NAVIGATUS CONSULTING

Fiordland Risk Assessment Reflecting Increasing Cruise Ship Activity and the grounding of the cruise vessel L'Austral

Prepared for Environment Southland

by

Navigatus Consulting

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Contents

Overview of Report

Sections

This report is organised into four sections:

1. Top ten Fiordland navigation risk issues and proposed mitigation actions.
2. Regional perspectives from national wreck removal exposure study.
3. Review of incident records
4. Passing point analysis
5. Consideration of the introduction of automated vessel tracking technology

The first section describes the ten risks considered most pertinent within the context of increasing numbers of cruise ships transiting through Fiordland. It rates the change in the level of those risks previously identified given the increasing activity. It suggests potential actions that could be taken to further mitigate these risks over and above mitigating factors that are currently in place. The ratings of the top ten risks have been modified from the previous listing by Environment Southland (ES) to reflect increased activity and the effect of proposed mitigations. Of the ten risks, three previous weather-related risks have been combined into one and two newly defined risks being included. These two new risks are; 'vessel conflict/near miss' and 'human factors'.

The second section presents an Environment Southland perspective on the results of a recent study undertaken by Navigatus that investigated wreck removal exposure. This also provides some indication of the Fiordland risk profile.

The third section describes risks related to the four recorded incidents involving cruise ships including the most recent – the momentary grounding of L'Austral, in Milford Sound entrance during February 2017. Where applicable, recommendations regarding mitigations in response to these incidents have been offered.

The fourth section presents the results obtained from an analysis of northbound and southbound cruise ship passing points, with the full report included in Appendix A.

A final short section explores the introduction of automatic tracking technology and its use during pilotage in Fiordland.

Throughout the report, specific recommendations and key conclusions have been highlighted with a boarder and grey highlighting.

Introduction

Fiordland is an important feature in the itineraries of cruise ships visiting New Zealand. While cruise ship activity in the region has been significant for some years, recent and proposed levels of activity have reached a level that has prompted questions regarding the safety of these operations. Of particular note is that the activity now involves, at times, the need for ships to pass in opposite directions. The point at which vessels pass may at times require near real-time coordination between vessels and pilots. This issue is specifically considered in the third part of this report.

Other factors that may affect the risk of Fiordland cruise ship operations include:

- The time required to train pilots for Fiordland operations.
- Number of pilots available (now and ongoing).
- The indirect relationship with cruise ship operators and the regional council.
- Allocation / contracting of pilots.
- Multi-visit days.
- Increasing numbers of vessels.
- Increasing size of vessels and numbers of souls onboard.
- The inherent hazardous nature, environment and remoteness of Fiordland coast and the fiords.
- Differing capability of cruise ship classes.
- Multi-stakeholder environment.

In recognition of the above potential issues, Environment Southland sought this risk assessment to determine the level of risk and consider what mitigations, including planning, rules and limits, may need to be imposed to maintain a tolerable level of risk in the forthcoming seasons and into the future.

The key tasks undertaken to complete this work included:

1. Boarding and riding onboard the Dimond Princess with the Pilot (Port Charmers to Milford Sound).
2. Risk workshop session in Auckland with; Lyndon Cleaver Captain Kees Buckens (Pilot assessor), Kevin O'Sullivan (NZ Cruise).
3. Review and analysis of up-to-date incident records held by Environment Southland.
4. Review of current Environment Southland Fiordland risk registers and prior versions completed over a number of years.
5. Navigational analysis of standard passage plans to calculate a range of expected cruise ship passing points.
6. Presentation and debate of incident analysis and passing point study with Fiordland pilots at pilots' meeting held July 2018.
7. Review of TAIC Report on the grounding of L'Austral in Milford Sound entrance (as made Late July 2018).
8. Extracting Environment Southland and Fiordland portion of analysis of regional council wreak removal liability (undertaken as a separate project).
9. Review of the findings of pilot working group considering the TAIC recommendations.

10. Discussions with the working group lead.
11. Consideration of the use of developing track keeping technologies.
12. Consideration of possible additional risk mitigations.

Context

Maritime activity risk is a function of many complex factors - many of which are created by the environment (geophysical, meteorological, climatic, physical etc.), are human induced (performance, knowledge, communications), or are related to the type and level of maritime activity (number of vessels, type / size of vessels, cargo carried).

For Fiordland, while the real-time factors are influenced by the operational decisions taken by pilots, many underlying key factors are inherent in the physical environment while others are the result of various planning activities over an extended time period. Conversely, maritime activity creates significant economic value to New Zealand and to the Southland region, as well as enjoyment and education for passengers. Thus, provided the operational activity is undertaken safely, it is beneficial to the region and beyond.

Background

A risk assessment has previously been undertaken for Milford Sound; however, this was aimed at tourist launch operations and did not explicitly include cruise ship-related risk. While the heightened risk associated with Fiordland operations has previously been identified—the pilotage requirements reflect this—it is now recognised that there is a requirement to undertake an area-wide risk assessment and profiling of cruise ship operations in Fiordland. This will reflect the significant increase in the level of actively and frequency of vessel passing.

This risk assessment is developed in a way to give both an overall view of risk (the risk profile), as well as to inform procedures, limitations and controls that can be implemented in the near term to mitigate the key operational risks.

Summary

The following summarises the findings of the five parts of this study.

Part 1. Top ten Fiordland navigation safety risk issues:

The rating of some of the top ten risks is not materially affected by the increasing numbers of cruise ships. However, some are notably influenced by the level of activity compounded by the increasing size of vessels. The three prior weather-related risks have been combined and two new risks introduced: Vessel conflict and Humans Performance / Human Factors.

Further mitigations are suggested to address the heightened risks. The most consistent and effective mitigation proposed is the development of a best practice Safety Management System (SMS). Additionally, among the other proposed mitigations, it is noted that any action that can aid human performance should be considered.

Part 2. Regional perspectives from national wreck removal exposure study:

This study gives an indication of how the region's overall navigational risks compares to that of the other regions. It has been determined that the Southland region ranks fourth for overall navigational risk.

Part 3. Review of incident records:

This review focuses on the four cruise ship incidents in the records. The other key incidents are also reviewed to identify aspects that may be relevant to cruise ship operations.

Also considered are the three options put forward to a working Group following the July 2018 Pilots' forum that resulted from the TAIC's investigation of the grounding of the vessel L'Austral. The working group's task was to consider three options and advise which Environment Southland should implement.

- *install AtoN for night navigation purposes;*
- *prohibit cruise ship night time navigation between the hours of "nautical twilight sunset to nautical twilight sunrise"; (Harbourmaster's Direction)*
- *retain status quo*

While the working group recommended the status que option, this risk assessment has identified a range of other additional mitigations for consideration by Environment Southland.

Part 4. Passing point analysis:

This separate analysis found that there is a range of points at which cruise ships may be expected to pass. It also informed the vessel conflict risk listed under the top-ten risks. The identification of 'preferred passing points' is recommended.

1. Top-Ten Fiordland Cruise Ship Risks

This section of this report sets out the ten cruise ship operations-related issues identified as carrying the highest risk. The focus is on those issues that are created by risks specific to cruise ship operations and navigation in Fiordland. Each issue is presented as:

- Issue title and # (for tracking purposes, based on # from original ES risk register)
- The rating of risk resulting from increasing numbers of vessels assuming no further mitigation action (business as usual). This is highlighted on ES Risk Matrix (labelled as 'Revised rating)'. For the purposes of comparison, the original ES risk ratings (both most likely and worst case) are also highlighted on the same matrix (worst case is labelled 'Existing rating')
- Issue description – A brief outline of the identified issue (hazard threat or risk)
- Fiordland factors – Those factors peculiar to Fiordland
- Current mitigating factors – Factors currently mitigating the risk
- Risk rating statement – the revised rating and score assigned using the risk scales adopted by ES – The score reflects the sum of the risk values from the most likely to the worst-case situation. The risk scale is given by the geometric sequence scale representing a 3-time increase in risk between the risk levels: Very Low = 1; Low = 3; Moderate = 9; High = 27; Very High = 81; Extreme = 243
- Additional mitigations that ES could consider – these being suggested by Navigatus as a result of this study, commentary by the Pilots or as promoted by knowledge from other regions or sources.
- The rating of risk resulting from increasing numbers of vessels but assuming additional mitigation implemented. This is highlighted on a second ES Risk Matrix and labelled 'Mitigated rating'. The revised rating (see above) is also highlighted for comparison.

Note that in light of the trend of increasing numbers of vessels (future) and the ability to influence the level of risk associated with some of these issues, the listing is given in the current Risk Register ID # order in so far as possible; this as opposed to a risk ranking of highest to lowest. New risks are listed at the end (Issues #9 and #10). The prior Risk Register ID number is also retained in the header of each matrix to further aid tracking.

The top-ten risks are listed in Table 1 over:

Table 1: Listing of top ten risks, change, and effect of increased activity

Risk Reg ID #*	Description (title)	Change from prior top ten listing	Changed rating due increased activity?
1	Provision and capacity of Emergency Services	Expanded risk title	*Yes - increase*
2	Failure of steering or propulsion	As before	*No change*
6	Fire on board Vessel	As before	*No change*
9	Earthquake or Tsunami	As before	*No change*
10	Injury to passenger on board	As before	*No change*
16	Severe changeable weather conditions	Combined 3 risks	*Yes - increase*
22	Suitability of vessels for transfer role	Improved risk title	*Yes - increase*
27	Larger visiting vessels more frequently	Expanded scope	*Yes - increase*
12	Vessel conflict / Near Miss	Brought into top ten	*Yes - increase*
28	Human Performance / Human Factors	Newly identified risk	*N/A*

** Note: The order of the listing does not donate a ranking within the top ten risks.*

These risks are described in detail in the sub-sections below. **Error! Reference source not found.** gives similar information but presents the effect on risk of the suggested mitigations.

1.1. Details of Top Ten Risks / Issues

Issue 1: Provision and Capacity of Emergency Services

Description

Increased numbers of cruise ships will increase the likelihood that coordination of emergency services will be required if an incident occurs. The large size and capacity of cruise ships may also mean that the capacity of local emergency services is exceeded.

In simple terms, given all else remains equal, for a given increase in cruise ship activity, a similar increase in the chance of an incident must be expected. Equally, the potential capacity demands on emergency services in the event of a major incident increases at least proportionally with the number of persons onboard a vessel.

Provision of Emergency Services (ID = 1)						
	Negligible	Minor	Major	Severe	Catastrophic	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	Revised rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	Existing rating
Risk	252					Revised score

Fiordland factors

Although a large-scale incident of this type can occur anywhere, Fiordland's remoteness makes for a higher level of risk compared with most other parts of the coast of New Zealand. In spite of this, Fiordland can be considered similar in terms of response difficulty to any remote location routinely visited by the cruise lines south of New Zealand and elsewhere where there is a limited national emergency response capacity (in particular, where there are not large air and sea military assets and capability to call upon).

Communication blind spots (VHF shadowing) is a factor that may hinder response efforts should the vessel lose communications capability, and/or survivors are dispersed near to cliffs and ashore.

The cold conditions and frequent poor weather contribute to the risk should persons have to abandon ship.

Current mitigating factors

Support and coordination would come from Rescue Coordination Centre NZ, NZ Police, the Passenger Ship Emergency Plan, on board vessel management systems, and the operator's emergency response teams based at the home base (understood to be typically the USA).

Additionally, the Maritime Incident Response Team (MIRT) has roles and responsibilities which include facilitating the provision of additional external maritime resources required for maritime emergency response to a large incident.

The remoteness and limited far-reach response capability in New Zealand restricts what large scale rapid response could be effectively staged.

While large cruise ships have advanced self-resilience, advanced vessel capabilities, high training standards and are backed by highly capable cruise line operational support, smaller

vessels operated by smaller companies cannot be expected to be as self-sufficient and capable in the case of emergencies. It therefore must be assumed that the chance of an incident requiring emergency response is higher for the smaller vessels and that the level of immediate external support possibly required is also higher.

The greatest mitigation for this issue is prevention of incidents. The continued focus on high standards of pilotage and seamanship must continue.

It is noted that the ongoing enhancement of the VHF coverage has the additional benefit of reducing communication blind spots.

Risk rating

This issue has been rated: Extreme Risk (36 increases to 252 due to higher ship numbers)

Additional mitigations that Environment Southland could consider

1. Given the VHF blind spots and also limited cellular coverage ashore normal lines of communication are not as robust in the Fiordland area as can be typically expected elsewhere. While cruise ship masters can be expected to retain communications with headquarters via satellite channels, the same may not be the case with local NZ authorities and agencies. This weakness would become notable in the case of incidents and emergencies or simply when schedules change. A requirement for all Fiordland Pilots to be equipped with satellite phones to aid local communications under emergency situations would be an effective and simple mitigation. *The use of these phones would also aid pilot to pilot-boat-master communications.*

2. The development of a formal Safety Management System for the Fiordland area and operation that formalises the ongoing review or navigational performance, review of all incidents and the maintenance of existing mitigations within a structured SMS framework.

Provision of Emergency Services (ID = 1)					
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	**36**				

Revised rating
Mitigated rating
Mitigated score

Issue 2: Failure of steering or propulsion

Description

A fire, mechanical, or systems failure may lead to a cruise ship losing steerage, propulsion, or power while transiting a fiord. The consequences of this may include a collision, grounding, oil spill, and the required rescue of a large number of passengers and crew.

Failure of Steering or propulsion (ID = 2)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	No change from existing rating
Risk	**36**					No change from existing score

Fiordland factors

This type of event can occur anywhere but the consequence is heightened in any confined waters—particularly where tugs are not in attendance. This is the case in Fiordland. It would also require provision of emergency services with associated problems already discussed (Refer to Issue 1).

In simple terms, given all else remains equal, for a given increase in cruise ship activity, a similar increase in the chance of a failure incident must be expected. Conversely, the increasing use of advanced electrical steerable propulsion reduces the chance of a single rudder steering failure while the resilient design of large cruise vessels means that the outcome of an onboard fire or similar should be self-containable.

Current mitigating factors

Cruise ships have response plans and standard operating procedures to help prevent and address this issue. Additionally, the Fiordland pilot would assist in finding locations where repairs could be carried out safely.

Risk rating

This issue has been rated: High Risk (36). No change due to higher ship numbers.

Additional mitigations that Environment Southland could consider

The reliability and resilience of cruise ships is beyond the control of Environment Southland. However, continual monitoring of incidents remains an important aspect of Environment Southland's role. As a Fiordland cruise ship SMS framework would create a framework in which to formalise this as a mitigation, the development of an SMS is recommended.

A MOU with Maritime NZ to ensure the timely sharing of all incident information would, if not already in place notably strengthen this mitigation.

Failure of Steering or propulsion (ID = 2)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	No change from existing rating
Risk	36					No change from existing score

Issue 3: Fire on board Vessel

Description

A fire on board a vessel caused by either systems failure or deliberate action may lead to issues with other critical systems if not extinguished, resulting in danger to passengers and crew.

As with many other issues, in simple terms, given all else remains equal, for a given increase in cruise ship activity, a similar increase in the chance of an onboard fire related incident must be expected. Conversely, the increasingly resilient design large cruise vessels means that the outcome of an onboard fire or similar should be self-containable.

Fire (ID = 6)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	No change from existing rating
Risk	36					No change from existing score

Fiordland factors

Fire onboard can occur at any time and location. Fiordland's remoteness may inhibit adequate emergency response (Refer to Issue 1).

Current mitigating factors

Cruise ships have response plans and standard operating procedures to help both prevent and address this issue. Additionally, the Fiordland pilot would assist finding locations where the fire could be extinguished safely.

Risk rating

This issue has been rated: High Risk (36). No change due to higher ship

numbers) *Additional mitigations that Environment Southland could consider*

The capability of cruise ships with regard to fire fighting and survival is beyond the control of Environment Southland.

Fire (ID = 6)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	No change from existing rating
Risk	36					No change from existing score

Issue 4: Earthquake or Tsunami

Description

The significant impact associated with an earthquake or locally induced tsunami can be expected to create significant wave fronts within the narrow constraints of the fiords. Very high, tide-like currents that can overwhelm a vessel's ability to counter, can be expected to be generated in the case of rapid water level changes. Capsize, swamping, impact against rock walls and grounding are all credible outcomes. Very large loss of life and/or injuries can be expected, overwhelming local emergency services.

Earthquake or Tsunami (ID = 9)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	**Low[3]**	**Moderate[9]**	**High[27]**	**Extreme[243]**	**Extreme[243]**	
Likely	**Low[3]**	**Low[3]**	**High[27]**	**Very High[81]**	**Extreme[243]**	
Possible	**Very Low[1]**	**Low[3]**	**Moderate[9]**	**Very High[81]**	**Extreme[243]**	
Low Likelihood	**Very Low[1]**	**Very Low[1]**	**Moderate[9]**	**High[27]**	**Extreme[243]**	
Improbable	**Very Low[1]**	**Very Low[1]**	**Low[3]**	**Moderate[9]**	**High[27]**	**No change from existing rating**
Risk	**30**					**No change from existing score**

Fiordland factors

Earthquakes and tsunamis have historically occurred in the fiords. The shape of the fiords further increases their effects with a subsea slip-induced tsunami also posing a significant risk. Fiordland's remoteness would also impact emergency response time, which may already be stretched depending on the severity of the earthquake and/or tsunami. It is noted that a major release of the Alpine Fault is overdue.

The increase in vessel numbers and passenger numbers increases the overall exposure (societal risk). However, the percentage increase has no material effect on the risk rating.

Current mitigating factors

There will be adequate warning for tsunami generated from more distant sources to ensure that the ship has time to move from the fiord to the open ocean.

Locally generated tsunami (above or below water land slips or major earthquake event) cannot be predicted and response options are very limited, short of turning into wave front.

Emergency planning is understood to have been considered for response to a locally generated tsunami, on land and in Milford Sound.

Risk rating

This issue has been rated: High Risk (30). No change due to higher ship numbers)

Additional mitigations that Environment Southland could consider

As an Act of God, short of avoiding the area entirely, no credible mitigations available.

Earthquake or Tsunami (ID = 9)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	No change from existing rating
Risk	**30**					No change from existing score

Issue 5: Injury to passenger on board

Description

A passenger injury or other medical event on board a vessel that is unable to be handled by on board medical staff may occur. Multiple or ship-wide issues could overwhelm on-board support.

As with many other issues, in simple terms, for a given increase in cruise ship activity, a similar increase in the chance of a medical emergency occurring in the Fiordland area can be expected. However, the percentage increase has no effect on the risk rating.

Injury to passenger on board (ID = 10						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	No change from existing rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	
Risk	**30**					No change from existing score

Fiordland factors

Fiordland's remoteness means that evacuation to a suitable location is relatively more difficult, arguably putting people at further risk.

Current mitigating factors

Cruise ship operators have documented processes and standard operating procedures for dealing with medical issues, including a moderate scale virus issue involving several hundred passengers. However, larger scale issues will require evacuation to the nearest available port for assistance.

That noted, the Master is most likely to opt to retain the person on board until in a position to enable a safe evacuation. This is no different to the case should the event occur well off shore.

For limited cases, the DHB can be expected to advise and arrange hospitalisation. For major events, national level medical agencies are likely to be involved, and the Rescue Coordination Centre will take charge of any evacuations.

Risk rating

This issue has been rated: High Risk (30). No change due to higher ship numbers).

Additional mitigations that Environment Southland could consider

Aside from continuation of the enhancement of VHF communications that may help in some situations, no further Environment Southland mitigation is credible.

Injury to passenger on board (ID = 10						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	No change from existing rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	
Risk	**30**					No change from existing score

Issue 6: Severe changeable weather conditions

Description

Severe changeable weather conditions reduce the safe operating envelope of vessels. See also original issues 8 (met information) and 9 (Weather operating limits) – now combined together. The increase in numbers of vessels increases risk.

Severe changeable weather conditions (ID = 16)					
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	**246**				

Existing rating | Revised rating Revised score

Fiordland factors

The nature of Fiordland's geography means that severe changeable weather is more common than elsewhere. Moreover, the narrowness of some fiords means that winds can be accelerated and the direction unexpected while the vessel's safe operating envelope is reduced (90+ knots of wind is not unusual). Some areas are particularly prone to wind.

Current mitigating factors

Fiordland Pilots Standard Operating Procedures (Section 3.2) addresses local weather conditions. The key mitigation remains good seamanship and sound advice on expected conditions being given to the Master to ensure wise decision making.

Cruise ships now have access to sophisticated weather reporting and forecasting via satellite and decisions are made by the master well in advance of weather fronts and change. This has a significant mitigating effect.

In simple terms, for a given increase in cruise ship activity, a similar increase in the chance of a weather induced event occurring in the Fiordland area. However, the increasing capability of the large vessels due to Azipod propulsion and high-power bow thrusters acts to counter this effect on risk.

Risk rating

This issue has been rated: Extreme Risk (30 increases to 246 due to higher ship numbers). *Additional mitigations that Environment Southland could consider*

While additional weather reporting stations could be considered, the limited area that they can report on limits the value. The advanced systems on board act to mitigate the inherent increase. No specific additional mitigations are therefore suggested.

Severe changeable weather conditions (ID = 16)					
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	**30**				

Mitigated rating
Mitigated score

Issue 7: Suitability of vessels for transfer role

Description

Currently, tourist vessels used for the transfer of passengers and crew to and from cruise ships are not always suited for that purpose. This can potentially lead to incidents including man overboard, trips, and stumbles.

The increasing numbers of cruise vessels can be expected to also lead to an increase in requests to transfer passengers in Milford Sound. This in turn will increase the risk.

Suitability of vessels for roles (ID = 22)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	Revised ranking
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	Existing ranking
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	
Risk	**84**					Revised score

Fiordland factors

Fiordland's proneness to adverse weather conditions such as strong winds may increase likelihood of injury during passenger and pilot transfer.

Tourist vessels are chosen for their suitability for their primary role as opposed to the transfer of passengers.

Current mitigating factors

Passenger transfer vessels have developed a standard operating procedure for moving up to 200 passengers per day to and from overland tours. Also, a limited number of ships are being used to transfer passengers, so that while the ship may not be fit for purpose, it is not unfamiliar to the crew carrying out the transfer. Lastly, a purposely designed pilot vessel with a standard operating procedure for pilot transfer is currently being utilised.

Risk rating

This issue has been rated: Very High Risk (30 increases to 84 due to higher ship numbers)

Additional mitigations that Environment Southland could consider

As part of the existing Milford SMS, consider requiring Cruise Ship Masters and tourist vessel operators to report on all passenger transfer operations (using report template). This would be expected to focus tourist company oversight of transfer training and enable an ongoing picture of the risk to be maintained as part of the ongoing management of the safety of Milford Sound maritime activity

Suitability of vessels for roles (ID = 22)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	Revised rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	Mitigated rating
Risk	**12**					Mitigated score

Issue 8: Larger vessels visiting more frequently

Description

The trend towards larger vessels visiting Fiordland could affect the operation of other vessels and introduce a new scale of potential incidents which, when combined with the increased numbers of vessels acts to increase risk.

Larger visiting vessels (ID = 27)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	Revised rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	Existing rating
Risk	**246**					Revised score

Fiordland factors

As with other issues mentioned, Fiordland's challenging features demand very high standards of seamanship and navigational performance and combine to heighten otherwise routine maritime risks. The area's remoteness also means that incidents that could otherwise be adequately managed through normal means, may exceed response capacity.

Current mitigating factors

Fiordland pilots training, competency and currency are inherently the key mitigation for Fiordland cruise ship risk. Large vessels result in less room for error and require tighter adherence to the Passage Plan and track keeping.

Larger ships tend to also have greater capability and, being effectively flag ships for their lines, will tend to be crewed by highly professional teams.

Risk rating

This issue has been rated: Extreme Risk (30 increases to 246 due to higher ship numbers)

Additional mitigations that Environment Southland could consider

Currently, there is a Deed of Agreement between cruise ship operators and Environment Southland that limits two cruise ships in any waterway at any one time. This could be amended to one ship in the case of; very large ships, for particular Fiords, or if planning manoeuvres. In addition, the total number of vessels in Fiordland at any one time could be restricted to limit the chance of unintended conflict situations occurring.

Development of a Fiordland SMS that meets best practice is likely to be the most effective action that Environment Southland can take to address risk created by the combined effects of larger and greater numbers of vessels.

Larger visiting vessels (ID = 27)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	Revised rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	Mitigated rating
Risk	**30**					Mitigated score

Issue 9: Vessel conflict / Near miss

Description

The incident reports illustrate that unplanned vessel-on-vessel encounters do occur and so must be expected into the future.

While the likelihood for such encounters is highest in Milford Sound, the highest potential consequence could occur at any location where larger ships may be operating on differing courses (or undertaking differing operations) in the same water space. While this is again most likely in Milford Sound, any fiord where vessels may pass or where vessels are conducting any slow speed manoeuvre creates the potential for a near miss.

Cruise ship and vessel interaction (ID = 12)					
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	**28**				

Existing rating | Revised rating Revised score

Fiordland factors

In the case of vessels passaging in opposite directions (North vs South), the passing point becomes the location of potential risk. The Passing point analysis (see Section 4), identified that in most instances the expected point of passing will be outside of the fiords; however, this may not always be the case.

Current mitigating factors

Discussions at the Pilots' Forum in July 2018, showed that the general view held by the pilots was that normal maritime protocols and rules suffice to address this risk. However, there was an agreement that 'preferred' passing points should be defined and passing in fiords during the hours of darkness should be avoided.

Risk rating

This issue has been rated: High Risk (10 increases to 28 due to higher ship numbers)

Additional mitigations that Environment Southland could consider

Define 'preferred' passing points for vessels expecting to pass each other (south bound vs north bound). Prior review of schedules enables advanced planning so masters can be advised of expected vessels and intended and alternative passing points to be determined. Vessels making late changes their passage times would also be expected to advise the other vessel.

Development of a Fiordland SMS that meets best practice is likely to be the most effective action that Environment Southland can take to address risk created by the combined effects of larger and greater numbers of vessels passing as this offers the most effective way of embedding and monitoring operational practice.

Cruise ship and vessel interaction (ID = 12)					
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	**10**				

Mitigated rating | Revised rating
Mitigated score

Issue 10: Human Performance / Human Factors

Note: Given this risk is newly identified, the description, rating and consideration of additional mitigations below is more comprehensive than that for the risks listed before.

Description

As with other issues mentioned, Fiordland's challenging features demand very high standards of seamanship and professional maritime performance of the bridge team and the pilot. While within the pilotage areas, bridge teams must maintain track adherence and situation awareness (SA), this is particularly important in specific situations in the sounds, such as the entrance to Milford Sound and when the vessel is manoeuvring in confined waters. SA refers to the use of appropriate knowledge (held by individuals, captured by devices etc.) that relates to "the state of the environment and those changes as the situation develops" (Stanton et al., 2006, p.1291, in Salmon et al, 2009) – in this case the 'operational environment'. In other words, a dynamic understanding of 'what is going on' and what is the totality of the current situation. In order for a system (in this case a vessel) to operate safely, all operators (crew) need to have access, and pay attention, to relevant information that provides an understanding of a situation compatible with that of the other participants in the system. The incident of the grounding of L'Austral in the Milford Sound entrance provides an example of what can occur when SA within the bridge team is lost (Executive summary in Appendix B). Factors that can impact SA include, procedures, communications, role responsibilities, workload, attention, and individual-level factors that can impact these, such as fatigue.

Workload and its impact on attention are key factors within the fiords. The challenging environment means crew face a high level of cognitive workload and stress, particularly when manoeuvring in less than ideal conditions such as low visibility or poor weather. Under high workload conditions, operators can experience an effect referred to as 'attentional narrowing'. This is where a person's focus narrows to only a particular failed system or they become fixated on particular instruments or information deemed to be the most important and do not monitor other systems – and so in turn, they lose SA. This can be seen in the L'Austral case, where the Pilot was focused on the rate-of-turn information to the detriment of focusing on the vessel's position in relation to the planned course.

Another phenomenon commonly experienced in high workload situations and relevant to operations in the fiords is 'perseveration'. This is where people continue with a strategy that has been effective in the past, despite evidence that it is not proving effective in the present situation. This means that even experienced operators can peruse ineffective actions or fail to notice or rectify dangerous situations in novel or unexpected circumstances. Even, in this case, if the pilot onboard the L'Austral had noticed the vessel's position prior to grounding, he may have continued with his intended course of action (20-degree turn) despite a different response being necessary to avoid grounding. The combination of 'attentional

narrowing' and 'perseveration' results in what is referred to as 'cognitive tunnelling', where attentional resources, decision making and solution development become fixed on a narrow band of information and options at the expense of the overall picture and effective SA. Procedures, information presentation and communication and other factors that reduce individual workload, can assist in mitigating these cognitive impacts.

In the context of maritime operations, recognising and mitigating cognitive limitations such as those described above, is the intent of a methodology known as Bridge Resource Management (BRM). This is a methodology designed to achieve the effective management and utilisation of all resources, human and technical, available to the bridge team, to ensure the safe completion of the vessel's voyage. Key areas include situation awareness, teamwork, decision making and communication. BRM is now acknowledged as a key component of sound large vessel operation and seamanship and a key tool in managing operational risk. Effective BRM can help ensure that the key information needed for effective SA is communicated to all participants in the system when needed. It can also reduce workload and decrease the impact of the cognitive effects described above.

All these important aspects that act to control risk can be classed as Human Factors.

Human Factors (ID = 28)						
	Negligible	**Minor**	**Major**	**Severe**	**Catastrophic**	
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]	
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]	
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]	
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]	New rating
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]	
Risk	**246**					New score

Fiordland factors

As mentioned above, Fiordland's challenging features demand very high standards of seamanship and navigational performance from the entire seamanship crew. The conditions in the fiords combine to heighten otherwise routine maritime risks to a notably higher level. Conditions mean that crew are often operating in high workload situations, making the potentially subject to cognitive tunnelling and loss of SA. Even more so than in other locations, human performance and effective team work are key mitigations of risk.

The development of a fully integrated team able to demonstrate effective BRM and maintain distributed SA is particularly challenging in the fiords due to the limited time the pilot and bridge team have time to get to know each other prior to entering the fiords. It demands training, discipline, extended experience of the ship type and the local area and cultural awareness.

Risk rating

This issue has been rated: Extreme Risk (246). Note, this is a newly defined risk, and hence, has no previous rating.

Additional mitigations that Environment Southland could consider

Given human factors risk, Environment Southland could consider any mitigation that either reinforces BRM practice in the context of Fiordland or that gives assurance that required actions that supports human performance have been undertaken. While Environment

Southland cannot be responsible for the content of training and assurance programmes, it can influence pilot requirements for currency and training course content.

BRM is a key risk mitigation strategy used on large vessels. While it will be up to individual operators to design and enforce the training of their staff, the ability of pilots to integrate quickly into a bridge team is a key skill that can mitigate risk.

While a good understanding of BRM is a recognised aspect of the required knowledge of pilots, and for example, the New Zealand Maritime Pilots Association, frequently includes articles on BRM and HF in its regular magazine, without further research it cannot be assumed that pilot training has included these factors to a level that reflects the demands of operations in Fiordland.

Mitigations actions to consider:

A: Engage with Maritime NZ to encourage the setting of a requirement that pilots must undergo BRM training prior to becoming qualified to pilot in Fiordland.

B: Engage with Maritime NZ to encourage the setting of a requirement for refresher / currency training prior to the cruise ship season. This could be simulator based or involve a passage through the fiords on a vessel as a pre-season refresher. A simulator-based programme has the advantage of enabling scenarios to be played out and, given the formal educational environment, facilitates an awareness of developing best practice thinking across the sector.

C: Engage with Maritime NZ to encourage the setting of a requirement that ensues that pilot training regime for Fiordland is designed around HF principals and that the necessary steps are in place to ensure currency of these skills by undertaking annual (pre-season) refresher training. Such training could bring awareness to cognitive phenomena that could potential impact people's performance. While awareness does not make a person immune to such cognitive impacts, training enables best practice concepts to be progressively developed and maintained across the pilot cohort.

D: It is noted that each of the vessel grounds that have occurred in New Zealand in recent years has occurred while vessels have not been in adherence of the approved passage plan – specifically the vessels have not followed the designated path in a turn – either by turning too early, too late or with insufficient helm. Given the Fiordland passage plan is approved and well tested, but on the understanding that vessels do not always adhere to the defined track, Environment Southland may wish to consider issuing instructions that the Passage Plan is to be followed and the defined track to be followed unless situational factors require otherwise (for example on passing another vessel).

E: Development of a Fiordland SMS that meets best practice is an effective action that Environment Southland could take to address risk created by human factors. An SMS, if properly developed will ensure that the performance of soft controls, including the above suggestions, are assessed and monitored on a regular basis.

Human Factors (ID = 28)					
	Negligible	Minor	Major	Severe	Catastrophic
Frequently	Low[3]	Moderate[9]	High[27]	Extreme[243]	Extreme[243]
Likely	Low[3]	Low[3]	High[27]	Very High[81]	Extreme[243]
Possible	Very Low[1]	Low[3]	Moderate[9]	Very High[81]	Extreme[243]
Low Likelihood	Very Low[1]	Very Low[1]	Moderate[9]	High[27]	Extreme[243]
Improbable	Very Low[1]	Very Low[1]	Low[3]	Moderate[9]	High[27]
Risk	30				

Final rating | Raw rating
Mitigated rating*
Mitigated score

** Note: As this is a newly identified risk, 'Raw risk' refers to the assessed rating given current conditions, 'Mitigated rating' is the assessment given the additional mitigations, and 'Final rating' reflects the effect of the increased ship numbers.*

1.2. Summary of top ten risks

Summary of the top ten risks and how they have changed from the prior assessments is given in Table 2 below:

Table 2: Listing of top ten risks, change, ratings, proposed mitigations and resulting ratings

ID #*	Description (title)	Changed rating due increased activity?	Rating (Most likely / Worst case)	Additional mitigations for ES consideration	Resulting rating
1	Provision and capacity of Emergency Services	Yes	Mod / Extreme	Pilots to be equipped with satellite phones Develop Fiordland SMS	Mod / High
2	Failure of steering or propulsion	No change	Mod / High	Develop Fiordland SMS MOU with MNZ re incident information	Mod / High
3	Fire on board Vessel	No change	Mod / High	Nil	Mod / High
4	Earthquake or Tsunami	No change	Low / High	Nil	Low / High
5	Injury to passenger on board	No change	Low / High	Continued roll out of enhanced VHF coverage	Low / High
6	Severe changeable weather conditions	Yes	Low / High	Nil	Low / High
7	Suitability of vessels for transfer role	Yes	Low / V.High	Require routine reporting as part of Milford SMS	Low / Mod
8	Larger visiting vessels more frequently	Yes	Low / Extreme	Restriction on number of v.large ships in fiord. Develop Fiordland SMS	Low / High
9	Vessel conflict / Near Miss	Yes	V.Low / High	Develop Fiordland SMS	V.Low / Mod
10	Human Performance / Human Factors	N/A	Low / Extreme	Strengthen BRM and HF training requirements. Seasonal currency training. Develop Fiordland SMS	Low / High

** Note: The listing number does not denote ranking within the top ten risks.*

2. Analysis of Incidents

2.1. Overview

This section considers recorded cruise ship incidents and makes a number of recommendations.

An incident register provided by Environment Southland that covered the period between 2008 and 2018 was analysed. Only four records related to cruise ships. These are described below. It is noted that these incidents were discussed at the July 2018 Pilots' Forum. The general view of the room was that the low number of incidents involving cruise ships was indicative of there being no significant issues to address.

2.2. Cruise Ship Incidents

Near miss between kayak and the Ovation of the Seas, Milford Sound, 20/01/2018.

Kayaking guides were not exercising due care which led to a near miss with a cruise ship. The incident is related to Fiordland specifically because the sounds that kayakers are taken through are deep-water and can also accommodate cruise ships. This means that kayaks and cruise ships may come into contact with each other during normal operations.

Unintended interaction between tourist activities and cruise ships must be viewed as a standing risk for Milford Sound. The mitigation of such risks should be considered and address within the framework of the existing Milford Sound SMS.

If not already completed or programmed, it is recommended that this incident be reviewed by the Milford Sound safety committee established under the SMS, and appropriate risk mitigation action taken.

Near miss between kayak and the Golden Princess, Milford Sound, 21/01/2018.

This incident took place the day after the one described above and involved the same kayak company.

Momentary grounding of L'Austral, Milford Sound entrance, 09/02/2017[1]

The L'Austral cruise ship grounded momentarily while entering Milford Sound during night-time conditions.

The Transport Accident Investigation Commission investigated this incident and published a report on July 26 2018 (Executive Summary of report reproduced in Appendix B). TAIC concluded that:

- *The primary means for navigation on board the L'Austral, the electronic chart display and information system, was not being used to its full potential as a tool for planning*

[1] TIAC Final Report MO 2017-202 Passenger vessel L'Austral, grounding, Milford Sound, Fiordland 9 February 2017, dated June 2018.

and monitoring the ship's passage, and the crew were not fully conversant with its safety features.

- *The standard of bridge resource management on board the L'Austral during the Milford Sound pilotage did not meet good industry practice.*
- *Conducting 'blind pilotage' with large ships in confined waters represented risks that had not been fully considered by Environment Southland, the regional authority that regulates maritime activity in the area.*

Therefore, while the narrow passages characteristic of Milford Sound played a part in this incident, human factors, and in particular poor Bridge Resource Management was the key cause in the incident. While the approach to the fiord, the need for pilot and passenger transfers and the required turn within the sound heighten the operational with Milford Sound, human performance and a high standard of Bridge Resource Management (BRM) practice are fundamental to safe operations while in the fiords.

A number of aspects came out of consideration of the above incident by the Environment Southland arranged Fiordland Pilots' Forum held in July 2018. The Forum requested that a Working Group be established and consider implementation of the following three recommendations drawn from the TAIC report;

- *install AtoN for night navigation purposes,*
- *prohibit cruise ship night time navigation between the hours of "nautical twilight sunset to nautical twilight sunrise"; (Harbourmaster's Direction)*, or
- *retain the status quo.*

The Working Group reported back recommending the latter option. (see executive summary in Appendix B and Work Group views and recommendations in Appendix C).

With regard to the options considered above, it is noted by Navigatus, that it would take a number of AtN to enable an adequate positional picture to be developed by a bridge team, and that this would be the case at each location within each fiord resulting in the need for potentially a considerable number of AtN. Even without the complexity and resources required to fit such AtN in the remote and rugged Fiordland area, given the National Park status and Department of Conservation ownership, the associated consenting processes would undoubtedly be a significant burden.

As it is therefore, the progressive development of satellite based high-integrity and independent precise navigation systems that offer a full and complete positional picture to a level of accuracy and confidence far exceeding that available by visual means has effectively made visual sighting to establish vessel position redundant.

Given these technologies are equally effective in good or poor visual conditions and during night-time, the reasoning for the second TAIC recommendation is not self-evident. While blind pilotage does demand a high level of skill of the bridge team, a high level of skill is required to navigate large vessels in the fiords in daylight. Also, provided the Passage Plan is adhered to, a vessel should remain safe regardless of the ability to see the shore line and land features.

The operations where this logic may not hold, are those undertaken outside of the normal published passage plan – these being activity associated with exploring a given area,

anchoring, or unplanned activity forced on a vessel (such as seeking shelter or to anchor

to effect repairs).

It is also noted that Environment Southland requires refresher Blind Pilotage training within 3 years prior to piloting night passages.

Recommendations

1. Given the above points, it is suggested that Environment Southland consider undertaking a specific risk study of operations undertaken outside the scope of the approved passage plan. It is further noted that such operations are most likely to be undertaken by smaller cruise vessels. These may also be less well equipped with modern precision navigation systems and advanced vessel control systems. Such a study may identify area specific risks and consider the capability of the ships likely to undertake these operations.

2. Reinforce aspects of training that support human performance. Specific suggested actions for Environment Southland to consider are detailed under Risk # 10 discussed previously.

Man overboard – false alarm, Queen Victoria, off Sutherland Sound, 16/03/2017

Queen Victoria's electronic MOB alarm system indicated that a person had fallen overboard. However, it was later shown that it had not been a person, but likely a piece of clothing.

This risk is inherent in cruise ship activity at all times and the management falls firmly to the cruise lines. No recommendations are therefore made for Environment Southland to address in this regard.

2.3. Other Incidents Noted.

In addition to these incidents involving cruise ships, listed below are several additional incidents. These involve smaller tourist vessels where the causes are arguably attributable to the nature of Fiordland itself, or could equally have involved cruise ships. The management of safety of tourist operations in Milford is covered by the existing Milford Sound SMS and these incidents should be reviewed and addressed within that framework.

No specific recommendations are therefore made within the context of this report.

Illustrative of Fiordland wind / weather conditions:

- Vessel made contact with the wharf following a gust of wind (Milford Sound, 19/19/2017).
- Vessel made contact with rock wall following a sharp increase in wind speed (Milford Sound, 02/01/2014).

- Passenger blown off feet during strong winds causing injury (Milford Sound, 27/10/2013).
- Vessel collided with wharf following gust of wind (Milford Sound, 29/11/2012).
- Vessel broke free of moorings and grounded following high wind gusts (Deep Water Basin, 23/06/2012).

Vessel near misses due to constrained / shared operating areas:

- Near miss between two vessels (Milford Sound, 02/01/2013).
- Near miss between vessel and kayaks (Milford Sound, 27/11/2012).
- Near miss between vessel and kite surfer (Milford Sound, 19/01/2010).

Underwater hazards that could damage propulsion systems:

- Vessel struck submerged log (Crooked Arm, undated).

3. Wreck removal exposure risk – Fiordland

3.1. Explanation

A recent study undertaken by Navigatus investigated exposure to costs of wreck removal following a total loss given the number and type of vessels transiting through an area (represented by 10km hexagonal cells) and the associated navigational hazards with that area. Figure 1 below shows how exposure to these costs compares to that of other regions. As can be seen, Southland ranks fourth for overall navigational risk.

Figure 1: Relative exposure to wreck removal exposure across regions

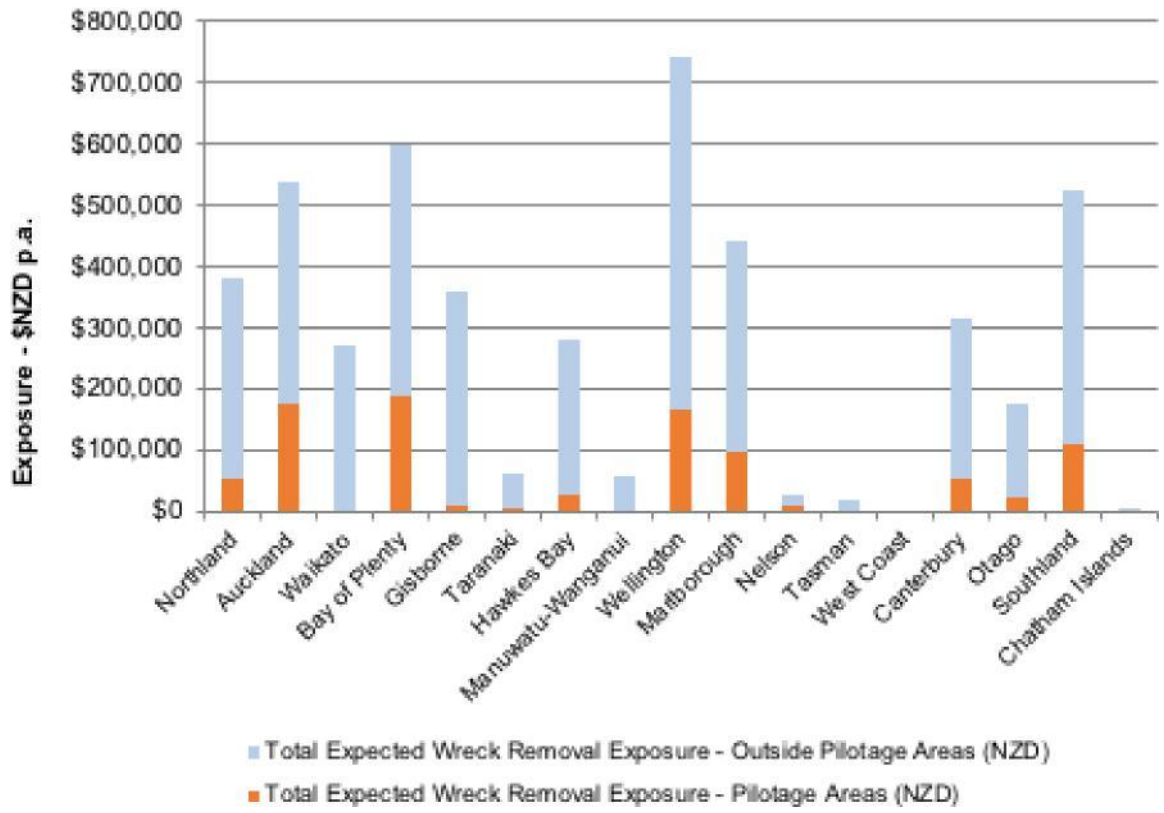


Figure 2 shows how the vessel types contribute to risk for the Southland region as a whole. Evident from the graph is that Foreign Cargo and Passenger vessels represent the majority of risk. Cruise ships represent a significant contributor to this category.

Figure 2: Vessel types contributing to risk - Southland

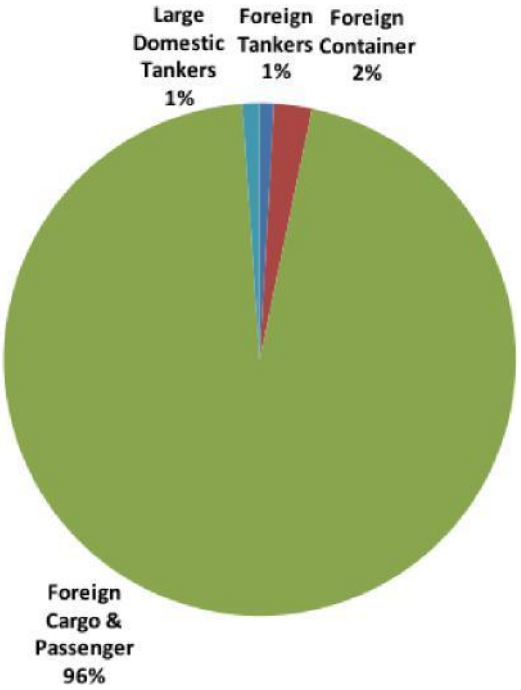
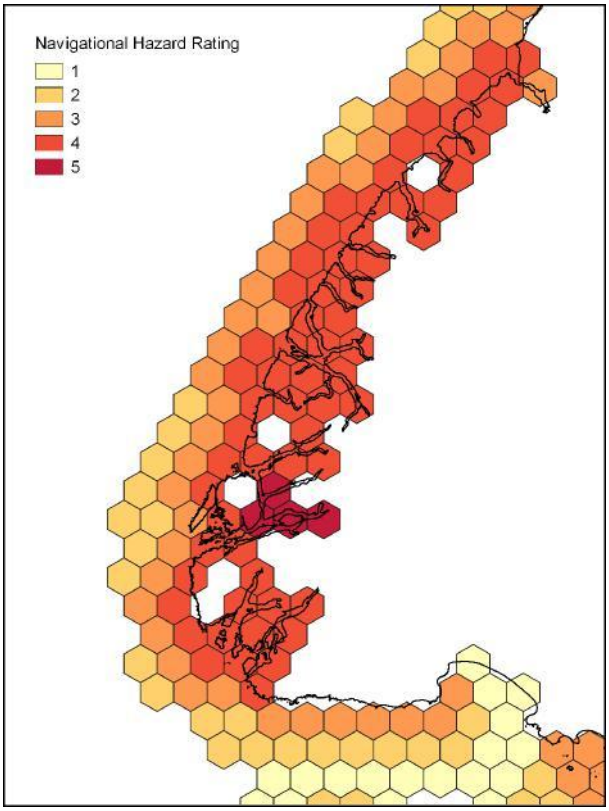


Figure 3 displays the navigational hazard ratings calculated for the Fiordland region. These range from 1 (minor) to 5 (critical), taking into account the density of shipping activity, the physical characteristics of the coastline, and other environmental conditions.

Figure 3: Navigational hazard ratings – Fiordland



3.2. Conclusions Drawn from Project

This separate project offers a broad context setting perspective of the Region's overall maritime risk exposure and serves to highlight the dominant effect of the Fiordland cruise ship activity on that exposure. This in itself will not be a revelation; however, the project usefully quantifies, in relative terms, how the region sits relative to others.

As stated previously, Southland ranks fourth for overall navigational risk.

It is considered that 'wreck removal exposure' equates closely to a region's overall regional navigational risk relative to that of other regions. Given that Southland comes fourth compared to the other regions, this serves to highlight the relative high level of risk the region is exposed to as a result of the cruise ship activity.

4. Summary of Cruise Ship Passing Point Analysis

At the commencement of this 2018 assessment of risk for Fiordland, it was understood that there was no agreed protocol as to where vessels may pass or should pass as a result of some heading south and others north. As a result, the work included a specific analysis to determine where ships can be expected to pass each other given various routine situations and circumstances. A summary is presented below along with the full analysis report reproduced in Appendix A.

The findings of this analysis were summarised, presented and debated at the 2018 Fiordland Pilots' forum.

4.1. Summary of analysis undertaken

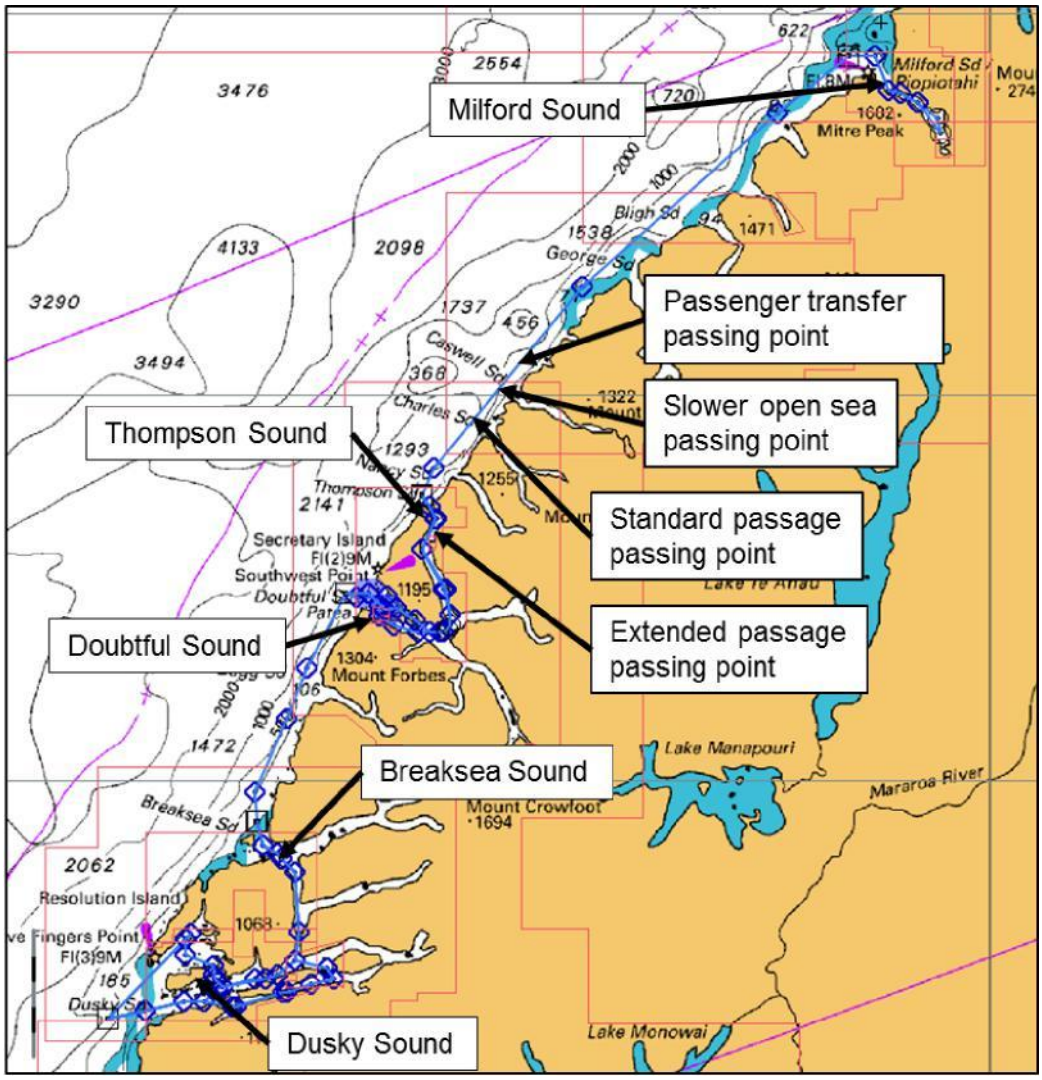
With reference to waypoints and speeds detailed in the passage plans contained in the pilots' standard operating procedures, northbound and southbound cruise ship passages through Fiordland were examined using LINZ NZ Charts. A chart plotter programme was used to determine likely passing points in different scenarios where both ships begin their journey at the same time. The full report can be found in Appendix A.

The four scenarios considered were:

- 'Standard Passages', where both the northbound and southbound ships follow the standard passages.
- 'Passenger Transfer', where both northbound and southbound ships follow the standard passages but with an additional 30 minutes spent in Milford Sound carrying out a passenger transfer.
- 'Extended Passages', where the northbound ship follows the longest passages (i.e. Dusky Sound to Breaksea Sound via Paget Passage, and Doubtful Sound to Thompson Sound via the Gut) and the southbound ship remains on the standard passages. Neither ship takes part in a passenger exchange.
- 'Slower Open Sea Passage' where both the northbound and southbound ships follow the standard passages, but their open sea passage is carried out at 15 knots, instead of 20 knots.

Results are presented below in Figure 4.

Figure 4: Cruise ship passing points



The blue line represents the passage taken by the cruise ships, the blue diamonds represent waypoints, and the black squares representing sound entry and exit waypoints.

From this study it can be reasoned that:

- Increasing the delay of the southbound ship leaving Milford Sound moves the passing point further north. This delay could be by:
  - A delay due to a passenger transfer in Milford Sound;
  - The ship crossing the open sea between Milford Sound and Doubtful Sound at a lower speed; or
  - By the ship starting the passage later.
- Increasing the delay of the northbound ship leaving Thompson Sound moves the passing point further south. This delay could be due to:
  - Extending the passages taken;
  - The ship crossing the open sea at a lower speed; or
  - By the ship starting the passage later.

It is reasonable to assume that passing in the open sea can be undertaken safely using existing procedures. It is also reasonable to assume that passing within the confined space of a sound carries a heightened, and probably unacceptable, level of risk. The aim must therefore be to ensure that ships pass in the open sea. Any measure that moves the passing point further north is therefore to be welcomed, whilst anything that moves the passing point further south is to be avoided.

4.2. Conclusion of debate at Pilot's forum

The findings of the analysis as described above were debated at the 2018 Fiordland Pilots' meeting in July 2018. The forum agreed with the analysis; however, the general view held was that normal maritime protocols and rules suffice to address this risk. There was an agreement that 'preferred' passing points should be defined and passing in fiords during the hours of darkness should be avoided.

ACTION: Define and publish 'preferred passing points' for large cruise ship operations in Fiordland. It is noted that to pass in a fiord, ships will need to depart the passage plan track. It therefore follows that the preferred passing points should ideally be outside of fiords and if points within fiords are selected, the passage plan should be updated to reflect this.

5. Use of Track-Keeping Technologies

During the 2018 Fiordland Pilot's meeting in July 2018, a question regarding the acceptability or otherwise of the use of Track-Pilot was raised.

Automated track-keeping technologies can either maintain a steady ship's head, maintain a steady track to a given waypoint, follow a pre-defined track including following curved paths, have advanced control passage speed to optimise arrival time, and also act to help control vessel behaviour while at anchor. Example modes include:

> **Track mode:** In track mode the system steers the vessel along a sequence of waypoints. Wind and current are considered and a drift correction angle is computed to aid track adherence.
>
> **Anchor control mode:** In this mode, the system monitors the vessel riding at anchor and automatically controls the stern thrusters to keep the vessel on the preferred heading and within a pre-defined area.
>
> **Speed control - arrival mode:** The system is given a destination arrival time and it then calculates automatically the required set speed in order to reach the destination at the required time taking due account of current and wind conditions.

Further modes, such as required for docking, approaching moorings etc. are also advertised as being available by various manufacturers.

These systems have been made possible by the progressive development of satellite-based high-integrity and independent precise navigation technology and are just one of a range of continually developing aids to bridge teams.

As with the general development of most other vessel systems—in particular navigation system—it is difficult to see how Environment Southland can possibly influence their use. Likewise, Environment Southland are unlikely to be able to influence ship's staff training on these systems as they become more commonly used. In the case of Fiordland pilotage, it is self-evident that pilots need to be comfortable with the way a vessel is being conducted (con) and confident that the vessel remains safe.

Given the above, it is concluded that this technology should be allowed, subject to the acceptance of the pilot prior to its use and close monitoring of its performance and use by the bridge team. This is likely to require the pilot to engage with the master on how he proposes to use the various systems on board and for them to, together, determine the optimum practice within the context of the vessel, the technology, its intended use and the training and competency of the bridge team.

6. Summary

The following summarises the findings of the four parts of this study:

1. Top ten Fiordland navigation safety risk issues:

The rating of some of the top ten risks is not materially affected by the increasing numbers of cruise ships. However, some are notably influenced by the level of activity compounded by the increasing size of vessels. The three prior weather-related risks have been combined and two new risks introduced: Vessel conflict and Humans Performance / Human Factors.

Further mitigations are suggested to address the heightened risks (see Error! Reference source not found.). It is noted that the following two are considered of particular importance:

- The most consistent and effective mitigation proposed is the development of a best practice Safety Management System (SMS)
- Additional training to address human performance (HF and currency) and BRM.

2. Regional perspectives from national wreck removal exposure study:

This study gives an indication of how the region's overall navigational risks compares to that of the other regions. It has been determined that Southland ranks fourth for overall for navigational risk. This ranking is driven to a significant extent by the Fiordland cruise ship activity.

3. Review of incident records:

This review focuses on the four cruise ship incidents in the records. The other key incidents are also reviewed to identify aspects that may be relevant to cruise ship operations.

Also considered were the three options resulting from the TAIC's investigation of the grounding of the vessel L'Austral that were put forward to a working Group following the July 2018 Pilot's forum. The working group's task was to consider the three options and advise which Environment Southland should implement.

- *install AtoN for night navigation purposes;*
- *prohibit cruise ship night time navigation between the hours of "nautical twilight sunset to nautical twilight sunrise"; (Harbourmaster's Direction)*
- *retain status quo*

While the working group recommended the status que option, this risk assessment has identified a range of other additional mitigations for consideration by Environment Southland.

4. Passing point analysis:

This separate analysis found that there are a range of points at which cruise ships may be expected to pass. It also informed the vessel conflict risk listed under the top-ten risks. The identification of ‘preferred passing points’ is recommended.

5. Tracking technology

This section explores the introduction of automatic tracking technology and its use during pilotage in Fiordland. It is concluded that this technology should be allowed subject to the acceptance of the pilot prior to its use and close monitoring of its performance and use by the bridge team.

Appendix A. Analysis of Cruise Ship Passing Points

[Attached over – note with separate page numbering]

Appendix B. Exec Summary L'Austral, grounding

Executive Summary of Final report MO-2017-202: Passenger vessel L'Austral, grounding, Milford Sound, Fiordland, 9 February 2017

1. Executive summary

1.1 At about 0530 on 9 February 2017, the passenger cruise ship L'Austral began its entry to Milford Sound with an authorised harbour pilot on board. Because it was dark and there were no external visual navigation aids, the bridge team was using only the ship's electronic navigation systems to conduct the pilotage.

1.2 As the ship was making a turn off Dale Point, the pilot lost awareness of exactly where the ship was, the direction in which it was heading and the effects of the wind and tide on the ship.

1.3 The L'Austral deviated well off the planned track and struck a stony bank near the shoreline of Milford Sound. The ship suffered scraping and indentation of the hull on its starboard side, but the hull was not breached and nobody on board was injured.

1.4 The Transport Accident Investigation Commission (Commission) found that the ship's crew on the bridge noticed the ship was off its planned track but did not bring this to the pilot's attention until it was too late to avert the grounding.

1.5 The Commission found that the bridge team were not making full use of the ship's electronic navigation systems to ensure that the ship stayed on track.

1.6 The Commission identified three safety issues:

- the primary means for navigation on board the L'Austral, the electronic chart display and information system, was not being used to its full potential as a tool for planning and monitoring the ship's passage, and the crew were not fully conversant with its safety features
- the standard of bridge resource management on board the L'Austral during the Milford Sound pilotage did not meet good industry practice
- conducting 'blind pilotage' with large ships in confined waters represented risks that had not been fully considered by Environment Southland, the regional authority that regulates maritime activity in the area.

1.7 The Commission repeated two previous recommendations to the ship's operator (Compagnie des Iles du Ponant) and made one new recommendation to Environment Southland to address the safety issues.

1.8 The Commission had previously found that poor bridge resource management under pilotage was a factor contributing to accidents involving two other ships in New Zealand. Their two reports had made several recommendations aimed at improving the standard of pilotage and making the transition of the pilot into the ship's bridge team seamless.

1.9 Key lessons arising from this inquiry were:

- a ship's passage plan is more than just the planned track for the ship to follow. Every part of a ship's voyage must be planned and all members of the bridge team be fully familiar with and agree to the plan. This is a cornerstone of good bridge resource management
- good bridge resource management relies on a culture where challenge is welcomed and responded to, regardless of rank, personality or nationality

- an electronic chart display and information system is a valuable aid to navigation. However, mariners need to fully understand and be familiar with all aspects of the system, particularly when using it for blind pilotage.

Appendix C. Response to TAIC recommendations

Working Group response to TAIC recommendations from the L'Austral grounding incident

The following is a copy of correspondence regarding the Working Group's recommendations.

From: Kees Buckens [mailto:Kees.Buckens@manukau.ac.nz]
Sent: Wednesday, 15 August 2018 10:50 a.m.
To: Lyndon Cleaver
Cc: 'Craig Holmes - gmail'; 'doran wadd@yahoo.co.nz'
Subject: L'Austral Grounding & TAIC Recommendations

Dear Lyndon,

Further to our meeting in July and the request to formulate a recommendation to the ES Council to answer the TAIC recommendation regarding entrance into Milford Sound in darkness and other Fiords/Sounds: ***"prohibiting night time navigation of certain passages if that were felt necessary***".

You provided three options for us to consider:

- *install AtoN for night navigation purposes;*
- *prohibit cruise ship night time navigation between the hours of "nautical twilight sunset to nautical twilight sunrise"; (Harbourmaster's Direction)*
- *retain status quo*

Following are the workgroup's considerations and the recommendations to retain the status quo: **Need to maintain status quo**

Emergencies such as medivacs, and non-emergencies such as shelter from weather as well as requests for night time pilotage from customers mean that ships and pilots will inevitably be caught inside fiords or be otherwise required to be there during hours of darkness and pilots need to be competent, as indeed they already are, to navigate in the fiords during those times.

Risk assessment for navigating in hours of darkness

A search of SOLAS Chapter V, Safety of Navigation; STCW; and other IMO publications we could not find any reference to specific requirements regarding night time navigation. Navigation in the hours of darkness, or restricted visibility. Navigating in hours of darkness and restricted visibility is part of the normal operation of a vessel and all officers, crew and pilots are trained for this. Maritime Rule, Part 90 requires a structure training programme for pilots that includes night time navigation and it refers regularly to night time navigation, including in subpart F: 90.106 where it refers to the visibility and characteristics of lights and fog signals that must be included in the training programme.

Navigation includes navigating by sight, radar and GNSS using all available navigation equipment and instruments on board. *SOLAS – Chapter V, Safety of navigation, Regulation 19* requires amongst others the carriage of both X-band and S-band radars, two independent ECDIS systems (with independent (GNSS) positioning inputs), AIS, as well as Gyro, speed log and depth sounder. Vessels will also carry Rate of Turn indicators (mandatory for vessels > 50,000t) as well as rudder and engine indicators. Cruise ships are typically equipped with an integrated bridge system that *"Integrated bridge systems, shall be so arranged that failure of one sub-system is brought to the immediate attention of the officer in charge of the navigational watch by audible and visual alarms and does not cause failure to any other subsystem In case of failure in one part of an integrated navigational system, it shall be possible to operate each other individual item or equipment or part of the system separately"*

Considering the above, the risk assessment for entering narrow passages in Fiordland should take consideration of the specific risks associated with entering the Sounds and Fiords, in particular in the hours of darkness (and restricted visibility). During the hours of darkness the information and senses obtained by sight have been reduced and must be compensated for by posting additional lookouts, and heightened concentration and focus on the radar and ECDIS. In particular, the use of radar overlay or chart-radars increases the situational

awareness of the navigation team (including the pilot) and the use of a personal Portable Pilot Unit by the pilot is an additional risk mitigating instrument. When using this equipment, the approved passage plans should be uploaded and monitored on all available equipment, including ECDIS and PPU when carried.

As per SOLAS chapter V/reg.34 the Master of the vessel is responsible to prepare a passage plan as per IMO resolution A.893(21). Upon boarding, the Master and Pilot should exchange information that must include an agreement on the passage plan, as per IMO resolution A.960(23). Environment Southland has prepared such passage plans, for all Sounds and Fiords, that have been moderated and accepted by both pilot organisations that provide pilot services to Fiordland compulsory pilotage areas. These passage plans provide for course, speed, wheel over line and Radii for all legs of the plans* and it is imperative for maintaining good situational awareness that the vessels adhere to these approved plans. The passage plans are available to all ships via the Environment Southland website and on request.

* The moderated and approved passage plans for all Sounds and Fiords are generic plans with most radii set at 1 nautical mile, i.e. requiring a rate of turn (ROT) equalling the ship's speed. This rate of turn can be achieved by all ships without creating undue list to the vessel at the prescribed speed for each leg.

Need for additional AtoM's

Due to the remoteness of the region and associated problems of monitoring, maintenance and cost of installing a comprehensive network of AtoM's, we acknowledge the impracticality of installing such network.

Conclusion

Therefore we recommend that no changes should be made to the current requirements of navigating in the Fiordland area.

Best wishes,

From: Lyndon Cleaver [mailto:Lyndon.Cleaver@es.govt.nz]
Sent: Monday, 23 July, 2018 10:22 a.m.
To: Vin Smith <Vin.Smith@es.govt.nz>
Cc: Sean Bolt (sbolt@portotago.co.nz) <sbolt@portotago.co.nz>; Geoff Finnerty (GFinnerty@southport.co.nz) <GFinnerty@southport.co.nz>; Kees Buckens <Kees.Buckens@manukau.ac.nz>
Subject: L'Austral Grounding & TAIC Recommendations

Hi Vin

A quick update on the outcome of the discussions around the TAIC recommendations at the Annual Fiordland Pilots meeting last week.

One of the TAIC recommendations were that the regional council could take to better manage the risks to navigation safety within Fiordland , including: "prohibiting night time navigation of certain passages if that were felt necessary".

I informed the group that I have several options to consider on how the Council would be best placed to address the recommendation:

- *install AtoN for night navigation purposes;*
- *prohibit cruise ship night time navigation between the hours of "nautical twilight sunset to nautical twilight sunrise"; (Harbourmaster's Direction)*
- *retain status quo*

The general consensus from both pilotage providers, was that there was no need to apply night time navigation restrictions on cruise ships in Fiordland. The group feels that this was an isolated incident, they are professional mariners and there is sufficient training and experience in place to mitigate such events occurring again.

To better inform and assist the Council with the decision making process on a suitable action, I have asked both pilotage providers to form a group headed by Kees Buckens (ES independent pilotage auditor) and supply me with recommendations.

The findings from the group will need to be completed before 30 September 2018, which is the date by which we need to reply to TAIC on the action/s that we intend to implement.

Regards

Lyndon Cleaver
Maritime Manager - Harbourmaster
Environment Southland *Te Taiao Tonga*

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