，他會做些事情，而不是被他自己的感覺所吞噬，對他自己說話。

好了，這並不容易，讓一個乙級船員去做他的主張。錯的！我們只需要好好練習，如何加上你的感覺，越多越好，對於表露情緒有障礙是好的，即使是吞吞吐吐，這可以強調，你對成為這一個團隊的熱情跟熱心，跟你的**“仗義”**。另外一個在人為因素領導統禦訓練裡面的術語，代表的意思是**“把別人的希望當作你的義務”**。別人的希望裡，當然包括本船的安全跟他自己的性命。

3-48 Practice assertive on your opinions? Add your feelings

Back to the scene with new skills,

- at 1939 hours: there will be a collision I am afraid *if not complying to the rules that* I must oblige.
  (my feeling + one question + command)
- at 1946 hours: *Charlie is passed,* I am afraid *the CPA is ... zero.* A little to starboard*?*
  (first fact + my feeling + second fact + my command)
- at 1947 hours: No, I am afraid *a big vessel.* we need action now.
  (same feeling again + third fact + same command again)

Unless 3/O is a rock, he will think about doing something or talking to you rather than absorb in his own feeling and talking to himself. Well, this is not easy for rating to assert. Wrong. You only need to practice to include your feeling as often as possible. Stumble at showing emotion is very good which can emphasize your enthusiasms to be part of the team and your **Accountability**. Another term in HELM training which means “Take other’s wish as your obligations”. Other’s wish must have included the safety of ownship and his own life.

Chapter 3: Situational Awareness for Junior Officer

3-09 雷達瞭望的資源管理

3-49 長峰水晶輪船員所說的故事

2018 年 1 月 24 日在調查委員會的見證下，這兩條船航行資料記錄器 VDR 被下載，作為調查的依據。這是在上海四方的代表都同意，長峰水晶輪的資料紀錄只有下載 4 個小時，因為在事件發生的期間，資料被覆寫了。相對的桑吉輪的航行資料記錄器有 58 個小時的資料，在上海被下載。所有的碰撞情況，在長峰水晶輪的部份，都顯示在他們的口述裡，都是沒有航行資料記錄器的證據。

3-09 Resources management of Radar lookout

3-49 The story told by CF Crystal Crew

On 24 January 2018, under the common witness of the parties, the investigators completed two ships’ VDR downloading in Shanghai. Agreed by delegates from all four parties, only 4 hours of CF CRYSTAL’s VDR data was downloaded because the incident period data was overwritten. About 58 hours data was downloaded from SANCHI’s VDR.

-all situation of collision are shown as CF Crystal seaman’s statement without VDR evident.

3-50 對這個世紀航運界的潛在威脅

約 1942 時，長鋒水晶輪航向 225 度，航速 13.2 節。這是對地的航向航速，因為現在的資料來源，大部分來自于衛星的定位。 桑吉輪大約是在 3.1 海浬，方位 205 度的方向，當值船副發現桑吉輪是由唯一的自動識別儀資料，它的 CPA 變成 0.4 海浬，他認為這是一條小船，沒有碰撞危機。這時間是大副班，他並沒有去看桑吉輪的雷達回跡，只是由 AIS 在左舷雷達的信號顯示，決定桑吉輪的 CPA。

- 目標：桑吉輪大約 3.1 海浬，方位 205.3 度。這是採取行動的距離，對讓路船來講，當值船副的義務，是要確認目標的性質與大小，在這個距離，不容許自行妄加臆測，利用不充分的資料，擅做假設，不可以用來取代他瞭望的職責。

- 205 度是左舷 20 度的相對方位，因為現在本船的航向是 225 度，當值船副只要抬起頭看一看，目標不會很麻煩的被遮蔽，因為就在船頭附近，他只是心裡想著那是一條小船，沒有碰撞危機，這就是預設立場，擅自假設。
- 這是沒有適當聊望的藉口，你的想法，並不能取代你在航行安全的義務。
- 3 海浬的距離與現行的天候狀況，回跡尺寸並不會被海浪雜斑所遮蔽，這表示大型目標仍然會有比較大的回跡顯示，可以判讀為大型目標，在螢幕上的雷達回跡，請參考圖形 3-05。
- 大副沒有想要使用他的眼睛去檢查目標，是一個缺乏訓練與目視瞭望知識的徵兆。
- 沒有目視瞭望的技術，這是一個航運界的潛在威脅，尤其是在這一個世紀，大家都太過依賴機器，雷達瞭望。這個趨勢會更加惡化，因為學校的教育對當值船副，取代了傳統的現場指導與航海導師，在上個世紀以前所做的傳承，想想以前的船副跟著船長做一輩子，船長不是他舅舅，就是姑丈，船長就是雇傭人，跟著同一個人，學多少用多少，現在的船副跟著外國人的船長，不求最好，只要剛剛好，不會有任何精進，恐怕失傳的更多。
- 桑吉輪的 CPA 是 AIS 目標資料，現在是 0.4 海浬。大副也沒有檢查雷達回跡，桑吉輪這條船隻有使用 AIS 的訊號顯示，在左舷雷達上，就此決定桑吉輪的 CPA 是多少？

此時並沒有任何阿帕的資料，可以使用，並沒有檢查雷達的回跡，只有看到 AIS 資料 0.4 海浬，這是他知道的。這是一個典型的 AIS 瞭望，單一的瞭望。

3-50 Potential threat to shipping industrial in this century

At about 1942LT, CF CRYSTAL's, COG 225° and SOG 13.2 kts. SANCHI was about 3.1 nm x bearing 205°. The OOW found the *CPA of SANCHI's AIS target became 0.4 nm*. *He thought that it was a small vessel without risk of collision. The C/O did not see the radar echo of SANCHI, only by the AIS signal displayed on portside radar determined the CPA with SANCHI.*

⇒ *Target SANCHI was about 3.1 nm bearing 205°*: 3 nm is the action distance for give-way vessel. It is the obligation of OOW to verify the target's type and size in this distance by all means of look-out, not any wide guess (assumptions) can replace his lookout duty.

⇒ Bearing 205° is 20° degrees to port side of ship's course 225° degrees now. It won't be hard if OOW just raise his head and check what target is outside the window even he stand behind the radar screen.

⇒ The reason why he don't want to raise his head is because he has no confident that he can positive identify which one is the target shown on radar 3.1 nm x bearing 205°. (this is a real problem in any lookout duty.)

He thought that it was a small vessel without risk of collision.

⇒ This is an excuse of no proper lookout. Your thought cannot relive your obligations in safety and leave no evidence does you really have thought about this possibility.

⇒ A 3 nm target with small CPA concern should not use just one way to lookout. C/O should use all means like visual or radar or ARPA to cross check.

⇒ In 3 nm range and current weather condition, target echo size had not depressed by sea clutter yet. It means the large target still have bigger echo on screen, please refer to figure 3-05. C/O's thought was an excuse only.

⇒ C/O don't want to use his eye to check target is a sign of lack proper training or knowledge in visual lookout. (In C/O ranking, how astonished he is.)

No visual lookout skill is a potential and popular threat to shipping industrial in this century and this tendency will worsen due to academy education of OOW replaced mentoring at scene in past century.

CPA of SANCHI's AIS target became 0.4 nm.

⇒ The C/O did not check radar echo of SANCHI, only by AIS signal displayed on portside radar determined CPA with SANCHI.

⇒ There are no ARPA data available. C/O had not check on Radar Echo. Only AIS CPA 0.4 nm is acknowledged. This is a typical AIS lookout only. Thus it will develope new collision risk in new generation to come.

3-51 誤認大船為小型漁船

在大約 1943 時，長鋒水晶輪的航向 223 度，航速 13.3 節，三副來到駕駛台接大副班，三副首先檢查海圖上本船的船位，以及附近的海域，然後他使用左舷雷達來檢查附近船隻交通狀況，發現左舷有兩個 AIS 目標，在 3 公分雷達上，（回跡比較小的雷達）。

⇒ 三副利用時間來調整他的夜間視力，先檢查船隻的位置，這條船在紙海圖上面定位，這是優良船藝。

⇒ 左舷兩個 AIS 目標在雷達上，一個目標桑吉輪在左舷方位 20 度，一個是在左舷的 45 度，鄭大嶼這條漁船，請參考圖形 3-06 桑吉輪的雷達畫面

最後的故事：大副並沒有這兩個目標的阿帕資料，而三副也沒有去做擷取的動作。不良的瞭望。

⇒ 為什麼三副跟大副不會煩惱方位 20 度跟 45 度，**在左舷只有 2.5 海浬的目標**，這不是良好的瞭望習慣。這個距離，**就是最需要用來正向確認目標的時候，**尤其是考慮到後續要採取可能的避碰行動。

⇒ 可能是他們已經對這些小型漁船，很有經驗，就像桑吉輪三副說的，如果你不回答，或是不要理他，他將要被迫採取行動，讓他自己能夠脫身。在中國沿海，包括臺灣海峽，漁船在搶船頭是常態，搶的過就過，搶不過經常會自行掉頭轉向或停車避讓，對於常跑東南沿海的船員，跑了幾年都會有些麻痺。對於很少回到遠東區域的遠洋船員來講，就會有很大的心理壓力，讓這些小漁船去自生自滅，就是在這一個案件裡面潛在的原因，跟碰撞的潛在因素。

⇒ 我們沒有長鋒水晶輪在 1944 時的雷達畫面，因為沒有航行資料紀錄，如果我們參考桑吉輪雷達畫面，在圖形 3-06 可以看到目標回跡，以長峰水晶輪來說，在 2.5 海浬的距離，回跡比較小，即使他是一個 225 米的船隻。

⇒ 目標的回跡變得比較小，海浪雜斑的抑制功能，減弱了大型船隻的回跡強度，就跟減弱海浪的回跡一樣。

這裡有一個很大的問題，我們必須要小心檢討。誤認大船為小型漁船，調查報告裡面並沒有，（長鋒水晶輪在 1944 時的）雷達畫面或航行資料紀錄，如果我們參考桑吉輪 3 公分雷達的畫面，在圖形 3-06 可以看到目標的回跡，長鋒水晶輪在 2.5 海浬的距離遠，即使他是一個 225 米長的船隻，目標的回跡，因為海浪雜斑的抑制功能，變得太小，就像漁船一樣大。**這個就是大船讓當值船副船誤認為小船的關鍵**。雷達的設計不良，不能清楚地顯示目標正確的尺寸，所以以後目標應該要用船隻的符號來代替，加上我們前面討論過的花開效應，在多少距離遠，就應該要佔有一定的水準夾角，在一海浬遠的水準夾角 20 度，要大於 2 海浬遠的水準夾角 10 度，這些都是可以使用軟體程式的計算，加以顯示克服的議題。

3-51 Mistook big vessel as small fishing boat

At about 1943LT, CF CRYSTAL's GPS position was 30°52'.3N / 124°59'.0E, COG 223° and SOG 13.3 kts. The 3/O came up to take over watch from C/O. *The 3/O first checked on paper chart of vessel's position and surrounding sea room in the chart room. Then he used portside radar to check traffic condition and found two portside AIS targets on X-band radar (small echo Radar).*

⇒ 3/O use the time needed to adjust to night vision to check ship's position on paper chart first. This vessel had fixed her position in paper chart. Good seamanship.

⇒ *two port side AIS targets on the X-band radar*: one target SANCHI at bearing 20^0 degrees to port. Another 45^0 degrees to port side (fishing boat ZHEDAIYU 03187). Refer to Figure 3-06 of Sanchi's radar.

⇒ last story: C/O had not acquired echoes of these two targets in ARPA and 3/O did not acquire either. Bad lookout practice on board.

⇒ Why 3/O and C/O did not worry about target bearing 20 degrees and 45 degrees to port side at distance of 2.5 nm? No knowledge or skill needed.

⇒ Because they have experienced with small fishing boat before as SANCHI 3/O said

- "*But if you don't answer (or don't care), he shall be forced to take action to make himself clear.*"

It is in this mindset that cause the collision.

⇒ Here has one big problem reader have to examine carefully: mistook big vessel as small fishing boat.

⇒ We did not have CF Crystal radar picture at 1944 hours at hand as no VDR records available. If we refer to SANCHI X band radar picture as Figure 3-06 we can see the target echo is relatively small for CF Crystal at 2.5 nm distance away even he is a 225 meters vessel.

⇒ Target echoes became smaller due to sea clutter function depressed big vessel echo to same amount as sea wave echoes.

⇒ It is also relative to echo's size in where it located on radar screen. That is to say same size vessel's echo displayed on radar screen is smaller when their distance to ownship is decreased. This is "Anti-Blossom Effect" on radar screen.

⇒ This is exactly the reverse phenomenon of visual lookout's "Blossom Effect" where target's horizonal angle getting wider as they close to ownship.

⇒ This "Anti-Blossom Effect" on radar screen is because same 360 degrees displayed on one NM range ring is much smaller than same vessel echo displayed in 5 NM range ring although their horizon angle is the same.

在大約 1944 時，長峰水晶輪的航向 225 度，航速 13.3 節，三副認為桑吉輪是一條漁船，由 AIS 的符號來判斷，這裡沒有雷達的回跡，而且沒有碰撞的危機。所以報告上面怎麼說？沒有雷達回跡，當三副最需要他們的時候，我們不能說這是三副的錯，這是他第一眼看到的雷達畫面，雖然來船距離已經很近了。這是雷達製造商或是聯合國海事組織安全委員會的錯，因為並沒有想辦法方法來克服這種困難。
需要系統化的觀測，才能夠瞭解左舷桑吉輪真正的情形，這是避碰規則 7。
這時沒有碰撞危機，這個不是事實。整個航運已經接受雷達的限制，然後在海上冒著自己生命的危險在航行，所以一個當值船副應該要做些什麼？而不只是單純的接受有缺陷的雷達。
設定左舷 3 公分雷達的距離範圍到 12 海浬，然後右舷的 10 公分雷達距離到 6 海浬。

At about 1944LT, CF CRYSTAL's COG 225° and SOG 13.3 kts. *The 3/O thought SANCHI was a fishing vessel by the AIS symbol (there was no radar echo) and there was no risk of collision.*

⇒ what he said? *there was no radar echo* when 3/O need it most. We cannot say this is 3/O's fault as this is his first look at Radar although the distance is close. It is radar manufacturer's fault or IMO safety committee fault for not find a way to overcome this.

⇒ In this generation, radar can easily identify vessel's size by AI logarithm and replace radar target display from graphical varying size of echo into fixed target shape which can avoid Anti-Blossom effect on radar.

⇒ 3/O needs systematic observation to get the real picture of SANCHI as rule 7.

⇒ *there was no risk of collision*. This is not truth. Whole shipping industrial had accepted this limitation of radar and risk their life at sea. So, what an OOW have to do more than just accept?

⇒ Set Port side X-band radar's range scale on 6 nm to detect small vessel, while starboard S-band radar on 12 nm to detect large vessel.

3-52 探測小型目標

雷達具有不同的波長，與不同的滲透跟反射的性質，3 公分電波的波長比較接近較小的雨滴跟雪花的尺寸，使用 3 公分雷達波探測小型目標，比較容易被海浪與雨雪雜斑所遮蔽，**所以要探測小型目標：**

⇒ 我們應該使用 10 公分雷達來探測小型目標，尤其在近距離，因為回跡的尺寸會比較大，比較不會被雨雪海浪雜斑，蓋過目標反射波的強度。

⇒ 在惡劣天氣，10 公分的雷達滲透海浪的能力強，使得他們對探測小型目標，較為合適。

⇒ 當值船副有需要降低探測的距離到三海浬，這樣做的目的是放大回跡在螢幕上面的尺寸，或是離心顯示讓 5 海浬的目標，可以被顯示在船頭前面。

⇒ 當值船副設定雷達的顯示模式，當在本船附近有些小型目標，速度向量線跟回跡，都應該設成相對運動模式。

⇒ 尤其相對運動尾跡的設定，當值船副可以看一眼，就可以立刻知道碰撞危機。請看圖形 2-19 雷達回跡在三海浬的尾跡顯示

⇒ 使用相對運動模式，本船可以注意到哪一個目標，有碰撞危機，用電子方位線來設定目標的真方位，以監控目標方位變化。請看圖形 3-01。

3-52 For smaller target detection

Different wavelengths of electromagnetic radiation have different penetrating and reflection properties. X-band radio wave length is 3 cm which closer to smaller rain and snow size than 10 cm radar (S band radar). Because of the smaller wavelength, X Band radar wave is more sensitive to small target and more easily blocked by sea/rain clutter. **So, for smaller target detection:**

⇒ **We shall use S Band 10 cm radar to detect smaller target at close range** due to its echo size is bigger and rain or sea clutter won't deteriorate target reflection quality.

⇒ 10 cm radar penetration capabilities through rain and sea allow them to detect small target through heavy weather more easily.

⇒ OOW will need to reduce detection range to 3 nautical miles (to enlarge echo size on screen) or off centered to allow 5 nautical miles ahead for smaller target.

⇒ When OOW set up radar presentation mode for small targets around ownship, target speed vector and trail should set to relative motion. In relative mode, we can verify collision risk by checking which target relative motion vector is pointing to ownship.

⇒ Especially with relative bearing trail setting OOW can read collision risk by one look immediately. See figure 2-19: RADAR ECHO WITH 3 MIN TRAIL PRESENTATION.

⇒ With relative motion mode, ownship can beware which target has collision risk by using Electric Bearing Line EBL to set up target's true bearing line to monitor target's bearing change. See figure 3-01.

3-53 對遠洋船隻的探測

⇒ 我們應該使用 3 公分雷達去探測大型船隻，而且只觀測大型船隻，利用降低本船雷達的增益設定，用來消除所有的小型船隻回跡，在雷達螢幕上，大型船隻具有較強的回波，將會留在雷達螢幕上，這是雷達觀測課程的第一課，如何確認目標的技術。

⇒ 3 公分雷達的電波雖然沒有那麼強有力的回波，對於 200 300 公尺長的船隻，這不是問題。

⇒ 雷達這樣對大船的探測調整，應該由有經驗的當值船副來操作，因為每條船不同的雷達性能，與雷達的廠牌也不一樣。

⇒ 如果這些設定調整，已成為例行的實務，在船上當值船副可以使用馬克筆標出“增益”，“雨雪雜斑”所需要設定的刻度，好讓其他的當值船副知道，觀測大型船隻的時候，最好的調整設定是多少。

⇒ 當小型目標的回跡在 3 公分雷達上面被消除掉後，當值船副可以設定阿帕的功能，去“自動擷取”，這樣可以讓當值船副立刻知道大型船隻的動態，只要當大船進入到我們雷達探測的範圍。

⇒ 目標船可以被阿帕自動擷取，它的速度向量線，會自動顯示在雷達螢幕上，我們可以立刻做雷達瞭望，來核對碰撞點，碰撞距離與碰撞時間。

⇒ 這是一個省時又不會誤事的實務，節省當值船副忙著應付小型船隻，在避讓時的時間，在 10 公分雷達螢幕上。

⇒ 3 公分的雷達螢幕上，小型船隻的回跡比較小，相對於 10 公分的雷達，所以我們使用 10 公分雷達，在近距離來放大小型船隻的回跡尺寸，就是這原因。

3-53 For ocean going vessels detection

⇒ We shall use X band radar to detect big vessels only by reducing ownship's radar "Gain" setting so as to eliminate all small target's echo on radar screen by reducing Gain setting level.

⇒ Big vessels with strong echo strength will remain on Radar screen even when all small vessels' echoes had disappeared. This is first lesson in Radar observation class. Target identification skill.

⇒ The radio waves produced by X Band radars although they are not so powerful, but for a 200 or 300 meters vessel it is not a problem.

⇒ X band radar setting for big vessels detection should be achieved by experienced OOW on board due to every vessel has different radar performance and manufacturer.

⇒ If this setting become a common practice on board, OOW can mark "Gain" and other relevant sea/rain clutter setting scale on radar equipment with mark pen to facilitate relieving OOW to know preferred setting for big vessel detection.

⇒ When small target echo are not seen on X band radar, OOW can set ARPA function to "Auto Acquisition" to give OOW immediate warning of big vessels coming inside our Radar range.

⇒ When targets are auto acquired by ARPA their speed vectors will show on screen for our Radar lookout to check collision point, distance and time.

⇒ This is a time saving and unfailing practice to detect large target when OOW is busy with small targets avoidance in S bans Radar screen.

X band radar has smaller echo on screen than S band radar so we use S band radar in close range to enlarge small vessels' echo on screen. This is the reason.

3-54 使用“增益”來做目標識別

⇒ 雷達的增益控制，是調整接收波的放大比例。如果增益的控制設的太高，這時螢幕顯示充滿了雜音跟回波，目標的回跡，就會被這些雜波雜斑所遮蔽。

⇒ 也有可能把增益設的太低，直到所有的雜音與目標的回跡，都通通消失，這是過猶不及。

⇒ 理想的增益設定，操作者可以看到些微的雜訊回跡在螢幕上，這樣可以避免好的回跡被抑制掉，雖然這是相對的比較性。

⇒ 借由監控雜音回波在螢幕上的顯示，當值船副可以對現在的氣象狀況，可以有一回饋。當值船副設定的增益，應該讓海浪的回跡在螢幕上，出現一點點，如果這些雜波增多，他就知道海浪變大了，如果海浪回跡通通消失不見了，那他就可以知道現在的海浪是變小了，所以原來的設定，海浪抑制是太大了，增益控制可以開大一點，以便小型目標不會被海浪雜斑遮蔽。

像這樣子，當值船副可以保持與海浪大小稍微同步，雖然海浪回跡會蓋過小型目標的回跡，這是避免不了的，我們能做的是，**只要目標回跡的強度比海浪回跡大，我們希望能夠在雷達螢幕上看到。**所以我們的調整策略，就是抑制海浪回跡的強度，讓小船能從海浪雜斑裡識別出來。

⇒ 小船的回跡強度比海浪回跡更低的船隻，那我們就是無力，也是無法從海浪回跡裡面分辨出來，就只有放棄。

⇒ 目標的回跡強度也是忽隱忽現，這是因為反射波強度，隨著船體的波浪運動，反射的角度隨時在變，有時候很好回波很強，有時候反射的角度，又會把回波反射到天空去，我們就沒有看辦法在雷達天線上，接受到他的回波。

因為回波強度的不穩定，**所以在雷達上看見目標的定義是，雷達天線回轉比 6 次，其中有三次在同一個地點出現回跡，叫做雷達上面的看見。**

⇒ 這跟我們眼睛看見不一樣，我們眼睛看見，主要是目標的光線強度比背景燈光強，眼睛可以區分出來，就是看見。

⇒ 雷達上的看見呢，是比回跡出現的次數，6 次裡面有 3 次顯示在雷達螢幕上，就算看見，這是雷達瞭望的實務。

⇒ 現在阿帕訓練呢，很難講是不是還有提到這麼仔細的看見，而不是光顧著，教我們如何操作機器。

即使是非常有經驗的當值船副，他們還是有可能在雷達上，測不到小型目標，尤其是海象惡劣時，小型目標在浪裡面起起伏伏，也就是在浪頭上時雷達探測的到，等他降到穀底，整條船船體高度就消失在海浪之間。

這就是海上的危險，因為雷達設備的限制所引起的。幸運的是，我們現在可以收到主動性的資料回報，由 AIS 自動識別儀目標船主動發出的信號，來解決這個困難的狀況。

自動識別儀在航行中，要保持開啟的狀態，這是海上人命安全公約的要求，

也是我們自身安全的保障。

3-54 Radar target identification with GAIN

⇒ Radar target identification is mostly accomplished by using varied “Gain” setting level.

⇒ The Gain control adjusts the overall amplification of echo.

⇒ If Gain control set too high the screen display will be full of noise and targets all disappear inside.

⇒ It also have the possibility to set Gain too low until all of noises and targets disappear at all.

⇒ The ideal Gain setting level is the operator can see a little noise echo on the screen to avoid smallest target be depressed.

⇒ By keep monitoring noise echoes on radsar screen OOW can have a feedback of weather condition at scene.

When OOW has set the Gain to let sea clutters appear a little on screen he may know the seas has getting rougher by increased sea clutters on screen. If the sea clutters disappeared from radar screen at all he will know that seas have getting calmer now.

⇒ If one echo seems to stay in one place 3 times out of 6 antenna scanning round, this echo is considered as a target. This is the radar observation practice.

⇒ Even most experienced OOW they still have possibilities that small target undetected in Radar especially the sea state is very rough when small target is up and down inside the sea wave.

⇒ This is perils at sea caused by radar equipment limitation.

⇒ Luckily, we have AIS reports received from target to help the difficult situation with Radar in rough sea.

The AIS system should keep operating during underway by SOLAS requirement.

3-55 控制增益的強度，來搜尋小型目標

⇒ 如果要尋找小型目標，利用增益的控制，需要降低海浪雜斑的抑制，從抑制的最大值（最小的雜音程度）也就是沒有海浪雜斑在螢幕上的顯示，這個操作就是先把所有的回波，不管是船隻還是海浪，通通都關掉，把它抑制到最低，然後慢慢的減低抑制，讓海浪回跡在螢幕上重新出現，並加大雷達回波的增益。

⇒ 回跡如果停留在同一位置，六次天線掃描裡面，有 3 次停留在一個位置，而不是跳來跳去，就是一個可能的小型目標。

⇒ 使用 10 公分 S BAND 雷達來探測所有的小船，近距離的可能目標。這個目的就是讓小型的目標，在近距離，利用 10 公分雷達的回波強度比較強的特性，讓小型目標的回波與海浪雜斑的回波，做出區分，能夠被本船收到。海浪回波被 10 公分雷達接收到的頻率，也比較低。

⇒ 小型目標還需要借助它的尾跡幫忙，來加以監控，因為目標的回跡，可能忽隱忽現，他的尾跡雖然也是同樣的忽隱忽現，但是這幾個回跡點，會排成直線，代表他的可能位置，這樣子使得我們對目標的辨認，更為容易一些，真的風浪大的時候，我們應該把尾跡的長度設的長一點，可以收集更多的雷達回波，在一固定的時間範圍內，協助碰撞危機的探測。這是我們在第二章圖形 2-19 裡面討論過的。

⇒ 如果小型目標的數量太多，我們應該減少螢幕上的顯示距離，集中注意力在近距離的目標上。

現在的大型船，都有第三部的雷達，所以如何利用這第三部的雷達，來重複核對這些小型的漁船目標，現在這些第三部雷達，都是裝在船頭，所以呢過去對於這些雷達的反射波角度不好的，都比較不成問題，也沒有受到我們駕駛台視線盲區的限制，同樣也是適用于駕駛台雷達天線也有探測盲區，波浪裡面的船隻，在船頭雷達不受盲區的限制，回跡比較容易顯示。

⇒ 有效的雷達瞭望，對小型船隻的探測，應該連同目視瞭望的技巧，而不是使用另外一部雷達去重複核對，像我們已經知道目視瞭望的好處，是直覺性的，反應更快。

⇒ 如果我們用另外一部雷達去重複核對，我們看了一部雷達，才確認一條小型船隻的回跡，到底方位距離是多少等等，我們這個確認的時間動作，如果是熟練的話也許是 1 分鐘的時間，（短期記憶已滿），如果再用另外一部雷達來核對，你同樣還要再花上一分鐘的時間，很可能你得到的資訊，還是斷斷續續不連續的，（短期記憶已超載）。

⇒ 不要忘記，小型船都是在近距離，時間非常緊迫，所以可能的話，應該是一部雷達的資訊，加上我們目視瞭解的方位距離等等，來協助瞭望，這樣可以節省更多的時間。

⇒ 要不然兩個雷達的資料不一致的時候，你甚至會懷疑，應該要使用哪一部雷達的資料？

⇒ 用兩部雷達去重覆核隊船隻動態，這個是在能見度不好的時候，不得已的選項。**但是如果眼睛能看得到目標，當值船副就要充分利用，目視瞭望的優勢，**這個我們前面討論過了。

3-55 Control Gain in searching mode to detect small target

⇒ If searching by Gain control is to reduce Gain from Maximum to minimum noise level (when no sea clutters appear on screen) then increase Gain from a little we will see some sea clutters re-appear on the screen.

⇒ Any echo that seems to stay in one place rather than flicker around (wave echo is not stable) is a possible target.

⇒ Use 10 cm (S band) radar to detect all small and possible target in close range.

⇒ Small target is easy to handle within 6 miles range setting.

⇒ The purpose is "Not to leave small target unseen at close range on 10 cm radar."

⇒ Small targets can be monitored by her trail at the same time.

⇒ Set trail longer can help identify small target radar echo and collision risk detection as figure 2-19.

⇒ If small boats number are too many reduce range on screen to concentrate on closer target.

How to double check small fishing boat by extra third radar?

The effective of radar lookout for small target should accomplish by visual lookout not another radar as we already know what good in visual lookout. Luckily, these days big vessels have third radar at fore mast to help detect close range small target. By its location in fore mast this third radar can scan in better angle to avoid the sea clutter coming in horizontal direction and radar blind area forward. OOW should made best use of it if fitted whether it is an X band or S band Radar.

3-56 使用增益控制來搜尋大型目標

使用 3 公分 X Band 雷達探測大型目標的目的是，找出長距離不受雜斑干擾的目標。

⇒ 我們比較在近距離的小型目標，大型目標的航向航速，不會任意改變，我們希望可以得到早期的警報，不要等到最後一刻，已經沒時間來避碰的時候，才發現它的存在，就像這一個案件。

⇒ 大型目標的探測距離，應該設在 12 海浬，增益設定應該是在最低的水準，甚至於消除掉所有小型船隻與海浪雜斑回波在近距離的顯示，小船就在我們附近，可是在這一部 3 公分雷達上面，我們不希望它顯示小船的回跡，我們要單純化我們的畫面，只有大型船隻動態的顯示，只有回跡強度夠強的目標，我們會讓它留在螢幕上。

⇒ 這樣做的原因，是因為我們要把阿帕設在自動擷取的模式，自動追蹤測繪大型船隻，對當值船副太忙於對付小型船隻的操控，也就是正在避讓小船，就像桑吉輪呢，要處理鄭大嶼這一條漁船，而他的碰撞點隻早於長鋒水晶輪兩分鐘。

⇒ 在瞭望的時候，**最危險的處境就是近距離誤認大船長峰水晶輪為一小型的漁船**，原因呢？很簡單，撞了漁船呢，本船並不一定會沉沒，一旦撞上了大船，本輪所有的生命財產，都沒有保障，這是最基本的生命安全守則。

⇒ 所以阿帕的自動擷取模式，與自動警報模式，在 3 公分雷達上的設定，對有很多漁船與小船的情況下，對本船是一種安全的保障，如同圖形 2-19。

⇒ X BAND 雷達在這個模式下使用，要可以不必煩惱小型目標，專心於取出大型目標，自動擷取測繪大型目標。

⇒ 永遠不要忘記分配一部雷達來幫助阿帕的自動擷取功能，自動擷取大型船隻，與自動發出他們的碰撞警報，減少對海員的生命致命性的錯誤，可以節省自己的麻煩。

圖形 3-13 目視瞭望與雷達瞭望，都沒辦法突破強降雨

3-56 Control Gain in searching mode to detect large target

Using 3 cm (X band) radar, the purpose is to detect large target at longer range without interfering.

⇒ The range setting should be 12 nm (early warning as COLREG required) and the Gain setting is in lower level only to eliminate all small targets and sea/rain clutter at close range even we know its presents, **only strong echo (large vessel) should remain on screen.**

⇒ The reason to do so is for ARPA to set on auto acquisition mode to track large vessel automatically if OOW is too busy on small fishing boats maneuvering like SANCHI is handling ZHEDAIYU 03187 when he also has collision point two minutes ahead CF Crystal.

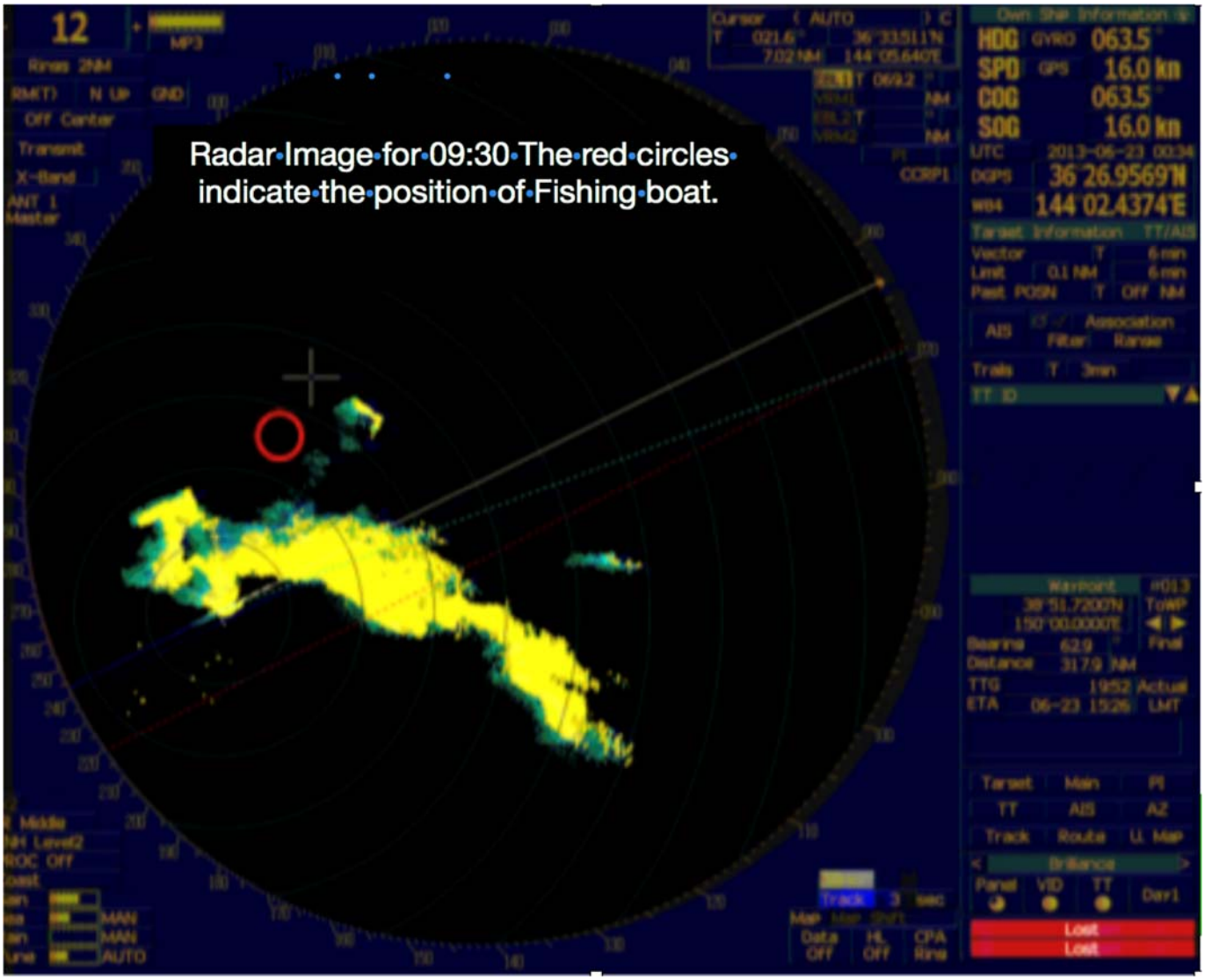
⇒ When Sanchi have two radar to detect collision risk separately. 3/O will not confuse CF Crystal as a small vessel.

⇒ **The most dangerous situation in lookout is mistook big vessel (CF Crystal) as a small fishing boat.**

⇒ APRA automatically acquired mode and automatic collision alarm in 3 cm radar with only big vessels on screen is a safe guide in multiple fishing ships situation like Figure 2-19.

⇒ **X band radar use in this mode do not need to worry about small targets but pick up large target automatically.**

⇒ Never forget assign one radar to help ARPA auto acquisition mode in big vessel (as their collision is fatal to seaman's life) to save your trouble.



圖形 3-13 目視瞭望與雷達瞭望，都沒辦法突破強降雨

3-10 盲目航行的幫助：AIS

3-57 案例探討：強降雨中無法探測到目標的碰撞

碰撞時間是在 0944，與一條 19 噸的漁船發生碰撞，這可能是三副無法注意到其他船隻或是漁船，雷達的畫面收不到漁船的回跡，因為雷雨所造成的影響，同時漁船跟雷雨胞一起移動 15 分鐘之後，是以同一方向接近本輪。

⇒ 在大約 0930 的時間，當船隻進入濃厚的雲層，能見度因為降雨開始惡化，船頭的桅杆在 30 米之前，只能勉強看到，三副停止了目視瞭望，開始利用 2 號雷達瞭望。

⇒ 因為降雨，漁船在雷達畫面上，無法被看到，而且沒有自動識別儀的資料顯示，三副心想附近沒有其他船隻，因為他們在大洋中航行，沒有向船長報告能見度受到限制，維持原來的航向航速，沒有釋放音響信號，就是能見度受限制的霧號。

⇒ 強降雨在熱帶區域，像新加坡海峽，巴拿馬運河區域是常見的現象。

⇒ 在強降雨的區域附近航行，當值船副應該將這些雷雨胞，當成是潛在的碰撞危機。

⇒ 使用兩部雷達去探測目標，大船要用發射功率比較小的 3 公分雷達，相對的小型船隻使用近距離的 10 公分雷達。

在這類意外事件發生之後，具有下列這些共同的因素，

1.他們發生在公海上和開闊水域
2.它們是商船跟漁船的碰撞事件，在開闊水域。
3. 商船配置有自動識別儀，漁船並沒有強制去裝設 AIS，而且沒有這項設備。根據海事調查報告，由日本運輸安全局所發佈，從 2009 年 1 月到 2013 年 1 月最少有 10 件碰撞，其中的商船無法探測到漁船，雷達探測不到漁船的存在。

3-10 Blind sailing's help: AIS

3-57 Case study: Collision inside heavy showers without detected anything.

Collision time 0944 hour with 19 tons fishing boat.

It is probable that third officer can not notice other vessel (fishing boat) because screen of the No. 2 radar did not have fishing boat echo as a result of the rainfall. In figure 3-13, Also fishing boat is approaching in same direction as the heavy rainfall until 15 minutes later.

⇒ As Vessel A had entered thick rain fall area at around 09:30 and visibility had deteriorated due to heavy showers of rain so bow mast approximately 30 m ahead could barely be seen, Third Officer stopped keeping watch by eyesight and began keeping watch by No. 2 radar.

⇒ Because fishing boat could not be seen on radar display due to rainfall reduced the radar echo of it and no information displayed from automatic identification system (hereinafter referred to as "AIS"), the Third Officer thought no other ships around as they were sailing in the middle of the ocean, did not report to Master that visibility was restricted, and maintaining same course and speed without conducting audio signals (fog signal) in restricted visibility.

⇒ Heavy rain fall is common in tropical area like Singapore strait or Panama Canal area.

⇒ Navigate near the heavy rain fall area OOW should treat these rain clouds as potential risk of collision.

⇒ *Use two radars to detect possible big vessel with small gain X-band radar and small vessels with close range in S-band radar.*

After occurrence of this accident, these accidents had following points in common.

1. They occurred on open sea.
2. They were collision accidents between merchant ships and fishing boats on open seas.
3. Although merchant ships were equipped with AIS, fishing boats were not obligated to be equipped with AIS and did not have this equipment.

Furthermore, according to Marine Accident Investigation Reports released by the Japan Transport Safety Board from January 2009 to January 2013, there were at least ten collision accidents in which a merchant ship was not able to detect the fishing boat by radar.

3-58 AIS characteristics useful for preventing collision

According to the Marine Accident Investigation Report of the prior accident, it is probable that AIS has the following characteristics that are useful for preventing collision accidents.

1. The influence of rain and waves to AIS is less than radar, making it easy to obtain information such as the position of other ship.
2. While detection ability of radar is affected by factors such as the size of the other ship because it captures reflected radio waves, because AIS emits radio waves on its own, its detection ability is not affected by the size of ships.
3. Compared to the detection distance of small ships by radar, simplified AIS*10 can also stably send and receive information such as ship position from a comparable distance (more than approximately 4.5 NM) between ships. Radar detection range for small fishing boat is subject to weather condition especially sea and rain clutters. In good weather condition, the report said 4.0 NM fishing boat could be detected.

4. It can send and receive information of ship name and ship type which cannot be obtained from radar information.

3-59 在交班前對窗戶外的目標再做最後一次的觀測

在大約 1945 時，長鋒水晶輪航向 223 度，航速 13.4 節，桑吉輪大約在方位 205 度，距離 2.0 海浬。大副收到船長打來的詢問電話。

在大約 1946 時，長鋒水晶輪的航向 225 度，航速 13.4 節，大副交班給三副，大副說交通情況是清爽，並沒有告訴三副其他船隻的情況。

⇒ 大副並沒有最後再觀測駕駛台外面的情況便離開，這是一個不好的實務。

⇒ 大副說交通狀況是清爽的，這不是事實。

⇒ 大副並沒有說明其他船隻的狀況，是對現在的情況沒有概念，瞭望時他被其他海圖室的作業所束縛，並沒有看到桑吉輪的燈光信號，然而有了三副的同意，大副離開了駕駛台。事實上，大副要走，三副很少會攔阻，這是船上的權力結構問題，只有大副的主動負責能解決，一般來說，如果大副與三副不同國籍，情況更嚴重，這時不同國籍的三副，會借助他本國的ＡＢ，來協助他接班的問題。

⇒ 三副並沒有看到燈光訊號，也沒有看到閃光的信號，大副沒看到，值班 AB 在這麼近的距離，也沒有看到。

⇒ 每一個人都在駕駛臺上，但是眼睛看不到，心不在焉，沒有警覺的瞭望。

⇒ 過了一下子，三副的瞭望來到駕駛台接班，前一班的瞭望告訴他，航向是穩定在 226 度，是自動舵行駛後，離開了駕駛台。

⇒ 公司可能沒有要求值班 AB 交接的程式，是否應該對他所觀測到的交通狀況，在他交班的時候，做一個交接。

⇒ 駕駛台瞭望只有提到航向 226 度，跟舵機的自動舵設定。

⇒ 船隻外部的交通情況，並沒有交接給接班的 AB。

⇒ 一條大船在近距離，當值人員甚至於沒有危機感，當瞭望在駕駛台並沒有其他的職務，只需要專心瞭望。

這就是人為因素領導管理訓練的另外一個主題。

3-59 One last look outside the window before hand-over

At about 1945LT, CF CRYSTAL's COG 223° and SOG 13.4 kts. *SANCHI was about 2.0 nm bearing 205°. The C/O took a call from the Master.*

At about 1946LT, CF CRYSTAL's COG 225° and SOG 13.4 kts. *The C/O handed over the watch to the 3/O and he said the traffic was clear and did not tell the situation of another vessel.*

- C/O did not take one last look outside the window. What a bad practice.
- C/O said the traffic was clear: This is not the truth.
- C/O did not tell the situation of other vessel: he has no idea of current situation. His lookout is interrupted by other errands in chart room.

The 3/O did not see the signal of SANCHI. Then with the consent of the 3/O, the C/O left the bridge.

- 3/O did not see the signal (ALDIS): No other man saw this flash signal, no C/O, No AB in this close range.
- Everybody is absent minded at bridge, no awareness (lookout) at all.

Shortly after the departure of the C/O, the 3/O's lookout came to the bridge to take over his watch from previous lookout who advised him of the steady course 226° and autopilot condition before leaving the bridge.

- company may have no procedures to ask duty AB report what traffic he noticed during his watch.
- ship's OOW did not ask lookout to pass on traffic situation *before leaving the bridge*.
- previous lookout at bridge only remind the course 226° and autopilot setting.

- No outside traffic hand over to relieving AB.
- No sense of danger even one big vessel in 2 nm is approaching when lookout has no other errands on bridge like chief mate.
- So, this is another topic of HELM training need to address.

3-11 你在做什麼，你卻不知道

3-60 為什麼要推給權威

因為權威人士有比較好的位置，他的知識，專業與可信度，可以提供一個公平公正的決策。這是我們從一個小孩子開始的習慣，當我們還沒有能力，知道什麼是對的？什麼是錯的？任何東西我們抓到手裡，就會把它放到嘴裡，不管接下來的後果是什麼？這叫口腔期，從兩個月大就開始了。完全靠我們父母親的叫喊，來幫助我們決定，什麼是對的？什麼是不能吃的？經過這麼長長大的過程，我們習慣于聽從同事，朋友跟我們的上級，替我們做決策，我們受的教育，是希望給我們能力去分辨什麼是對的？什麼是錯的？黑白是非分明，是我們追求的目標。真實的海上，是非對錯永遠是一個迷霧，我們永遠不知道太陽有多遠？有多大？或是有多熱？甚至於太陽是什麼東西？大多數時候，我們不會去追究這些疑問，要求解釋，只是讓權威替我們做決定，這是一個習慣，我們過去生命經驗所養成的。當在駕駛台做瞭望的工作的時候，AB 只是交給當值船副處理，不論當值船副在做什麼？他是不是很忙？或是目標已經多近了，全部都仰賴他自行觀測，自行決定，當然也依靠他的決策。這是他的班，他要去做船隻的辨識。

我作為一個舵工，只要負責操作舵機，不是瞭望。當值船副是一個航行當值權威人士，他要負責瞭望，不是我。

當然在駕駛台，這樣是不健康的。每一個人在瞭望，都推給權威，乙級船員可能不能維持一個良好的瞭望，因為他們的語言限制，尤其是在遠東的國家，AB 只會變成一個手操舵的機器而已。這樣船長只能禱告，並且希望當值船副不會打瞌睡，無論如何是公司或是船長，都應該確保任何的船隻動態，只要接近本船，都要立刻報告，這是當值瞭望應該要有的海員常規，駕駛台操作程式，或者需要透過船長的值更命令簿，來對乙級船員做出瞭望的要求。

3-11 What you are doing without knowing

3-60 Why Refer to Authority?

Because the authority is in better position—based on his knowledge, expertise and/or accountability—to render an equitable and just decision. Ever since we were a small baby, we did not have any ability to know what is right or wrong. Everything we grabbed we just put into mouth no matter what consequence will have. It is by the sound of our parent to help us decide what is good or bad to eat. We grow up by following our parent, teacher, friends and our superior at work to make decision for us. Our education wants to give us the ability to distinguish what is right or wrong. The real sea is always a mystery to us. We never know how far is the Sun? How big? How hot? What inside the Sun? Most of the time, we just leave these questions to authority to explain or decide for us. Refer to authority is a habit out of our past life experiences.

When doing lookout job in bridge, AB just refer to OOW no matter what OOW is doing and how close target vessel is. It is his watch, OOW's watch. I am quarter master only who is in charge of steering only, not an official lookout. OOW as an authority has watch keeping license to lookout, not me. It is not healthy at bridge if every lookout refers to authority. The ratings may have very limited ability to keep up a good lookout duty due to their language restriction especially in Far East nationalities. The AB will become a hand steering machine only. Captain can only cross his finger and hope OOW won't fall into sleep at night. Anyway, Company and Captain should ensure that reporting of any traffic of vessels close to ownship is a must-be in their watch keeping practice by bridge procedures or Master Standing Order for rating.

3-61 瞭望接班前，錯過了些什麼

在大約 1947 時，長峰水晶輪航向 226 度，航速 13.5 節，瞭望提醒三副桑吉輪的 AIS 信號的 CPA，在雷達上是 0.2 海浬。當值船副也注意到這個目標，並且認為他是一條小船，這是碰撞前 3 分鐘。

⇒ 這一個瞭望比前一個瞭望好，因為當值船副是三副，可能需要更多瞭望的協助。

⇒ 瞭望看到桑吉輪 AIS 目標，在雷達上面的 CPA 大約是 0.2 海浬，這是使用 AIS 瞭望而已，這是所有船員能做的事情，只要他願意提供協助，因為只要看雷達螢幕上面的數字變課以報告，實際是否危險與如何決策，還是由當值船副來做決定的。

⇒ 這個調查報告同時也指出，瞭望並沒有對雷達目標，做視覺上的接觸，這就是沒有用眼睛去確認。瞭望並沒有提到這個目標是大船？或是小船？因為大家都是看著雷達而已，儘管天候狀況非常好。

⇒ 視覺接觸的重要性，尤其是在近距離，這在第二章 2-10 解釋過。

⇒ 瞭望遺失了目視報告的 1 個大重點，前面有一條大船。

⇒ 三副聽到這個字，“大船“他也許會有一些太空船的情境警覺，請看圖形 3-07。

連同使用主張，如果瞭望在狀況內，那有效的溝通應該是有如下述：

“三副，這有條大船，在我們前面，CPA 0.2 海浬，我恐怕會撞船。”，這有一個無法否認的情緒，加上 3 個事實，1.有大船，2.在船頭，3. 0.2 海浬。

⇒ 當值船副同樣在雷達上觀測到這個目標，並且認為是一條小船。這是一個先入為主的想法，這不應該是當值船副的態度，當值船副不必做任何的猜想，去用眼睛確認，在雷達螢幕上看到的是什麼？對我們來講，應該是一種習慣，在做決策的過程中，如果他很少使用到目視瞭望的技巧，正確的方法應該是看看窗戶外面，在這麼近距離的情況下，因為目標現在的雷達距離，也只有兩海浬遠，為什麼眼睛就不能看？

⇒ 如果三副想要確認目標，使用雷達的回跡來確認，在 1.5 海浬近距離的目標是不容易的，就像我們在桑吉輪的雷達畫面上面所看到的，1.5 海浬的近距離雷達回跡，沒辦法分辨大小船隻，請看圖形 3-09。

⇒ 最佳的方法就是。當他們剛上駕駛台的時候，所錯過的實務，往駕駛台的窗戶玻璃外面，去瞭望去確認。

3-61 What lookout had missed before take over?

At about 1947LT, CF CRYSTAL's COG 226° and SOG 13.5 kts. *The lookout reminded the 3/O that the CPA of SANCHI's AIS target on radar was around 0.2 nm. The OOW also observed the target by radar and thought it was a small vessel.*

- This lookout is better than last one because OOW is 3/O who may need more help than Chief.
- Lookout said the CPA of SANCHI's AIS target on radar was around 0.2 nm: Once again, this is AIS lookout only which can be done by any crew who is willing to help.
- This report also indicate lookout did not have visual contact with this radar echo. Lookout said nothing about this target big or small.
- **Visual contact is important for close range target is explained in chapter 2-10.**
- One big point lookout had not reported. This is a big vessel ahead.
- When 3/O heard this word "BIG" vessel he may have some situational awareness of space ship status as figure 3-07.

Together with Assertiveness if lookout is in situation, the effective communication should be as follow:

"3/O, I am afraid there is a Big vessel -ahead of us -CPA 0.2 nm." (one undeniable emotion, three facts)

- *OOW also observed the target by radar and thought it was a small vessel*: the preoccupied thought is not seamen like. OOW don't need to do any guess.
- He needs to verify what he had seen on Radar.

- The thought came out reflect the truth it is a habit of decision-making process which 3/O seldom used visual lookout practice.
- The correct way is to look outside the window in this close range now.
- If 3/O want to make sure target size by radar echo now, it is almost impossible for 1.5 nm close range target as we can see in SANCHI's radar picture in figure 3-09.
- The best way is what they had left behind when they just arrived the bridge" look out the window" to ascertain.

3-62 驚人的錯誤容許值：阿帕系統 CPA 是 0.5 海浬

在大約 1948 時，長峰水晶輪航向 226 度，航速 13.5 節，AB 提醒當值船副，有一個目標的 CPA 是 0.1 海浬。

⇒ 為什麼三副沒有望向窗戶外面？為什麼瞭望沒有望向窗戶外面？這個理由是一樣的，原因是一樣的，訓練不足。這就是電動玩具世代的悲哀，或是模擬機世代的悲哀，嘗試錯誤變成常態，沒有導師在我們的事業中，可以討論，商量，精進自己的技術。

⇒ 您的資淺船副到船上工作，可能來自不同的國籍，從不同的國籍的船長跟大副那裡，也得不到任何實際可用的指導，除了公司的通告的指示。

⇒ 為什麼在這麼近的距離，0.75 海浬 1300 公尺遠的一條 274 米的大船，就在船頭附近，CPA 在 AIS 上面是 0.1 海浬，185 公尺的距離? 大家會沒看到。

⇒ 185 公尺只是兩條船的駕駛台間的距離，實際上的船身距離，碰撞早就已經發生。

⇒ 也許許多的當值船副，並不知道一個阿帕系統的功能，應該是在 3 分鐘的時間，穩定的追蹤一個目標的動態後，使用下列的準確度容許值（95%的可能數值），CPA 小於 0.5 海浬就可以，這是聯合國決議案 A.8 23（19）。還有 5%的機率，CPA 可以大於 0.5 海浬。如果回跡不穩定，忽隱忽現，誤差值可以更大，或是算不出 CPA，都不算系統的錯誤，航運界都可以容忍。

⇒ 這個決議案的意思，是在經過 3 分鐘的計算，使用阿帕系統計算的 CPA，可以有 0.5 海浬的誤差容許值。**實際上目標的 CPA 如果少於 0.5 海浬，就是在誤差容許值內，就是會碰撞**，這是因為阿帕計算的錯誤容許值。

⇒ 185 公尺只是 50 公尺的小船，長度的 3 倍，就算是對小船來講，這樣的 CPA 也是不安全的。

⇒ 最重要的雷達瞭望，在近距離天侯不好的時候，也是毫無用處，當目標回跡經常會遺失，或是因雜斑的干擾，或是跟海浪混在一起，計算的 CPA 就會完全錯誤，或是遺失在波浪裡，這是沒有解救的方法，在阿帕或是雷達的系統上。

我們認為雷達的缺陷是無法接受的，這需要用其他的方法來確保我們本身的安全。

3-62 Amazing error allowance in ARPA system: CPA = 0.5 nm

At about 1948LT, CF CRYSTAL's COG 226° and SOG 13.5 kts. *The AB reminded the OOW the CPA of one target was 0.1 nm.*

- Why 3/O did not look out the window? Why lookout did not look out the window? The reason is the same: lack of training.
- This is the sadness of TV game generation (or simulator generation). Try and error is the norm. No mentor to consult in their career.
- Every year Junior OOW join the vessel to work with different nationality Master and Chief who are also far from receiving anything practical to use beside company's circular.
- Why in this close range 0.75 nm = 1300 meters with a very big vessel= 274 meters long ahead, CPA of AIS give a 0.1 nm =185 meters clearance? Is this 185 meter distance enough for two vessel's bridge?

- Maybe many OOW did not know: An ARPA should be able to present within three minutes of steady state tracking the motion of a target with the following accuracy values (95% probability values) with CPA calculation error within 0.5 nm is acceptable by IMO Resolution A.823(19).
- This resolution means after three minutes tracking the CPA calculated by ARPA may has 0.5 nm error.
- 185 meter is three times more for a 50 meters vessel length over all which 3/O considering is safe for small vessel.
- Radar lookout is useless in close range where target lost or interference or target swap with no remedy can be provided.
- Radar deficiencies are not acceptable which need other means to ensure our safety.

3-63 最後一分鐘的轉舵，對他的航向改變，沒有作用

在 1949 時。這是碰撞前 1 分鐘，長鋒水晶輪的航向 226 度，航速 13.6 節，瞭望再一次告訴當值船副，AIS 目標的 CPA 是 0.1 海浬，但是他也不知道，螢幕上的目標就是桑吉輪，然後當值船副要求他的瞭望，將自動舵改為手操舵模式，並且下令右舵，卻沒有明確的舵角指示，這又是一個心力不濟，三副知道要向右轉，但是不知道要向右邊轉多少度，所以舵令又再亂下，瞭望向當值船副報告，當舵角到達右舵 20 度。在大洋上讓船，舵角 20 度是警急時用的。

⇒ 瞭望警告當值船副，但是仍然看不到桑吉輪在哪裡？這個當值船副做對了一件事情，把自動舵改為手操舵，當他聽到瞭望報告 CPA 大概是 0.1 海浬，但是仍然沒辦法確認桑吉輪是在哪裡？跟怎樣的狀況？

⇒ A B 操舵到右舵 20 度，三副沒有下令，如果他對操舵的舵工，使用右滿舵，也是合理的。這是下一章，我們要討論的主題，使用多少舵角來避碰。

⇒ 長峰水晶輪已經是在太空船狀態，已經到了碰撞前 3 分鐘之內，碰撞已是無可避免，也無法避免，現在這一時間，碰撞前 1 分鐘，只用一分鐘的時間，用在右舵 20 度，對於轉向是毫無功用。

這時船頭不會轉動，當碰撞發生時，長鋒水晶輪的航向是 22 6 度（跟 8 分分鐘前一樣），桑吉輪的航向是 358 度（這是跟 20 分鐘前一樣），這兩條船船首向的交角，226 度跟 358 度，跟他們兩個的碰撞角度 Angle of Blow ，都是完全一樣，這兩條船在碰撞前，沒有任何轉向的效果。雖然有回報操舵，這個跟船上損害的調查報告，結果相符，兩條船就是直接撞上去。

圖形 3-14 桑吉輪碰撞 4 天后的一月十號空拍照

3-63 Wheel over at last minute has no effect on her heading change

At about 1949LT, *CF CRYSTAL's COG 226° and SOG 13.6 kts. The lookout reminded the OOW again that the CPA of the AIS target was 0.1 nm, but not aware that the target was SANCHI. Then the OOW asked his lookout to change the autopilot to hand steering and ordered to steer starboard rudder without giving a specific rudder order. The lookout reported to the OOW when the rudder angle was starboard 20.*

- the lookout warned OOW again but still cannot see where is SANCHI.
- the OOW did one thing right "*change the autopilot to hand steering* " and "*ordered to steer starboard rudder* " after he heard what lookout had said about CPA is 0.1 nm but still cannot make sure where and what situation SANCHI is now.
- the AB steered the rudder to "Starboard 20" even without the order of 3/O. If he is more competent in lookout he will know the emergency which will make "hard Starboard" also reasonable. This the topic of next chapter.
- CF Crystal is already in space ship status. Collision is inevitable now. Only one minutes in Rudder order of Starboard 20 has no effect in turning. Vessel's bow did not turn in any way within one minute.

When the collision occurred, CF CRYSTAL was heading 226° (same as 8 minute before), and SANCHI 358° (same as 20 minute before). The cross angle of these two heading 226° and 358° is same as angle of blow about 48°. *This was consistent with the damage inspection of both vessels.*

圖形 3-14 桑吉輪碰撞 4 天后的一月十號空拍照

3-64 碰撞後主機的停車

在大約 1950 時，長峰水晶輪的船頭撞上桑吉輪的右舷，介於桑吉輪的第二艙與第三艙右邊的壓水艙，穿過貨油艙，以 48 度的角度插入碰撞，造成長峰水晶輪船頭的嚴重損傷，甲板的邊緣，在第三艙之前的變形，後續發生的火災，長峰水晶輪的左舷甲板跟部分的甲板設施損害。碰撞之後，長峰水晶輪的船長立即沖到駕駛台，把俥鐘拉到停車的位置。

碰撞之後，船長停止主機的出力，可以減少船頭水壓，減少海水的進水率，這是正確的行動，同時可以保護本船的主機，避免負荷過重。

3-64 "Stop" main engine after collision

At about 1950LT, *CF CRYSTAL's bow struck the starboard side of SANCHI between her No.2 and No.3 starboard ballast tanks and breached her cargo tanks with the angle of blow at about 48° degrees. The collision caused severe damage to CF CRYSTAL's bow and deformation of her main deck and hatch covers forward of No. 3 cargo holds. The subsequent fire caused damage to CF CRYSTAL's port side bulwark and partial deck facilities. After the collision, the captain immediately rushed to the bridge. The telegraph was pulled to "Stop" position.*

- After the collision, the captain "Stop" main engine can reduce the ingress rate of sea water into both vessels is correct at that moment, also to protect ownship's main engine from overload.

3-65 碰撞之後，震驚反應或碰撞程式開始

在 1951 時，長鋒水晶輪船長在 VHF 頻道 16 做了“MAYDAY“的遇難呼叫，而且將車鐘拉到全速倒車的位置，提到他發覺情況已經太危急，無法去備份航行資料記錄器的資料，然後他發佈了棄船的命令，全船船員稍後從船隻的尾部自由落下救生艇逃生，而被漁船鄭大嶼號救起。

⇒ 碰撞之後，震驚反應已經開始，長峰水晶輪的船長做了 MAYDAY 遇難呼叫，因為船頭的部位發生火災跟爆炸。

⇒ 將車速拉到全速倒車的位置，是他船長做的，三副可能在震驚之後，無法動彈，（90%的人受到這樣的打擊後，開始頭腦一片空白）

⇒ 全速倒車的車鐘，這樣嚴重的碰撞之下，也許並不正確。主要考慮是保全其他的船隻或本船免於沉沒，避免船隻破洞大量進水，但是也要避免本船陷入火災與爆炸，是同樣的重要。

⇒ 應該考慮的還有其他的現場的狀況，天候海象的情況，和火勢的大小，無論如何儘量救助其他遇難船隻的船員性命，這是優良傳藝，船長基本常識與職責。

這麼多年以後，大家可能忘了，SOLAS 對商船的保障是，一個貨艙破裂，船隻應該有剩餘浮力，不致沉沒。如果是重大碰撞，可能會一次破兩個貨艙，這項規定，對船隻就沒有保護。因為我們不在現場，所以這些就不能只憑個人好惡，只能談些基本的概念。

⇒ 沒有備份航行資料紀錄器資料是錯誤的，航行資料紀錄器的裝設要求，是在 SOLAS 公約的第 5 章 20 節，2002 年 7 月 1 號開始生效。

⇒ 船員被漁船鄭大嶼號所救，漁船就是讓桑吉輪在 1940 到 1945 時分心的船隻，他向左轉讓過桑吉輪的船尾後，馬上回頭來提供人員的救援。

⇒ 桑吉輪的船長，沒有時間施放通用警報器來警告其他的船員，沒有借由棄船部屬，施放小艇來拯救船員的性命，船長可以做事的時間只有三分鐘，災難來的太快，船員不可不防。

⇒ 所有常峰水晶輪的船員被鄭大嶼號救起，所有桑吉輪的船員都犧牲了。

⇒ 不論是長峰水晶輪，或任何一位船長船員，在碰撞之後，都可能會產生，一些或對或錯的行為與後果。

3-65 After collision, shock reaction or collision procedures should begin.

At about 1951LT, *the Captain of CF CRYSTAL made a "Mayday" call on VHF channel 16 and pulled the telegraph to "Full Astern" position, mentioning that he found the situation too emergency to realize about backing up the VDR. Then he gave abandon ship order. Later the crew were evacuated through the free fall lifeboat on the stern of the vessel and rescued by the fishing boat ZHEDAIYU 03187.*

- After collision, the shock reaction already begins.
- the Captain of CF CRYSTAL made a "Mayday" call: because fire and explosion experienced at ship’s bow.
- Pulled telegraph to "Full Astern" position by himself. 3/O may not be mobile after shock (90% people may have this shock reaction or blow / blank in head).
-"Full Astern" engine: May not be correct after this heavy collision to preserve another vessel from sinking but in this case fire and explosion at other ship it is important to prevent ownship from fire.
- No backing up VDR: the carriage requirements for voyage data recorders contained in the revised SOLAS regulation V/20, which had entered into force on 1 July 2002.
- rescued by the fishing boat ZHEDAIYU 03187: this fishing vessel distract SANCHI at 1940-1945 hours had turned around quickly to render his assistance to crew. How sad that SANCHI master have no time to sound general alarm to alert all crews and do boat station to save crew lives through abandon ship.
- All crews in CF Crystal were rescued by ZHEDAIYU 03187. All crews in Sanchi are failed.
- CF Crystal or every master may do something right or wrong after the collision.

3-66 航行資料記錄儀 VOYAGE DATA RECORDER (VDR)的船東與資料回收準則

- .1 收回航行資料儀的資料應該在意外發生之後，立刻進行來最佳的保留相關的證據，作為調查與船東的使用。因為事故調查，非常不可能在事件發生之後，就有立場來處置航行資料儀，採取這樣的行動，尤其是在意外之後，是船東的責任，一定要負責通告他的屬船，或是在船上的值更命令簿上明確規定，來確保及時的保存這些證據。

.2 棄船的時候，尤其是在緊急時，船長應該在當時時間跟其他職責許可下，採取必須的步驟來保存航行資料儀的資訊，直到他能夠交給調查員。

所以在這裡我們就知道，

- 備份航行資料儀的資訊，應該在事故發生後執行，越快越好。
- 船東要確保他船隻的當值命令簿，有做出相關規定，及確保及時保存這些證據，這是船東的責任。
- 緊急時船長應該在時間及其他的責任許可之下，採取必要的步驟來保存航行資料儀的資訊。

3-66 GUIDELINES ON VOYAGE DATA RECORDER (VDR) OWNERSHIP AND RECOVERY

- .1 Recovery of the VDR information should be undertaken as soon as possible after an accident to best preserve the relevant evidence for use by both the investigator and the ship owner. As the investigator is very unlikely to be in a position to instigate this action soon enough after the accident, the owner must be responsible, through its on-board standing orders, for ensuring the timely preservation of this evidence.

.2 In the case of abandonment of a vessel during an emergency, masters should, where time and other responsibilities permit, take the necessary steps to preserve the VDR information until it can be passed to the investigator.

- So in here we know:
  - Recovery of the VDR information should be undertaken *as soon as possible after an accident.*
  - *the owner must be responsible, through its on-board standing orders, for ensuring the timely preservation of this evidence.*
  - In the case of *abandonment of a vessel during an emergency, masters should, where time and other responsibilities permit, take the necessary steps to preserve the VDR information.*

3-67 但是創傷後遺症必須克服

創傷後遺症是任何的意外事件發生後，對原船，人員與貨物運作的安全，造成威脅。結果就是，個人的高強度情緒障礙，心理跟生理的壓力，干擾到他們出事後的工作能力，無法採取適當的運作。創傷反應後，阻礙駕駛台當班的正常工作能力，包括：

- 降低注意力跟記憶力：失去短期記憶，不知道現在的航向是多少？
- 迷惑與神智不清：不能集中注意力於任何事情，不知道多少的航向，火勢會燒到駕駛台？
- 恐懼，焦慮以及驚惶：在震驚之後，身體冒冷汗，不能呼吸，眼睛看不到，耳朵聽不見。
- 震驚：對於已經發生的事情，感到漠然跟混淆，沒辦法做任何事。
- 感覺遲鈍：兩腿不聽使喚，沒辦法走到雷達前面。
- 暫時失明：因為眼壓太高，眼前一片白光。

- 持續的警戒：在事件之後，感覺危險，仍然不時的出現。

在創傷之後，一般的行為反應，會讓我們的生命變得不同：

我會冒冷汗並且顫抖，在這樣的事情，我可以告訴你。

畢竟，對一個海員，去刮到本來應該永遠漂浮的船底，在他的照顧之下，是一種不可原諒的罪惡。

可能沒人知道，但是你永遠不會忘記，那就像在心口上的一記重擊。

你會記得，你會夢到，你在夜裡醒來又會想到，多年過後，它仍然使你全身發熱又發冷。

這是約瑟夫康納德在 1899 年寫的“黑暗之心”

一旦壓力的事件過去，你也許會發現自己正在試圖做出合理化的解釋，這些包括會想到：

- 事件為什麼又是如何發生的？這取決於你的知識基礎，你可能永遠也找不到真正的重點，你的解決辦法，就是第一時間就避免這些麻煩：像是早期的避碰行動，就像避碰規則 8 所要求的優良船藝，船東不知道為此花了多少冤枉錢。
- 你又是為什麼及如何被牽涉到的？為什麼你在事前，沒有感到有什麼不對勁。
- 為什麼你總覺得你做的是對的？在事件發生之前，你還有什麼好的選擇呢，但你卻是使用壞的方法來做。
- 是否你現在的感覺，反映出你是什麼樣的人？是不是我的個性有問題？工作習慣馬虎？重要的事情會被我忽略忽視？
- 是否這些經驗會改變你的優先順序，而且是怎麼改的？不好的經驗，會帶來壞的感覺，現在是要再一次檢討你生命中的優先順序。

在碰撞發生之後，自我懷疑是正常的，如果我們不想跑船，終止這個事業，這也是合理的。如果我們想要繼續跑船，任何負面的思想，都會腐蝕掉我們的身體跟靈魂，日復一日。

作者並沒有遇上碰撞，但是碰撞的陰影，跟隨著我這些年，負面的想法，讓我離開海上越遠越好，如果我們能夠擁有更多的技術支援，我們的事業就會更容易在現今的海上存活。如果海上情況變得惡劣，我們也可以簡單的進入狀況，只要多看一眼雷達螢幕，或是窗戶外面。只要我們能關注在速度向量線的交點上，就能夠知道碰撞的位置，離碰撞的距離跟離碰撞的時間，是否有其他船隻接近，只要看著目標船，我們就能夠知道他的水準夾角，距離，相對方位，方位變化與是否有小船在他旁邊。

3-67 But a traumatic experience is there to overcome

A traumatic experience is an sever experience after any event that causes a threat to our crew, ship or cargo safety on board. As a result, a person will experience high levels of emotional, psychological, and physical distress that disrupts their ability to function normally on bridge afterward.

Physical reactions to trauma disrupt our ability to function normally including:

- *reduced concentration and memory*: lost short- term memory like: what the course now?
- *confusion or disorientation*. Cannot concentrate on anything like: don’t know what course we steering now will cause the fire burn to bridge?
- *fear, anxiety and panic*: Sweating a lot, cannot breathe after shock.
- *shock* – difficulty believing in what has happened, feeling detached and confused, cannot do anything.
- *feeling numb*: Unmovable legs at scene: cannot access to radar by walk.
- *Temporally blind* due to high eyes pressure.
- *continuing alarm* – feeling like the danger is still there from time to time after this incident.

Common behavioral reactions to trauma cause our life different afterward:

I. sweated and shivered over that business considerably, I can tell you.

After all, for a seaman, to scrape the bottom of the thing that's supposed to float all the time under his care is the unpardonable sin.

No one may know of it, but you never forget the thump--eh? A blow on the very heart.

You remember it, you dream of it, you wake up at night and think of it--years after--and go hot and cold all over.

(Heart of Darkness (1899) by Joseph Conrad)

Once distressing event is over, you may find yourself trying to make sense of the event. This includes thinking about:

- How and why it happened: depends on your knowledge base, you may never find the key points. Your solution is to avoid the trouble in the first place, an earlier action like good seamanship acted in COLREG rule 8: *Action to avoid collision*.
- How and why you were involved: Why you did not feel anything wrong beforehand?
- Why you feel the way you are doing is right: What option you may have before the incident but you had done in other way?
- Does the feeling you have now reflect on what kind of person you are: Am I wrong in my personality or working habit to overlook such thing so important in the incident?
- Whether the experience has changed your priority, and how: Bad experiences only bring bad feeling. It's time to review your priority in life again.

Self-doubting is normal. After all the collision had happened. If we want to quit this career it is reasonable. If we want to stay on business any negative thought will erode our body and soul day by day. The author did not have a collision. But the threat of collision is always with me. These negative feeling keep me away from the sea as long as I can. If we can have more skill to support our career it would much easier to survive the days at sea. If the situation is getting tough we can easily figure out the situation by one more look whether it is in Radar screen or outside the window. By focusing on speed vectors intersection point we can know collision position, collision distance and time and other vessels near by the collision spot. By looking at Target vessel we can know its horizontal angle, distance, relative bearing or any small vessels around her might cause a second collision case.

3-12 總結資淺船副的情勢感知

兩個三副，一個大副造成不注意的災難。悲傷的是，在這兩條船都不具有目視與雷達瞭望的技術，船員生命的代價，總是太昂貴。如果我們只能用雷達瞭望，至少我們必須要能充分利用它，並且知道什麼時間，我們必須要用眼睛來確認目標。使用雷達要控制增益，要設定固定距離圈，速度向量線的長度，真運動/相對運動的模式，尾跡長度，雨雪雜斑的抑制，搜尋模式的調整，這些瞭望的需求，就像是優良船藝，是熟練的航海家所應該做的，我們應該有信心，去調整雷達的螢幕顯示，使其處於在最佳的性能狀態，而不是讓這鞋畫面不變不動。

1. 要讀出碰撞危機，利用速度向量線，是資淺船副雷達瞭望的基本知識。
2. 要利用目視瞭望，來讀出碰撞危機，是實習船副目視瞭望的基本知識。

我們不應該依賴創傷經驗來幫助我們成長自己的知識，或是增進對危機的感覺。

嚴重的創傷反應是這樣的：

- 在碰撞之後，90%的人會感覺到無法動彈，無法呼吸，在那短暫的時刻。
- 對那些從一開始就在現場的人，他們累積的壓力，會越來越大，然後在最後事件發生的時間點，造成情的緒崩潰。
- 碰撞時，桑吉輪船員的聲音，在駕駛台顯示出，他劇烈的情緒改變。這是不應該的。
- 人類會經驗到不可動彈或無法呼吸，實際上，這是一種殭屍狀態。沒有辦法回應，你在當場當時的命令，或當時的挑戰。
- 如果你是一個船長，在駕駛臺上的每個人都可能進入殭屍狀態，我們要有心理準備。

是否這些船隻有更好的機會來避免碰撞？如果是大副或是船長在當班？

- 桑吉輪的三副從頭到尾都在雷達前面瞭望，但是被雷達的回跡所迷惑，並且 AIS 的警報訊號在雷達上面的顯示，也是斷斷續續。

- 這兩個三副都不希望使用目視去幫助他們的瞭望工作，但是他們兩個都沒有雷達瞭望的技術。
- 阿帕的製造商應該負起責任，對他們無法使用的目標回跡，尤其是在近距離，當值船副最需要的時候，提出來一套解決辦法。
- 是否一套閉路電視系統，用來偵測紅外線輻射，對於這些大型船隻主動發出的熱輻射圖像，可以整合到電子海圖，或是使用阿帕的系統，適當的運算來分辨這些 200 300 400 米的船隻，合併使用 3 公分和 10 公分的雷達，應該也不是一個問題。
- 這些誤導的回跡顯示，在這些雷達畫面裡面，是很明顯的，我們的航運界應該深入關切此事，想出解決的辦法來改善這種情況。

最重要的當值船副對這些雷達和 AIS 的限制要清楚知道，並付出更多的注意力，對於他們每天的當值工作，善用他們的目視或是雷達瞭望。

在下面的章節中，我們會做更多瞭望的探討與披露。

第三章完。

3-12 Summary of Situational awareness for junior

Two 3/O and one C/O bring out this disaster in-attentionally. Sadly, there are no ARPA and visual lookout skill in both vessels. The cost of crew's life is always too expensive to pay. If we are sticking to radar lookout, we should at least good at it and knowing what time we must go get visual contact of target. Using RADAR, controlling Gain, range rings, speed vector length, true/relative motion, trail length, sea/rain clutter in searching mode is a basic requirement through whole watch as good seamanship or prudent navigator should do. We should have confidence to adjust the Radar display on screen into its best performance rather than just leave it untouched.

⇒ To read the collision risk by speed vectors is a basic knowledge for Junior OOW.

⇒ To read the collision risk by visual is a basic knowledge base for Cadet Officer.

We should not rely on traumatic experience to help us to grow our knowledge or sharpen our senses of risk. Acute trauma reaction are: **after collision 90% people experienced unmovable or unlivable at short interval especially for those people at scene from the beginning.** The stress accumulated more and more and finally come to break down. When it collides like SANCHI *the voice of duty crew in bridge which reflected the dramatic emotional changes* is not healthy. People experienced unmovable or unlivable at short interval after the accident is actually in Zombie Status which will make him cannot response to your command at the time if you are a Master then.

Could these vessels have better chance to avoid the collision if Chief or Captain are on the watch? SANCHI 3/O had looked at the Radar all the time. He just confused by Radar echo and interrupted AIS warning signal presented at screen. Both 3/O don't want to use ARPA to help their lookout job. Both of them did not have proper visual and radar lookout skills. ARPA manufacturer should take the responsibilities of their unusable echoes especially in close range when OOW need it most. Could a CCTV to detect the thermos radiation of these big vessels can be incorporated in ECDIS system or through better algorithm to discriminate 200, 300, 400 meters vessel through 3 or 10 cm radio wavelength should not be a problem. These misleading echo presentations are obvious in those figures they copied from VDR in this chapter. Our industrial should look into it and find the remedy to correct this situation. Most importantly **OOW should respect these RADAR or ARPA or AIS limitations and pay more attention to their daily lookout job by visual and Radar**. We will reveal more details to these in the chapters to come.