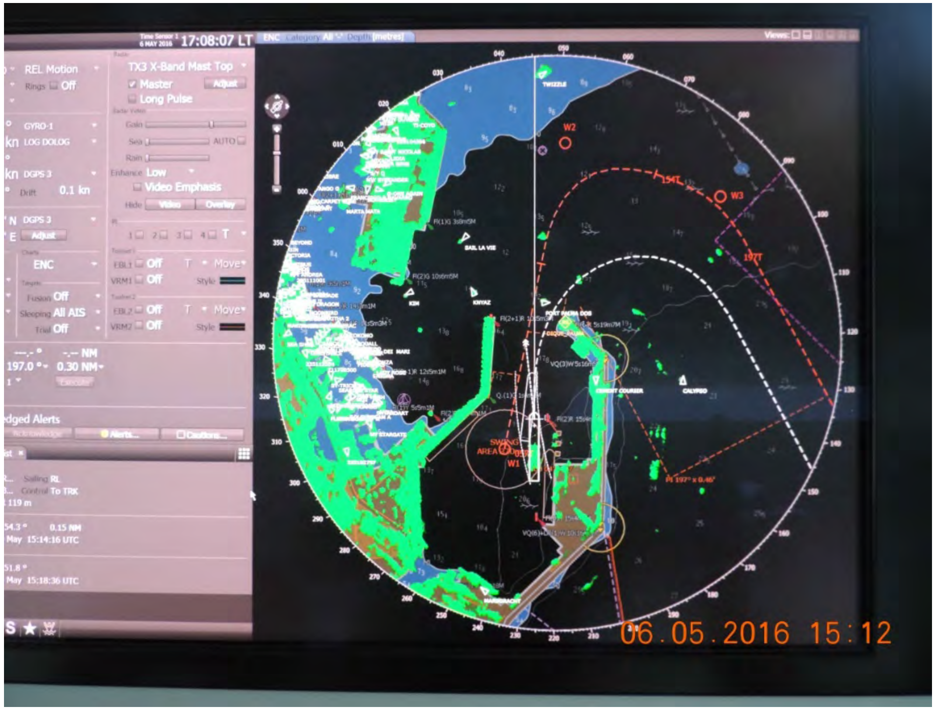
Art to Science……..(or Precision)

Captain Nick Nash, CMMar, FNI

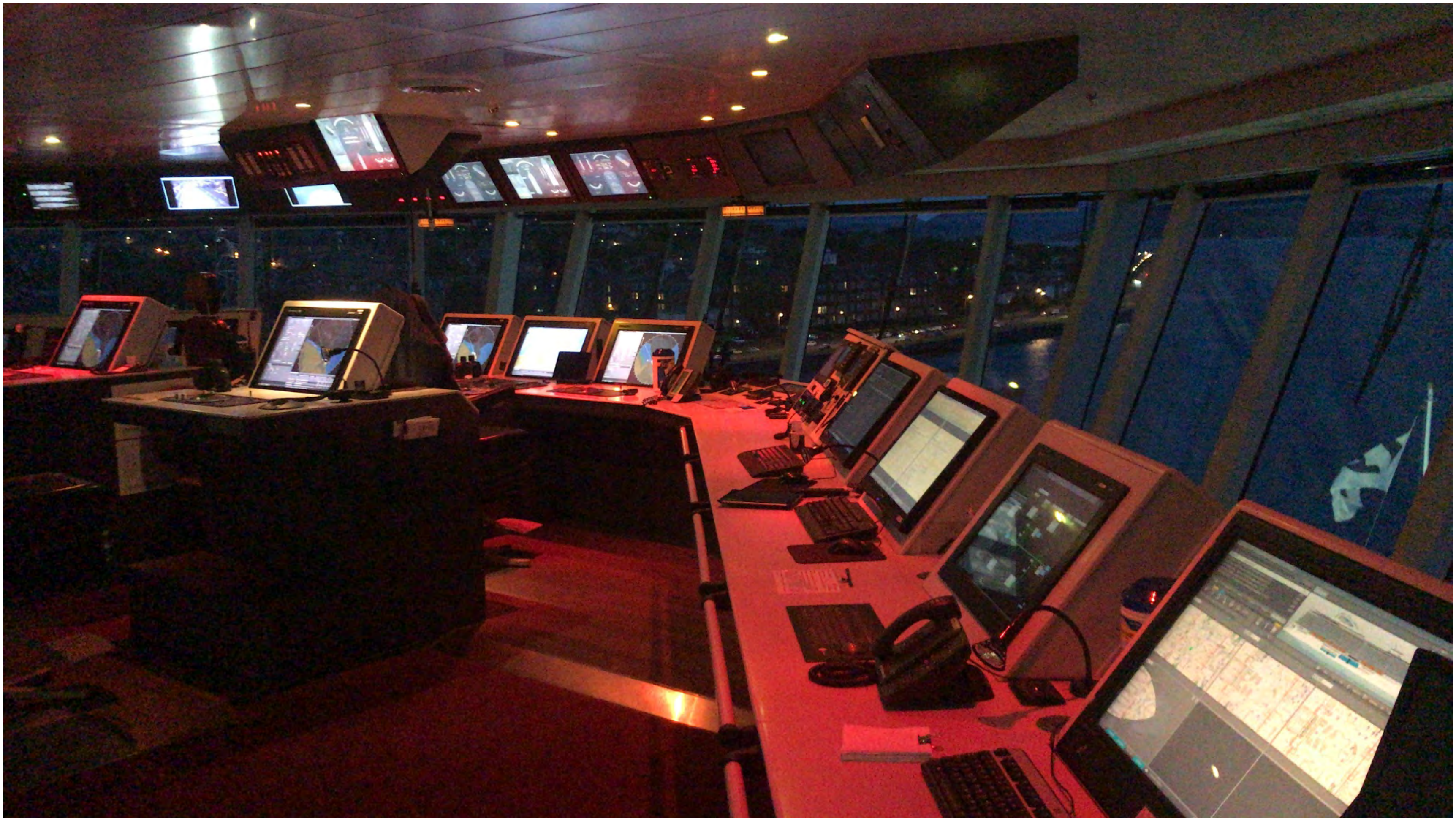


CSMART
Center for Simulator Maritime Training

The Art!

The Science of Precision!

A Modern Cruise ship Bridge

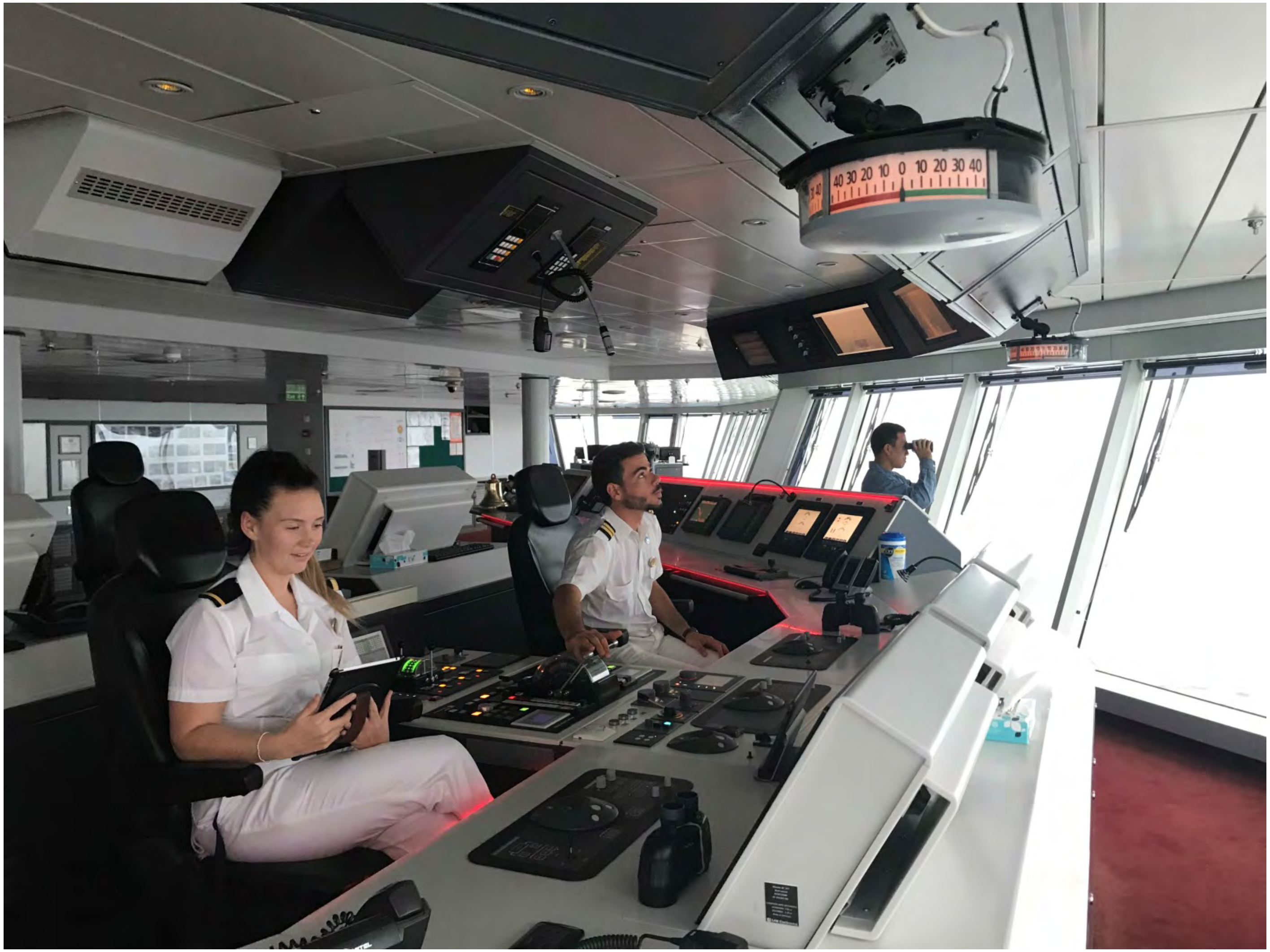


Our Goal?

Pilote dans le cockpit d'un A320 Photo : Guillaume GRANDIN Réf : 22774

Pilot in an A320 cockpit Tous droits sauf publicité / Not for advertising purposes

Instrument Based: Multi Nav Systems: Highly Trained

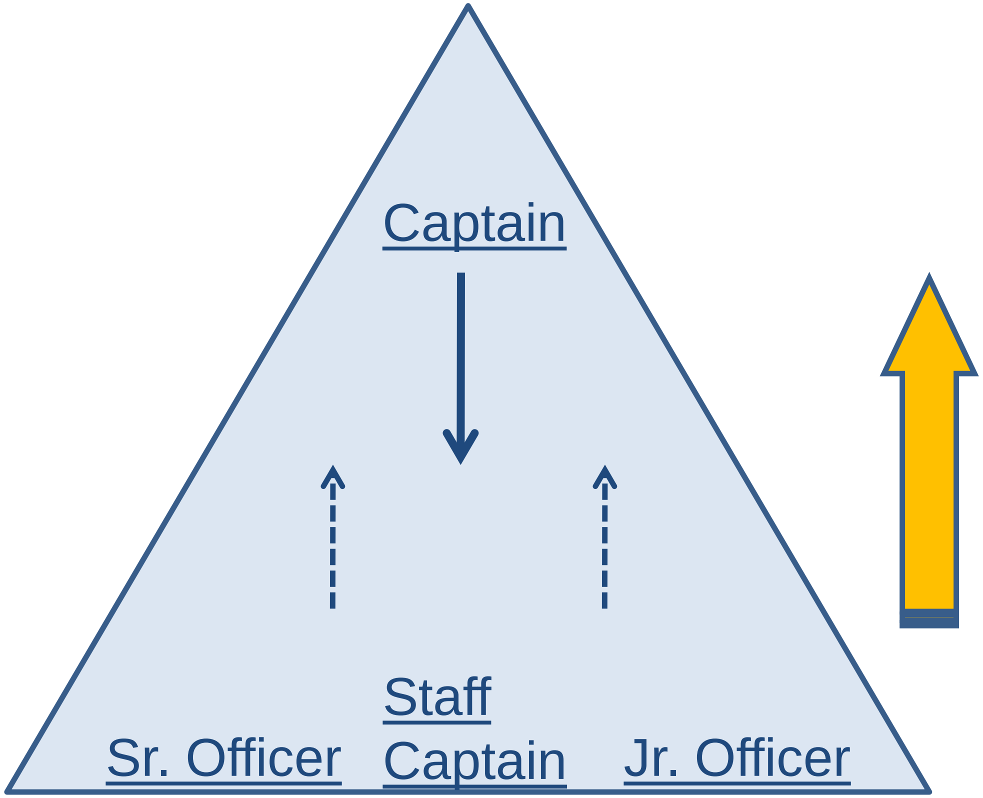


Nearly There - Checklists, Cockpit Bridge,Multi Nav systems – & Training!!

“Instrument Navigators backed up with Visual Clues” – Nick Nash

Traditional Bridge Organisation

Captain as Operator



Captain

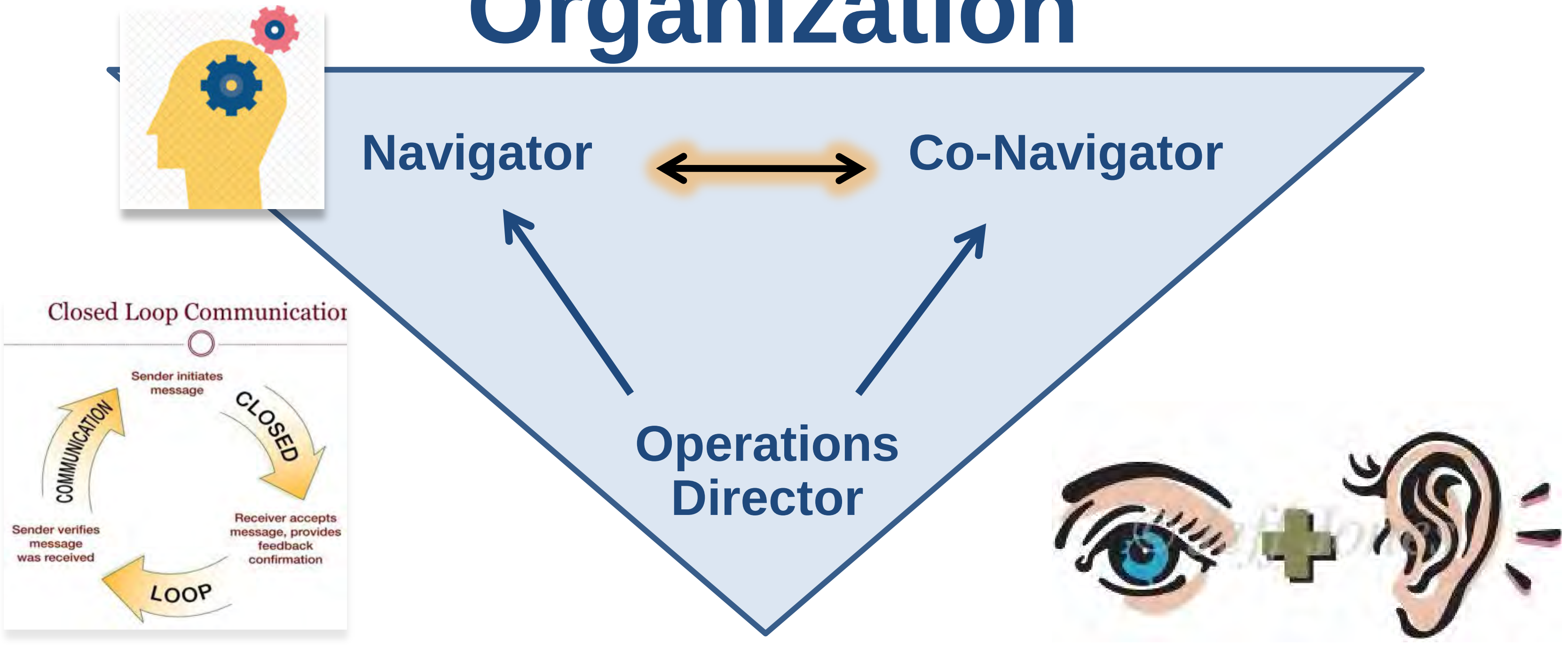
Staff Captain

Sr. Officer

Jr. Officer

Increasing Gap

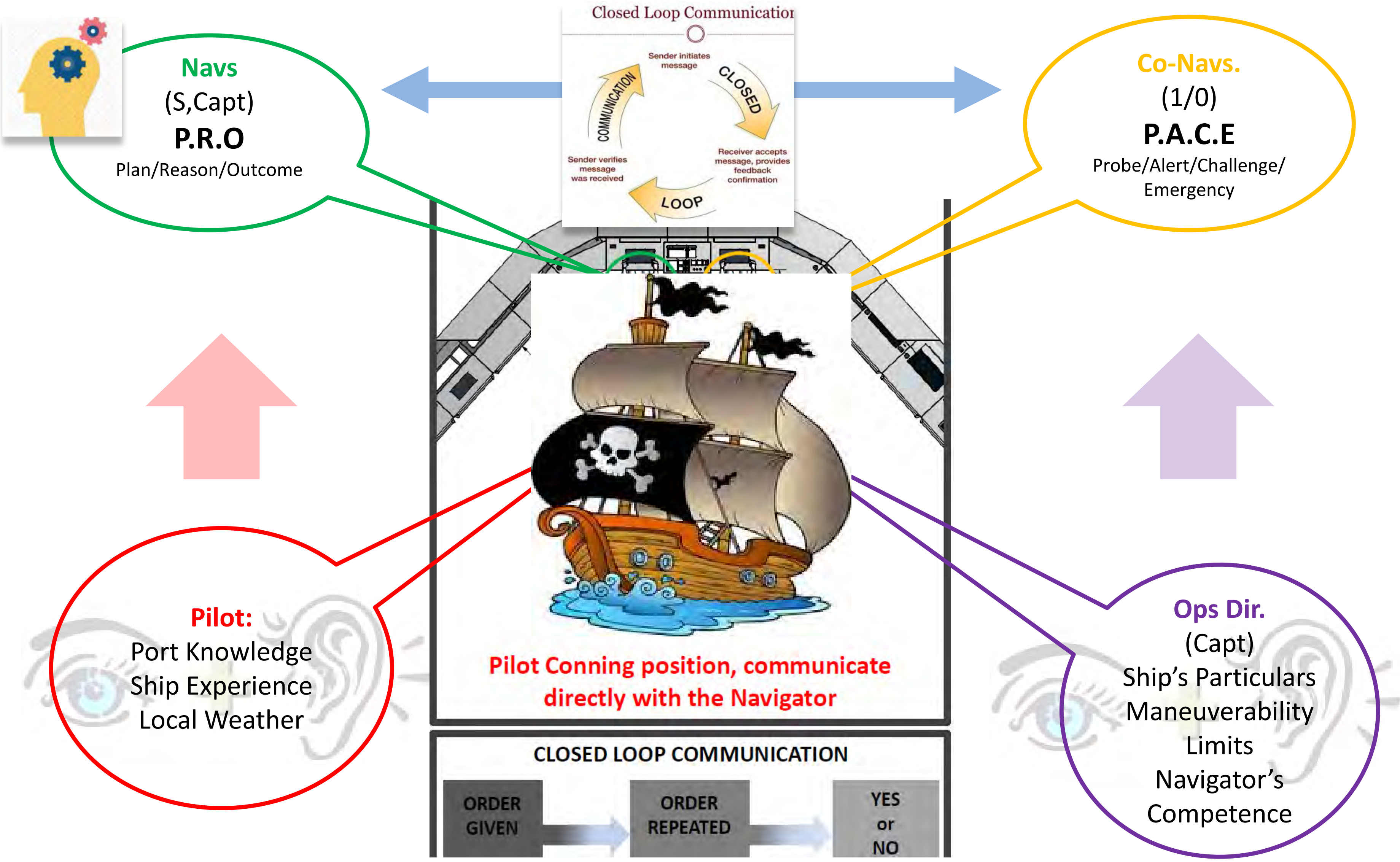
Function Based Bridge Organization



Navigator ⟷ **Co-Navigator**

Operations Director

‘Human Error is inevitable and must be expected at any time and for that reason **we must build a system** that can detect and manage human error before it causes negative consequences’



Navs
(S,Capt)
P.R.O
Plan/Reason/Outcome

Co-Navs.
(1/0)
P.A.C.E
Probe/Alert/Challenge/ Emergency

Pilot:
Port Knowledge
Ship Experience
Local Weather

Pilot Conning position, communicate directly with the Navigator

Ops Dir.
(Capt)
Ship's Particulars
Maneuverability
Limits
Navigator's Competence

CLOSED LOOP COMMUNICATION

ORDER GIVEN → ORDER REPEATED → YES or NO

A Resilient Bridge Organisation is when there are control functions in place to prevent risk from increasing to unacceptable levels and the plan has been briefed with realistic LIMITS set.

However…………………

If ship is in the safety Corridor and within the briefed set limits – Shut up!

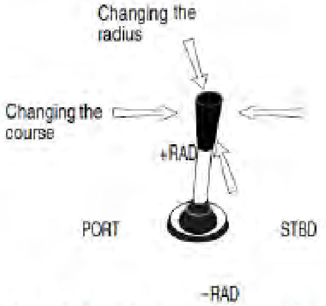
Kevin had a funny feeling that his boss was monitoring Him Too closely!!

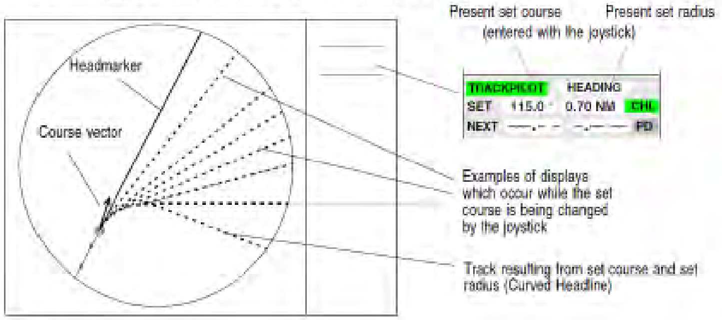

PROPULSION PORT
PROPULSION STBD
SAM Electronics
BOW
STERN
THRUSTER EMERG. MAREN
Change-Over Switch
System 1
System 2
046.9°
Repeater
Rate-of-Turn
06.05.2016 09:46


Gain
Sea
Stop Buzzer
ACK
Alarm
Track Pilot
Speed Pilot
Master
+Radius
PORT
STBD
-Radius
Brilliance
Range
Video
Overlay
Off Center
Center
REL True
HDG
CRS
Track
Mode
EBL 1 Off
EBL 2 Off
VRM 1 Off
VRM 2 Off
Next Course
Next Radius
PI Off
Execute
Bearing
Distance
RADARPILOT
TRACKPILOT

Various Input Possibilities for the Set Course and Set Radius:

Steering with the joystick: The new set course and the radius with which the ship is to sail can be entered at any time with the joystick. In this case, the manoeuvre is executed immediately.

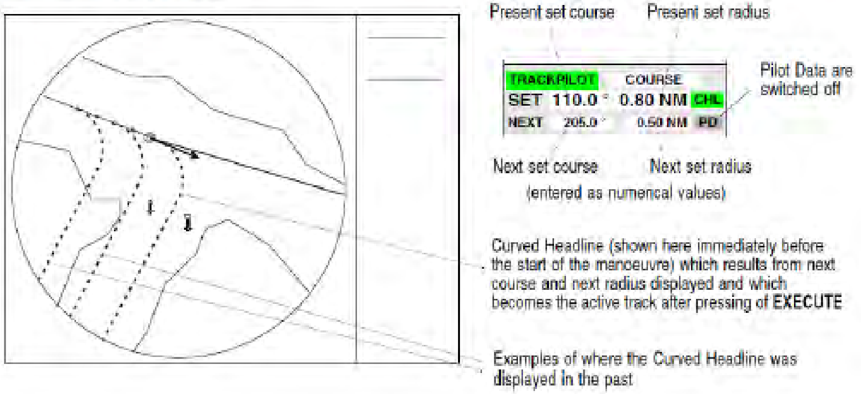


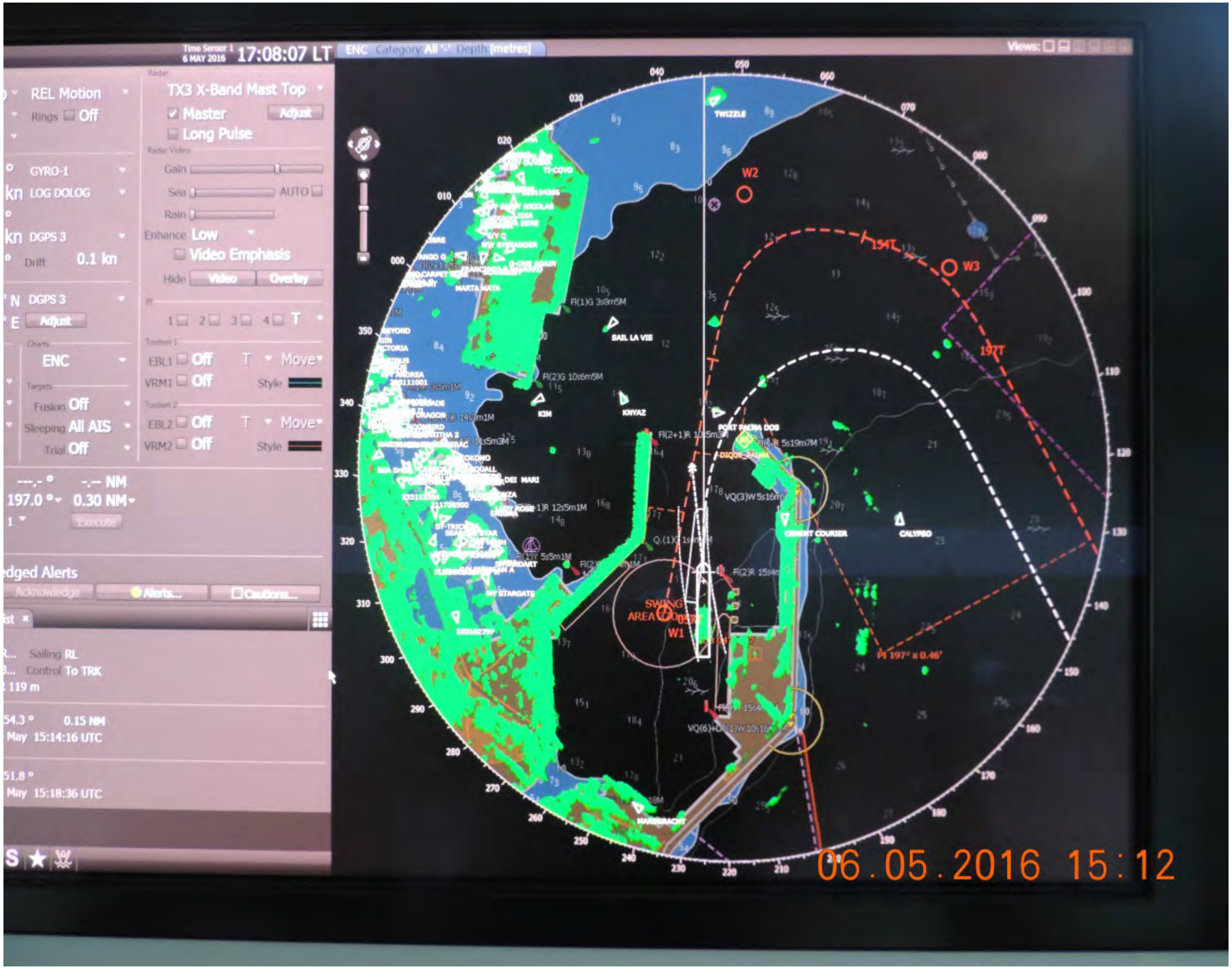


NOTE:

It is advisable to keep the joystick port or starboard-inclined until the desired course is displayed, instead of changing course one degree at the time. The reason is that at every "click" the system is recalculating the rudder angle needed.

Steering with the NEXT data: The set course and the radius are entered **as numerical values** before the manoeuvre. In the PPI, the Curved Headline, defined in this way is, moved along together with the ship until the manoeuvre is triggered by pressing of the **EXECUTE key**.





Time Sensor 1 6 MAY 2016 17:08:07 LT

ENC Category All Depth [metres]

REL Motion

Rings ☐ Off

GYRO-1

kn LOG DOLOG

kn DGPS 3

Drift 0.1 kn

N DGPS 3

E Adjust

Charts ENC

Targets

Fusion Off

Sleeping All AIS

Trial Off

Radar TX3 X-Band Mast Top

☑ Master Adjust

☐ Long Pulse

Radar Video

Gain

Sea AUTO ☐

Rain

Enhance Low

☐ Video Emphasis

Hide Video Overlay

PI 1 ☐ 2 ☐ 3 ☐ 4 ☐ T

Toolset 1

EBL1 ☐ Off T Move

VRM1 ☐ Off Style

Toolset 2

EBL2 ☐ Off T Move

VRM2 ☐ Off Style

---.- ° -.-- NM

197.0 ° 0.30 NM

1 Execute

dged Alerts

Acknowledge Alerts... Cautions...

ist

R... Sailing RL

B... Control To TRK

119 m

54.3 ° 0.15 NM

May 15:14:16 UTC

51.8 °

May 15:18:36 UTC

Critical navigational elements need to be **controllable** and **observable through monitoring** by the bridge team, and are determined by:

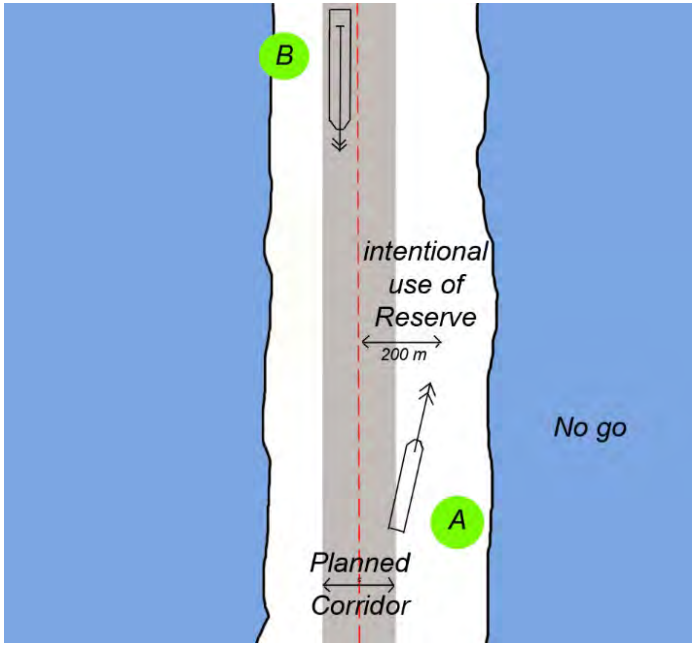
a range of **planned** values that represent the normality of operations. If everything goes according to plan, none of the planned values would have been exceeded.

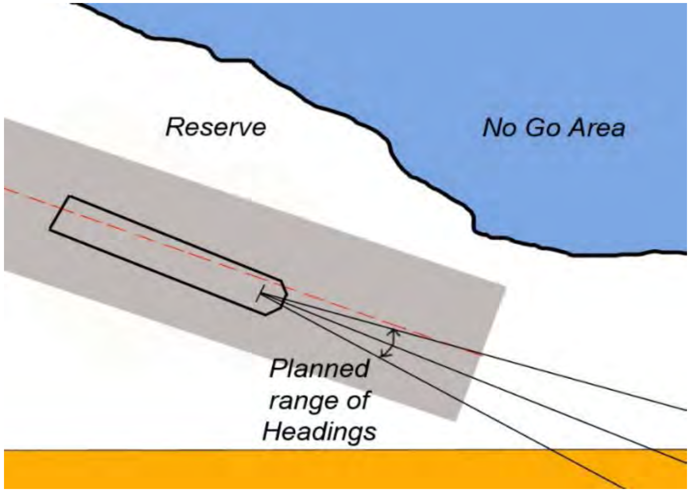
no go area/values that cannot be exceeded (i.e. non-navigable waters, breakwaters, speeds beyond or below which it is impossible to control the vessel). If the no go value is exceeded, then the ship is either aground, has had an allision or collision.

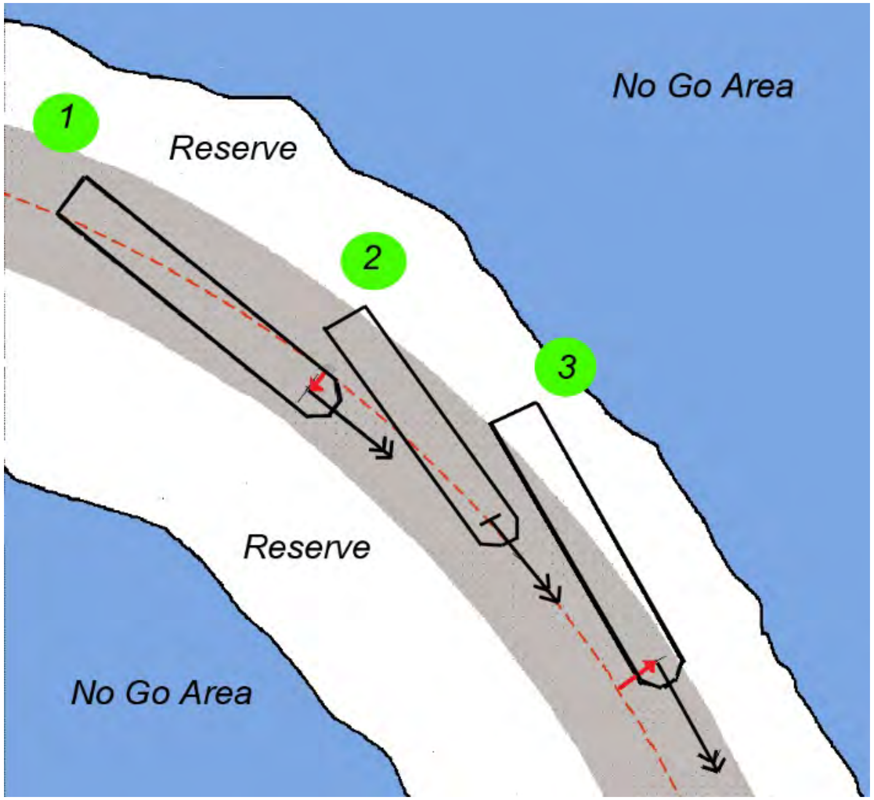
the **reserve** that is the difference between planned values/areas and no go values/areas. It represents the **safety margin** available for a specific critical element. The reserve can be used intentionally, in order to reasonably adapt to unplanned situations (i.e. traffic, changes in environmental conditions etc.) or not intentionally because of conning errors.

Sharing mental models in confined waters

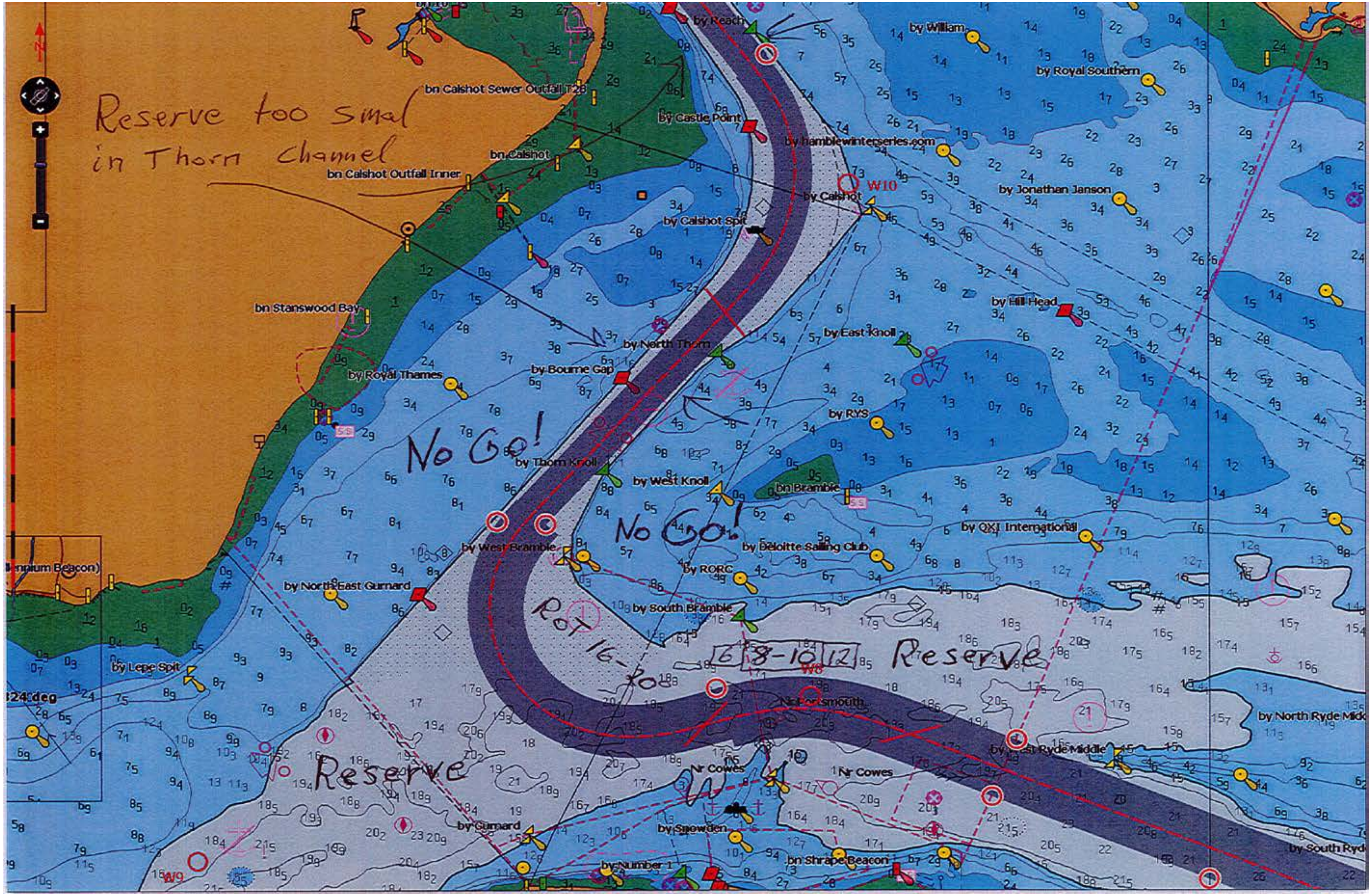
Antonio Di Lieto – Hans Hederström –







Plan: "I intend to turn keeping the conning position right of track"
Reason: "Because I want to keep the port quarter within the planned corridor"
Outcome: "The Cross Track Distance will be between 0 and 40m right of track"



Reserve too smal
in Thorn channel

No Go!

No Go!

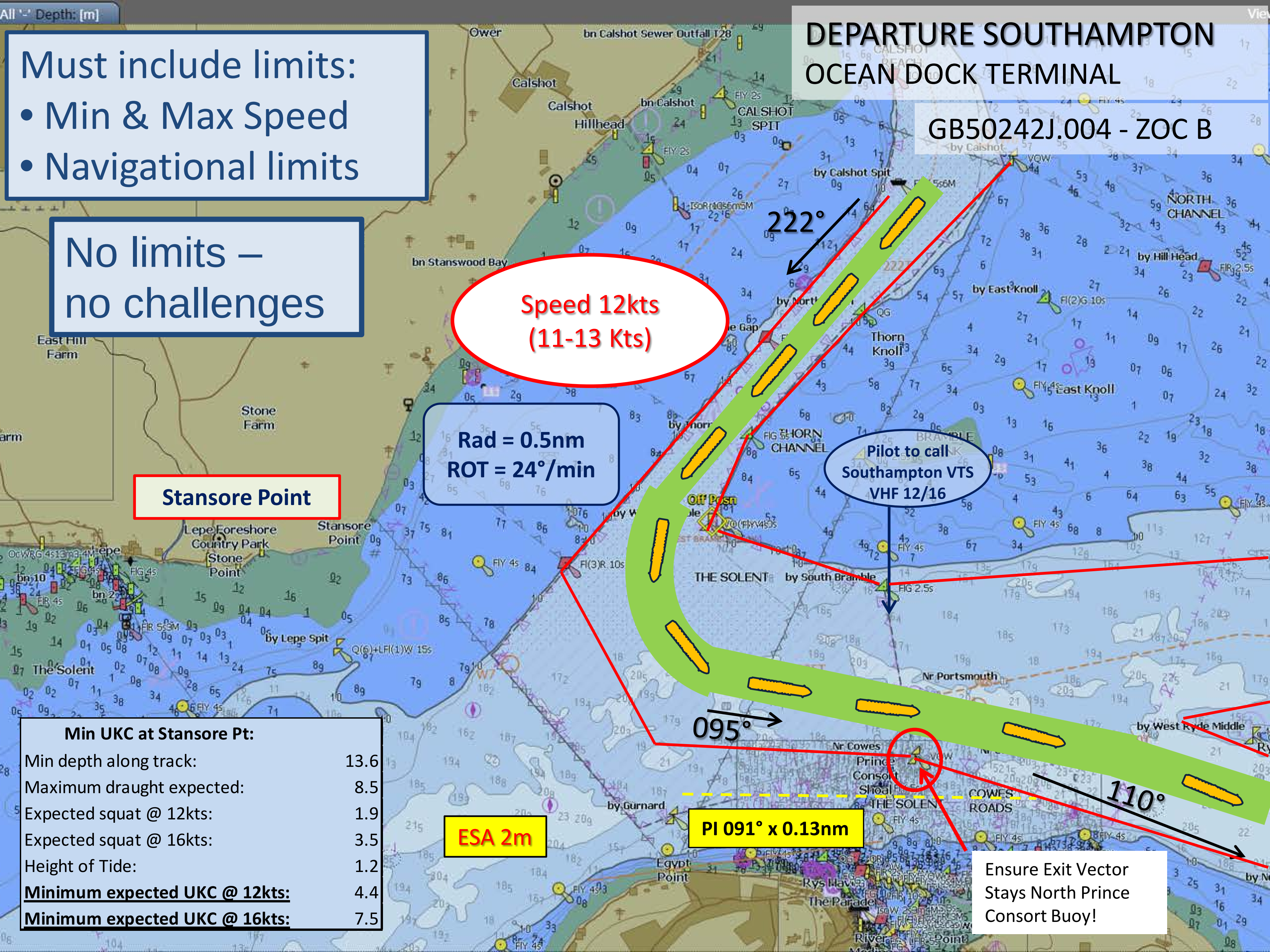
Rot 16-20

6 8-10 12 Reserve

Reserve

DEPARTURE SOUTHAMPTON
OCEAN DOCK TERMINAL

GB50242J.004 - ZOC B



Must include limits:

- Min & Max Speed
- Navigational limits

No limits – no challenges

Speed 12kts
(11-13 Kts)

Rad = 0.5nm
ROT = 24°/min

Stansore Point

Pilot to call
Southampton VTS
VHF 12/16

Min UKC at Stansore Pt:

Min depth along track:	13.6
Maximum draught expected:	8.5
Expected squat @ 12kts:	1.9
Expected squat @ 16kts:	3.5
Height of Tide:	1.2
Minimum expected UKC @ 12kts:	4.4
Minimum expected UKC @ 16kts:	7.5

ESA 2m

PI 091° x 0.13nm

Ensure Exit Vector
Stays North Prince
Consort Buoy!


Radar
Time Sensor 1 5 AUG 2018 19:09:19 LT
ENC Category: All '-' Depth: [m] Status: Overscaled X1.4
Views: ☐

Display
Orient. Head Up REL Motion
Range 0.75 NM Rings ☐ Off
REF CCRP

Heading & Speed
HDG 162.3 ° GYRO-1
STW 12.9 kn LOG
COG 167.0 °
SOG 11.7 kn DGPS 1
Set 272.6 ° Drift 2.9 kn

Position WGS84
LAT 50°46.988' N DGPS 1
LON 001°18.805' W Adjust

Vector & Trails
REF Ground
Vector 3 min T
Plot Off T
Trails Off T
Predict 90 s

Charts
ENC

Targets
Fusion ARPA
Sleeping All AIS
Trial Off

Radar
TX3 X-Band Mast Top
☑ Master Adjust
☐ Long Pulse

Radar Video
Gain
Sea
Rain
Enhance Off Auto Sea ☐
☐ Video Emphasis
Hide Video Overlay

PI
1 ☐ 2 ☐ 3 ☐ 4 ☐ T

Toolset 1
EBL1 ☐ Off REL Move
VRM1 ☐ Off Style

Toolset 2
EBL2 ☐ Off REL Move
VRM2 ☐ Off Style

Trackpilot
Heading Set 100.0 ° 0.50 NM
☑ AUTO Fill Next ---.- ° -.-- NM
Settings Economy 1 Execute
☐ Master-TP1 Route SOU-GCI

Alerts
No Unacknowledged Alerts
Silence Acknowledge Alerts... Cautions...

Voyage M...
Name SOU-GCI
From 8 BRAMBLES... Sailing RL
To 9 PRINCE CO... Control To TRK
TRK 168.1 ° XTD L 97 m

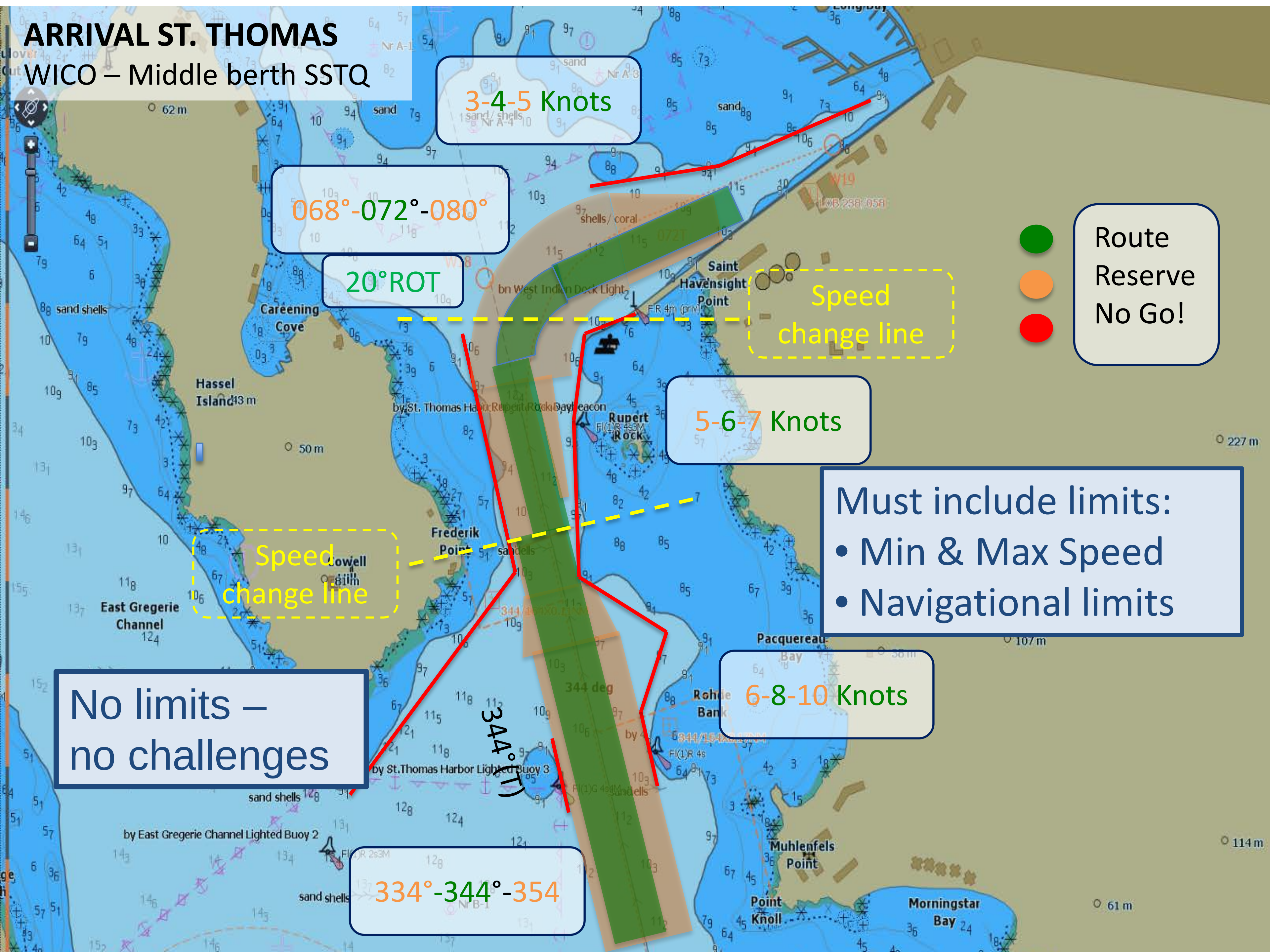
Wheel Over Point
WOP 996 m Next ---.- ° -.-- NM
TTG 00:02:44 ETA 5 Aug 18:12:03 UTC

To Waypoint
WPD 1.08 NM WPB 112.0 °
TTG 00:05:33 ETA 5 Aug 18:14:52 UTC

MENU

ARRIVAL ST. THOMAS

WICO – Middle berth SSTQ



3-4-5 Knots

068°-072°-080°

20°ROT

Speed change line

5-6-7 Knots

Speed change line

6-8-10 Knots

334°-344°-354

No limits – no challenges

- 🟢 Route
- 🟠 Reserve
- 🔴 No Go!

Must include limits:

- Min & Max Speed
- Navigational limits

KMDW/MDW
-MIDWAY INTL

JEPPESEN
21 APR 17 (11-3)
Eff 27 Apr

CHICAGO, ILL
ILS or LOC DME Rwy 31C

D-ATIS	CHICAGO Approach (R)	MIDWAY Tower	Ground
132.75	128.2 126.05	135.2	121.65

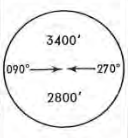
BRIEFING STRIP ™

LOC IMXT	Final Apch Crs	GS HOBEL	ILS DA(H)	
109.9	318°	1700' (1087')	863' (250')	Apt Elev 620' TDZE 613'

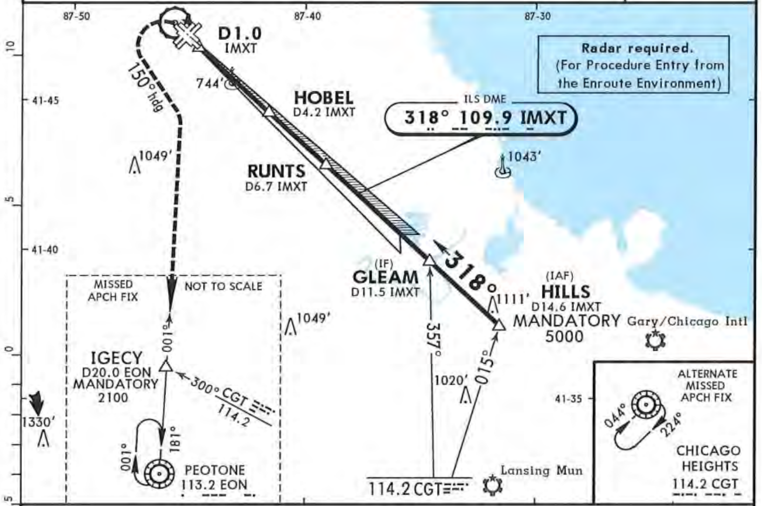
MISSED APCH: Climb to 1100' then climbing LEFT turn to 2100' on heading 150° and inbound on EON VOR R-001 until crossing IGECY INT/D20.0 EON, then climb to 2600' to EON VOR and hold, or as directed by ATC.

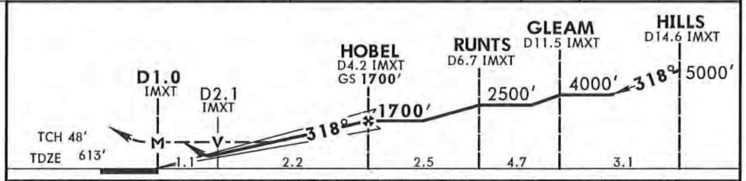
Alt Set: INCHES Trans level: FL 180 Trans alt: 18000'

1. Night landing: Rwy 31R not authorized. 2. VGSI and ILS glidepath not coincident.



MSA CGT VOR





Gnd speed-Kts	70	90	100	120	140	160
GS 3.00°	372	478	531	637	743	849

MAP at D1.0 IMXT

RLLS
REIL ○
PAPI ○
○

1100' ↑ | 2100' LT on 150° hdg | and EON 113.2 R-001

TERPS STRAIGHT-IN LANDING RWY31C | CIRCLE-TO-LAND

	ILS DA(H) 863'(250')	RLLS out	LOC (GS out) MDA(H) 1020'(407')	RLLS out	Max Kts	MDA(H)
A	RVR 40 or ¾		RVR 55 or 1		90	1120'(500') -1
B					120	
C			RVR 60 or 1⅛		140	1340'(720') -2
D					165	1340'(720') -2¼

TERPS AMEND 3 24 JUL 2014

CHANGES: Tower frequency, chart format.

St Thomas WICO Inner - SSTQ

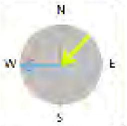
Royal Class 144,000 GRT L 330m B38m
Max Draft 8.60m Air Draft 60.7m
Windage 13,446m Max wind 25Kts→ = 120T
Swept Track 3°=56m 6°=73m 10°=96m

St Thomas Port VHF Ch. 16/14	Pilot CH 14	Agent:

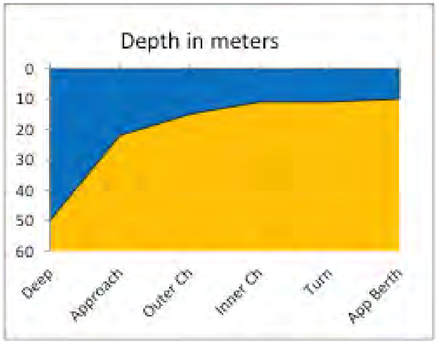
⚠ A 9.0 m shoal patch is close to 344° Leading Line track in just south of Rupert Rock Red Buoy. Watch Stern on turn into Harbour on shallows on West side of Narrows's entrance – Keep speed up!
Watch Shallows to North of Piers and Yachts!

1. Commit/Turn away:
0.5' South Of Point Knoll **Set 230° Rad 0.3'**
Reduce speed, Watch ROT! Watch Anchored Ships. Either go around again/Anchor or abort Port. Confirm to VTS & Pilots

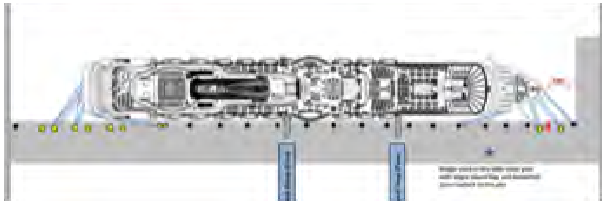
Limits:
For Channel Transit:
Max Cross Wind 30 Gusting 40
Max wind inside (North) 25
Gusting 30



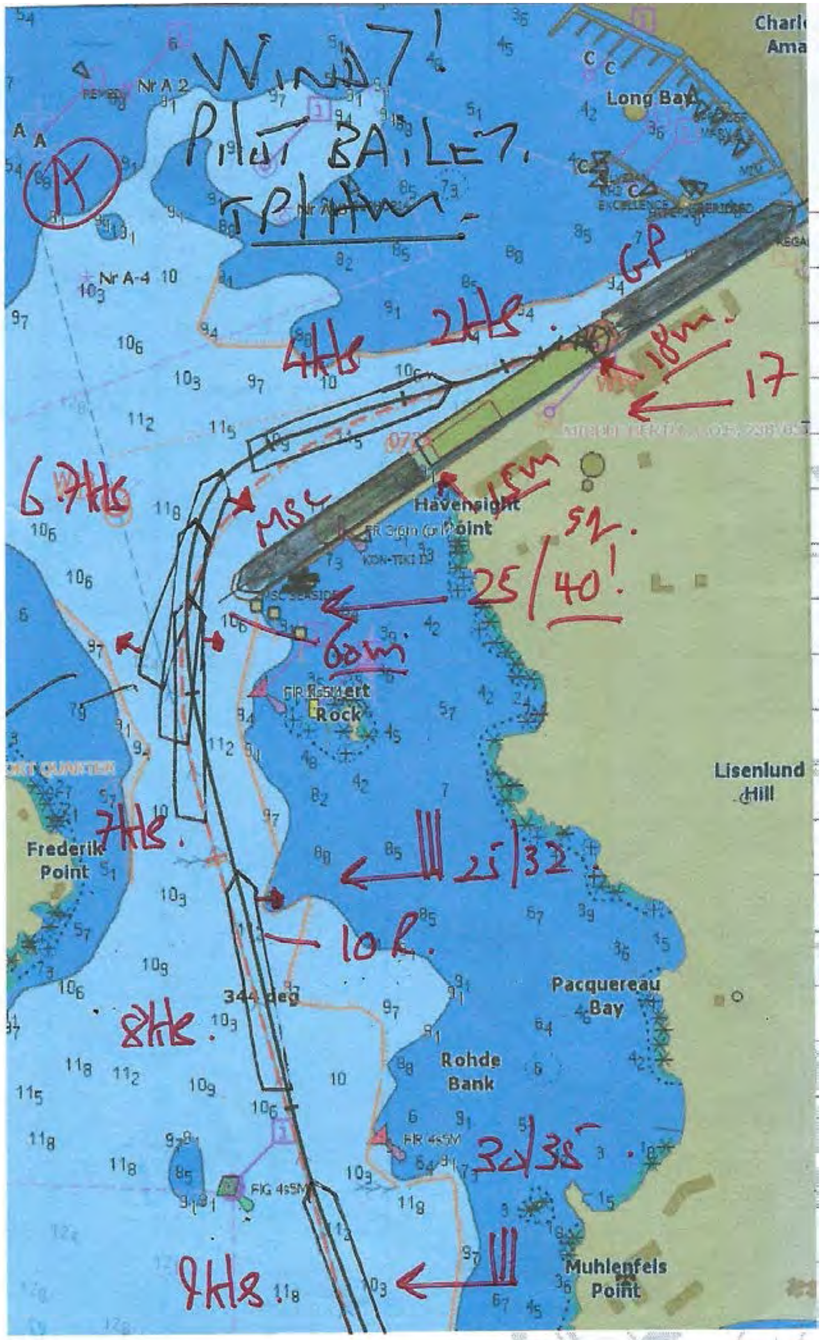
Leads	Approach Track° & Speed (Knots) Ranges						
344°	Approach	334	344	354	8	12	13
	Outer Ch.	338	344	350	7	8	9
🟢 🟥	Inner Ch.	340	344	348	4	5	6
	TURN	ROT	↻	20°	3	4	5
🟢 🟥	Approach	065	070	080	2	3	4
	LOB	055	058	062			



LOB 058°/238° Plan 7+2 F&A



Notes:
Nice leads and approach track, watch drift to Left if strong Easterly trades, lose wind North of point Knoll. If 30 Knots outside, 15 Knots inside the Harbour. Worst wind is NW.
Pilots good and allow us to keep the con in TP.
Keep close to pier after passing middle position- shallows & yachts!


WIND 7!
Pilot BAILEY.
A
Charl
Ama
Long Bay
Nr A 2
Nr A-4
GP
2kts
4kts
18m.
17
15m
6.7kts
MSC
Havensight Point
KON-TIKI
MSC SEASIDE
52.
25/40!
60m
ert Rock
Lisenlund Hill
7kts.
Frederik Point
25/32
10R.
344 deg
8kts.
Pacquereau Bay
Rohde Bank
Fl R 4s5M
Fl G 4s5M
30/35
9kts
Muhlenfels Point

Made it!

AIDA

Carnival®

P&O CRUISES

SEABOURN

PRINCESS CRUISES®

Costa

CUNARD®

P&O CRUISES

Holland America Line®

Port Study Program @ CSMART

BACKGROUND

- Carnival Corporation & Plc. Group has allocated significant resources for conducting Nautical Risk Assessments for navigationally challenging ports around the world
- This risk assessment program is conducted at CSMART
- Target is to study 20 ports per year

Aims - Port Study

-To conduct a nautical risk assessment using full mission bridge simulations leading to a determination of a level of risk of a specific class of cruise ship while entering and leaving a specific port under various metocean conditions.

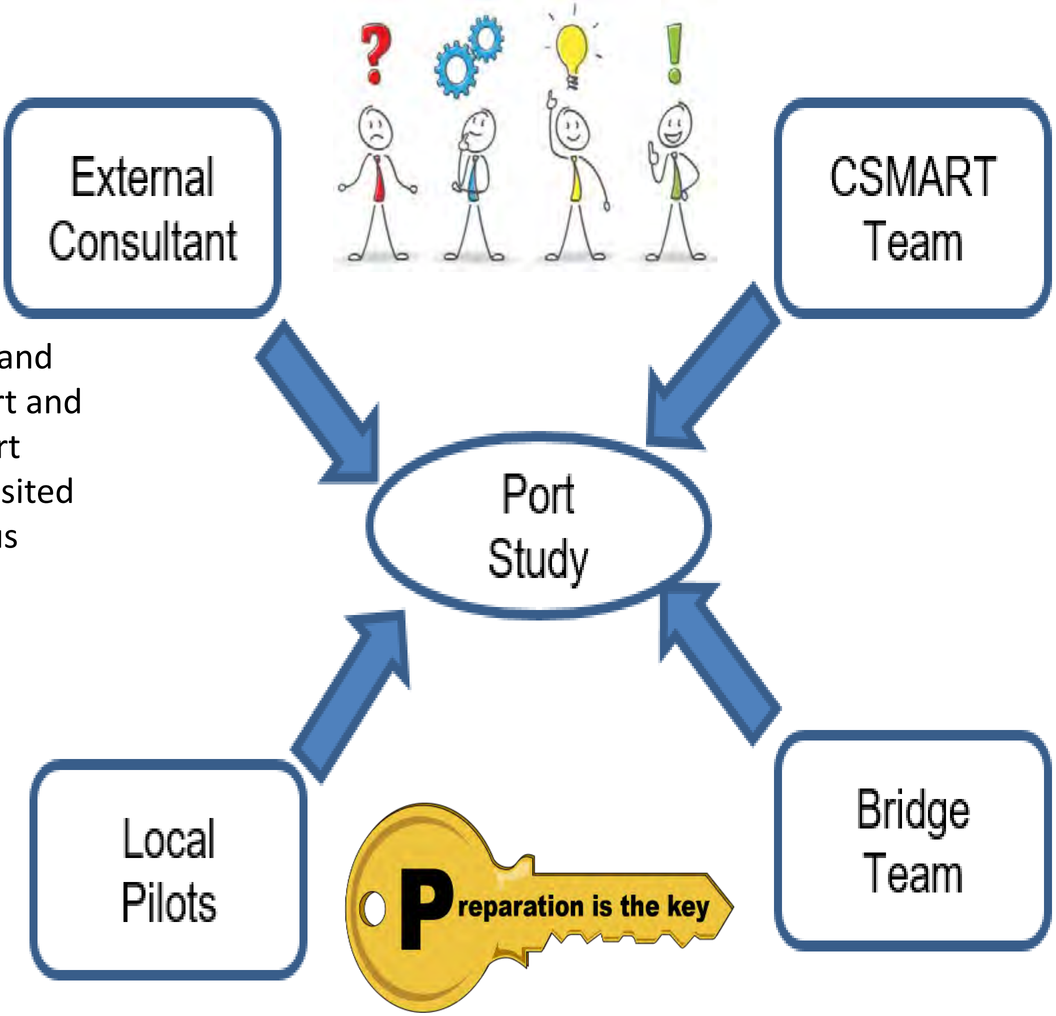
-To conduct mooring analysis for possible ship-berth arrangements in the port leading to identification of risks related to mooring and to assess the limiting environmental conditions for mooring.

Multiple Objectives - Port Study

- Identify the generic hazards and navigational/mooring challenges
- Test various possible manoeuvring/mooring strategies
- Conduct a risk assessment of every individual simulator run
- Identify and test "commit point"
- Strengthen and enhance pilot-bridge team working relationship
- Share best practice between bridge team and pilots
- Agree on waypoint route, manoeuvring plan and berthing/mooring plan
- Develop the shared Mental model

Port Study Team

In past 3 years, 45 pilots and 23 representatives of port and pilot authorities from port around the world have visited CSMART to attend various port studies



External Consultant

CSMART Team

Port Study

Local Pilots

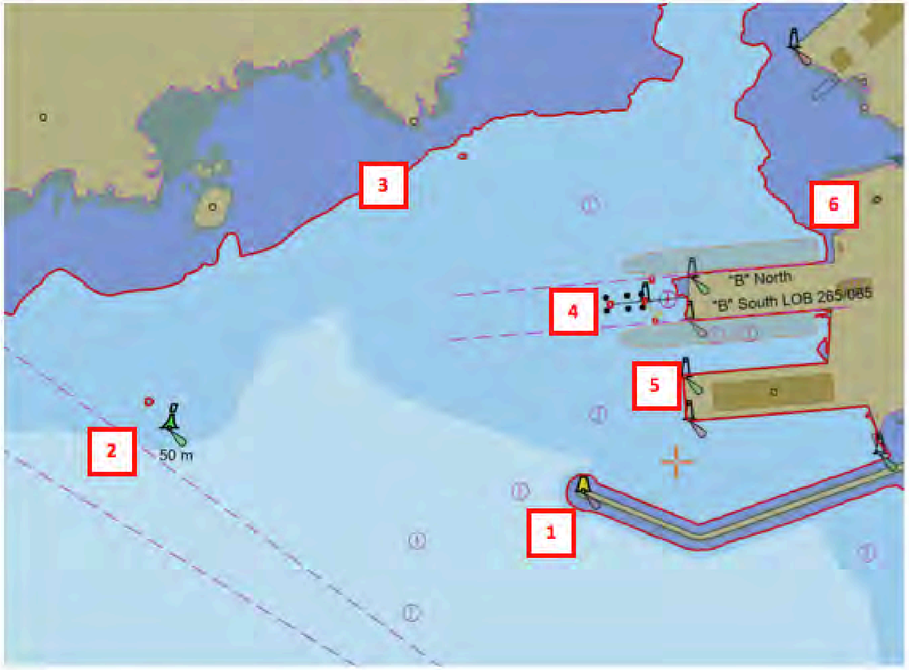
Bridge Team

2 APPRAISAL OF THE PORT

2.1 FACTS AND FIGURES

[This section is written by Julia]

2.2 HAZARDS AND NAVIGATIONAL CHALLENGES



2.2.1 HAZARDS:

1. Breakwater
2. Green buoy
3. Shallows on the north side, Mc Laughlin
4. Mooring dolphin
5. NW corner of berth "A"
6. Shallows northeast of the berth "B north"
   The shallow part at "B north" is illustrated in detail with measurements below. This hazard was considered related to the static and exact mooring position and

2.2.2 NAVIGATIONAL CHALLENGES:

The study revealed that out of the various combinations of approaches & manoeuvres, together with the wind and different current conditions, some combinations were more favorable than others. Below is a brief summary of the strategies that was found to be more challenging and with higher risk.

Arrival from West South West:
- In ebb tide;
  - Swing to port (inside or outside)
- In flood tide;
  - Swing inside

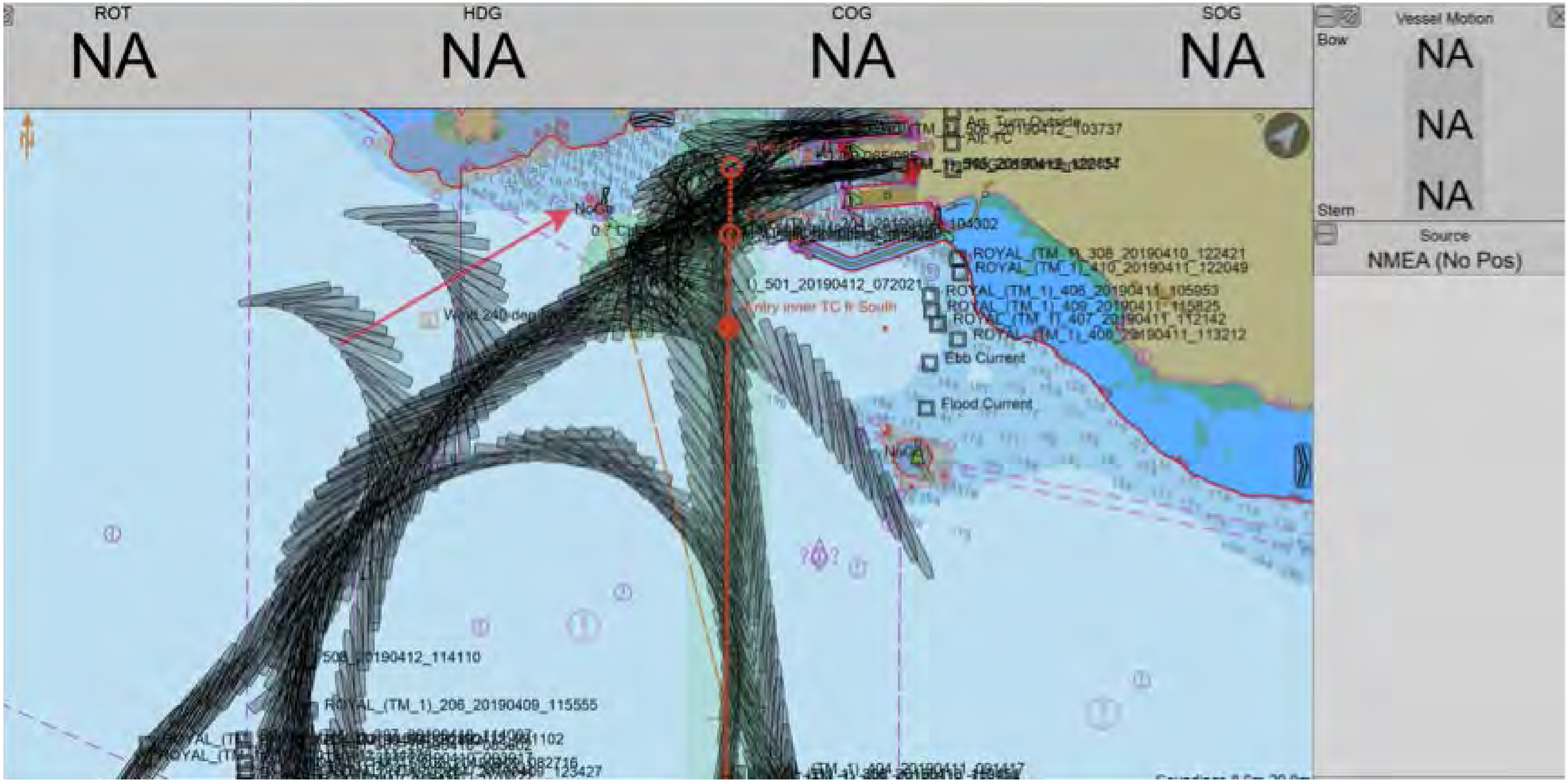
Arrival from South
- In flood tide;
  - Swing inside

It was found that the berthing manoeuvre was similar for both berths "B north" and "B south". The main challenge was when the wind pushed on the vessels port side in the docking/undocking phase of the manoeuvre. For berth "B south" this means the vessel was pushed towards the dolphins, as for the berth "B north" there were more room for the bow making it possible for aborting the docking manoeuvre, should that be necessary.

Run 505 – docking in winds of 30 kn – 240°


ROT
11.4°
HDG
287.0°
True
COG
062.1°
True
SOG
-1.0
0.53
0.72
2.66
29
0°
242°
167°
121m
144m
Flood Current
Playback


ROT
2.9°
Stbd \194\176/m
HDG
265.0°
True
COG
064.7°
True
NoGo
☐ Arr. turn inside
☐ Arr. Turn Outside
☐ Alt. TC
☐ NoGo & Fenders
Inner TC
10.6m
9.1m
NoGo
0.7 Cbl
0.05 Cbl
Outer TC
TC Out
Wind 240 deg (060)
Turn to outer TC fr South
☐ Ebb Current
☐ Flood Current
NoGo



ROT NA

HDG NA

COG NA

SOG NA

Vessel Motion

Bow NA

NA

Stern NA

Source

NMEA (No Pos)

3.2.1. *SCENARIO 1 – STRATEGY 1*

Simulation Outcome

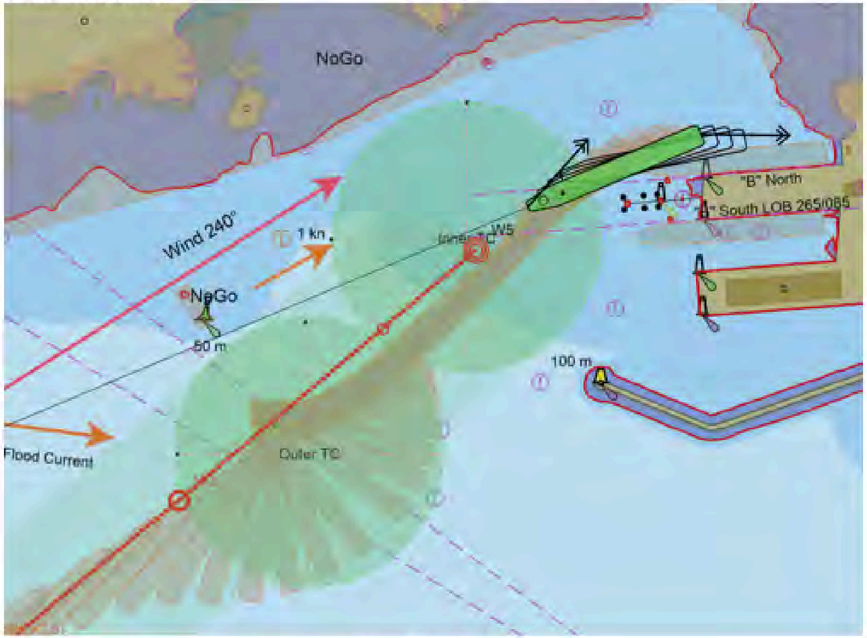
Scenario description: Arrival "north B" with wind 240° & flood current

Strategy description: Swing on arrival outside the breakwater & berth PST

Run no.: 304, Wind: NW @ 20 kn Current: 2 kn flood Wind Waves: 0.5m

Details of the manoeuvre: Run # 304 Arr. from west, port swing in the outer turning circle

Visual Overview:



Pros/Suggestions

- Approach from west, minimal set on approach, wind and current assist the swing
- Swing clear of hazards
- Once swung to port, much engine ahead power used to push against the wind and flood current
- Backing up and docking presented no particular challenges

Cons/Challenges

- Position within the Turning Circle
- Hold the bow during the swing, ensuring exit positon is bow in the wind prior to moving astern

Observed Limits (with and without tugs)

- Wind240° x 25 kn (without tug use)

Any Other Comments

- On approach, both the wind and flood current are pushing ahead, need to go astern

3.2.3.3 *SCENARIO 2 – STRATEGY 1*

Simulation Outcome

Scenario description: Arrival "south B" with wind 240° & flood current

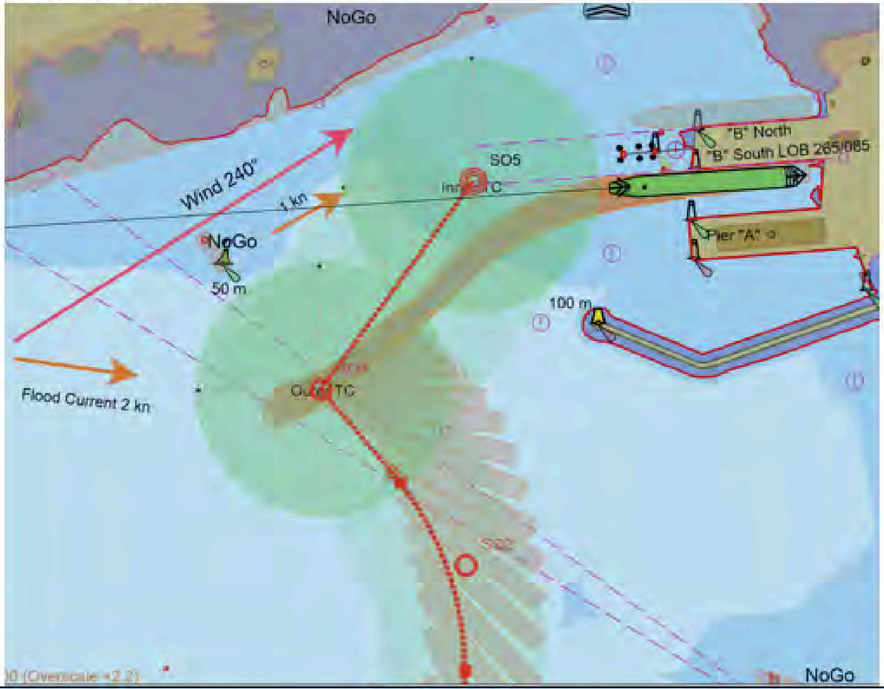
Strategy description: Swing on arrival outside the breakwater, berth SST

Run no.: 402 Wind: NW @ 25 kn Current: 2 kn flood Wind Waves: 0.5m

<u>Details of the manoeuvre</u>:

Arrival from south, port swing in the outer turning circle

<u>Visual Overview:</u>

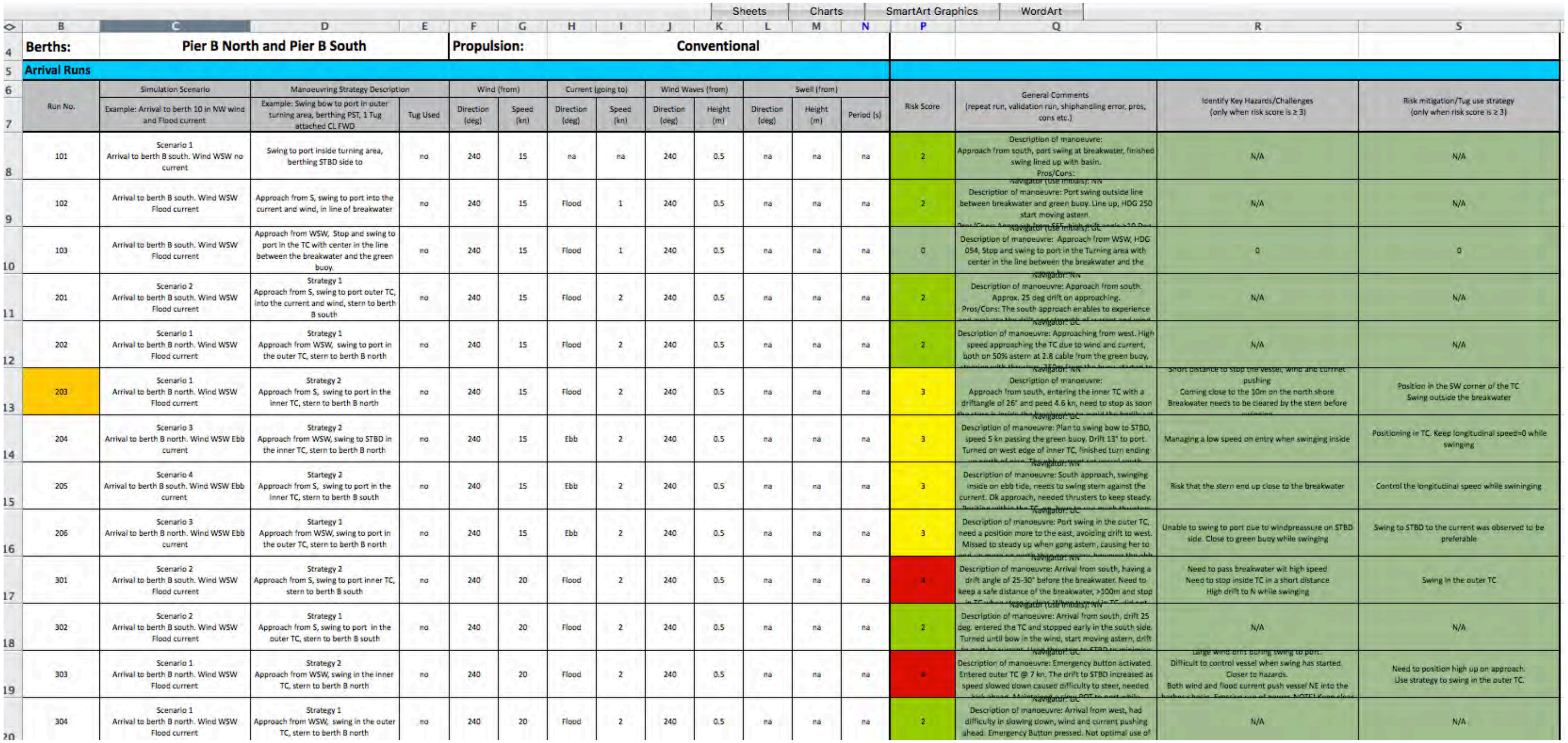


Pros/Suggestions

- Turning bow into wind and current enables good control throughout the swing
- This approach has an abort route available throughout the manoeuvre

Cons/Challenges

- The wind and current causes a high drift angle on the approach
- Keep speed up, position high up in the TC, the NW side
- Ensure swing completed fully until bow in the wind
- Once swung, build up speed astern to get out from the current setting east
- Keep a heading with wind on the bow as long as possible not exposing the port side



Berths: Pier B North and Pier B South **Propulsion:** Conventional

Arrival Runs

Run No.	Simulation Scenario	Manoeuvring Strategy Description		Wind (from)		Current (going to)		Wind Waves (from)		Swell (from)			Risk Score	General Comments (repeat run, validation run, shiphandling error, pros, cons etc.)	Identify Key Hazards/Challenges (only when risk score is ≥ 3)	Risk mitigation/Tug use strategy (only when risk score is ≥ 3)
	Example: Arrival to berth 10 in NW wind and Flood current	Example: Swing bow to port in outer turning area, berthing PST, 1 Tug attached CL FWD	Tug Used	Direction (deg)	Speed (kn)	Direction (deg)	Speed (kn)	Direction (deg)	Height (m)	Direction (deg)	Height (m)	Period (s)				
101	Scenario 1 Arrival to berth B south. Wind WSW no current	Swing to port inside turning area, berthing STBD side to	no	240	15	na	na	240	0.5	na	na	na	2	Description of manoeuvre: Approach from south, port swing at breakwater, finished swing lined up with basin. Pros/Cons: Navigator (use initials): NN	N/A	N/A
102	Arrival to berth B south. Wind WSW Flood current	Approach from S, swing to port into the current and wind, in line of breakwater	no	240	15	Flood	1	240	0.5	na	na	na	2	Description of manoeuvre: Port swing outside line between breakwater and green buoy. Line up, HDG 250 start moving astern. Navigator (use initials): GC	N/A	N/A
103	Arrival to berth B south. Wind WSW Flood current	Approach from WSW, Stop and swing to port in the TC with center in the line between the breakwater and the green buoy.	no	240	15	Flood	1	240	0.5	na	na	na	0	Description of manoeuvre: Approach from WSW, HDG 054, Stop and swing to port in the Turning area with center in the line between the breakwater and the Navigator: NN	0	0
201	Scenario 2 Arrival to berth B south. Wind WSW Flood current	Strategy 1 Approach from S, swing to port outer TC, into the current and wind, stern to berth B south	no	240	15	Flood	2	240	0.5	na	na	na	2	Description of manoeuvre: Approach from south. Approx. 25 deg drift on approaching. Pros/Cons: The south approach enables to experience Navigator: GC	N/A	N/A
202	Scenario 1 Arrival to berth B north. Wind WSW Flood current	Strategy 1 Approach from WSW, swing to port in the outer TC, stern to berth B north	no	240	15	Flood	2	240	0.5	na	na	na	2	Description of manoeuvre: Approaching from west. High speed approaching the TC due to wind and current, both on 50% astern at 2.8 cable from the green buoy, Navigator: NN	N/A	N/A
203	Scenario 1 Arrival to berth B north. Wind WSW Flood current	Strategy 2 Approach from S, swing to port in the inner TC, stern to berth B north	no	240	15	Flood	2	240	0.5	na	na	na	3	Description of manoeuvre: Approach from south, entering the inner TC with a driftangle of 26° and peed 4.6 kn, need to stop as soon Navigator: GC	Short distance to stop the vessel, wind and currnet pushing Coming close to the 10m on the north shore Breakwater needs to be cleared by the stern before	Position in the SW corner of the TC Swing outside the breakwater
204	Scenario 3 Arrival to berth B north. Wind WSW Ebb current	Strategy 2 Approach from WSW, swing to STBD in the inner TC, stern to berth B north	no	240	15	Ebb	2	240	0.5	na	na	na	3	Description of manoeuvre: Plan to swing bow to STBD, speed 5 kn passing the green buoy. Drift 13° to port. Turned on west edge of inner TC, finished turn ending Navigator: NN	Managing a low speed on entry when swinging inside	Positioning in TC. Keep longitudinal speed=0 while swinging
205	Scenario 4 Arrival to berth B south. Wind WSW Ebb current	Startegy 2 Approach from S, swing to port in the inner TC, stern to berth B south	no	240	15	Ebb	2	240	0.5	na	na	na	3	Description of manoeuvre: South approach, swinging inside on ebb tide, needs to swing stern against the current. Ok approach, needed thrusters to keep steady. Navigator: GC	Risk that the stern end up close to the breakwater	Control the longitudinal speed while swininging
206	Scenario 3 Arrival to berth B north. Wind WSW Ebb current	Startegy 1 Approach from WSW, swing to port in the outer TC, stern to berth B north	no	240	15	Ebb	2	240	0.5	na	na	na	3	Description of manoeuvre: Port swing in the outer TC, need a position more to the east, avoiding drift to west. Missed to steady up when gong astern, causing her to Navigator: NN	Unable to swing to port due to windpreassure on STBD side. Close to green buoy while swinging	Swing to STBD to the current was observed to be preferable
301	Scenario 2 Arrival to berth B south. Wind WSW Flood current	Strategy 2 Approach from S, swing to port inner TC, stern to berth B south	no	240	20	Flood	2	240	0.5	na	na	na	4	Description of manoeuvre: Arrival from south, having a drift angle of 25-30° before the breakwater. Need to keep a safe distance of the breakwater, >100m and stop Navigator (use initials): NN	Need to pass breakwater wit high speed Need to stop inside TC in a short distance High drift to N while swinging	Swing in the outer TC
302	Scenario 2 Arrival to berth B south. Wind WSW Flood current	Strategy 1 Approach from S, swing to port in the outer TC, stern to berth B south	no	240	20	Flood	2	240	0.5	na	na	na	2	Description of manoeuvre: Arrival from south, drift 25 deg. entered the TC and stopped early in the south side. Turned until bow in the wind, start moving astern, drift Navigator: GC	N/A	N/A
303	Scenario 1 Arrival to berth B north. Wind WSW Flood current	Strategy 2 Approach from WSW, swing in the inner TC, stern to berth B north	no	240	20	Flood	2	240	0.5	na	na	na	4	Description of manoeuvre: Emergency button activated. Entered outer TC @ 7 kn. The drift to STBD increased as speed slowed down caused difficulty to steer, needed Navigator: GC	Large wind drift during swing to port. Difficult to control vessel when swing has started. Closer to hazards. Both wind and flood current push vessel NE into the	Need to position high up on approach. Use strategy to swing in the outer TC.
304	Scenario 1 Arrival to berth B north. Wind WSW Flood current	Strategy 1 Approach from WSW, swing in the outer TC, stern to berth B north	no	240	20	Flood	2	240	0.5	na	na	na	2	Description of manoeuvre: Arrival from west, had difficulty in slowing down, wind and current pushing ahead. Emergency Button pressed. Not optimal use of	N/A	N/A

What can you find in the reports?

Mooring Analysis Results

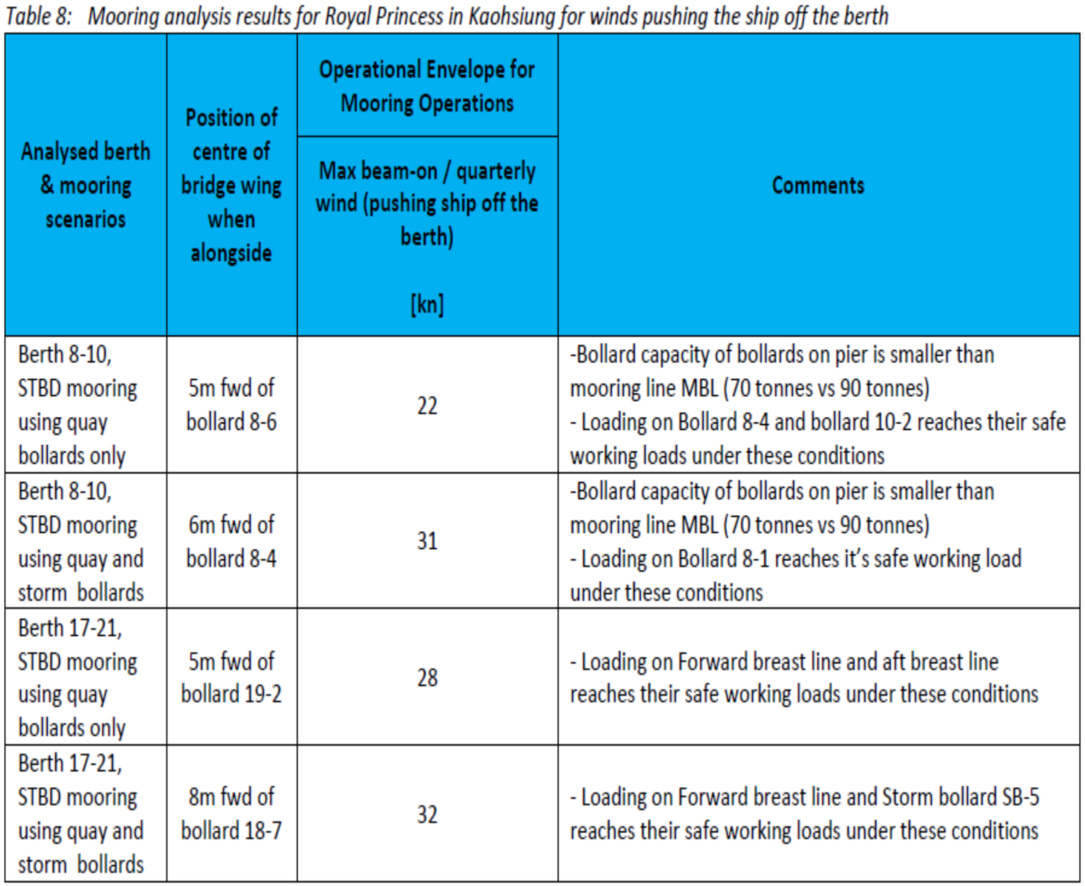
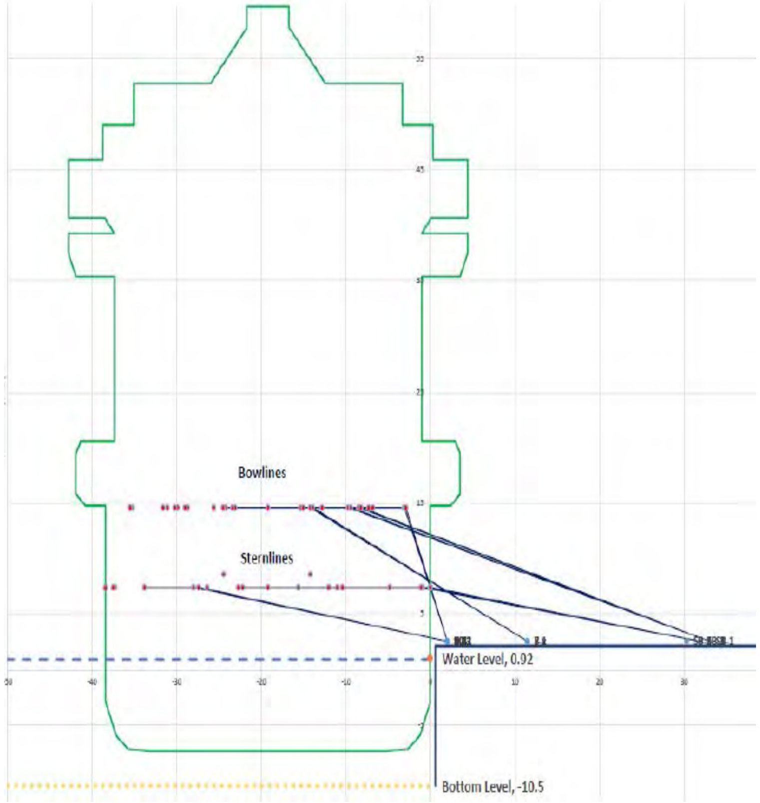


Table 8: Mooring analysis results for Royal Princess in Kaohsiung for winds pushing the ship off the berth

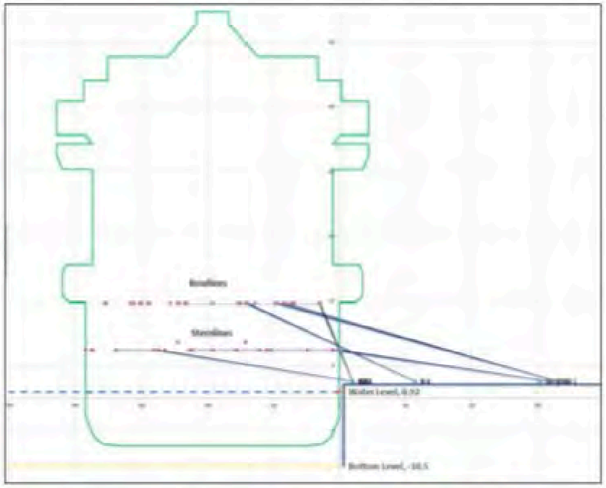
Analysed berth & mooring scenarios	Position of centre of bridge wing when alongside	Operational Envelope for Mooring Operations	Comments
		Max beam-on / quarterly wind (pushing ship off the berth) [kn]	
Berth 8-10, STBD mooring using quay bollards only	5m fwd of bollard 8-6	22	-Bollard capacity of bollards on pier is smaller than mooring line MBL (70 tonnes vs 90 tonnes) - Loading on Bollard 8-4 and bollard 10-2 reaches their safe working loads under these conditions
Berth 8-10, STBD mooring using quay and storm bollards	6m fwd of bollard 8-4	31	-Bollard capacity of bollards on pier is smaller than mooring line MBL (70 tonnes vs 90 tonnes) - Loading on Bollard 8-1 reaches it's safe working load under these conditions
Berth 17-21, STBD mooring using quay bollards only	5m fwd of bollard 19-2	28	- Loading on Forward breast line and aft breast line reaches their safe working loads under these conditions
Berth 17-21, STBD mooring using quay and storm bollards	8m fwd of bollard 18-7	32	- Loading on Forward breast line and Storm bollard SB-5 reaches their safe working loads under these conditions

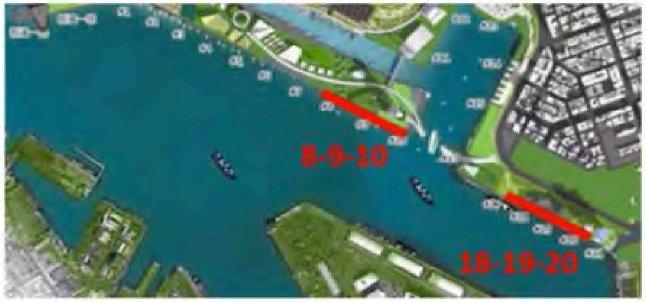


CSMART
Center for Simulator Maritime Training
Part of the Carnival Corporation & plc Group

Kaohsiung Mooring Analysis Report with M/V Royal Princess (Royal Class)

Mooring analysis conducted at
CSMART, Almere, The Netherlands





2.3.3 SCENARIO 1: BERTH 8-10 SST – USING QUAY SIDE BOLLARDS ONLY

The mooring configuration used for doing mooring analysis for this scenario is shown below. Bollards 8-2, 8-3 and 8-4 each have two lines, bollard 10-2 and 10-3 each have three lines. The most forward and aft lines have a large plan view angle, which means that they are inefficient in transferring lateral wind loads. Details on this mooring configuration, larger figures, side view figures and cross sections can be found in Appendix E.

Figure 12: Line Allocation – Plan View, Bollard arrangement on berth and OPTIMOOR Mooring Configuration

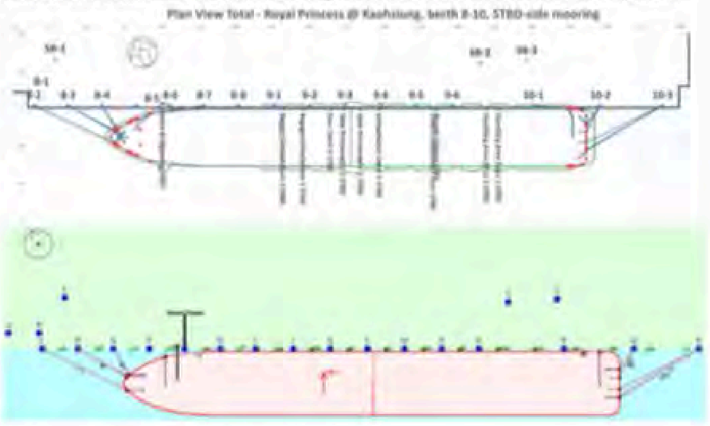


Table 3: Line Allocation – Line Lengths and Line Angles

Line Allocation for STBD mooring								
Centre bridgewing STBD is 5m fwd of bollard 8-6								
Line#	From fairlead	To bollard	Line function	Length on Deck [m]	Fairlead - Bollard [m]	Total Length [m]	Vertical Angle [illegible] [°]	Planview Angle [illegible] [°]
Line01	F-28Pa	8-2	Fwd breastline	10.7	61.6	72.3	11	-65
Line02	F-23Pf	8-2	Fwd breastline	10.9	60.9	71.9	11	-65
Line03	F-23Sf	8-3	Fwd breastline	10.9	37.7	48.6	19	-61
Line04	F-23Sa	8-3	Fwd breastline	10.7	38.0	48.7	19	-62
Line05	F-22Sf	8-4	Fwd breastline	11.0	22.4	33.4	33	-33
Line06	F-22Sa	8-4	Fwd breastline	10.1	22.5	32.6	32	-33
Line07	F-16Sf_1	8-7	Fwd springline	16.9	38.1	55.0	18	82
Line08	F-16Sa_1	8-7	Fwd springline	16.4	37.5	53.9	19	82
Line09	A-22Sf	10-1	Aft springline	20.0	23.5	43.5	12	-85
Line10	A-22Sa	10-1	Aft springline	20.2	24.0	44.2	12	-85
Line11	A-16Ss	10-2	Aft breastline	7.9	16.2	24.0	18	37
Line12	A-16Sp	10-2	Aft breastline	8.3	16.7	24.9	17	35
Line13	A-14S	10-2	Aft breastline	5.3	20.4	25.7	14	28
Line14	A-13Pp	10-3	Aft breastline	6.1	57.1	63.2	5	66
Line15	A-16Ps	10-3	Aft breastline	8.3	59.2	67.5	5	60
Line16	A-16Pp	10-3	Aft breastline	7.9	59.5	67.4	5	60

2.3.4 SCENARIO 2: BERTH 8-10 SST – USING QUAY SIDE AND STORM BOLLARDS

The mooring configuration used for doing mooring analysis for this scenario is shown below. Four lines go to storm bollards SB-1 and SB-3 and two lines go to quay bollards 8-1 and 10-1. This distribution has been selected because of the different capacity of the bollards (quay bollards have 70 tonnes and the storm bollards have a capacity of 150 tonnes each). The spring lines go to bollards 8-6 and 9-5 and are approximately the same length. SB-2 has not been used, as the pretension in the lines resulted in a net forward force which could only be counteracted by the forward springs and this mooring configuration proofed to be inefficient. Details on this mooring configuration, larger figures, side view figures and cross sections can be found in Appendix E.

Figure 14: Line Allocation – Plan View, Bollard arrangement on berth and OPTIMOOR Mooring Configuration

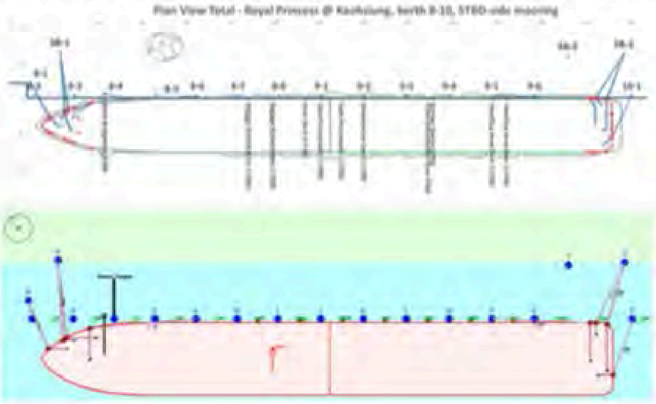
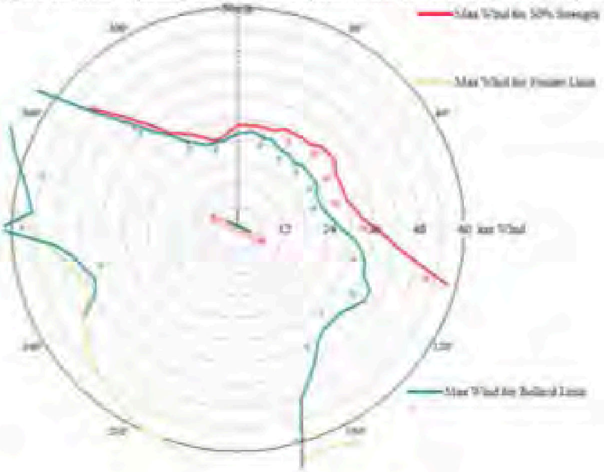


Table 4: Line Allocation – Line Lengths and Line Angles

Line allocation for STBD-mooring								
[illegible]								
Line #	From Fairlead	To Bollard	Line function	Length on Deck [m]	Fairlead-Bollard [m]	Total Length [m]	Vertical Angle [illegible] [°]	Horizontal Angle [illegible] [°]
Line 01	F-225f	8-1	Fwd breast line	11.0	30.3	41.3	23	-23
Line 02	F-225a	8-1	Fwd breast line	10.1	30.3	40.4	23	-24
Line 03	F-195f	SB-1	Fwd breast line	16.4	43.5	59.9	16	-6
Line 04	F-195a	SB-1	Fwd breast line	16.4	43.2	59.7	16	-7
Line 05	F-205f	SB-1	Fwd breast line	5.8	44.4	50.2	16	-5
Line 06	F-205a	SB-1	Fwd breast line	6.6	44.2	50.8	16	-4
Line 07	F-165f_1	8-6	Fwd spring line	16.9	61.2	78.1	11	66
Line 08	F-165a_1	8-6	Fwd spring line	16.4	60.6	77.0	11	66
Line 09	A-225f	9-5	Aft spring line	20.0	55.2	75.2	5	-88
Line 10	A-225a	9-5	Aft spring line	20.2	55.6	75.8	5	-88
Line 11	A-205f	SB-3	Aft breast line	6.3	36.2	42.5	8	27
Line 12	A-205a	SB-3	Aft breast line	6.0	36.0	42.0	8	27
Line 13	A-185f	SB-3	Aft breast line	24.7	34.7	59.4	8	37
Line 14	A-185a	SB-3	Aft breast line	24.2	34.7	58.9	8	36
Line 15	A-165Ps	10-1	Aft breast line	8.3	31.8	40.1	9	21
Line 16	A-165Pp	10-1	Aft breast line	7.8	32.4	40.2	9	20

The wind capability diagram for this mooring configuration is shown in the following figure. This diagram is explained in Annex D.

Figure 13: Wind Capability Diagram (wind speeds relate to meteorological wind speed)



KEY FINDINGS

- The bollards on the quay side are 70 tonnes capacity. The minimum breaking load of the mooring lines is well above the bollard capacity, which is a risk to the mooring bollards (and to the ship/surrounding people when the bollard breaks).
- For winds from "beam on and quarterly" sector (pushing ship away from pier):
  - The mooring risk increases for wind speeds higher than 22 knots.
  - For wind directions of this sector, bollard E (bollard 8-4) and bollard Q (bollard 10-2) are loaded most and are governing for the strength of the mooring system.
- For winds from "beam on and quarterly" sector (pushing ship towards the pier):
  - The mooring risk increases for wind speeds higher than 40 knots for some particular directions. In this case, bollard Q (bollard 10-2) and the fenders are the weakest link in the system. For most directions, the limits were much higher.
- For winds from "head on" sector:
  - Bollard E (bollard 8-4) is loaded most and governing for the strength of the mooring system.
  - Caution must be taken with wind speeds over 36 knots.
- For winds from "stern on" sector:
  - Bollard Q (bollard 10-2) is loaded most and governing for the strength of the mooring system.
  - Caution must be taken with wind speeds over 32 knots.
- The ship motions are relatively small and have not been used to evaluate this mooring.

2.3.7 SUMMARY OF RESULTS

A summary of the results of the mooring analysis calculations are shown in below tables.

Table 7: Summary of mooring analysis results for Royal Princess in Kaohsiung for wind from all four quadrants

Analysed berth & mooring scenarios	Position of centre of bridge wing when alongside	Operational Envelope for Mooring Operations			
		Max beam-on / quarterly wind (pushing ship off the berth) [kn]	Max beam-on / quarterly wind (pushing ship towards the berth) [kn]	Max head-on wind [kn]	Max stern-on wind [kn]
Berth 8-10, STBD mooring using quay bollards only	5m fwd of bollard 8-6	22	40	36	32
Berth 8-10, STBD mooring using quay and storm bollards	6m fwd of bollard 8-4	31	44	48	55
Berth 17-21, STBD mooring using quay bollards only	5m fwd of bollard 19-2	28	70	60	60
Berth 17-21, STBD mooring using quay and storm bollards	8m fwd of bollard 18-7	32	65	60	55

Table 8: Mooring analysis results for Royal Princess in Kaohsiung for winds pushing the ship off the berth

Analysed berth & mooring scenarios	Position of centre of bridge wing when alongside	Operational Envelope for Mooring Operations	Comments
		Max beam-on / quarterly wind (pushing ship off the berth) [kn]	
Berth 8-10, STBD mooring using quay bollards only	5m fwd of bollard 8-6	22	-Bollard capacity of bollards on pier is smaller than mooring line MBL (70 tonnes vs 90 tonnes) - Loading on Bollard 8-4 and bollard 10-2 reaches their safe working loads under these conditions
Berth 8-10, STBD mooring using quay and storm bollards	6m fwd of bollard 8-4	31	-Bollard capacity of bollards on pier is smaller than mooring line MBL (70 tonnes vs 90 tonnes) - Loading on Bollard 8-1 reaches it's safe working load under these conditions
Berth 17-21, STBD mooring using quay bollards only	5m fwd of bollard 19-2	28	- Loading on Forward breast line and aft breast line reaches their safe working loads under these conditions
Berth 17-21, STBD mooring using quay and storm bollards	8m fwd of bollard 18-7	32	- Loading on Forward breast line and Storm bollard SB-5 reaches their safe working loads under these conditions

Outcome

- Expected outcome
  - Pilotage plan created together by captains and pilots
  - Shared mental model even before pilot boards the ship
  - Only need to discuss dynamic topics like weather and traffic
  - Evidenced based guidance in case of Go - No Go situations
  - Navigation and mooring conducted according to pre-determined parameters
  - Reduced risk of nautical operations

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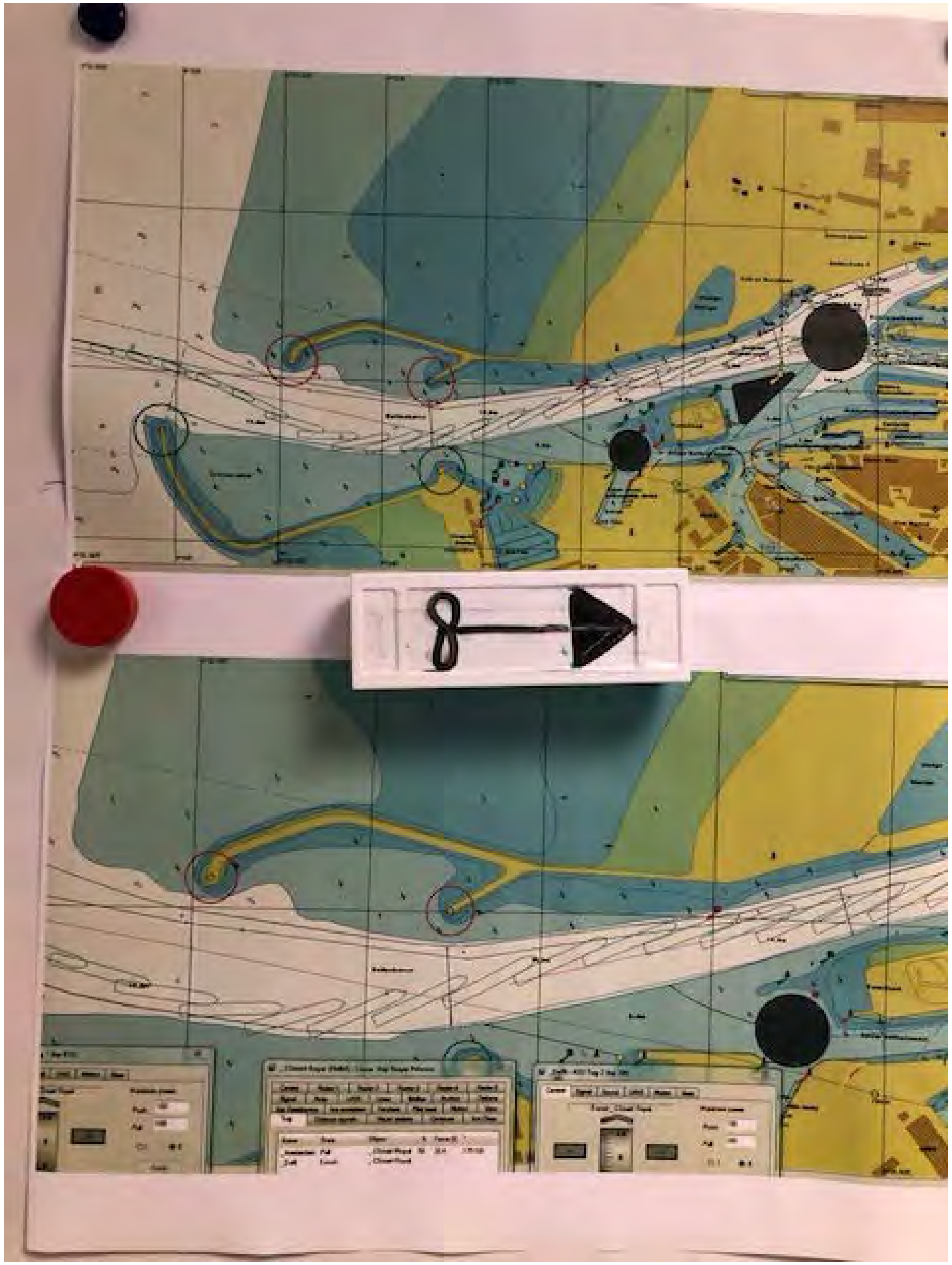
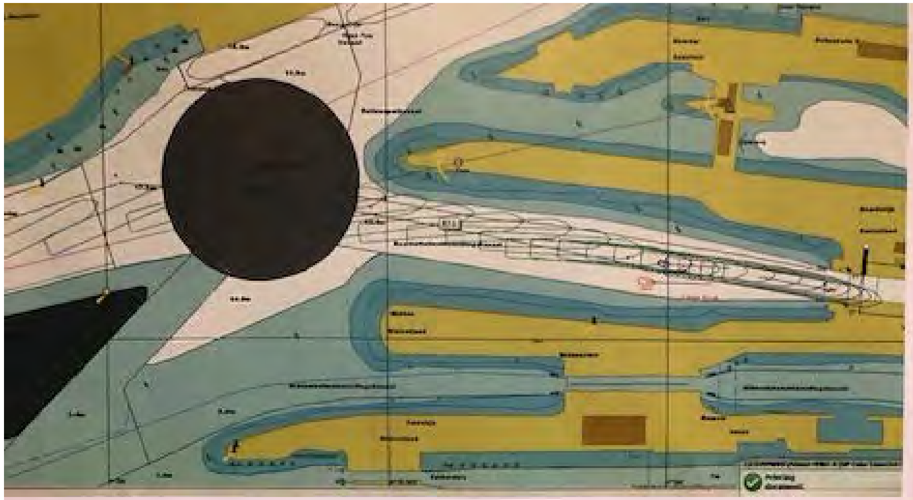
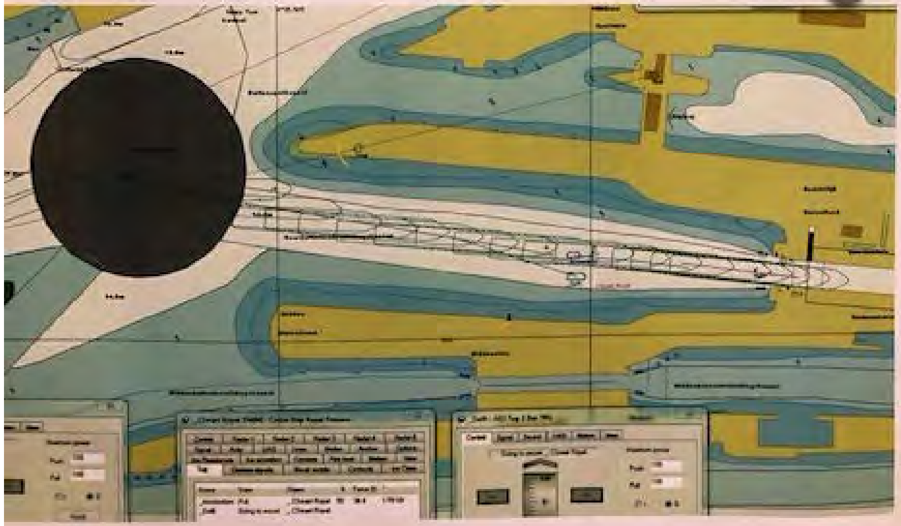
100.0°


HDG 096.0°
HDG 096.0°


HDG 095.9°







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