How Maritime Spatial Planning can jeopardise shipping safety

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Wind energy, oil-gas exploration and shipping

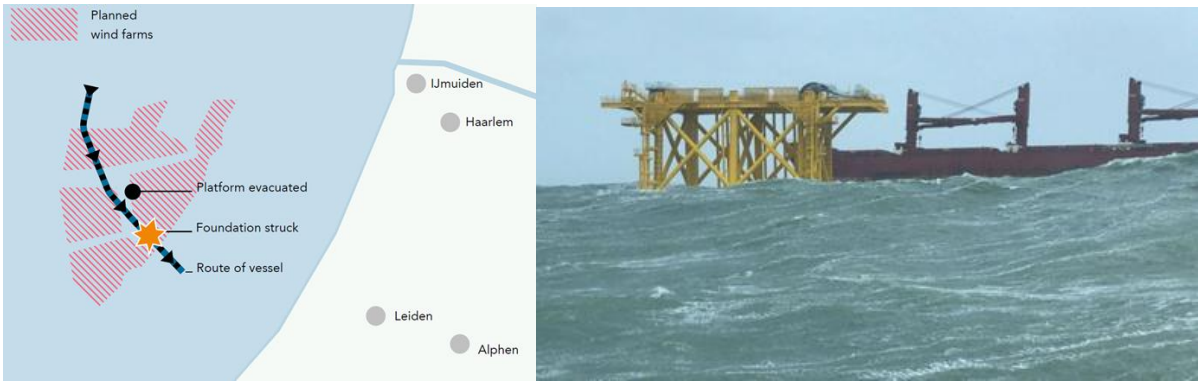
Introduction.

This article is based on the seminar, initiated by the Nautical Institute Netherlands (NINL) branch in collaboration with IFSMA (International Federation of Ship Masters Association), MARIN (Maritime Research Institute Netherlands) and Delft University of Technology: "Safety on the North Sea 2050, the Future has begun" (October 2024). The seminar was based on the report of the Dutch Safety Board (June 2024) regarding the effects of Maritime Spatial Planning (MSP) on the North Sea up to the years 2030-2040-2050 on shipping safety, safety of navigation and risk assessment/management[1].

The decision to start an investigation by the Dutch Safety Board was the bulk carrier "Julietta D" uncontrolled drifting incident during the storm Corrie on 31st January 2022[2]. This incident was classified as a "very serious shipping accident ". It is one of many incidents of an upward trend, involving both ships and (multiple) fixed objects. Successive incidents in the North Sea have possible serious consequences for people, the environment and damage to ships and offshore infrastructure. They may also obstruct the flow of traffic and affect the accessibility of ports. This prompted the Dutch Safety Board to initiate an investigation into risk management for North Sea shipping.

[1] The Dutch Safety Board report can be found on: https://www.rijksoverheid.nl/documenten/rapporten/2024/06/13/ovv-rapport-schipperen-met-ruimte

[2] MARS report incident "Julietta D" in Dutch part of North Sea. https://safety4sea.com/transport-malta-investigation-loss-of-control-of-the-maltese-registered-bulk-carrier-julietta-d/. Marine Safety Investigation Report by Transport Malta 02/2023 final



Drifting Julietta D

The Safety Board study focused on the Dutch part of the North Sea, namely the 12Nm zone and the adjacent Exclusive Economic Zone (EEZ). The investigation was restricted to the risk management regarding the positioning of fixed objects offshore in relation to the safety of shipping.

The present situation.

The North Sea itself is one of the busiest seas in the world. The Dutch EEZ (Exclusive Economic Zone) zone also encompasses the busiest traffic lanes and shipping routes of the North Sea. Northern bound routes to Germany, Denmark, the UK and Norway, via Skagerrak to Sweden and Finland. The Southern bound routes towards The Netherlands, Belgium, the UK and France. The North Sea embraces Europe's largest ports such as Hamburg, Bremerhaven, Amsterdam, Rotterdam, Felixstowe and the ports on the Wester Scheldt. In the Dutch part of the North Sea, the risk of incidents has already resulted in the implementation of VTS, Traffic Separation Schemes (TSS) and other shipping routes, with very complex traffic junctions, shipping composition and intensity[3].

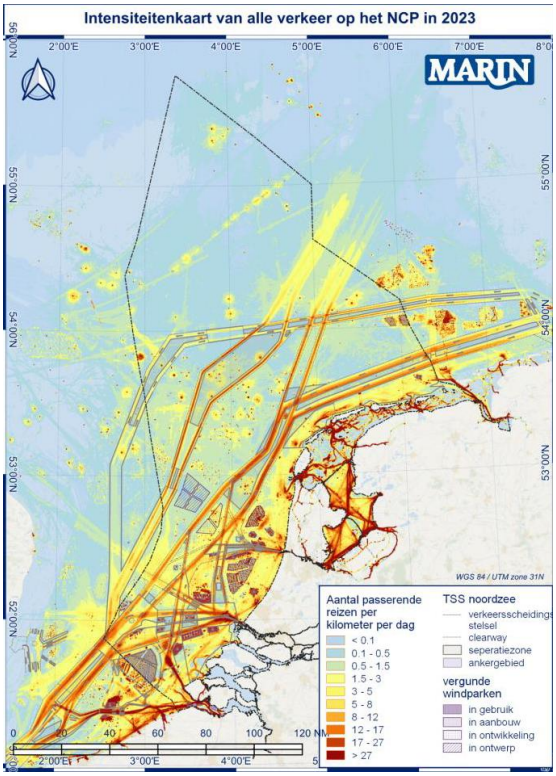
This is mainly reflected in traffic lanes on the North Sea and in port approach areas, some of which extend beyond the territorial waters.

For example at junctions to the port of Rotterdam with annually 70.000 vessel movements or in the TSS (Traffic Separation Scheme) leading to the port entry and with an annual 28.000 vessel movements per sailing direction. See figure X.

Additional there are the service-, recreational- and fishery vessel movements.

The development of large future windfarms will result in additional traffic for the installation, construction, and maintenance phase.

Present estimates for a windfarm are for an additional 5000 vessel movements on an annual basis.



Traffic density North Sea 2023

Recently, the Dutch Safety Board finished a study of the risks to shipping safety from the installation of fixed (multiple) objects and innovative new developments in the North Sea. A large variety of offshore activities

[3] MARIN; network analyse North Sea 2023

will have a claim on the North Sea domain such as fishery, offshore wind energy, offshore oil & gas exploration, anchored floating solar fields, subsea field tidal current generators, anchored wave and swell generators, dedicated military training areas, areas for sand, shell and gravel extraction, offshore farming for fish and shellfish, plus environmental protection areas and artificial islands for the North Sea wind power hub[4]. The Board concluded that the present management of the identified risks is inadequate and that unsafe situations remain unidentified, i.e. the analyses used contains multiple gaps and does not recognise new developments.

Outlook.

The North Sea is under investigation for the installation of multiple offshore windfarms and other new developments. On the Dutch EEZ, within the 12Nm zone there are 700 operational wind turbines. This may result in an increase to perhaps 5500 by the year 2050 within the Dutch EEZ alone. For the entire North Sea, these future developments **will reach tens of thousands of wind turbines**. The political and social pressure for this wind energy targets is urgent and compelling. Far-reaching plans have already been made to allocate available marine space in the North Sea to support this energy transition. However the details are presently unavailable.

The present nautical risk assessment.

From 2018 (last issue 2022) Nautical Risk Analysis (NRA), network analyses, supplemented with IMO-FSA (Formal Safety Assessement) were carried out on the Dutch EEZ and within the 12Nm zone. These are in line with the risk-based approach for maintaining the safety level for shipping in the North Sea. The intent is that the highest risks should all be managed to an acceptable level. The top 10 list of nautical risks to shipping[5], resulted in the following Risk Control Measures (RCM):

1. Periodically carry out NRA, network analyses and IMO-FSA analysis;
2. 1,87NM Safety- and Buffer zone between the TSS and the windfarm boundary;
3. VTMon. (Vessel Traffic Monitoring = passive VTS), focus in- and around wind parks;
4. ERTV's (Emergency Rescue Towing Vessels) requirements;
5. Promoting the use of a North Sea pilot on board;
6. Temporary VTS on board offshore vessels during installation, construction, maintenance and decommissioning offshore structures;
7. Above the Dutch Wadden islands: route differentiation advice for ULCS's (Ultra Large Container Ships), to prevent loss containers;
8. Identified passageway through wind parks; and
9. Standardisation of Dutch AtoNs (Aids to Navigation) including sector lights for wind turbines.

Extension and improvement of the NRA.

Risk assessment and management.

The advanced software used for NRA is designed for drifting and sailing collisions with one standalone platform (oil & gas exploration with an associated risk profile) i.e. not for multiple fixed objects, like hundreds parallel inline standing wind turbines in close proximity to a TSS. The software is not suitable for the present or the foreseeable future. There are no historical data available for shipping close to wind farms. Beside the restricted historical accident and incident data, the consequences of drifting and sailing collisions between ships and wind turbines are also not properly understood, nor are the nautical risks associated. The wind farm, oil and gas exploration are analysed separately in the NRA, making it impossible to get a detailed picture of the total nautical risks. Meaningful NRA is essential before the approval of any developments in the North Sea.

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[4] Grid integration routes, sector coupling. North Sea Wind Power Hub feasibility and preparation studies is co-financed by the Connecting Europe Facility of the European Union: https://northseawindpowerhub.eu

[5] Risk analysis North Sea; Rijkswaterstaat; June 2018

Shipping is also developing, as reflected in the increases in both in ship sizes and cargo capacity. ULCS of 30.000 TEU are expected to enter the market shortly, while at present the latest cruise vessels have 9400 crew and passengers! New shipping classes are coming for Ammonia, CO2, liquid Hydrogen- and LNG (Liquefied Natural Gas) carriers. New energy sources for propulsion e.g. LNG, liquid Hydrogen, Ammoniac, Methanol and Ethanol are likely, but they are not considered in the NRA work.

Resent research shows that vessels sailing in close vicinity of wind farms will experience GPS and AIS distortion and disruption, RADAR multiple blind sectors and interference by false targets and RADAR/ECDIS multipath overlay errors. Communication distortion and disruption on VHF (Very High Frequency), UHF (Ultra High Frequency) and Mobile phone G4 & G5 base stations is also likely. This data has not been considered by the NRA.

Safety- and Buffer zone between the TSS and the windfarm boundary;

UNCLOS[6] (United Nations Convention on the Law of the Sea) and IMO[7] defined a 500m safety zone around an artificial islands, installations or manmade structures. Additionally, to this compulsory safety zone, a buffer zone between the TSS and the offshore fixed objects have been introduced in 2013; in order to reduce the risk of collisions between ships and fixed objects[8]. The additional buffer zone is free of wind turbines and provides space for vessel handling and evasive manoeuvres. The current design criterion prescribes 1.87 NM on the starboard side and 1.57NM on the port side (for a vessel of 400m length) this includes the 500m safety zone. This is based on the emergency manoeuvre that requires the most manoeuvring space, an 360° round turn over starboard or port[9]. These distances are internationally accepted as a design criteria for MSP but are not recognised by IMO[10]. It is promoted in international standards and guidelines[11]. IMO requires sufficient manoeuvring space extending beyond the side borders of TSS should be provided to allow evasive manoeuvres and contingency planning by vessels making use of routeing measures in the vicinity of multiple structure areas. IMO defines for the emergency manoeuvre the 360^0 round turn 6 times the ship length in deep water[12]. The 500m safety and the additional buffer zone is recognised in MSP as one of the most important RCO's in use at this moment in time.

However, the Dutch EEZ has an average depth of 30 to 40 metres, ranging from about 20 to 30 metres in the southern part to 30 to 50 metres in the northern part. To understand the manoeuvring behaviour under realistic hydrological, hydrodynamic, and meteorological conditions in the available manoeuvring space, the Dutch Safety Board initiated research, using the high-end MARIN simulator in the Netherlands[13].

This simulator showed very disturbing results for wind-sensitive and/or heavy vessels[14]. The available manoeuvring space of 1,87NM **is not sufficient**. Above Beaufort 5 the effects of wind forces, wind-drift forces, current forces, shallow water and the motion energy in waves from large wind fields and storms in from the Atlantic Ocean start to be significant. The high-end simulator results showed that manoeuvring and vessel handling of the large wind-sensitive and/or heavy ships in TSS:

1. Beaufort 6-7 manoeuvring and vessel handling starts to be difficult;

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[6] UNCLOS art. 60.5; Vessels of all nations are required to respect them through UNCLOS and Coastal State Legislation.

[7] IMO Resolution A.671(16).

[8] 'Afwegingskader voor veilige afstanden tussen scheepvaartroutes en windparken op zee'; Min.IenW; July 2013.

[9] IMO Resolution MSC.137(76). Standards for ship manoeuvrability, 4 December 2002 and IMO Circular 1053. Explanatory notes to the standards for ship manoeuvrability, 16 December 2002. Additionally a number of IACS classification societies also have requirements for conducting and accepting manoeuvring tests.

[10] IMO Resolution MSC.419(97).

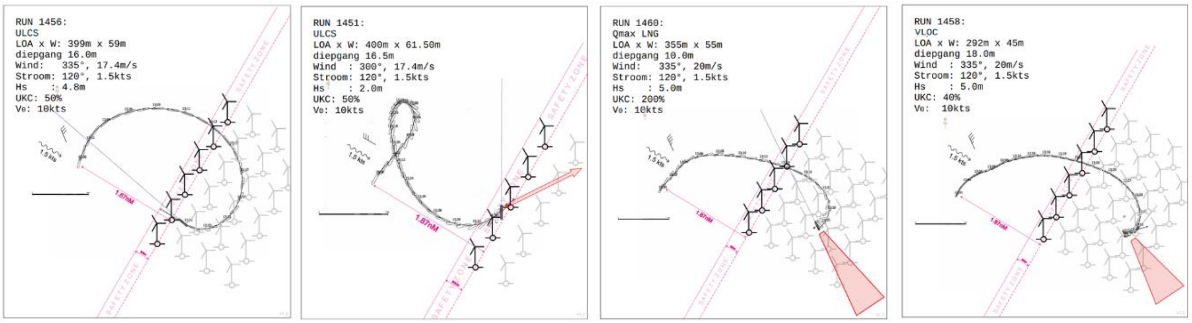
[11] PIANC 161-2018 Interaction between offshore windfarms and maritime navigation (2018), Nautical Institute publication The Shipping industry and Marine Spatial Planning. A professional approach – November 2013.

[12] Annex, Chapter 2, paragraph 2.1.2, IMO MSC/Circ.1053 Explanatory Notes to the Standards for Ship Manoeuvrability, December 2002.

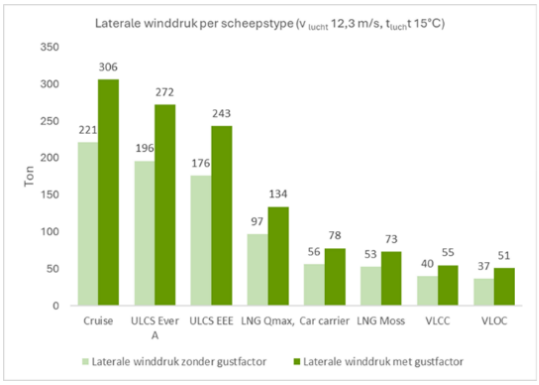
[13] The analyses was performed under the following circumstances Vessel speed 10-13,5 Kts, draughts 10-18m, UKC 40-200%, wind side stern, bow and a beam 10-20m/s, current side stern, bow and a beam 1-1,5Kts, wave-swell beam to bow 2-5m significant.

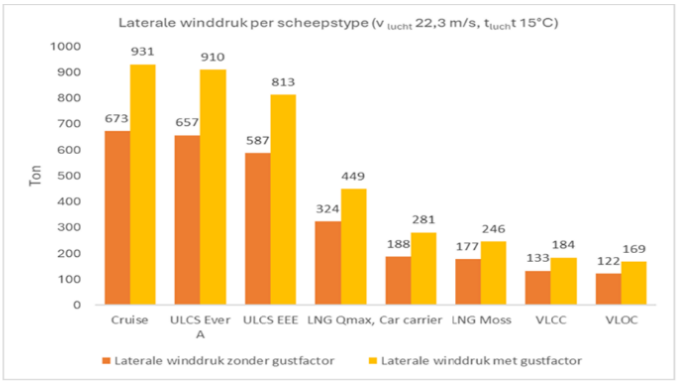
[14] In the MARIN high-end simulator runs the following wind-sensitive and/or heavy vessels where selected: single- and double propeller ULCS, Q-max LNG carrier, VLOC (very Large Ore Carrier). Other wind-sensitive vessels are large car carriers, large cruise ships.

2. Beaufort 7-8 manoeuvring and vessel handling starts to be critical, dangerous and unpredictable;
3. Beaufort 9+ manoeuvring and vessel handling becomes a mission impossible;
4. Vessel manoeuvring behaviour may become unpredictable for the other vessels in the TSS. The manoeuvring tables showing that these classes of vessels will not be able to make a round turn within the 1,87NM in such circumstances, they need much more space. The red arrow and areas in the manoeuvring tables are the uncontrolled drifting areas and directions. All assume no problems with the vessel's equipment;



5. These vessels have a large wind area (green table outcome for Beaufort 6, orange table outcome for Beaufort 9). e.g. a cruise vessel has a lateral wind force area that results at Beaufort 6 in 306 tons and for an ULCS in 272 tons wind force pressure, at Beaufort 9 this increase to 931 tons for the cruise vessel and for the ULCS is 910 tons, including wind gusting factors of 10 minutes.





6. Large wave drift forces, wind pressure forces together with tidal currents can result in a unpredicted 'Not Under Control' (NUC) states for these vessels; propulsion line and rudder steering capability available, no failure of on board critical systems. The result is that these classes of vessels can hardly or are no longer unable to comply with the COLREGS;
7. Low vessel speeds, will result in large wind-drift angles and a larger path width in the TSS;
8. With large wave drift forces and low vessel speeds, course stability and the turning behaviour changes;
9. Large shallow-water effects are noticeable from 50 % Under-Keel Clearance (UKC); at 20 % UKC, the turning circles and stopping distances of these ships can increase by 200% or more (the North Sea is for the most part shallow water);
10. Sudden unexpected NUC status can result in uncontrolled drifting in the TSS and generate cascade effects (complex and multidimensional dangerous traffic situations). In other words unsafe situations with the vessel in the TSS can quickly escalate;
11. In the event of a NUC status, vessels may come to lie abeam and have high, uncontrollable drift speeds from 1,5-3,5 knots;
12. At certain wave heights and periods (wave spectrum), extreme rolling movements and consequently draft increase may occur. This could possibly result in seabed contact or -disturbance, green water on deck, wave impacts (slamming), springing and parametric excitation (rolling-amplification); and

13. As a consequence of extreme movements, shocks and vibrations, these vessels have an increased risk of losing containers overboard or of damage to or loss of the cargo. This can result in mechanical failure of propulsion and/or steering.

VTS on the North Sea;

The history of VTS in the North Sea and the English Channel goes well back to the 1970's. A joint initiative of England, France and the Netherlands in the 1970's initiated new TSS's and a "deep water route" in the English Channel from the Cherbourg TSS to the Euro-channel access channel of Rotterdam (maximum draught 23 m) and later the IJ-channel of Amsterdam. In these TSS's and the deep-water routes in and outside the 12NM zone of England and France with VTS implemented. VTS outside the 12NM zone must comply with the IMO and IALA guidelines and must be based on the same principles[15]. Examples of voluntary, well-functioning VTS operating outside the 12NM zone can be found in the Dutch EEZ for entering the ports of Amsterdam, Rotterdam (up to 45NM from the coast), and the Western Scheldt. Voluntary participation of vessel traffic of the Rotterdam VTS systems outside the 12NM adds up to 98% and for the international VTS systems 95% or more of all vessels.

VTMonitoring

In the Dutch EEZ a new concept of passive VTS is under development, introduced as Vessel Traffic Monitoring (VTMon), it is a new way of passive traffic guidance and monitoring, which is clearly different to the existing VTS as defined by IMO and IALA[16]. The intended mode of operation of VTMon, is vessel monitoring in and around a wind farms and their approaches. VTMon will not be announced in any nautical publication[17]because of its passive philosophy: passing vessels will not made aware that they are sailing in a VTMon area. This is different to the promulgation of the VTS, as noted in IALA Standards, Recommendations and Guidelines The focus of IALA remains on VTS standardisation, harmonisation and uniformity for the shipping industry sailing with international crews. This passive VTMon philosophy is different to IMO and IALA guidelines and requirements and can be very confusing for crews sailing in a non-authenticated VTMon area. Given the fact that effective VTS are operational elsewhere in the Noth Sea and the English Channel, the question may be asked why a VTS has not been introduced for this purpose. This VTMon development, in light of the new NRA findings could create additional unsafe situations rather than addressing and controlling nautical risk.

ERTV's requirements

For many years in the North Sea there is the provision for ERTV's to respond incidents. An ERTV can be used to assist vessels that are adrift or have a NUC status. In this MSP process the VTMon and ERTV control measures are being considered as two of the most important RCM for the purpose of shipping safety.

The present bollard pull requirements for the ERTV's are clearly not adequate to counteract the large wind forces on the wind-sensitive and/or heavy vessels, especially noting the increased size and tonnage of shipping. The ERTV's in service today are mostly normal AHT (Anchor Handling Tugs) from the offshore industry. For the next generation of ERTV's there are no requirements for FMEA (Failure Mode and Effect Analyses) or any reliability QA/QC offshore-standard[18]. The ERTV's are not required to meet the ERRVA (Emergency Rescue Response Vessel Association) internationally good practice standards. Absence of real reliability and operability requirements in light of the new NRA findings means the ERTV, as currently stated,

[15] IALA Guideline G1071 Establishment of a VTS beyond territorial seas, Edition 1.1, January 2022.

[16] IMO resolution 1158. See Chapter 3.1 Purpose of Vessel Traffic Services: The purpose of VTS is to contribute to the safety of life at sea, improve the safety and efficiency of navigation and support the protection of the environment within a VTS area by mitigating the development of unsafe situations through, 28 January 2022.

[17] VTS must be indicated on the sea chart, in sailing instructions, or in other relevant nautical publications (IALA guideline 1142 Chapter 4.3).

[18]The International Maritime Contractor Association (IMCA)192 sets requirements for operational deployment and safety management system checks, according to the eCMID system. The eCMID is an internationally standardised test system for safety management systems.

are not future-prove. The Dutch Safety Board concluded that the deployment of ERTVs as a RCM is of limited effectiveness.

North Sea pilot

The North Sea Pilot is an advisor to the captain on board seagoing vessels all over the North Sea and the routes to and from European seaports. A North Sea Pilot is called in for assistance by the captain, charterer agency, shipping company policy. A North Sea pilot currently has mainly a role as navigator. The North Sea pilot is seen as a possible, effective RCM on board large container ships in the future with all upcoming changes in the offshore infrastructure. At this time, there is no legislation under international or European law to use the service of a North Sea pilot. No pan-European or pan-North Sea regulation or standard is available for (emergency) manoeuvring and vessel handling of large wind-sensitive and/or heavy ships in confined and restricted areas.

Temporary VTS

During the installation phase of fixed objects on the Dutch North Sea, temporary VTS services can be deployed. These services are deployed and funded by the Dutch Coastguard and provided by commercial company[19] from an offshore fixed object or offshore vessel. For these temporary services there is no pan-European or pan-North Sea regulation or standard. A standard should include QA/QC management system, emergency preparedness and emergency response guidelines.

Passage way through wind parks

The policy in the Dutch EEZ and within the 12NM zone is that vessels are not a allowed to sail freely through new wind farms, but for large wind farms a passageway for ships up to 46 metres can be accommodated In the Dutch EEZ. However, there is no standard for such passageways. There are different views amongst the North Sea Coastal States regarding passage lanes near wind farms. There is no pan-European or pan-North Sea regulation standard for the Seawind farm passageways, and this lack of standardisation can be confusing for passing vessel.

Standardisation Dutch sectors navigation lighting wind turbines and AtoNs;

Within the 12NM zone of the Dutch EEZ, the lighting and marking of the individual wind turbines and the wind farm clusters with AtoN's are now being standardised. While there is an IALA Recommendation and Guideline on the marking of offshore structures[20] there is no pan-European or pan-North Sea regulation standard for the North Sea.

The changing operational context for shipping.

It is expected that common practice for shipping will become much more dynamic and complex because of the infrastructure developments in the next decades in the North Sea. In the future the difference between shipping traffic in a TSS and the shipping traffic in the major European seaports will change. It will intensify and tend to merge into one industrial zone. This could have an impact on UNCLOS.

[19] IMO Resolution A.1158(32) "guidelines for Vessel Traffic Services' (VTS), terms and definitions chapter 2.3 VTS provider.
[20] IALA G1162 The marking of offshore man-made structures, edition 1.1, December 2021. IALA R0139 (O-139) The marking of man-made structures, edition 3.0, December 2021.

The navigator will navigate in a channelised TSS between wind farms, oil- and gas exploration platforms and other new developments. There will be less space for ship handling and manoeuvring, and difficulty in finding a safe position to ride out storms, less waiting spots and/or controlled drifting areas. In the future channelised TSS, incidents could result in traffic congestion, blocking of the TSS traffic lane and a limitation of the port accessibility.

To safely guide and monitor large wind-sensitive and/or heavy ships in a TSS close to wind farms, the following additional RCM's could be considered:

1. Separate traffic lane in outer edge of the TSS;
2. A VTS to guide, monitor and inform all surrounding traffic (IMO & IALA);
3. Define Reporting points in TSS;
4. Upgrade of these vessel status when sailing in the area to "restricted in their ability to manoeuvre and maintaining of safety of navigation in those areas";
5. Investigate the mandatory use of well trained, skilled and competent North Sea pilots in defined circumstances;
6. Prediction software for assessing vessel handling and manoeuvrability, to be used by the master to enhance the vessel's resilience in critical circumstances;
7. Shore based prediction software for assessing the traffic conditions during hydrological, hydrodynamic, and meteorological circumstances, to make available through VTS services;
8. All RCM to be standardized and harmonized in pan-European or pan-North Sea for the Mondial shipping sailing with international crews in the North Sea[21];
9. Further complexity of the changing operational context due to upcoming new technical developments such as Maritime Autonomous Surface Ships (MASS) and Port Call Optimalisation (PCO); and
10. Investigate additional equipment requirements (SOLAS) for these vessel to increase vessel reliability and critical system redundancy.

Stakeholder consultation.

In the Environmental Impact Assessment (EIA) procedure of the Dutch MSP-process, shipping safety effects (from installing new offshore manmade objects) were assessed as environmental effects[22]. The effects of the new fixed objects - and their claims on navigable space - on shipping safety as such were not assessed in this procedure. Also, the indirect effects on shipping safety in TSS and hotspots, due to these fixed objects, were not investigated.

At the end of the Environmental Impact assessments (EIA), questions about the completeness of information, and knowledge gaps regarding the consequences of collisions were asked by the EIA Review Committee. The knowledge gaps were recognised in the decisions taken, but it was noted they had no consequences for the actual decision-making[23].

Common law of shipping.

At the seminar, MARIN showed results from network analyses of (historical) shipping traffic routes in which the planned plots for offshore installations interact with many ship traffic routes. The plots for planned wind farms will become restricted areas for vessels, which will need to find other, mostly longer alternative routes. Subsequently current trade patterns may need to be changed, economies of scale need to be reconsidered, and the extra costs for shipping may need to be compensated for.

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[21] All RCM are written from a shore based regulation perspective, not from an vessel operational or technical perspective. more attention should be given to additional vessels SOLAS requirements and vessels equipment functionalities.
[22] Chapter 4.1 of the Dutch Safety Board report 'Compromise on room to manoeuvre; Managing the safety of shipping in an increasingly crowded North Sea'.
[23] Chapter 4.3 of the Dutch Safety Board report 'Compromise on room to manoeuvre; Managing the safety of shipping in an increasingly crowded North Sea'.

The starting point of current Dutch policy is for multiple use of the MSP space in the Dutch part of the North Sea. In the process that followed, the common law of shipping[24] was made secondary to this policy, the spatial assignment of offshore wind farms took preference over recognized TSS essential to international navigation. Hence, the interests of shipping safety, particularly the safety of navigation, may be adversely affected by the MSP process; this should be recognised by the competent authorities.

Precautionary principle.

To deal with the uncertainties and risks which are not manageable by public rules the research suggested **application of the precautionary principle in this maritime domain**. This means that new risk problems resulting from future technologies and their applications need to be identified in advance (pro-active), not as a result of accidents and/or incidents afterwards (reactive, or passive). It also means that the classical risk approach, including formal safety assessments (IMO-FSA and IALA risk toolbox), deserves reconsiderations in this respect.

Policy makers should recognise that in assessing the probability of hazardous scenarios, they should not restrict themselves to assessing empirical data only. It was proposed to consider a new risk approach, in which risks are viewed as an intrinsic aspect of the activities and the operational setting. Consequently, risk assessment implies a thorough understanding of the activities concerned in their operational setting. These views referred to an extended risk approach that was introduced by the Netherlands Scientific Council for Government Policy in 2008, showing how to assess and value new risk problems and uncertainties.

Based on this review, the following conclusions are identified:

1. It should be recognised that future innovative developments correlate with present users in the North Sea instigate new uncertainties for shipping safety.
2. In guarding shipping safety, dealing with uncertainties should be included (as good seamanship does).
3. At this point of time, the current approach to assessing risk, and the overall risk-based approach of Dutch Government deserves reconsideration.
4. Scenario-thinking, using expert sessions, developing multiple incident-scenarios (common- and worst-case scenarios), and correlate the quantitative and qualitative outcomes of all assessments to handle uncertain risks.
5. Scientists, policy advisers and policymakers should adopt an uncertainty-tolerant attitude.

In summary, based on the research carried out, there are questions with regards whether the current implemented RCM are fit for handling the risks identified. The focus on the MSP process without suitable, and corresponding nautical risk scenario development, should be revised to help securing the safety of navigation in the North Sea, provide a consistent and all-encompassing approach for both those onboard ships and those monitoring shipping ashore, and to prevent shipping safety to be jeopardized further.

[24] UNCLOS art. 60.6