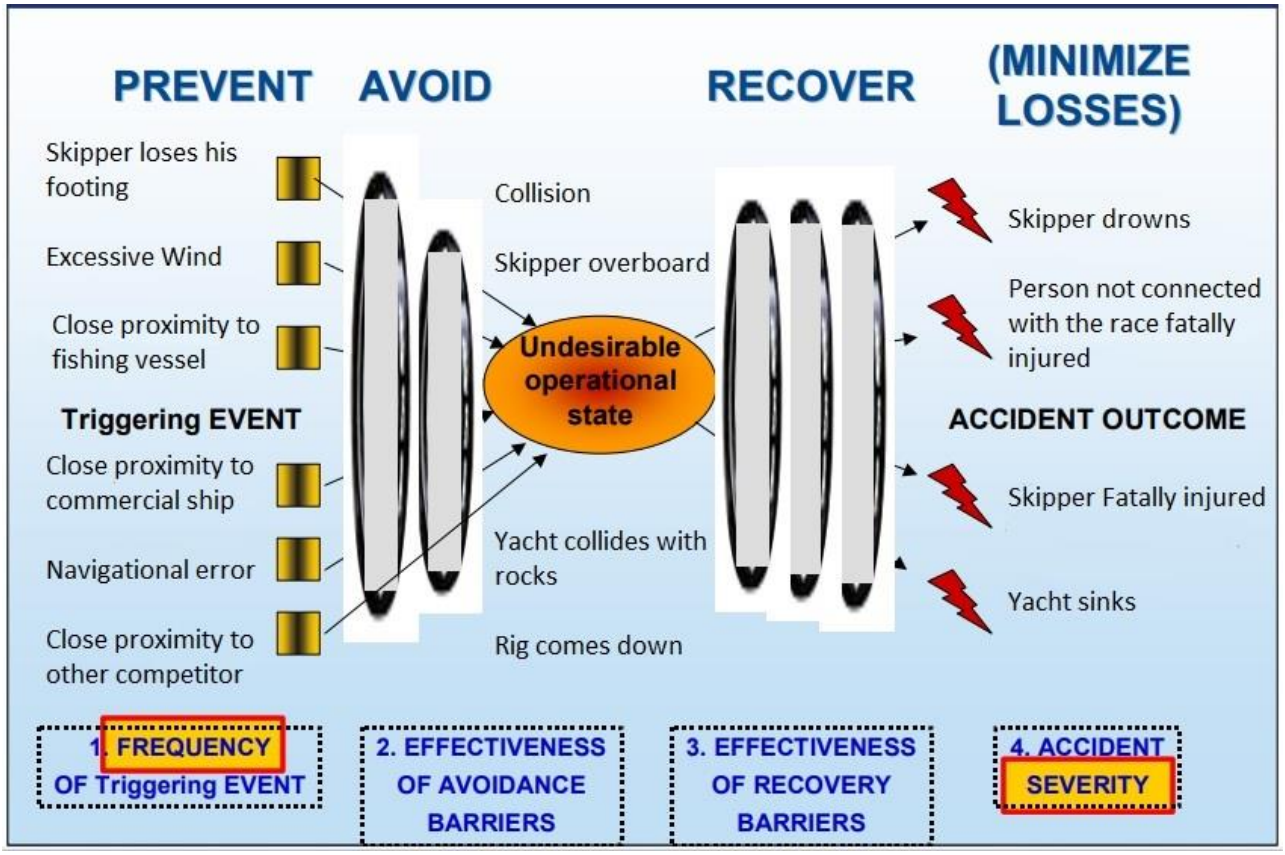
Safety Issue Risk Assessment – SORC soloFASTNET

Revisions:

Version	Date	Description	Made By
Original	17 Dec 15	Original draft	Richard Breese
Rev 1	09 Feb 16	Edited in accordance with comments received from Subject Matter Experts and Round the Rock Race director.	Richard Breese
Rev 2	11 Feb 16	SORC Director of Racing & Round the Rock Race Director validations added / minor correction / SME Comments Appendix removed.	Richard Breese
Rev 3	22 Mar 16	Paragraph 3.1 changed to “sleep and fatigue management” to emphasise this issue, subsequent paragraphs re-numbered / paragraph on “sleep and fatigue management added to conclusions. / Minor corrections.	Richard Breese
Rev 4	23 Jan 18	References to “Round the Rock Race” changed to “soloFASTNET”, “Assumption – Compliance with Special Regulations” amended to take account that the RC may accept deviations that have been mitigated in another way. Addition of Paragraph 0 – Terms, Definitions & Concept. Change to the assumption that the skipper will have significant experience in the boat he will take part in. Addition of AIS man overboard beacon as this is a requirement of the revised Cat 2 Regs. Likelihood that both yachts will not sink in the event of a collision added. Various editorial changes following review by Kirsteen Donaldson & Jerry Freeman.	Richard Breese

0 – Terms, Definitions & Concept

This Risk Assessment is based around the concept that an accident will always be the outcome of a chain of events and that if this chain is broken the accident to be prevented as depicted in the following diagram;



The terms used in this concept and definitions of these terms are as follows;

Triggering Event – A reasonably common occurrence which could start a chain of events leading towards an “Accident Outcome”.

Avoidance Barriers – The barriers in place which will normally prevent the chain of events progressing from “Triggering Event” to “Undesirable Operating State”.

Undesirable Operating State – A seriously compromised operating state where the “avoidance barriers” have failed to prevent the chain of events from progressing towards an “Accident Outcome”. In some cases, the “Undesirable Operating State” might be considered to be an accident in its own right, just less serious than the “Accident Outcome” for the given scenario.

Recoverability Barriers – The final barriers in place which might prevent the chain of events progressing from “Undesirable Operating State” to “Accident Outcome”.

Accident Outcome – The envisaged likely outcome if the “Recoverability Barriers” fail to prevent the chain of events progressing beyond the “Undesirable Operating State”, in the context of this Risk Assessment this is considered to be the point where loss of life occurs, either to a competitor or a person not involved in the race.

1 - Executive Summary

The safety issue being assessed here is the risk to life (both to competitors and the general public) that will be present during the SoloFASTNET.

This SIRA (Safety Issue Risk Assessment) has been prepared to compliment the "Port Marine Risk Assessment" that SORC (Solo Offshore Racing Club) already has in place to assess and highlight the risks and mitigating measures (avoidance & recoverability barriers) applicable, this SIRA addresses the areas of the greatest risk to life in more detail and in the context of the SoloFASTNET.

The intention of this SIRA is to assist the organisers of, and competitors in, the SoloFASTNET in fully understanding the level of risk that will be present during the race. It is not however intended to reduce in any way the sole responsibility of the person in charge for their own safety as defined in Racing Rules of Sailing (RRS) Rule 4 *"The responsibility for a boat´s decision to participate in a race or continue racing is hers alone."* and World Sailing Offshore Special Regulations 1.02 Responsibility of Person in Charge.

This SIRA does not attempted to define what an acceptable level of risk is, the colour coding used for the outcome is intended to represent the relative level of risk associated with the outcome from each scenario and not whether any particular level should be considered acceptable or not.
It is for each individual skipper to decide what an acceptable level of risk is for them when deciding whether to participate in the race or not.

It is suggested that the colour coding might be used by skippers in the following manner, however it is the responsibility of the individual skipper to determine his response the findings presented in this risk assessment and the risks present.

Red	Highest risk level – skippers should look carefully at these scenarios in order to determine whether the level of risk as acceptable to them, it is strongly recommended that they should look to add more avoidance and/or recoverability barriers.
Orange	Second highest risk level – skippers should look carefully at these scenarios in order to determine whether the level of risk as acceptable to them, it is recommended that they should look to add more avoidance and/or recoverability barriers.
Yellow	Third highest risk level – skippers should look carefully at these scenarios in order to determine whether the level of risk as acceptable to them, it is recommended that they consider adding more avoidance and/or recoverability barriers if appropriate.
Blue	Low to Moderate level of risk – skippers should review the avoidance & recoverability barriers to ensure they maintain them at all times.
Green	Low level of risk – skippers should review the avoidance & recoverability barriers to ensure they maintain them at all times.

2 - Introduction

This risk assessment is being carried out because SORC intends to organise a race from the Central Solent to Plymouth via Fastnet Rock, which is considered to have risks which are not adequately covered by the existing “Port Marine Risk Assessment”.

6 Safety Issues were identified;

1) Skipper falling overboard
2) Serious injury to competitor
3) Adverse weather conditions
4) Collision with commercial shipping / fishing vessel
5) Collision with other competitor
6) Grounding of competitor yacht

Within these Safety Issues, individual accident scenarios were developed to encompass the above mentioned hazards as follows:

Safety Issue #1 – Skipper falling overboard
Accident scenarios:

1) Conscious skipper falls overboard when not attached by a tether.
2) Unconscious skipper falls overboard when not attached by a tether.
3) Conscious skipper falls overboard when attached by a tether.
4) Unconscious skipper falls overboard when attached by a tether.

Safety Issue #2 – Serious injury to competitor
Accident scenarios:

1) Skipper falls down companionway steps and breaks bones so as to render him incapable of sailing the yacht but he remains conscious.
2) Skipper falls and is knocked unconscious but remains on board.

Safety Issue #3 – Adverse weather conditions
Accident scenario:

1) Competitor yacht is loses its mast.

Safety Issue #4 – Collision with commercial shipping / fishing vessel
Accident scenarios:

1) Competitor yacht collides with a fishing vessel.
2) Competitor yacht collides with commercial shipping.

Safety Issue #5 Collision with another competitor
Accident scenario:

1) Competitor yacht collides with another competitor yacht.

Safety Issue #6 Grounding of competitor
Accident scenario:

1) Competitor yacht collides with rocks and vessel is holed.

This Risk Assessment involved the following people in establishing / validating the accident scenarios to be used and the assumptions used for avoidance and recoverability barriers failing;

The Risk Assessment was prepared and edited by;

- **Safety Officer;** Richard Breese

The original Risk Assessment produced for the 2016 race was reviewed and commented on by;

- **Subject Matter Expert;** Simon Mitchell
- **Subject Matter Expert;** Deb Fish
- **Subject Matter Expert;** Tony White

For the 2018 race this Risk Assessment has amended following review and comment by;

- **Subject Matter Expert;** Kirsteen Donaldson
- **Subject Matter Expert;** Jerry Freeman

This Risk Assessment has been validated by the following race committee members;

- **SORC Director of Racing;** Nigel Colley
- **Race Director SoloFASTNET;** Rob Craigie

3 - Risk Assessment:

3.0 Estimates, Data & Assumptions Used

Data & Estimates – Given that there is a lack of accurate data in respect of the safety of singlehanded offshore racing, estimates have been used in order to determine probability of the various events assessed based on the following definitions;

Almost certain, might well be expected > 50 %

Quite possible > 1/10

Unusual but possible > 1/100

Only remotely possible > 1/1.000

Conceivable, but highly unlikely > 1/10.000

Practically impossible > 1/100.000

Impossible unless aided > 1/1.000.000

(Virtually) Impossible < 1/1.000.000

Assumption – Compliance with SORC recommendations and in respect of wearing of lifejacket & carriage of PLB - The risk assessment assumes that all competitors will wear a lifejacket with harness and carry a PLB on their person at all times when on deck.

Assumption – Compliance with Special Regulations - The risk assessment assumes that all the World Sailing Special Regulations Category 2 will be applied without any exceptions that have not been mitigated by other means.

Assumption – This risk assessment assumes that all competitors will have significant solo & offshore racing experience in the yacht that they intend to compete in. Note: This was a requirement for the 2016 Race which has been removed from the Notice of Race for the 2018 event, if a skipper chooses to take part in sailing a yacht which he is not familiar then the effectiveness of some "Barriers" will be reduced and therefore the likelihood of encountering the "Undesirable Operating State" or "Accident Scenario" is correspondingly increased – in such cases it is the responsibility of the skipper to consider the impact on the level of risk and what further mitigating measures might be required.

3.1 Sleep & Fatigue Management

A key factor in all the following scenarios is that it is assumed that the skipper will adequately manage his sleeping patterns so as to maintain fatigue levels that will allow him to operate without significant impediment to his physical and / or mental performance.

Fatigue levels are personal and not easily measured or quantified; therefore, it is difficult to isolate the effect of fatigue on an individual's performance, which is one of the reasons for requiring skippers to have significant previous solo overnight experience so that they will know how they respond to a lack of sleep.

Whilst tiredness will not generally cause significant impediment, fatigue can have a similar effect to the consumption of alcohol; research has shown that the number of hours awake can be equivalent to blood alcohol levels as follows:

- 17 hours awake is equivalent to a blood alcohol concentration of 0.50mg/mL (French driving limit)
- 21 hours awake is equivalent to a blood alcohol concentration of 0.80mg/mL (English Driving limit)
- 24-25 hours awake is equivalent to a blood alcohol concentration of 1.00mg/mL

Studies further report the effects of fatigue as:

- reduced decision making ability,
- reduced ability to do complex planning,
- reduced communication skills,
- reduced performance,
- reduced attention and vigilance,
- reduced ability to handle stress,
- increased reaction time - both in speed and thought,
- loss of memory or the ability to recall details,
- failure to respond to changes in surroundings or information provided,
- unable to stay awake,
- increased tendency for risk-taking,
- increased forgetfulness,
- increased errors in judgement,
- increased accident rates.

In a race such as the SoloFASTNET, there will be a real temptation for skippers to push their limits in respect of fatigue so as to gain a competitive advantage. This can be dangerous as it can be difficult to judge one's own fatigue levels. In addition to this, the requirement to manage sleep / fatigue can come into conflict with other requirements such as maintaining a good lookout for compliance with Colregs. Skippers will need to mindful of this and manage themselves accordingly.

It is clear that poor sleep management leading to fatigue will significantly reduce the effectiveness of the avoidance and recoverability barriers used in all the following scenarios and therefore cause a significant increase in the level of risk, skippers must be aware of this and take appropriate steps.

3.2 Safety Issue #1 – Skipper falling overboard

3.2.1 Accident Scenario 1 – Conscious skipper falls overboard when not attached by a tether.

Description of Hazard(s)	Skipper falling overboard and becoming separated from the yacht.
Description of Scenario	Skipper who is not wearing a harness and tether goes forward to change a headsail, he slips and falls overboard, the boat continues sailing on autopilot, no rescue is launched and the skipper dies from hypothermia / drowning.

<table>
<tr><th>Triggering Event</th><th>Avoidance Barriers</th><th>Undesirable Operational State</th><th>Recoverability Barriers</th><th>Accident Outcome</th><th rowspan="2">Risk
Class / Mean
Accident Frequency</th></tr>
<tr><td>Skipper loses his footing whilst going forward to change a headsail.</td><td>Sleep / Fatigue Management
Toe rail required by special regs.
Handholds
Guardrails
Deck non-slip
Non-slip boots
Moving forward on the windward (high) side</td><td>Skipper falls overboard.</td><td>EPIRB Personal Locator Beacon
AIS Personal Locator Beacon
Lifejacket
Clothing
Other skipper noticing strange behavior of the yacht.
Other skipper seeing casualty in the water.</td><td>Skipper dies from hypothermia / drowning.</td></tr>
<tr><td>Frequency (per sea day)</td><td>Barriers will fail in avoiding the undesirable operational state</td><td>Frequency</td><td>Barriers will fail in recovering the situation before the accident</td><td>Severity</td><td rowspan="3">1.E 05
Once in every 100,000 sea days</td></tr>
<tr><td>About every 10 sea days</td><td>Once in every 1000 events</td><td>Once every 10,000 sea days</td><td>Once in 10 MOBs</td><td>Major</td></tr>
<tr><td>This is based on an estimate that it would be quite possible that the skipper might lose his footing whilst going forward onto the foredeck.</td><td colspan="2">This is based on an estimate that it is only remotely possible that the avoidance barriers would fail in preventing the skipper for falling overboard</td><td colspan="2">This is based on an estimate that it is quite possible that the recoverability barriers would fail in preventing the skipper from drowning as the fleet is likely to be well spread out once in the Celtic sea so the chance of another competitor or external shipping spotting the MOB is quite slim (although not impossible), the skipper is therefore reliant on the PLB raising the alarm (which can take some time) and the lifejacket / clothing keeping him from drowning and becoming hypothermic until help arrives.</td></tr>
</table>

3.2.2 Accident Scenario 2 – Unconscious skipper falls overboard when not attached by a tether.

Description of Hazard(s)	Skipper falling overboard and becoming separated from the yacht.
Description of Scenario	Skipper who is not wearing a harness and tether goes forward to change a headsail, he slips bangs his head, becomes unconscious and falls overboard, the boat continues sailing on autopilot, no rescue is launched and the skipper dies from hypothermia / drowning.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	Risk Class / Mean Accident Frequency
Skipper loses his footing whilst going forward to change a headsail, in falling he bangs his head and becomes unconscious.	Sleep / Fatigue Management Guardrails Moving forward on the windward (high) side	Unconscious Skipper falls overboard.	Automatic Lifejacket Clothing Other skipper noticing strange behavior of the yacht. Other skipper seeing casualty in the water. AIS PLB that automatically activates on lifejacket inflation.	Skipper dies from hypothermia / drowning.	
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	**1.E-05** **Once in every 100,000 sea days**
About every 10,000 sea days	Once in every 10 events	Once every 100,000 sea days	Almost every MOB	Major	
This is based on an estimate that it would be conceivable but highly unlikely that the skipper would slip and knock himself out whilst proceeding to the foredeck.	This is based on an estimate that it is quite possible that the guard rails would not prevent the unconscious skipper from falling over the side.		This is based on an estimate that it is almost certain / might well be expected that the recoverability barriers would fail in preventing the skipper from drowning; as the skipper is relying on the life jacket to turn him over and keep his airway clear of water, also given the likely spread of the fleet once offshore it is unlikely that another competitor would notice the incident and raise the alarm in time for a rescue to be effective.		

3.2.3 Accident Scenario 3 – Conscious skipper falls overboard when attached by a tether.

Description of Hazard(s)	Skipper falling overboard whilst attached to the yacht by a tether.
Description of Scenario	Skipper who is wearing a harness and tether goes forward to change a headsail, he slips and falls overboard, the boat continues sailing on autopilot, he is unable to climb back on board and either drowns whilst being towed by the tether or manages to separate himself from (cut) the tether and therefore the yacht but no rescue is launched in time and the skipper dies from hypothermia / drowning.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	Risk Class / Mean Accident Frequency
Skipper loses his footing whilst going forward to change a headsail.	Sleep / Fatigue Management Toe rail required by special regs. Handholds Guardrails Deck non-slip Non-slip boots Short tether that restricts the skipper from being able to fall overboard Moving forward on the windward (high) side	Skipper falls overboard.	Skipper's ability to self-rescue (prior plan?) Tether short enough to keep skippers head above the water Personal Locator Beacon Lifejacket Clothing Other skipper noticing strange behavior of the yacht. Other skipper seeing casualty in the water.	Skipper dies from hypothermia / drowning.	
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	**1.E-06** **Once in every 1,000,000 sea days**
About every 10 sea days	Once in every 10,000 events	Once every 100,000 sea days	Once in 10 MOBs	Major	
This is based on an estimate that it would be quite possible that the skipper might lose his footing whilst going forward onto the foredeck.	This is based on an estimate that it is conceivable but highly unlikely that the skipper would fall over the side if he was attached to the yacht by a tether which is short enough to prevent him falling overboard on the leeward side.		This is based on an estimate that it is quite possible that the recoverability barriers would fail in preventing the skipper from drowning as the fleet is likely to be well spread out once in the Celtic sea so the chance of another competitor or external shipping spotting the MOB is quite slim (although not impossible), the skipper is therefore reliant on the PLB raising the alarm (which can take some time) and the lifejacket / clothing keeping him from drowning and becoming hypothermic until help arrives.		

3.2.4 Accident Scenario 4 –Unconscious skipper falls overboard when attached by a tether.

Description of Hazard(s)	Skipper falling overboard whilst attached to the yacht by a tether.
Description of Scenario	Skipper who is wearing a harness and tether goes forward to change a headsail, he slips and falls overboard, the boat continues sailing on autopilot, he is unable to climb back on board and either drowns whilst being towed by the tether or manages to separate himself from (cut) the tether and therefore the yacht but no rescue is launched in time and the skipper dies from hypothermia / drowning.

<table>
<tr><th>Triggering Event</th><th>Avoidance Barriers</th><th>Undesirable Operational State</th><th>Recoverability Barriers</th><th>Accident Outcome</th><th rowspan="2">Risk Class / Mean Accident Frequency</th></tr>
<tr><td>Skipper loses his footing whilst going forward to change a headsail, in falling he bangs his head and becomes unconscious.</td><td>Sleep / Fatigue Management
Guardrails
Short tether that restricts the skipper from being able to fall overboard
Moving forward on the windward (high) side</td><td>Skipper falls overboard.</td><td>Tether short enough to keep skippers head above the water
Lifejacket
Clothing
Other skipper noticing strange behavior of the yacht.
Other skipper seeing casualty in the water.</td><td>Skipper dies from hypothermia / drowning.</td></tr>
<tr><td>Frequency (per sea day)</td><td>Barriers will fail in avoiding the undesirable operational state</td><td>Frequency</td><td>Barriers will fail in recovering the situation before the accident</td><td>Severity</td><td rowspan="3">1.E-06
Once in every 1,000,000 sea days</td></tr>
<tr><td>About every 10,000 sea days</td><td>Once in every 100 events</td><td>Once every 1,000,000 sea days</td><td>Every MOB</td><td>Major</td></tr>
<tr><td>This is based on an estimate that it would be conceivable but highly unlikely that the skipper would slip and knock himself out whilst proceeding to the foredeck.</td><td colspan="2">This is based on an estimate that it is conceivable but highly unlikely that the skipper would fall over the side if he was attached to the yacht by a tether which is short enough to prevent him falling overboard on the leeward side.</td><td colspan="2">This is based on an estimate that it is almost certain / might well be expected that the recoverability barriers would fail in preventing the skipper from drowning, as the skipper is relying on the tether to keep his head above the water (tethers are not designed to tow a casualty with his head above the water) and his life jacket to turn him over and keep his airway clear of water, also given the likely spread of the fleet once offshore it is unlikely that another competitor would notice the incident and raise the alarm in time for a rescue to be effective.</td></tr>
</table>

3.3 Safety Issue #2 – Serious injury to competitor

3.3.1 Accident Scenario 1 – Skipper falls down companionway steps and breaks a leg so as to render him incapable to sailing the yacht but he remains conscious.

Description of Hazard(s)	Skipper falling and injuring himself whilst proceeding down the companionway
Description of Scenario	Whilst the skipper is proceeding down the companionway steps he misplaces his foot just at the moment the yacht is hit by a wave, his foot slips from under him and he is unable to arrest his fall, he falls from the top of the companionway steps onto the cabin floor landing badly and breaking his leg. He is unable to raise the alarm or sail his yacht and eventually dies of his injuries.

<table>
<tr><th>Triggering Event</th><th>Avoidance Barriers</th><th>Undesirable Operational State</th><th>Recoverability Barriers</th><th>Accident Outcome</th><th rowspan="2">Risk
Class / Mean
Accident Frequency</th></tr>
<tr><td>Skipper loses his footing whilst proceeding though the companionway down into the cabin</td><td>Sleep / Fatigue Management
Handholds required by Cat 2 special regulations.
Skippers familiarity with his yacht (experience requirements)
Hatch design
Non-slip on steps</td><td>Skipper is unable to arrest his fall and on impact with the cabin breaks a leg</td><td>Requirement for EPIRB in Cat 2 special regs.
Requirement to have functional VHF preferably with DSC.
Required to have PLB.
First Aid training requirements in Cat 2 special regs.
Other competitors noticing unusual behavior of yacht on AIS and raising alarm.
Availability and capabilities of coastguard to affect a rescue.</td><td>Skipper is unable to call for assistance and eventually dies from his injury.</td></tr>
<tr><td>Frequency (per sea day)</td><td>Barriers will fail in avoiding the undesirable operational state</td><td>Frequency</td><td>Barriers will fail in recovering the situation before the accident</td><td>Severity</td><td rowspan="3">1.E-10
Once in every 10,000,000,000 sea days</td></tr>
<tr><td>About every 100 sea days</td><td>Once in 1000 times</td><td>Once every 100,000 sea days</td><td>Once in 100,000 times</td><td>Major</td></tr>
<tr><td>This is based on an estimate that is it unusual but possible that a skipper might lose his footing whist proceeding down into the cabin.</td><td colspan="2">This is based on an estimate that it would be only remotely possible that the skipper might fall un-arrested and break a leg since by the design of hatches they are not large so it is likely he will be able to grab the edge of the hatch if losing his footing at the top, whereas if near the bottom it is likely he will be able to grab a handhold to steady himself. Additionally skippers who have extensive experience on the boat they are sailing will have muscle memory regarding where to grab in order to steady themselves.</td><td colspan="2">This is based on an estimate that it would be practically impossible that the skipper would die in this scenario as there are many ways of raising the alarm available to him, he is at all times within helicopter range and even if he did not raise the alarm himself it is very likely that another competitor or person on the shore would raise the alarm before the event became fatal.</td></tr>
</table>

3.3.2 Accident Scenario 2 – Skipper falls is knocked unconscious but remains on board.

Description of Hazard(s)	Skipper falling and injuring himself whilst proceeding down the companionway
Description of Scenario	Whilst the skipper is proceeding down the companionway steps he misplaces his foot just at the moment the yacht is hit by a wave, his foot slips from under him and he is unable to arrest his fall, he falls from the top of the companionway steps onto the cabin floor hitting his head and knocking him unconscious. He is unable to raise the alarm or sail his yacht and eventually dies of his injuries.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	
Skipper loses his footing whilst proceeding though the companionway down into the cabin	Sleep / Fatigue Management Handholds required by Cat 2 special regulations. Skipper's familiarity with his yacht (experience requirements) Hatch design Non-slip on steps	Skipper is unable to arrest his fall and on impact with the cabin knocks himself unconscious.	Other competitors noticing unusual behavior of yacht on AIS and raising alarm. Availability and capabilities of coastguard to affect a rescue. Relative safety of the cabin floor for the unconscious skipper (i.e. unlikely to fall overboard / drown). Possibility that the head injury is not so severe and the skipper regains consciousness and is able to call for assistance using the means described in 3.2.1.	Skipper is unable to call for assistance and eventually dies from his injury.	Risk Class / Mean Accident Frequency
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	**1.E-09** **Once in every 1,000,000,000 sea days**
About every 100 sea days	Once in 1000 times	Once every 100,000 sea days	Once in 10,000 times	Major	
This is based on an estimate that is it unusual but possible that a skipper might lose his footing whist proceeding down into the cabin.	This is based on an estimate that it would be only remotely possible that the skipper might fall un-arrested and knock himself unconscious since by the design of hatches they are not large so it is likely he will be able to grab the edge of the hatch if losing his footing at the top, whereas if near the bottom it is likely he will be able to grab a handhold to steady himself. Additionally, skippers who have extensive experience on the boat they are sailing will have muscle memory regarding where to grab in order to steady them.		This is based on an estimate that it would be practically impossible that the skipper would die in this scenario as there are many ways of the alarm being raised, he is at all times within helicopter range and even if he did not raise the alarm himself it is very likely that another competitor or person on the shore would raise the alarm before the event became fatal.		

3.4 Safety Issue #3 – Adverse weather conditions

3.4.1 Accident Scenario 1 – Yacht is loses its mast.

Description of Hazard(s)	Yacht loses its mast during adverse weather conditions.
Description of Scenario	During the race weather conditions deteriorate significantly resulting in F10 winds, a yacht is rolled, loses its mast which then holes the yacht, the yacht sinks and the skipper drowns.

<table>
<tr><th>Triggering Event</th><th>Avoidance Barriers</th><th>Undesirable Operational State</th><th>Recoverability Barriers</th><th>Accident Outcome</th><th rowspan="2">Risk
Class / Mean
Accident Frequency</th></tr>
<tr><td>Force 10 winds</td><td>Sleep / Fatigue Management
Cat 2 special regulations requirements for;
- Storm sails
- Stability (STIX)
- Training
- Yacht design
SORC experience requirements for SoloFASTNET.</td><td>Yacht with broken mast still attached by rigging.</td><td>Cat 2 special regulations requirements for;
- Training
- Equipment (bolt cutters etc)
- Liferaft
- PLB, EPIRB & VHF
- Lifejacket with hood
Skipper’s clothing.
Skipper’s fitness
Sea area within helicopter rescue range</td><td>Yacht is holed by its broken mast and sinks, the skipper ends up in the water and dies of drowning / hypothermia.</td></tr>
<tr><td>Frequency (per sea day)</td><td>Barriers will fail in avoiding the undesirable operational state</td><td>Frequency</td><td>Barriers will fail in recovering the situation before the accident</td><td>Severity</td><td rowspan="3">1.E-06
Once in every 1,000,000 sea days</td></tr>
<tr><td>About every 100 sea days</td><td>Once in every 100 times</td><td>Once every 10,000 sea days</td><td>Once in 100 times</td><td>Major</td></tr>
<tr><td>This is based on an estimate that it is unusual but possible to encounter a Force 10 in July.</td><td colspan="2">This is based on an estimate that it would be unusual but possible that a competitor yacht would lose its mast when encountering adverse weather conditions because; firstly yachts will have to meet minimum stability requirements in order to enter, secondly yachts are required to carry storm sail and thirdly, given the combination of the experience requirements required to enter and training required for Cat 2 it could reasonably be expected that most skippers would be able to set their boat up to ride out adverse conditions.</td><td colspan="2">This is based on an estimate that it would be unusual but possible that in the event of the loss of the mast the skipper would die because; firstly with the training, experience and equipment that is required for this race it could reasonably be expected that the skipper would be able to cut the mast free, thereby securing the yacht, secondly the skipper has many ways of calling for assistance and assistance could reasonably be considered to be readily available in a reasonable timeframe, thirdly in the event that the skipper did have to abandon the yacht then the liferaft, lifejacket and clothing available should be able to sustain life long enough for a rescue to be effected.</td></tr>
</table>

3.5 Safety Issue #4 – Collision with Commercial Shipping / Fishing Vessel

3.5.1 Accident Scenario 1 – Competitor yacht collides with a fishing vessel.

Description of Hazard(s)	Collision with a fishing vessel
Description of Scenario	Whilst the skipper is sleeping his yacht collides with a fishing vessel, during the collision a member of the fishing vessels crew sustains fatal injuries.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	Risk Class / Mean Accident Frequency
Yacht comes in close proximity to a fishing vessel	Sleep / Fatigue Management Colregs Lookout / Sleeping pattern used by the skipper AIS alarms on both the fishing vessel and yacht Lookout by the fishing vessel Display of lights in accordance with ColRegs	Yacht collides with a fishing vessel	Size & construction of fishing vessels likely to be encountered Lookout by the fishing vessel crew to enable pre-warning to the crew Evasive action taken by either yacht or fishing vessel to reduce the impact of the collision Generally slow speed of most entries to the SoloFASTNET	During the collision a member of the fishing vessels crew sustains fatal injuries.	
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	**1.E-06** **Once in every 1,000,000 sea days**
About every sea day	Once in every 1000 times	Once every 1000 sea days	Once in 1000 times	Major	
This is based on an estimate that it is almost certain and might well be expected that a competitor yacht might come into close proximity with a fishing vessel as fishing is prevalent in all areas in which the race will take place.	This is based on an estimate that it is only remotely possible that a competitor yacht might collide with a fishing boat because; Colregs require that yacht keeps clear of a fishing vessel and experienced single handed skippers will have developed a sleep pattern that allows them short sleeps in between checking for conflicts, all yachts are required to transmit AIS and will generally have the possibility to set AIS alarms (although fishing vessels might not transmit), fishing vessels will generally keep a lookout as well as the yacht, although they may well not be in the position to take evasive action if required.		This is based on an estimate that it is only remotely possible that a crew member on the fishing vessel might be sustain fatal injuries during the collision because; the majority of the fishing vessels likely to be encountered in the race area (particularly later in the race and whilst well offshore when the skipper might well be less alert) will be of substantial size and construction affording the crew good protection, it is likely that one of the vessels will see the other even if at the last minute and initiate evasive action		

3.5.2 Accident Scenario 2 –Competitor yacht collides with commercial shipping.

Description of Hazard(s)	Collision with a commercial vessel
Description of Scenario	Whilst the skipper is sleeping his yacht collides with a commercial vessel, during the collision the yacht is seriously damaged and the skipper thrown overboard, the skipper dies either from injuries sustained during the collision or drowning / hypothermia.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	
Yacht comes in close proximity to a commercial shipping	Sleep / Fatigue Management Colregs Lookout / Sleeping pattern used by the skipper AIS alarm on the competitor yacht. AIS alarms, radar and lookout by the watch officer on the commercial ship. Display of lights in accordance with ColRegs TSS exclusion zone Flares required by Cat 2	Yacht collides with a commercial ship.	Evasive action taken by either yacht or commercial vessel to reduce the impact of the collision Generally slow speed of most entries to the SoloFASTNET Required construction for Cat 2 special regs. Liferaft and Lifejacket required by Cat 2.	During the collision the yacht is sunk and the skipper killed.	Risk Class / Mean Accident Frequency
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	
About every 10 sea days	Once in every 1,000 times	Once every 10,000 sea days	Once in 100 times	Major	**1.E-06** **Once in every 1000,000 sea days**
This is based on an estimate that it is quite possible that a competitor yacht might come into close proximity with commercial shipping as commercial shipping transit the areas in which the race will take place.	This is based on an estimate that it is only remotely possible that a yacht will collide with commercial shipping because; The SIs require the yachts to remain clear of the TSS zones, the colregs make the competitor yacht the stand on vessel in case of conflict with commercial shipping in open water so the required action would be to maintain course and speed which is what the yacht will do whilst the skipper is asleep, both the competitor yachts and the commercial shipping are obliged to transmit AIS and will also have CPA alarms fitted, most ships will also have radar so the officer on watch is likely to detect a competitor yacht in time to take avoiding action.		This is based on an estimate that it is unusual but possible that in the event of a collision the yacht will be sunk and the skipper killed because; even in the event of a collision it is very unlikely that the ship will be unaware of the yacht's presence so it is likely they will attempt evasive action even if too late, since the ship is likely to be aware of the yacht's presence then it is likely a swift rescue could be organised by the ship, in the event that the skipper ends up in the water then he should be able to request assistance with a PLB and be sustained by his lifejacket and clothing.		

3.6 Safety Issue #5 – Collision with another competitor

3.6.1 Accident Scenario1 – Competitor yacht collides with another competitor yacht .

Description of Hazard(s)	Collision with another competitor
Description of Scenario	Whilst both skippers are asleep, two competitor yachts collide, one loses its rig and is holed to the extent that it sinks, the skipper dies from drowning / hypothermia.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	Risk Class / Mean Accident Frequency
Two competitor yachts come into close proximity whilst the skippers are sleeping	Sleep / Fatigue Management AIS CPA alerts on both yachts Lookout / Sleeping pattern used by the skippers Colregs / display of lights Yachts will be sailing the same course	Two competitor yachts collide	Design of the yachts required by Cat 2 Generally slow speed of most entries to the SoloFASTNET Yachts will be sailing the same course Training required by Cat 2 PLB, EPIRB and VHF required by Cat 2 It is unlikely both yachts will be so badly damaged so as to sink, so the one still afloat should be able to provide assistance.	One of the competitor yachts is damaged to the extent that it sinks, the skipper ends up in the water and dies of drowning / hypothermia	
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	
About every 10 sea days	Once in every 1000 times	Once every 10,000 sea days	Once in 10,000 times	Major	**1.E-08** **Once in every 100,000,000 sea days**
This is based on an estimate that it is quite possible that a competitor yacht might come into close proximity with another competitor yacht as they are sailing the same course and are likely to make similar weather decisions + keep close to each other for tactical reasons.	This is based on an estimate that it is only remotely possible that two competitor yachts will collide because; both are required to transmit AIS and will have AIS alarms available to them, skippers sleeping patterns / lookout are likely to result in one of the skippers becoming aware of the other so as to prevent a collision, this is aided by the lights displayed, also the yachts will be sailing the same course and although this is a contributing factor to them coming into close proximity it also means that there will not be a great closing speed between them.		This is based on an estimate that it is conceivable but highly unlikely that a competitor will be killed as a result of a collision between two competitor yachts because; the yachts have to be strong by design to satisfy Cat 2, most of the yachts in the SoloFASTNET will not be sailing at >10kt or in opposite directions for the most part of the race so the likelihood of a high energy collision is extremely low, and even if there was a serious collision with the training and experience requirements and the required equipment for Cat 2 it is likely that it would be survivable and the skipper would be able to summon help.		

3.7 Safety Issue #6 – Grounding of a competitor

3.7.1 Accident Scenario 1 – Competitor yacht collides with rocks and vessel is holed.

Description of Hazard(s)	Competitor collides with rocks
Description of Scenario	Skipper makes a navigational error and collides with rocks, the competitor yacht is holed, sinks and the skipper dies from drowning / hypothermia.

Triggering Event	Avoidance Barriers	Undesirable Operational State	Recoverability Barriers	Accident Outcome	
Skipper makes a significant navigational error that puts him on a collision course with rocks	Sleep / Fatigue Management Lighthouses Chartplotters Depth sounder AIS display Skipper's crosscheck Pre-race planning Experience requirements	Competitor yacht strikes rocks	Equipment & training required by Cat 2 special regulations including; - VHF, PLB & EPIRB - Liferaft - Lifejacket Close proximity of help since all rocks within the course area are close to land and helicopter / lifeboat rescue.	Competitor yacht sinks; skipper ends up in the water and dies from drowning / hypothermia.	Risk Class / Mean Accident Frequency
Frequency (per sea day)	Barriers will fail in avoiding the undesirable operational state	Frequency	Barriers will fail in recovering the situation before the accident	Severity	**1.E-08** **Once in every 100,000,000 sea days**
About every 100 sea days	Once in every 1000 times	Once every 100,000 sea days	Once in 1000 times	Major	
This is based on an estimate that it is unusual but possible that a skipper would make a significant navigational error because; yachts are required to carry GPS by Cat 2 regs, skippers will be aware of the parts of the race that will bring them into close proximity with rocks and pay close attention to navigation for these.	This is based on an estimate that it is only remotely possible that a skipper, having made a significant navigational error, will not correct it in time to avoid colliding with rocks because; firstly there are a significant number of lights / buoys marking dangerous areas within the race area so one of these should catch the skipper's attention, secondly all yachts will have GPS and most will have chartplotters, which it is likely the skipper will crosscheck regularly including AIS (which might indicate something is wrong if all other yachts are taking a different route, and thirdly the level of experience required for the SoloFASTNET means that the skipper will be used to pre-planning a passage and will know where the dangerous areas which require a regular crosscheck can be found.		This is based on an estimate that it is only remotely possible that a skipper, having collided with rocks, will die as a result because; the skipper has many ways to call for help and is likely to be close to help if he has collided with rocks, he will have completed with training required by Cat 2 so he should be familiar in dealing with an emergency, also if he does end up having to abandon the yacht then he will have a liferaft and lifejacket at his disposal.		

4 - Conclusions:

The beginning of the Risk Statement that is signed by all competitors' states; "Sailing is by nature an unpredictable sport and therefore involves elements of risk" this Risk Assessment confirms that there are significant risks to taking part in a solo race of this length and in the waters it will take place.

As stated in 3.1 sleep / fatigue management is key to reducing all risk to as low as is reasonably possible, skippers should not underestimate the importance of this subject on their safety in respect of all of the scenarios described in this risk assessment and many that are not present.

The highest level of risk during the SoloFASTNET will be that presented by the man-overboard scenario, this is particular to solo racing because in the event of the skipper falling overboard there will be no alarm raised or assistance given unless the skipper is able to stabilize the situation and either self-rescue or raise the alarm by some means. It is strongly recommended that all skippers give adequate consideration as to how they might reduce this risk to as low as is reasonably practical.

Adverse weather also presents a significant risk, the mitigating actions that are normally taken by SORC in terms of adjusting the course delaying the start etc in order to avoid racing with significant adverse weather will be rendered considerably less effective during the SoloFASTNET due to the length of the race. It is therefore strongly recommended that skippers consider the possibility that they will have to remain at sea during significant adverse weather and give adequate consideration as to how they might reduce this risk to as low as is reasonably practical.

A collision with a fishing boat presents a significant risk since competitor yachts are obliged by the Collison Regulations to keep clear of fishing vessels but since skippers will need to sleep for some of the time at sea, their lookout and therefore ability to keep clear will be compromised to some degree, this is further exacerbated by the fact that often fishing vessels do not transmit AIS and most competitor yachts will not be equipped with radar and will therefore have to rely on a visual lookout in order to keep clear of fishing vessels. It is therefore strongly recommended that skippers give adequate consideration to how they will comply with the collision regulations and how they might reduce the risk of a collision to as low as is reasonably practical.

A collision with commercial shipping presents a significant risk since although the fact that commercial ships are obliged to keep clear of sailing yachts and will most likely be monitoring AIS means that the likelihood of a collision is less that that with a fishing vessel, due to the likely size and speed of commercial shipping the outcome of a collision is likely to be more severe. Skippers should give adequate consideration as to how they will use AIS alarms on board and might consider adding an active Radar Target Enhancer (RTE) to help commercial shipping spot them more readily or other means to reduce the risk to as low as is reasonably practical.

Whilst the other safety issues assessed resulted in a lower level of risk to those mentioned above, it is still strongly recommended that skippers give adequate consideration before the race as to how they might reduce their exposure to risk to as low as is reasonably practical.

This risk assessment should be reviewed and updated in the event that new data become available that suggest the probabilities used might not be correct – to this end all comments on how this document might be improved are welcomed and should be forwarded to richardjbreese@gmail.com