The 'soft pack' life raft remained tethered to the yacht and was used by the crew as a temporary platform during winching operations by the rescue helicopter.

The crew needed to use the rescue quoit provided in the raft to assist in-water crew and found it difficult to break the plastic covering, housing the quoit and line. The life raft knife was used with some difficulty to break open the packaging.

The crew was requested to remove the canopy from the life raft prior to rescue by the helicopter, but they found this exercise impossible in the prevailing conditions. The crew collapsed the canopy by sheer numbers, to assist in recovery. The crew did not inspect the life raft for attached equipment. However, they found the tether line and attached safety lines small in diameter and difficult to handle in the prevailing conditions.

Winston Churchill:

Following the knockdown and damage to the vessel, two life rafts were deployed, one a 4 man 'ME Petrel' life raft (#1), the other a 6 man 'ProSaver' (#2) life raft. The life rafts were stowed below and the crew found it difficult to get the life rafts on deck. At approximately 1545 hours on 27 December, the life rafts were launched after the yacht had lost all way, tethered together by a 10mm line, 10 to 15 metres in length, and the crew transferred to the rafts as the yacht foundered. (They all stepped up into the life rafts).

Life raft #1 was manned by Winning, Lumtin, Rynan and Gould, who took with them the 'grab bag' containing the EPIRB and personal effects. The EPIRB had been activated earlier and the flashing light indicated that it was transmitting.

Life raft #2 was manned by Stanley, Dean, Lawler, Gibson and Bannister. As the yacht foundered, the weak link to each life raft parted, and approximately 10 minutes later the tether between both rafts parted and the rafts separated. Comments from both crews indicate that the wave action was severe and jerked the life rafts in a dangerous manner; they were fearful of the interaction damaging a raft and were about to sever the tether when it parted.

Life raft #1

Crew deployed the drogue, which did stabilise the raft until the drogue line parted, some half an hour later (Comment ed.-tether line for drogue too small in diameter; no pockets for flares, knife, pump etc). The crew laced up the hood flap to stop ingress of water, checked the contents of the life raft bag and secured themselves as best they could.

Sometime between 2030 and 2100 hours on 27 December, the raft was inverted by wave action. Winning exited the raft (no safety harness), to right the raft in the recommended manner. He had to cut the ties and tear off retaining patches on the hood flap, as he was unable to untie small diameter nylon.

Upon righting the raft, it was inundated by further wave action and filled with water through the open canopy flap. A search for the bailer was carried out and it was found that the majority of the life raft safety bag contents, including some flares, had been lost during the inversion. The draw string on the safety bag proved ineffective. The raft was bailed using a plastic bag and a sea boot. Shortly afterwards further wave action inverted the raft again which was righted in the recommended manner. During the evening the raft motion was quite erratic, obviously due to the loss of the drogue, surfing down waves and being inverted several times.

As dawn approached, it was observed that the lower ring of the life raft was deflating. Investigation found that the top 2/3rd of the GME EPIRB aerial had broken off and had possibly punctured the lower ring. The pump nozzle and repair kit had been lost, and it took some time to re-inflate the section and secure the hole with a bailing sponge. The crew continued bailing using the sea boot as water flooded the raft.

During daylight hours on 28 December, the sea conditions changed and handling of the raft somewhat easier and the situation of the crew had somewhat improved, although every wave filled the raft. It was also noted that at some time during the evening the EPIRB had broken free of its tether and had separated from the life raft.

At approximately 1600 hours on 28 December, an aircraft was heard and sighted to the east heading south. It then turned to the west and a red parachute flare was fired from the life raft. The aircraft did not respond to the flare. Approximately 20 minutes later an aircraft was sighted and the crew fired their last red parachute flare, which was observed by the aircraft that flashed its lights in acknowledgment.

The crew was recovered by helicopter some hours later. Winning and Gould commented that as conditions had moderated, they were fairly comfortable and could have remained in the raft until the following day.

Life raft #2:

The crew was not aware of the length of the life raft tether and had some trouble in entering the raft with life jackets (Mae West type) on. Crew deployed the drogue, which did stabilise the raft until the drogue line parted, some 20 minutes later (Stanley's comment-tether line may have fouled during deployment-drogue tether too small in diameter-result cut fingers).

As the life raft motion was severely erratic, the crew sat with legs intertwined. This resulted in a crewman suffering torn muscles and a broken ankle following buffeting by large waves. The crew also untied the safety bag to make accommodation more comfortable and review its contents.

The hood and flap required heavy handling to secure and prevent the ingress of water. The ties were difficult to handle. The canopy also appeared loose, striking the back of heads all the time and they were unable to stop ingress of water down the installed rainwater tube.

The life raft was inverted by a wave. In the prevailing conditions, it was considered too dangerous to send a man outside to right the life raft. Gibson and Stanley both stated that they were unsure of how to right the life raft and the crew was of the opinion that the life raft was more stable in its inverted state. During the inversion, the safety bag was lost overboard and the canopy remained intact. Exiting the life raft wearing a life jacket was reported to be almost impossible due to the absence of grab lines.

Whilst inverted, the crew started to run out of air and it was decided to cut a small hole in the floor (now roof) of the life raft at a reinforcing patch approximately 200mm long. The life raft was again inverted by a wave (now upright) and it was observed that the canopy had been damaged, possibly by the crew standing on it. Stanley observed that the empty gas bottle was loose and damaging the raft and that there were no recovery lines on the base of the raft.

Sometime between 0100 and 0230 hours on 28 December, a large wave picked the life raft up and tumbled it some 8 to 10 times. As the raft was surfing down the face of the wave, Stanley saw that Lawler, Bannister and

Dean had been thrown out of the raft and were some distance (100+ metres) away from the raft in white water. Gibson was attached to the life raft via a harness and managed to regain the life raft. Stanley and Gibson were unable to recover the lost crew, as the raft progressed away from the trio in the water, at a considerable speed.

During the remainder of the night, the life raft was continually rolled, the two crew securing themselves around the centre tube. The floor of the life raft and the canopy disintegrated.

Some time in the morning on 28 December Stanley thought he saw an aircraft. Sea conditions were abating and by mid-day on 28 December crew reported being as comfortable as they could be under the circumstances. At approximately 1700 hours both crew saw an aircraft to the east approximately 500 metres away and signalled using a yellow life jacket. They thought they observed an acknowledging flashing of a wing light. They were not seen.

Soon after they observed a plane and a helicopter heading eastward. The fixed wing aircraft returned some time later and the crew attracted its attention by strobe light and torch. The aircraft acknowledged their signal and circuited for some time until a helicopter arrived.

A flare was then dropped to assist the helo rescue and Gibson recovered by helo 'teabag'. Conditions were such that it was too dangerous to attempt a second recovery with the 'teabag' and a sling was deployed. As Stanley was being winched up, he noted that he was attached to the remnants of the life raft, so he released the sling and fell some thirty feet into the water. Stanley untangled himself from the life raft and was again recovered by rescue sling. Both crew were recovered with serious injuries.

6.4.2 Other Safety Equipment

Yachts were required to carry safety equipment specified for Cat 1 Ocean Races to meet the SHYR eligibility criteria. All yachts underwent a Cat 1 Safety Inspection by a certified AYF Safety Officer at their own Club or at the CYCA. Random spot-checks were conducted on interstate and overseas yachts by accredited Safety Officers at the CYCA. It is nonetheless the skipper's responsibility to ensure that all stipulated safety equipment was on board and in good working order at the start of the race.

Most yachts claimed to use some of their safety equipment as a matter of standard yacht routine, as follows:

Safety Harnesses	91%
Personal Strobe Light	19%
Life Jackets	10%
Storm Boards	17%

(or had other safety procedures that they enforced).

During the race, yachts claim to have used the following safety equipment:

Safety Harnesses	97%
Life Jackets	38%
EPIRB	11.5%
Personal EPIRB (carried)	8%
Life Raft	3.4%
Life Ring	1.0%
Danbuoy/Jonbuoy	3.4%
Pyrotechnics	11.5%

*NB: yachts in this table might have activated more than one device with a 1.87 average

Forty two percent of all yachts claimed to have encountered some type of problem with various pieces of safety equipment, much of which was extensively used during the race.

Excluding yachts that went through SAR assistance, 25 individuals ended up in the water after knockdowns or large waves washing over boats. Of these, three people experienced problems with harnesses pulling off over their heads. One harness was integrated with a wet weather jacket and the jacket as well as the harness was pulled over the crew's head. The remaining two were separate harnesses.

Eight other problems were experienced with harnesses, seven with difficulties using clips and one where the webbing stitching failed. The latter was under extreme circumstances when the yacht was rolled through 360°.

Discussions with manufacturers with respect to the strength of webbing and stitching indicated that sunlight and storage conditions were most likely to impact the life of harness webbing. Concern was expressed regarding the storage of harnesses in yachts where they may be continuously or regularly wet or damp or exposed to foreign materials like diesel fuel. It was recommended that harnesses be rinsed in fresh water after use, dried and stored in a dry place out of direct sunlight.

There were multiple incidents of crew being washed to the limit of their harness strops, approximately 2 metres. In some cases this was overcome by shortening the strop by (for example) winding it around a winch.

Others reported that moving around, going below or coming on deck, represented a major risk as harnesses had to be unclipped. Most yachts overcame this by the use of multiple strops (using strops from harnesses from crew below deck), and at least one yacht reported having strops with an additional clip, mid-length on the strop. This precluded the need for the wearer to ever be unclipped.

Ninety six percent of yachts reported having adequate strong points on deck for harnesses and 86% claimed to have sufficient hand holds to enable crew to move about.

Only one yacht reported a jackline failing. Webbing jacklines were almost universally criticised during the interviews. The webbing was reported as stretching too much under load and was regarded by crew as a potential risk.

Man overboard equipment – danbuoys, Jonbuoys, and life rings – experienced some problems, mainly due to wave action.

Sixteen 'Jonbuoy' brand inflatable danbuoys were accidentally deployed by waves, all except two independently of the life ring to which they were attached. This is estimated to be more than one third of all 'Jonbuoys' in the fleet. 'Jonbuoys' are usually mounted to the pushpit rail on a plastic frame which is held in position by a length of shock cord. By design, the release mechanism doe not appear to be robust for extreme conditions of the type endured by the fleet in 1998 and consideration must be given to:

a) excluding such devices for Cat 1,
b) improving the mounting and release methods, and
c) finding an alternative (safer) mounting position.

Five yachts reported difficulties with Personal Flotation Devices (PFD). Three of these related to the automatically inflating type of life jackets that in these cases inflated unintentionally. (One of these caused the crew member concerned some difficulty as it nearly choked him!).

The yacht Aera had automatic, self-inflating life jackets. All of these inflated quickly in the conditions of heavy water and spray breaking constantly over the deck. The crew reported that when inflated they

became a nuisance to live with and several crew members deflated them when below.

During the interview process, it became clear that wearing PFD 1s of the 'standard' type size increased the risks to crews. Moreover, they increased the buoyancy of the individual and therefore increased the risk of being washed overboard. Crews reported being reluctant to wear PFD 1s as a matter of routine because they were bulky and cumbersome and would not enable freedom of movement. Also they were regarded as reducing work efficiency as they were cumbersome and restricted movement. The older Kapok filled type PFD 1s were identified as being particularly inappropriate for these reasons.

After being swept overboard in the 1993 SHYR and spending 5 hours in the water before being rescued, Mr John Quinn of Polaris stated that a flotation vest was instrumental in his survival. He developed a technique of diving under breaking waves, after experiencing considerable difficulty attempting to go over them. Quinn believes that a PFD 1 would have provided too much buoyancy precluding him from executing this diving technique.

Eleven yachts launched pyrotechnics. Five of these experienced problems. In three cases it was a direct result of the lack of knowledge/experience in deploying such devices. Four claimed the flares would not light.

Eight yacht lost lifebuoys (horseshoes/life slings), two prior to the storm conditions. Others were lost as a direct result of wave action. Several crews reported difficulty with the deployment/retrieval of lifebuoys due to the nature of the attachments in dye, drogue, whistle, light and danbuoy and the lines used to attach them. The lines tangled around themselves and the proximity of other equipment/fittings made retrieval difficult.

A few yachts reported problems with the operation of bilge pumps, but were able to make alternative arrangements.

The following 9 yachts deployed EPIRBs:

- Business Post Naiad,
- Winston Churchill,
- Solo Globe Challenger x 2 (it was not clear whether one of those was operational),
  B52,
- Team Jaguar,
  Kingurra,
- Sword of Orion,
- Miintinta, and
- Midnight Special.

There are two types of EPIRBs available – the 121.5/243 MHz and the 406 MHz. Both types operate with the COSPAS/SARSAT system of international distress monitoring. The 121.5/243 MHz system was compulsory for Cat 1, and was carried by all competitors. At least one yacht (B52) carried a 406 MHz EPIRB.

Presently, both units operate as typical 'beacons'; that is, they transmit a continuous signal in the case of the 121.5/243 MHz and a continuous signal plus a unique identifier in the case of the 406 MHz unit. This signal is picked up by satellite and retransmitted to the land based monitoring station.

When an EPIRB is activated it takes some time (usually an hour) for the distress signal to reach the AMSA Rescue Co-ordination Centre. SAR

aircraft 'home in' on these beacons using a combination of doppler guidance systems and radio direction finder equipment.

121.5/243 MHz EPIRBs were found to be inadequate in providing positions with sufficient precision for SAR authorities, as the nature of 121.5/243 MHz EPIRBs is to alert the position within < 20km radius. These EPIRBs do not allow discrimination of one beacon from another. In addition, the number of EPIRBs deployed (9) created signal clutter, thus magnifying the problem. Two additional EPIRBs, not belonging to the race fleet were also activated in the race area.

At least two telescopic aerials on EPIRBs broke. This appears to be a major design defect. The line designed to secure the EPIRB to the yacht when deployed, failed on at least one occasion through chaffing and was regarded to be inadequate.

Radio communications for the race were designated to be on 4483 kHz and 6 kHz. Back up was provided through VHF. The RRV Young Endeavour was designated "Telstra Control" for the event and conducted radio position reports twice daily at 0300 and 1400 hours and a Safety Sked at 2000 hours.
Dedicated radio facilities were set up on Young Endeavour and an experienced radio operator, Mr Lew Carter, along with two assistants, Michael and Audrey Brown were on board to manage the communication process. Lew Carter had been radio operator for 13 previous SHYR, assisted by the Browns on 10 occasions.

Yachts were required to have their radio installations checked and provide the CYCA with a certificate as part of the mandatory safety requirements. In addition, all yachts were required to have a licensed radio operator on board for the race.

Prior to the storm, two yachts had difficulty communicating with the RRV. These were Assassin, who subsequently retired due to prudent seamanship (radio failure being part of that decision) and Brindabella, who continued to have transmission problems for the entire event. Brindabella provided position reports through SatCom C.

As conditions deteriorated and multiple incidents occurred, significant pressure was applied to communications:

the RRV was at times receiving more calls than it could adequately cope with,

- a number of situations was urgent, including May Days,
- some yachts, having been dismasted, were working on emergency antennae,
- some yachts had lost the ability to communicate through HF altogether,
- some yachts were communicating on VHF with other yachts relaying on their behalf,

coastal stations became involved, some unnecessarily or with unauthorised use on the race frequencies, and

- licensed coastal station Penta Comstat had scheduled weather forecasts and the Sydney-Coffs Harbour Race Sked to run on 4483 kHz.

During the interview process, some yachts praised the work of the RRV and the operator Lew Carter in particular. The view of external parties and some yachts however, indicated that the RRV operator should have maintained a much tighter control on traffic, particularly the unauthorised use of the race frequency by competitors and non competitors alike. Their view was that some traffic should have been directed to other HF frequencies, particularly 2524 kHz or to other VHF frequencies.

Nine vessels reported having their HF sets unserviceable for at least some period and 11 had their VHFs unserviceable. These problems were due to flat batteries, dismastings or water ingress.

Radio communications were dealt with in greater detail in section 5.1 of this report.

6.4.3 Competitors' Views on Organisation, Safety and Equipment

In the Questionnaire, questions 100 and 101 gave crews the opportunity to comment open endedly on any facet of the race, its organisation, rules and safety.

Only a few things emerged with modest support. Importantly, 46.4% and 35% for question 100 and 101 respectively had no comment whatsoever to make.

Question 100: "Do you have any other comments or suggestions that you would like to make in respect to any aspects of the Event? (Please provide a separate attachment)"

Q100 Comments/Suggestions	Percentage of fleet
More training	7.3
Improve communication	5.5
More frequent weather information	
Personal EPIRBs	10.9
Life raft EPIRBs	4.5
Yachts to give weather info with Sked positions	1.8
Lights on life jackets	1.8
Integrated life jackets/harnesses	3.6
All other	
Detailed attachment supplied	7.3
Nothing/no answer	46.4

(NB: multiple answers possible)

Question 101: "Do you have any suggestions to do with any aspects of the race, particularly improving the ability of boats and crew to withstand difficult or extreme conditions? (Please provide a separate attachment)"

Q101 Suggested Improvements	Percentage of fleet
More training/demos for all equipment	22.7
More frequent weather information	12.7
Personal EPIRBs	20.0
SatCom C or other continuous trackers	0.9
Reduced price of safety equipment	2.7
Yachts to compete in more long races	8.2
2 part race – Eden/Hobart	2.7
Improved life rafts	8.2
Size of storm sails (make smaller)	3.6
EPIRBs in life rafts	0.9
All other	45.5
Detailed attachment supplied	5.5
Nothing/no answer	35.0

(NB: multiple answers possible)

The investigations have revealed that the competitors, while concerned about the 1998 SHYR itself, and keen to pursue improvements, generally believe that the rules, safety regulations and safety equipment with which they raced, met their needs in the conditions. From interviews of 28 yacht crews, it is clear that skippers and crews do not see a single (or several) reason(s) for the incidents occurring and certainly see no need to apportion blame to any particular group such as organisers, BOM, SAR etc. Furthermore, they do not see, as a result, any need for wide sweeping changes to safety regulations and equipment, but would welcome a series of incremental improvements based on the wider experience of the fleet.

7.0 ABILITY OF SKIPPERS AND CREWS TO WITHSTAND THE CONDITIONS

7.1 Level of Experience of Skippers and Crews

Crew experience was evaluated on a 5-point scale, based on the information collected in the Questionnaire. Data were collected on 948 of the 1135 crew in the race (84%). The average age of the crew was 39.5 years.

Each crew member was rated according to the following parameters:

Extremely experienced	=	10 SHYR (or equivalent) plus 15 years or more racing offshore
Moderately experienced	=	5-9 SHYR (or equivalent) plus 10-14 years racing offshore
Experienced	=	2-5 SHYR (or equivalent) plus 6-9 years racing offshore
Moderately inexperienced	=	1 SHYR (or equivalent) plus 3-5 years racing offshore
Inexperienced (novice)	=	0 SHYR (or equivalent) or 0-2 years racing offshore

Using experience racing offshore as a criteria rather than experience sailing (cruising) was done deliberately as a discriminator because yachts racing have to contend with all conditions they encounter, whereas yachts cruising may choose to shelter at an earlier point in time or stay at anchor if conditions are or may become adverse. This criteria discriminated against a large number of very experienced sailors, who no doubt, have highly developed seamanship skills.

The results from the Questionnaire regarding crew experience in the fleet are as follows:

Extremely experienced

Moderately experienced

Experienced

Moderately inexperienced
Inexperienced (novice)

This shows that 86% of crew had competed in at least one SHYR (or equivalent) and had 3-5 years ocean racing experience. Furthermore, the RRS define adequate crew experience for a Cat 1 ocean race as "...at least half the crew, including the skipper and/or sailing master shall have completed one race of the category entered or an equivalent passage".

Further, 7% competed in 1977 SHYR, 12.2% in 1984 SHYR, 21.8% in the 1993 SHYR, and 2% in the 1979 Fastnet Race, all races with extreme weather conditions.

Eighty- four percent of yachts had crew members on board who claim to have experienced similar conditions at sea, and 96% of skippers believed they had adequate experience on board at the start of the race. This dropped to 92% when asked if in hindsight, they now believe they had started with adequate crew experience.

7.2 Navigation

All yachts were required to be fitted with GPS computers that provide accurate continuous position fixing. In addition to the on board GPS, 89% of yachts had a hand-held GPS.

Eighty six percent had a designated navigator and 97% of the yachts maintained paper charts for navigation/plotting in addition to their GPS. Seventy four percent began a logbook for the event, however one third of these failed to maintain it throughout their time at sea because they became "too busy" with the situations that developed or the log became water damaged. (Note: Most yachts have their navigation table immediately at the bottom of the companionway for easy deck

access, increasing the likelihood of water ingress as crew enters and exits the cabin).

7.3 Watchkeeping, Routines and General Organisation

Ninety five percent of yachts ran organised watch systems, where crews have designated roles and rotate on or off deck in groups around a planned time schedule. Typically watch systems are designed to ensure that crews are adequately rested and that the ships' routine chores, like cooking, are formally shared. It is not unusual for a watch system to be 4 hours on and 4 hours off, with shorter watch periods during darkness or adverse conditions.

Sixty three percent of yachts maintained these watch systems throughout their time on the water. The remainder reported that their routines were changed or broke down because of seasickness and fatigue or the nature of the weather conditions. Eight percent claimed to have changed their watch routine exclusively for safety reasons.

Six of the twenty eight yacht crews interviewed (21%) have a very formal approach to organisation that begins well before the race. This includes providing the crew with a detailed list of what to bring on board, a watch list and schedule, safety procedures particular to the yacht, tips on seasickness management, 'housekeeping' and a layout of where equipment is stored on the boat (examples are provided in Appendix 18).

Eighty- four percent of yachts carried food especially prepared to be easily cooked and consumed during severe conditions. Sixty three percent claimed that they were able to prepare and consume acceptable food during the course of the storm.

Ninety four percent reported that they were able to keep their cabin in reasonable and tidy conditions and 78% did not find loose gear to be a hazard. Eighty- six

percent reported that there were adequate grab rails (or equivalent) below to facilitate moving about the cabin safely. In total 14 yachts reported crew injuries sustained while below deck. Half of these believed the injuries were sustained because of poor interior design features.

Thirty seven yachts reported crew injuries to 53 crew members of the 948 covered by the survey, most of whom (84%) sustained more than one injury. The type of injury amongst the 53 crew is outlined (including multiple injuries):

Broken/cracked ribs	51%
Laceration/gash/cut	
Concussion/other head	22%
Muscle strain/tear/bruising	35%
Other	

Eighty eight percent of yachts reported having adequate medical supplies to treat injuries, 3% claimed they did not and 9% failed to respond to the question.

7.4 Tactics Employed During the Storm

7.4.1 Information from the Fleet

From the interview process, it is clear that yachts that continued to "actively sail" in the conditions and had sufficient speed, and more importantly, power, to negotiate the waves, generally fared better. Having sail power enabled yachts to recover after being hit by waves, particularly when a succession of waves engulfed a yacht. Nonetheless 39% reported being knocked down to 90° and 17% beyond 90° at least once.

Eighty six percent of yachts deployed various storm sails. Of these, 86% used a storm jib and 48% a trysail. At least two yachts had specialist storm mains and several had fourth reefing points. Forty two percent of respondents claimed that their storm sails were too large. The size of storm jibs, in particular, was raised consistently during the interview

process. The view was that smaller jibs are required in the high wind speeds experienced.

Twenty two percent of those deploying storm jibs and 28% of those deploying trysails subsequently removed them; 20% removed both. This meant that 32 yachts (29%) were at some time under bare poles for an average period of 5-6 hours.

With knowledge that they were facing deteriorating conditions, a number of yachts took additional steps. Twenty six percent removed loose gear from the deck/cockpit, placing it below, 12% removed kite sheets and braces and 3% placed spinnaker and jockey poles below. Seventy eight percent installed storm boards and 14% made some other form of preparation.

Crews were asked to describe the trim under which the yachts best handled their conditions:

Beating	14%
Eased off up to 15%	36%
Reaching off	25%
Running before the storm	12%
Bare poles/Lying ahull	3.6%
Other	6.4%
N/A as retired before storm	9%

(NB: multiple responses occurred, adds up to more than 100%)

7.4.2 A Summary of Tactics employed by the Yacht Atara

Atara was skippered by Roger Hickman, a finisher in the 1984, 1993 and 1998 SHYRs, with vast experience in rough weather. His report has been included to demonstrate that a variety of tactics were used, even by the most experienced of heavy weather sailors. This demonstrates that no one strategy emerged as pre-eminent.

"By 0500 hours the wind was a solid 40 knots plus. The seaway by now was heavy going with a short sharp 5 to 6 metre swell running against the still present southerly current, the crest of the waves was starting to tumble, and foaming rollers were growing rapidly. At the first hint of daylight, all hands mustered on deck, fully kitted up with wet weather gear and harnesses, to lower the mainsail.

The mainsail came down with little fuss and the crew quickly had it rolled up tight on the boom and the mainsail bag was wrapped tidily around them. The reason for this careful approach is that when the larger waves crash over the boat, the boom and adjoining sail present a small, tight roll that offers little resistance to the tonnes of water that crash over a yacht when being overwhelmed by a rolling, breaking wave.

The trysail was working well, and as the breeze was now in excess of 50 knots, we decided to take the #4 headsail down. The boat was still maintaining a good course of 180° and sailing at between 8 and 8½ knots, so we felt that we didn't need the storm jib. By 1000 hours the wind was hitting 65 knots plus and the size of the trysail was probably more than we needed. However, as we had it set up on the main boom, we could twist the sail off, which enabled us to de-power it considerably. By midday, the seas had reached 9 to 10 metres and the crests were very often rolling and causing concern. We were also moving along fairly swiftly which caused

the boat to leap off some of the waves that were steeper and had little or no backs to them.

The gale was steadily in the upper 60's and peaking at over 70 knots. The storm trysail would flap heavily at times, which was causing us distress as the mast check stay was wrapped around the trysail about a metre down the leech. Eventually the check stay adjuster chafed through the leech and as the boat was well overpressed, we decided to take the trysail down and repair it before it tore completely which may have caused us to lose the main halyard.

By this time, we had and were registering up to 75 knots of gale force wind and on the odd occasion, the tops of the waves were just mountains of water, similar to the dumpers you find on Bondi Beach. During the time that we had no sails up, it was a good opportunity to have a long hard look at the best thing to do, so we sailed under bare poles for some 30 minutes. The boat felt manageable as we were still maintaining approximately 7 knots and on a course which coincidentally was the course that we would have been on in the absence of this full blooded gale. We were able to manage the wind and waves at approximately 60° to 80° apparent off the bow, which I felt was the most desirable under the conditions. The boat was fully battened down with both hatch boards in place and secured, with all but 2 of the crew below deck. I have an obsession with the fact that most personal accidents during stormy conditions happen below deck. We had made a big effort just after daybreak to ensure that every movable object except for the life rafts was securely lashed to our vessel's hull.

We were progressing well with bare poles when the breeze was in excess of 55 knots but occasionally the breeze would drop below this and the boat would not sail fast enough for us to be in control. The choice then lay

whether to put the storm jib up and continue sailing or whether to heave to.

The decision was finally made to put the storm jib up as when the breeze was lower, the seas were heaping up more and causing concern that the leeward gunnel would go under the water far enough to trip the boat up as we sometimes slid sideways down the monstrous waves.

With the storm jib up, we were off again at speeds between 8½ and 9 knots on a course of 190° with the wind averaging 70° apparent. One had to steer the boat very carefully throughout. By this time we were well clear of the most dangerous stretch of Bass Strait, the waves were fully formed storm waves and with Atara being 43 feet, we estimated the bigger rollers were some 80 to 90 feet from the top to the bottom."

7.5 Retirements – Who and Why

The following table represents the list of retirements (total number of 71 out of 115 competitors) from the 1998 SHYR:

	Yacht Name	Reasons for retirement
1	ABN AMRO Challenge	Rudder damage, prior to storm
2	Adagio	Prudent seamanship
3	Alexander of Creswell	Sail damage
4	Antipodes Sydney	Prudent seamanship
5	Antuka	Prudent seamanship
6	Assassin	Prudent seamanship
7	B-52	Rolled & dismasted
8	Bin Rouge	Prudent seamanship
9	Bobsled	Prudent seamanship/Sail damage
10	Boomaroo Morse Fans	Prudent seamanship
11	Bright Morning Star	Prudent seamanship/Crew injuries
12	Business Post Naiad	Rolled & dismasted
14	Chutzpah	Prudent seamanship
15	Cyclone	Hull damage
16	Dixie Chicken	Stood by Outlaw/Too much lost time to continue

	Yacht Name	
17	Elysion Blue	ident seamanship
18	Forzado	Prudent seamanship
19	Gundy Grey	Prudent seamanship/lost life raft
21	Hi Flyer	n/a*
		Prudent seamanship
23	Impeccable	Prudent seamanship
24	Indian Pacific	Prud[illegible]
25	Inner Circle	
26	Innkeeper	
27	Jack Guy	dent seamanship
		Prudent seamanship
	Lady Penrhyn	
	Loki	Wind[illegible]
33		Rig damage
36	Miintinta	Prudent seamanship, subsequently damaged, **sunk**
		dent seamanship
38	Nattel Adrenalin	Prudent seamanship
39	New Horizons	Equipment failure & rig damage
		Sail damage
41	Not Negotiable	Prudent seamanship
42	Ocean Designs	Prudent seamanship
43	Outlaw	Structural damage/Forward frames
44	Pippin	Stood by SGC/knockdown & radio failure
45	Red Jacket	Rig damage
46	Relish IV	Prudent seamanship/Crew injury
47	Renegade	Prudent seamanship
48	Ruff N Tumble	Equipment failure (engine)
49	Sagacious V	Prudent seamanship/equipment failure (radio)
		Prudent seamanship
51	Secret Mens Business	Prudent seamanship
52	She II	[illegible]
		Rendered assistance to VCOS/Crew injury
		Prudent seamanship
		Prudent seamanship, subsequently rolled, **sunk**
58	Sydney	Rudder damage, prior to storm
59	T42 Solandra	Dismasted

	Yacht Name	Reasons for retirement
60	Tartan	Prudent seamanship
61	Team Jaguar Infinity III	Dismasted
62	Tenacious	Equipment failure (engine)
63	Terra Firma	Prudent seamanship
64	Trust Bank Hummingbird	Prudent seamanship
65	Vagrant	Crew injury
66	VC Offshore Stand Aside	Rolled, damaged, **sunk**
67	Veto	Equipment failure & m:
		Equipment failure (radio)
71	Zeus II	Dismasted

(*no response)

Reasons for retirement are dealt with in some detail in Section 6.1, particularly those dealing with structural, gear and equipment failure.

A substantial part of retirements is attributed to "prudent seamanship", where skippers (and crews) decided not to continue racing based on the weather conditions or the condition of the crew or their boat.

Details of these decisions follow:

Who took the decision to retire?	
Owner/Skipper	51%
Skipper	3%
Core group	23%
Crew consensus	23%

Was there (a) particular event(s) that convinced you to retire?	
Knockdown	29%
Sustained damage	38%
Heard Doctel Rager/Sword of Orion advise of severe conditions	29%
Heard RRV remind skippers of their responsibilities	4%
Other event	35%

(NB: multiple responses, adds up to more than 100%)

In addition, 12% indicated seasickness and 10% crew fatigue were determining factors in the decision to retire. Of those that completed the race 8 yachts considered retirement at some time. Reasons which included multiple reasons from some yachts were:

Forecast of poor weather conditions	4 yachts
Condition of crew	2 yachts
Potential risks	5 yachts

Twenty seven of the retired yachts (38%) advise that they altered the course they originally took upon retirement. All of these did so because it was the best course to steer in the seaway for the safety of the boat and crew. Yachts generally altered course, to be running more before the seas than across them as their former course prescribed.

At retirement, the average distance from the 70 retired yachts (covered by the Questionnaire) from their chosen destination (usually Eden) was 62 nautical miles. The time taken to reach port was:

0-10 hours	22%
11-20 hours	29%
21-30 hours	16%
Average time	14.76 hours

(NB: table adds up to 67% of 110 Questionnaires which equals 70 retirements)

7.6 Abandonments – Who and Why

The following are descriptions by the yachts' crews of the events leading up to the abandonments. These have been prepared from interviews and submissions.

7.6.1 Business Post Naiad

By 1650 hours on 27 December the wind had increased to 75 knots and between 1700-1715 hours BPN recorded gusts between 80-85 knots.

The crew had discussion about the best course of action in the extreme winds. It was reported that skipper Bruce Guy was concerned that the yacht was going too fast, and being wiped out by the head and blown away as it crested waves, laying over at 45-50 degrees. Consideration was given to running before the storm but they were convinced that the yacht would have pitch poled in the waves. Consideration was given to going bare poles, but there was some hesitation in removing the jib as it would be difficult to head the yacht up without it.

Winds were continuing to build and waves consistently raking the whole boat. The crew commented that "the jib was in control of us, not us in control of it". Guy took the decision to "try it under bare poles".

After some 15-30 minutes under bare poles at around 1730 hours, BPN became beam on to the seas and was a little sluggish to steer. A big wave with a big breaking crest slammed into the boat, and started it surfing sideways and rolling it through 360°. The yacht flipped quickly, rolled and was back on its keel within about 10 seconds.

BPN had been rolled sideways, dropped on its cabin sides and top. The mast was broken, most bulkheads sprung, one window was gone and the rest cracked. There was a fracture 2 feet long across the coach house and a

hole in the top of the cabin. Where the compass was fixed in the side-decks was cracked and the deck had de-laminated.

The roll-over had emptied the contents of the freezer and this along with many of the crew and boat gear were scattered throughout the boat. There was a smell of diesel fuel and concern that the fuel tank may be contaminated, or breached.

The 5 crew on deck were all washed into the water on the starboard side (with the mast) and were able to scramble back on deck within 1-2 minutes. All were wearing harnesses.

The crew below came on deck to assist in clearing up the rig which was lashed on deck.

The crew reported no panic and a calm business-like approach to matters at hand. They were nonetheless anxious. They were also concerned about the cracks in the deck and broken bulkheads. "The boat was a wreck."

They set up a spare VHF aerial and transmitted May Days on VHF 16 and HF 4483 kHz, activated their EPIRB which they placed in a sheet bag, just inside the companionway, so it would not be lost.

After cleaning up the boat, the crew attempted to start the engine which started on the third try. The GPS was working intermittently and they adopted a strategy of trying to get into the lee of the land, a course of 290-300°. (Although steering this, they reported making north at about 2 knots). However, as the GPS was intermittent and paper charts destroyed, it was difficult to plot (or know sic) progress. They estimated their position to be about 10 nautical miles S/SE of Gabo Island.

Seas continued to get bigger and the crew reported that it was noticeable that BPN was more prone to roll without the mast.

The action of the yacht in the seas caused the crew to become increasingly concerned that BPN would be rolled again. They continued to be tossed by big waves.

At 2255 hours (with Skeggs & Matthews on deck), BPN was rolled for the second time. They were harnessed on the port side with their backs to the weather, with one calling out the compass reading to the other. White out conditions made it impossible to steer the course they wanted, so they steered the safest course up into the waves "by feel".

A breaking wave wiped the bow out quickly and bounced the boat sideways some 200 metres. It "fell upside down", right at the end of the impact. The boat was "surfing on its roof".

BPN remained inverted for 4-6 minutes. Within 30 seconds there was more than one metre of water inside. Batteries and electrics were "gone" and the motor stopped soon after the roll.

The two on deck were trapped under the cockpit. Matthews was trapped under the end of the cockpit at the end of his harness tether, became short of breath and was in fear of drowning. He had extreme difficulty unclipping his harness, but eventually did. He was able to pull himself forward and got to the mast (lashed to the deck). As the boat rolled back, he was "flipped into the cockpit", to land, remarkably, adjacent to his harness tether which he re-clipped. He found crewmate Skeggs face down in the cockpit and determined later that he was dead.

When a second big wave rolled BPN back up, it was apparent that everything below was "trashed". The EPIRB was still in place but the aerial was broken. Anchor chain, floorboards, crew bags and miscellaneous gear was all through the boat.

Skipper Guy below deck slipped in the companionway as he prepared to go on deck and assist. The crew reported that he had a massive heart attack at this time that caused his death.

On deck they were administering CPR to Skeggs, while the crew members below were preparing to get a life raft into the cockpit, as they were expecting the boat to sink. The raft was inflated and tethered astern, where it kept flipping over.

The crew deployed three parachute flares, made into an extremely difficult two person job by grease and diesel fuel that had been distributed throughout the yacht's interior. In addition, the storm jib was deployed over the bow as a sea anchor, to be joined later by a spinnaker to improve efficiency. The helm was lashed to keep the bow into the seas.

The crew bailed water from the boat, but when "1/2 full" of water it felt less likely to roll again so they concluded to leave it in this state after several hours of bailing, leaving around ½ metre of water. It was now about 2000 hours on 27 December.

Around 0200 hours, the crew noticed that conditions had improved marginally, although seas were still breaking and raking the boat. The crew believed BPN was in imminent danger of sinking.

In preparing to put the second life raft on deck in order to be fully prepared, it inflated accidentally half way through the companionway

creating difficulties. It was eventually brought on deck and tethered on the side. The crew sheltered below deck, leaving Skeggs lashed in the cockpit.

At approximately 0300 hours another big wave struck the boat and carried both rafts away. The crew had 'some sleep" and discussed what actions would have to be taken if no help came, ie. jury rig etc. They also sensed the weather continuing to improve slightly.

At around 0700 hours a two-engine plane flew an estimated ¾ mile ahead of BPN and the crew launched a parachute flare and 2 orange smoke flares. The plane acknowledged the sighting by flying overhead and staying overhead for approximately 15 minutes.

By 0800 hours a helicopter arrived and BPN crew signalled that they had 7 on board that were ok and two not. One of the BPN crew had had SAR training and armed with the knowledge of what to do, the helicopter was able to pick up the BPN crew within 30 minutes.

A tracking beacon was lashed into BPN and the yacht abandoned, with Guy and Skeggs on board. BPN was later found and towed into Eden and the bodies of Guy and Skeggs recovered.

7.6.2 Winston Churchill (WC)

By around 1400 hours on 27 December crew reported the sea conditions were deteriorating and were independently concerned about the boat and safety in the approaching darkness. They could see no advantage in turning around as it was a beam sea in either direction.

Winning and Dean were on deck at around 1700 hours, when a "rogue wave" overcame the yacht. WC was literally picked up and thrown sideways down the face of the wave, knocking the boat down beyond 90°.

The aft third of the WC took the brunt of the impact and the two crew on deck harnessed to the split backstay had their harnesses twisted and tangled. Stanley was first to assist and assumed they were both washed in opposite directions around the backstay.

To leeward, 2 metres of the bulwark was sheared off the deck midships, the dodger had been carried away and 3 windows on the aft cabin stoved in, allowing the ingress of a considerable volume of water.

The water pinned Stanley, who was in the aft cabin for a minute or so, until he was able to come up on deck and help untangle the two harnessed to the backstay who had called for assistance.

The boat was on a starboard tack, with the batteries on the port side. This meant that when the attempt was made to start the engine only a few minutes after the incident, the batteries were underwater, rendering starting impossible. This removed the opportunity to pump water out with an engine-operated pump.

The crew observed the water level rising rapidly and within approximately four minutes of the incident, it was at least two feet above the floorboards.

Gould called to Winning to put in a May Day call, which he did on VHF, as the HF was unserviceable due to water damage.
The crew realised that the boat was badly damaged and that the water level inside continued to rise. They assumed that WC may have sprung a plank and that it was impossible to stop the ingress of water.

When it became apparent that WC would sink, Stanley passed life jackets to the crew on deck who were preparing the life rafts for launch and who also deployed a number of flares.

Although they had dropped the storm staysail after the knockdown, WC was still doing about 5 knots, even ½ full of water. They knew they had to slow the boat down before launching the life rafts. They decided to wait for the moment when the boat was about to sink, as the best means of achieving the launching and getting into the two rafts safely.

About 25 minutes after being struck by the wave, WC sank, and the crew took to the two life rafts, which were initially tethered together. The tether broke almost immediately and within ten minutes the rafts lost contact with one another.

7.6.3 Sword of Orion (SOO)

SOO crew discussed retirement for several hours. Key considerations were related to the conditions ahead, how long would they last and the condition of the crew (some seasickness had occurred). Around 1630 hours on 27 December, the decision was taken to retire and the RRV logged SOO's radio report of this at 1644 hours.

After turning around, the intention was to head in the general direction of Eden, but the course chosen of 340° magnetic was considered the best and safest in the seaway.

The seas were difficult and great care had to be taken to watch the waves and steer the boat accordingly. This was difficult due to the wind strength creating flying spume.

Helmsman Glyn Charles had been steering prior to turning around and continued to do so on their new course. After helping jibe the boat (which was done with the engine running "just in case") and tying the boom down on the other side of the boat, Charles was left on deck with one other crew, Darren Senogles, as per their pre-determined heavy weather strategy.

SOO was down on course to about 30° magnetic when an extremely big wave hit the boat rolling it through 360°. This was about 25 minutes after turning around. The boat stayed inverted for about 5-6 seconds, and righted itself.

Below deck, the crew reported seeing black, hearing an horrendous noise, and not being sure exactly what had happened. The skipper was pinned under sail bags at the navigation station with an injured leg, with the rest of the crew (below) ok, but shaken.

On deck, helmsman Charles had been swept away, when the stitching of the webbing tether of his safety harness failed.

The mast was broken and wrapped around the boat, the alloy steering wheel partly ripped away and the wheel well was breached, allowing the ingress of water. The deck was parted from the hull for 4 metres from the transom to the coach house on the starboard side. The companionway hatch had been ripped away by halyard tails from the mast which had been stowed hanging into the boat. The cockpit frames along with all the rest of the yacht's ring frames had been dislodged.

Senogles immediately called MOB and most of the crew were immediately on deck. Charles was upwind and it was impossible to throw the life rings or heaving lines against the wind, which was gusting at up to 80 knots. Consideration was given to swimming after Charles with a line (the anchor line being the only one left available) but this would place additional crew at risk. They lost sight of Charles within 5-7 minutes.

SOO was drifting at 4.5 to 5 knots, with the rig down at the side of the boat, the boom gone and significant structural damage. The engine was

unserviceable and the fuel tank intake had been dislodged. There was considerable water in the boat that disabled the HF.

The crew cut away the rig with a hacksaw and removed the pins holding the rigging (note: the bolt cutters were not effective on the rod rigging) and deployed the anchor and warp as a drogue. This worked well, holding the boat's head to wind and slowing the boat to 2-3 knots. The crew deployed a spare VHF antenna and brought the EPIRB on deck, lashing it into position.

Approximately 1½ hours after the incident, SOO sighted a yacht, still heading south some 100-200 metres from them. They launched flares to attract attention, but the yacht continued (This yacht was identified as Margaret Rintoul II).

(The investigation of this incident falls outside the terms of reference for the SHRRC. The Committee has passed full details of the incident on to the Coroner and the Commodore of the CYCA for their own investigations- ed.).

Some 3 hours after being rolled SOO heard a SAR aircraft overhead and contacted them on VHF. Some 30 minutes later they made VHF contact with a SAR helicopter, and SOO gave their position and were instructed to place EPIRB in the water. Once in the water the telescopic aerial broke and the line attaching the unit to the boat chaffed and parted. The EPIRB drifted off.

SOO continued to take water. Bailing with a bucket and a drawer was continuous. The crew was able to light the stove, cook and eat some food, while waiting for the rescue helicopter.

At around 0200 hours a Navy helicopter approached SOO using strobe lights SOO had deployed to assist in locating them. SOO advised that they had two injured on board but were asked to begin the rescue with a "fit" person.

SOO was able to talk to the SAR helicopter with the yacht's VHF, but reception was poor and it was difficult to hear because of the helicopter overhead.

All crew put on PFD 1's, and the helicopter lowered a line with a monkey first to enable SOO crew to pull the winch line down. Senogles went first, and after some difficulty with the process, because his yacht's safety harness became unclipped from the helicopter's line, he was winched to safety. It had however, taken some 20 further passes to re-connect Senogles to the helicopter's line. Three crew were rescued by this first helicopter.

A second Navy helicopter arrived at around 0400 hours and stayed in contact, usually visual, with SOO. At first light the remaining six crew were extracted within half an hour. SOO was completely abandoned and presumed sunk.

7.6.4 VC Offshore Stand Aside (VCOS)

By the early hours of 27 December, with the wind at around 35 knots from the south-west, VCOS had a number of crew seasick and the watch system had broken down.

By midday the wind shifted more to the west and the crew noted a rapid increase in wind velocity and wave height. The decision was taken to remove all sails and run east under bare poles. The yacht was difficult to manoeuvre through the seas and was making about 5 knots.

The crew attempted to hoist the storm jib which, however, blew out of the foil. As the crew was unable to recover it, it was left in situ, with the yacht now heading on a course of between 110° to 140° magnetic and "comfortable".

At approximately 1415 hours, a large wave with a top of seven metres which was "completely vertical", broke over the yacht, rolling it through 360°. The mast was broken at deck level, the boom broke and the deck imploded. The windows were shattered and the storm boards were missing.

All eight crew members on deck were washed overboard during the roll, seven were tethered to yacht, one not tethered who was ten metres from the yacht. All overboard crew required the assistance of those, who were below during the roll-over, to get back on board the yacht- this took fifteen minutes. The crew then cut the rigging and mast away using bolt cutters. Fortunately, the yacht had an exceptionally large set of bolt cutters. The majority of crew suffered injuries during the roll-over.

The engine and the HF were unserviceable and with the coach house destroyed, the yacht filled to about 40% with water.

The crew determined to launch the life rafts, but one of the two failed to inflate. Additional tugs on the tether resulted in the tether breaking and the raft being lost. The second life raft was deployed and tethered astern of the yacht. The yacht's EPRIB was activated. The crew was anxious and fearful of the position they were now in.

The crew deployed a red parachute flare and two large smoke flares, as well as connecting an emergency antenna to the HF radio. The HF continued to be unserviceable.

A hand held VHF connected to an emergency aerial was used to send a May Day. This was received by the ABC helicopter, which responded and was overhead in 15 minutes. Twenty minutes later, a SAR helicopter arrived, lifting eight crew via the life raft as a staging point. A second helicopter lifted the four remaining crew in a similar manner.

The yacht was abandoned at approximately 1530 hours on 27 December and presumed sunk.

7.6.5 Midnight Special

At around 1500 hours on 27 December Midnight Special, feeling the full brunt of the storm considered two options- continue south, or head north to the nearest shelter at Gabo Island, some 30 nautical miles away.

They chose the latter and proceeding under storm jib alone at around 9 knots, were knocked down several times.

At approximately 2000 hours on 27 December a large breaking wave, estimated to be 15 metres high rolled the yacht through 360°.

Peter Baynes, the skipper reports:
"We were finally overcome by a large wave with breaking top which rolled the boat to starboard, snapping the mast at the gooseneck and below the first spreader as the boat rolled through 360°.

The cabin top on the port side was stoved in. The top edge of the cabin had inverted, there was a large hole approximately one metre long in the cabin – top just behind the bulkhead where the front window had been. The cabin top aft of this hole was collapsed leaving the second and third windows...[(broken ed.)]...The cabin was awash with approximately

30m³ of water]...[and the top of the companionway was smashed making it impossible to install the washboards]."

The tiller was also broken, and attempts to jury rig it failed. By 2300 hours the crew had deployed the EPIRB, bailed the cabin and plugged the damage with a spinnaker and sleeping bags. The rig had been cut free and the disabled steering lashed into a fixed position. The engine was started and the boat moved ahead, in a SW direction "quite comfortably" exposing the undamaged side to the swell and breaking waves.

Around midnight the crew thought they saw a ship and fired two flares, with no response. They established a watch system and decided to wait for daylight. For the remainder of the night the yacht was threatened by large swells and breaking waves. The items used to block the damaged deck, sleeping bags and a spinnaker, were washed away.

At 0430 hours on 28 December a plane was heard overhead and flares fired, the plane responding by flashing its landing lights. Some 30 minutes later a South Care helicopter arrived. Peter Baynes reports: "After some time an understanding of the signals became clear. The first crew member under instructions from the helicopter crew, jumped into the water behind the boat and in no time at all became separated from us quite a distance- approximately 100 metres by the time the diver finally connected with him. As this first lift was taking place, with two crew in the cockpit and six below deck, the yacht was overcome by a wave which rolled the boat upside down where it remained for quite some time. The two crew in the cockpit were secured by their harnesses which they were unable to release due to pressure]...[The crew inside the upturned hull did a headcount, observed the water depth as waist deep and looked to the companionway as the means of escape. One crew member attempted to dive through the hatch but was unsuccessful due to the halyards tangling him and his life

vest's positive buoyancy making it an impossible task. Thankfully the next wave rolled the boat upright (giving us a second complete 360° roll for the night), total time inverted approximately 20 seconds."

Five of the nine crew were lifted, and at around 0600 hours a Victorian Police helicopter arrived to rescue the remaining four (full details in section 8.2).

As communication with SAR was carried out using hand signals there was always a level of uncertainty about the content. On rescuing five of the crew, the first helicopter had suddenly departed. The remaining four crew became extremely fearful, as the yacht continued to take water with every wave. They had to wait approximately twenty minutes to be rescued.

Midnight Special was abandoned and presumed sunk a short time later.

7.6.6 Miintinta

On Sunday 27 December as weather degenerated, the yacht was sailing under a full main and #2 genoa approximately 40 miles east of Eden. Conditions deteriorated and a sail change to the trysail and storm jib was made. The main was lashed to the boom and the yacht secured for rough conditions.

Initially the yacht was under-powered and the crew found that the sail area was too small to maintain forward motion.

With winds increasing to 60 knots and seas rising to 8 metres, a decision to proceed to Eden for shelter was made late pm. Sea conditions became confused, with steep backless waves exceeding 10 metres in height. As the yacht was experiencing difficulties handling the conditions under sail alone, the motor was started and the yacht proceeded towards Eden. The

yacht had not retired and the crew intended to continue racing following abatement of the weather.

After approximately 4 hours the motor overheated and stopped. Brian Emerson examined the engine and could find no reason for its demise. (Emerson stated that the engine had been completely serviced prior to departure from Sydney). At this time the crew observed the ingress of water from an unknown source and two bilge pumps new prior to the race failed.

Emerson: "I suspect the stresses imposed on the strong point under the mast step and impact of the mast under extreme stress bearing on the keel destabilised the fibreglass attachment to the keel. I noted as the yacht was being hit by big waves we took in water badly amidships, indicating a likely delamination. When the waves stopped pounding, we were able to keep pace bailing out the water, this further indicating that with the lateral stress on the keel removed the delamination closed" (precluding the ingress of water ed.).

The newly installed manual bilge pumps failed to keep pace with the ingress of water and Emerson made a PAN PAN call, which was responded to by a container ship, which stood by to assist. The container vessel was released by Emerson following notice of the imminent arrival of a rescue trawler "Josephine Jean" from Eden and advice that the crew thought that they had the water ingress under control.

The position of the yacht was in some doubt and flares were released by the crew to indicate her position. Problems with ignition of flares were experienced by the yacht crew. The yacht Southerly observed the flares and reported the position to RVCP Radio. The trawler "Josephine Jean"

was re-directed to the location, arriving at 0155 hours on 28 December (36°56'S, 150° 42'E).

Difficulties were experienced in attaching and maintaining the tow line to the "Josephine Jean". At approximately 0530 hours, the crew of the yacht could no longer prevent the ingress of water and a decision to abandon the vessel was made. The crew launched the life raft and transferred to the "Josephine Jean", under extreme difficulty.

The crew was extremely fatigued. The "Josephine Jean" continued to tow the yacht towards Eden. The yacht foundered and sank at 36°57'S, 150°42'E at 0730 hours on 28 December. The crew of the yacht returned to Eden on the "Josephine Jean".

7.7 Fatalities – Chronology of Events Leading up to Deaths

7.7.1 Business Post Naiad

Details in this chronology have been prepared as a guide only, some times and events may not be completely accurate.

DATE	TIME	EVENT
27/12/98	1700	BPN removes storm jib and continues south under bare poles at 2-4 knots
	1720	BPN rolled 360° and dismasted, 5 crew on deck washed overboard and recovered, mast recovered and tied on deck, engine started and course set in northerly direction, May Day sent
	1749	Yendys advises of May Day from BPN; message that BPN had rolled over with major hull damage, its position 38°05'S,150°32'E, was attempting to steer 174° magnetic, BPN activates EPIRB
	1800	Crew clean up below after roll, life rafts in companionway ready to launch
	1815	BPN 43 miles from Disaster Bay, 38°03'S,150°32'E, steering 300° magnetic, 5.4 knots
	1830	Crew start engine and head 290-300° with

DATE	TIME	EVENT
27/12/98	1830	(contd.) strategy of getting to lee of land, set up 2-on deck watch system
	1915	BPN via Yendys, at 37°59'S,150°31'E steering 299° magnetic, 6 knots
	2007	BPN asks for helicopter airlift for 3 crew, and yacht to stand by
	2300	BPN rolls through 360° for second time, stays inverted for 4-6 minutes
	2305	BPN hit by wave and rights itself; EPIRB aerial broken; boat now in major disarray below deck, loose gear and equipment, grease and diesel fuel.; Skeggs on deck when BPN rolled is found dead in cockpit
	2315	Guy slips in companionway and has heart attack

7.7.2 Winston Churchill

Details in this chronology have been prepared as a guide only, some times and events may not be completely accurate.

DATE	TIME	EVENT
27/12/98	1700	WC knockdown by large wave, windows stoved in, hull presumed breached, yacht taking water rapidly
	1721	WC May Day, boat taking water, 9 crew are getting into life raft, EPIRB deployed, yacht sinks
	1730	2 life rafts are tied together, tether breaks, rafts loose contact within 10 minutes
	1750	Life raft with Stanley, Dean, Lawler, Gibson and Bannister: crew hears bang, and observes raft become more unstable, crew presumes drogue broke
	1800-onwards	Raft hit by rogue waves every 25 minutes, crew sit with legs intertwined and Stanley gets injured when raft gets lifted and dumped by big waves, raft fills with water
	1930	Rogue waves roll raft upside down and crew decides this is more stable; crew discusses Lawler going outside to right raft but all agree too dangerous
	2000	Crew cuts 5" slit in reinforced floor (now roof) to provide fresh air, canopy (now floor)

DATE	TIME	EVENT
27/12/98	2000	(contd.) destroyed from standing
	2130	Merchant ship "Patsy Ann" departing to area of WC
	2325	RRV in search pattern for WC
28/12/98	0000	Helicopter dispatched to search for WC
	0500	Raft rolled by extreme wave and 3 crew washed out – Bannister, Dean and Lawler lose contact with raft

7.7.3 Sword of Orion

Details in this chronology have been prepared as a guide only, some times and events may not be completely accurate.

DATE	TIME	EVENT
27/12/98	1400	**Sked 3**; Sword of Orion advises fleet of extreme winds of 50-70 knots and gusts up to 90 knots
	1644	Sword of Orion advises RRV of retirement, heading to Eden, 38°18'S,150°17'E, 2 crew on deck, Senogles and Charles, Charles steering
	1650-1710	Wave rolls Sword of Orion through 360°, dismasted, severely damaged hull, Charles and Senogles washed overboard, Charles harness tether parts, Senogles recovered, crew lost sight of Charles 5-7 minutes after incident

8.0 SEARCH AND RESCUE

8.1 How Competitors viewed SAR

The first call for assistance came in at approximately 1500 hours on 27 December, with the May Day from VC Offshore Stand Aside. By this time, some 25 yachts had already retired, or taken the decision to seek shelter. Soon after AMSA recorded distress signals from 3 EPIRBs, one of which belonged to Team Jaguar and the other two, not related to the SHYR fleet. By 1700 hours multiple incidents had caused AMSA to declare a May Day for the general area.

Seven yachts had crew airlifted:

Sword of Orion	10
Solo Globe Challenger	3
Winston Churchill	8 (including 2 deceased)
Business Post Naiad	7
VC Offshore Stand Aside	12 (full crew)
Kingurra	1
Midnight Special	9 (full crew)

In addition, 6 crew from Miintinta were taken aboard the fishing trawler "Josephine Jean" and 2 crew from Solo Globe Challenger were aboard "HMAS Newcastle".

16 yachts had asked for some form of assistance:
4 using HF,
6 using VHF,
5 using EPIRBs (note: 9 EPIRBs were activated in total) and
1 using Mobile phone

Eleven yachts launched flares, observed by a total of 20 yachts. Eleven yachts put out urgency (PAN PAN) or distress (May Day) calls, of which 3 were later downgraded. Nineteen yachts claimed to have been involved in some way in

SAR, 11 rendering assistance. Five yachts advised that their primary method of being located was by use of flares.

Time taken to locate yachts following Distress Call/EPIRB deployment:

Within 1 hour	- 1 yacht
Within 1-2 hours	- 2 yachts
Within 2-3 hours	- 1 yacht
Within 5-6 hours	- 1 yacht
More than 7 hours	- 1 yacht

(Note: not all yachts that deployed EPIRBs responded in the Questionnaire)

8.2 Training and Knowledge of Crews of SAR Systems and Techniques

In spite of most yachts claiming some level of SAR experience or training, evidence from actual search and rescue events demonstrates that crews were not well educated or prepared on the equipment they had at their disposal. Notwithstanding, crews demonstrated good seamanship skills and high levels of ingenuity and self-sufficiency.

Claimed levels of SAR experience/training on board:

Very experienced/trained	8%
Some experience/training	56%
Nil experience/training	28%
No answer	8%

Kingurra were able to communicate with the SAR helicopter through VHF. On arrival at the scene the helicopter proceeded to another yacht (Chutzpah) standing by. Kingurra crew believes the helicopter was either unable to identify which of the yachts required assistance or that they had not been seen. Kingurra deployed a red hand flare and the helicopter diverted immediately. (The Kingurra crew was immediately able to direct the helicopter to the man in the water as they had employed a simple, but effective MOB routine,

designating one crew member the exclusive role of 'spotter'. After some 40 minutes of the MOB incident, the 'spotter' was still able to see the MOB – if only for 2-3 seconds per minute.)

The Winston Churchill crew reported that a lack of familiarity with life raft features ultimately resulted in them cutting the floor of the raft for air when it capsized, rather than trying to right it.

Crews from all yachts involved in helicopter rescues reported from ignorance to some uncertainty in what procedures should be followed to facilitate rescue. This was compounded by the lack of ability to communicate (in some cases) due to yachts' VHF sets being inoperable from dismasting or water damage.

In the case of Midnight Special, different rescue methods were employed by each SAR helicopter, which created difficulties for the second group of the crew rescued. Having observed one method, this group assumed the second helicopter would employ identical techniques, which was not the case. An extract from the description of the particular incident by Peter Baynes of Midnight Special follows:

"Different methods of retrieval were used by the helicopter crews; the South Care team instructed the yacht crew to jump into the water, then they winched down their swimmer and tried to join up with the crew member. This took place up to 100 metres from the boat. By comparison the Victorian police method saw the swimmer winched down to the water then dragged to within 5 metres of the stern of the yacht. The swimmer then instructed the yacht crewman to jump in. The short swim, then harnessing, saw the yacht crewman in the water for approximately 15 to 30 seconds."

Three yachts were taken under tow: Team Jaguar, Miintinta and Solo Globe Challenger. Miintinta broke the tow lines twice, the first set tied around the bollard, the second a bridle to the primary winches. The yacht was ultimately abandoned and sunk. Team Jaguar made a towing bridle out of Spectra spinnaker braces. By the time the tow was effected, conditions had abated somewhat (28 December around 0530 hours). Solo Globe Challenger were

motoring to Bermagui, with jury rig and the balance of crew (3 had been airlifted and 2 were on board "HMAS Newcastle") when advised by a fishing boat that it was sent by their insurance company to tow them to Eden. They arrived in Eden 15 hours later.

Getting the towline from the tow boat to the yacht proved especially difficult for Team Jaguar and Miintinta mainly due to the conditions. Team Jaguar reported the proximity at one time of their tow ("Moira Elizabeth") was "more scary" than anything else that had happened. Both these yachts reported considerable difficulty in retrieving the towline.

Team Jaguar reported misfiring 2 parachute flares because the operator pushed the trigger the wrong way. This also occurred on Miintinta.

- One SAR aircraft, a P3 dropped a package for Solo Globe Challenger to retrieve. There was indecision amongst the crew if they were to retrieve that package. They did, and it contained amongst other things, a hand held VHF that enabled them to communicate with the "Orion".

8.3 Sailors Interface With SAR

The RCC in Hobart was attended full-time during the crisis by AMSA's Race Liaison Officer, Mr. Anthony Hughes. AMSA's Rescue Coordination Centre in Canberra maintained a continuous liaison with Hughes to gather the CYCA's information about events and to keep the CYCA informed about the progress of SAR respnses.

- AMSA (through Hughes) advised the RCC, who in turn had the responsibility of communicating with the RRV. The RRV in turn communicated with individual yachts.
- AMSA had no direct contact with the yachts but was in contact with the RRV through the Defence communications network.

  AMSA controlled SAR assets directly and these assets in turn communicated directly with yachts.

- The RRV assisted in directing SAR operators with the fleet on 4483 kHz, the race frequency, rather than one of the emergency frequencies.

AMSA confirmed that 9 EPIRBs were activated during the SHYR. Eight were 121.5/243 MHz and one was a 406 MHz EPIRB.

The technology used by AMSA has the capability of tracking at least ten 121.5/243 MHz beacons at any one time and ninety real-time 406 MHz beacons. The 121.5/243 MHz beacons give position on average within 20km and 406 MHz beacons on average within a 5km radius.

Because of those accuracy constraints, satellite fixes alone were rarely adequate to pinpoint a distressed yacht amongst other yachts. An aircraft with 121.5/243 MHz homing equipment despatched to a satellite position could normally find a distress beacon immediately. In this race, however, multiple beacons often confused homing equipment. At least one helicopter reported that it homed to the same yacht more than once.

For the first night it was difficult for AMSA to accurately determine the nature of most of the distress incidents. Communications from yachts were not always complete, or accurate, and were sometimes being relayed by a third or even fourth party. There was also some confusion caused simply by long yacht names that made passing information back and forward over VHF and HF difficult. (AMSA advised that some yacht names were passed on incorrectly as a result).

As a result of all of the above factors, AMSA faced considerable difficulties overnight 27/28 December in prioritising the deployment of SAR assets. However, SAR aircraft and helicopters proved a most reliable source of information and helped to clarify the picture considerably after first light on 28 December.

The 406 MHz beacon on B52, discriminated the yacht for authorities, but SAR aircraft still had some difficulties locating the yacht because it was either underway or drifting rapidly.

SAR crews confirmed that lack of training and, in some cases, the lack of VHFs for communication hampered rescue efforts. One helicopter reported attempts to direct a crew into their life raft as a staging point for air lifting resulted in a misunderstanding that led the yacht's crewman getting directly into the water.

Other issues identified by SAR crews were:

- difficulty sighting/locating white hulls,
  difficulty identifying boats because of the lack of markings/distinctive features, and
- extreme difficulty of sighting crew in the water at night and to a lesser extent during the day.

In addition, AMSA faced an extremely difficult task determining the validity of information. As mentioned above, information was coming direct from racing yachts, often second or third hand, the RRV, RCC, SAR assets and media aircraft. The information was further confused by yachts who were retiring but did not advise their situation in detail eg. position, condition, destination and ETA at the point of retirement. It was reported by AMSA as being like a "puzzle".

AMSA reported that SAR crews would be greatly assisted by a number of measures. These include:

- yacht identification numbers on deck that are visible day and night,
- the use of bright colours for wet weather gear worn by crews,
  the extensive use of retro reflective tape,
  personal strobe lights and
  personal marker dyes.

AMSA also advised that personal EPIRBs would be useful. They would suffer the same problem of mutual interference as multiple yacht EPRIBs and would therefore need to be reserved for grave circumstances. Likewise, the accuracy of the 406 MHz type and its identification features would make it significantly superior to a 121.5/243 MHz type EPIRB. AMSA suggested that a protocol for use of EPIRBs would be helpful.

AMSA received approximately 2500 telephone calls during the event, many from the media, NOK and friends on competing yachts seeking information on various yachts in the fleet. In most cases AMSA redirected callers to either RCC in Hobart or the CYCA, either because the CYCA's information on non-distress events would be better or because operational SAR lines were congested.

9.0 FINDINGS

9.1 General

From the evidence, the 1998 SHYR was conducted in accordance with the Notice of Race and the Sailing Instructions, and CYCA Regulations.

9.2 Eligibility

Based on the information supplied to the CYCA by owners or their representatives, all yachts complied (with the exception noted below) with Eligibility Requirements with respect to:

- provision of required certification, IMS/CHS Certificates, PHS stability,
- crew experience,
- safety and
- public liability insurance.

One yacht (Business Post Naiad) did not meet all eligibility requirements. The Rating Certificate did not meet the stability requirement of 110°, specified in Notice of Race 6.1.7. (A detailed report appears in Appendix 19).

9.3 Weather

The Bureau of Meteorology's report claims that they provided adequate and accurate weather information to race management. This information was, in turn, communicated to the fleet. Evidence confirms:

- The speed with which the depression developed caught most, even forecasters, by surprise.
- The intensity of the depression (978mb) was also not predicted, nor was the actual location of the low.
- BOM assumed that its forecasts would be interpreted differently to what they were, ie gusts would be up to 40% more than mean wind

strengths predicted and wave heights up to 86% more. This meant that the BOM expected the fleet to interpret their storm warning (wind speeds of 45 to 55 knots) as having the potential for gusts to be 63 to 77 knots. Forecasted seas of 5 to 7 metres would have the potential to be 9 to 13 metres.

The fleet expected conditions to be "as forecast" or a bit stronger-based on their experience.

At no time did the BOM advise directly of wind speeds in excess of 55 knots.

From the interviews, it is clear that there is a wide gap in understanding between BOM scientists forecasting and the interpretation of their forecasts on yachts.

Many competitors would have retired earlier had they known of the severity of the weather conditions ahead. Hearing extreme winds reported by Doctel Rager and/or Sword of Orion was instrumental in the decision of 23% of the retirements.

The lack of weather reporting assets in Eastern Bass Strait and the timing of preparation of forecasts and their communication to the fleet contributed to the quality of the forecasts given to yachts.

16.4% of yachts reported the desire for more frequent weather information through the RRV. At least nine additional scheduled weather reports were available daily to the fleet on HF, through VIS, VIM and Penta Comstat. Weather forecasts were also available on demand from Volunteer Coast Guard and RVCP stations and could be picked up from commercial radio stations. 74% of the fleet accessed some of these services.

At least two yachts, one that withdrew and one that continued racing and reached Hobart, reported that monitoring an on board barometer provided them with a means of recording the intensity of the low pressure system.

9.4 Waves

Yachts that experienced problems, or found themselves in difficulties, and even those that continued racing reported that "exceptional" waves were responsible for inflicting the damage or causing severe knockdowns. These waves were always a minimum of 20% and up to 100% bigger than the prevailing seas, and with one exception came from a direction other than the prevailing wave pattern.

These "exceptional" waves were responsible for a range of roll-overs and knockdowns, including the yachts involved in SAR activities:

- B52 (roll-over through 360°),
- Business Post Naiad (roll-over through 360° twice),
- Solo Globe Challenger (knockdown),
- Winston Churchill (knockdown),
- VC Offshore Stand Aside (roll-over through 360°),
  Sword of Orion (roll-over through 360°),
  Midnight Special (roll-over through 360° twice),
  Kingurra (knockdown),
- Team Jaguar (knockdown, partial pitchpole) and
- Veto (knockdown).

"Exceptional" wave actions struck boats that were actively sailing or racing, or were on course to shelter on the NSW coast.

Many yachts that retired to seek shelter, once the storm had hit, reported to be in "more peril" from the waves encountered in steering the course making for port, than the course they were sailing prior to retirement. This was the result of the

angle of waves being more on the beam or stern quarter rather than forward of the beam. Twenty-five percent of the yachts that retired changed the course originally set on retirement. The new course was chosen as the safest for each yacht to steer in the conditions.

The sea conditions experienced by the fleet, particularly with waves breaking and coming from inconsistent directions, make it difficult to prescribe the optimum course a yacht should sail to be safe in the conditions. The evidence clearly shows that being beam-on to the waves was exceptionally dangerous.

Nonetheless there is evidence from the interviews that yachts that continued to "actively sail" were better equipped to cope with big waves. Having the necessary sail power and sufficient boat speed enabled crews to manoeuvre yachts over the waves, and having power was, in particular, critical in enabling many yachts to recover, after being hit by a wave.

A number of yachts reported that they considered heaving to as their best option in the conditions, but did not have drogues or sea anchors on board, and chose not to use any makeshift substitute. The Committee's investigation into drogues, sea anchors and parachute anchors or a makeshift alternative, shows their use would have been a sound option in the conditions of the 1998 race. It is worth noting that Sword of Orion deployed their anchor, chain and warp after their 360° roll. This measure slowed the drift rate by 1/3 and kept the bow of the boat into the seas for another 12 hours.

9.5 Design, Construction and Stability

There is no evidence that any particular style or design of boat fared better or worse in the conditions. Age of yacht, age of design, construction method, construction material, high or low stability, heavy or light displacement or rig type were not determining factors. Whether or not a yacht was hit by an extreme wave was a matter of chance.

Five yachts were rolled through 360°. Each suffered considerable structural damage to the decks through the compression loading inflicted during the roll-over. It is clear that the structural integrity of decks is not up to these kind of loadings, which appear to the Committee to be a fundamental requirement of yachts competing in Cat 1 events.

Structural damage to yachts other than those rolled through 360° was relatively minor with only 3 yachts retiring with "hull/structural damage" as the "main factor in the decision to retire".

On the evidence it cannot be concluded that the age of the yacht and by implication, its design, played any role in whether or not a yacht finished the race.

The stability of CHS yachts is not derived from any measurement data, test or process designed specifically for that purpose. As a result it is not a robust measure of a yacht's stability.

9.6 Safety Equipment

9.6.1 Life Rafts

- No Australian Standard for the construction of life rafts for offshore racing or cruising yachts exists.

  The RRS, Addendum A Special Regulations, Section A.1 /4.19, and Appendix II (AYF & ORC Minimum Specifications for Yachtmen's Life Rafts) define the minimum requirements for life rafts for racing yachts and a recommendation for cruising yachts.
- The life rafts deployed by yachts in the 1998 SHYR race met the criteria defined above.
- The life rafts deployed were either new purchases or had been serviced and 'certificated' as required.

  The life rafts were deployed in conditions considered 'very extreme'

(Force 10).

One life raft failed to inflate for reasons unknown following deployment (VCOS).

One life raft inflated prematurely whilst being transferred to the deck from below for reasons unknown (BPN).

Two life rafts separated from the yacht for reasons unknown (Gundy Grey & Innkeeper).

- One life raft saved four lives (WC).
- One life raft saved two lives, but from it were three fatalities (WC).
- Two life rafts were used to transfer 18 crew from stricken yachts to rescue helicopters/vessels.
- The drogues on two life rafts failed shortly after deployment (WC).
- The destructive damage to WC's #2 life raft was most probably instigated by the crew cutting an air hole in the floor. Additional forces of body weight, wave action and tumbling of the life raft then compounded the damage. Basically, the two inflatable tubes form the base of the life raft as an annulus, with the floor section, a structural component engineered so that the life raft maintains a square shape.

  The life raft equipment bag or contents thereof were lost on two life rafts following inversion (WC).
- The diameter of cordage installed for the painter, lifelines and drogue tethers was too small, caused injury and was difficult to handle in the prevailing conditions.

  Stowage of life rafts:

  Crews found it difficult to recover soft-pack life rafts from below deck in the prevailing conditions; it is doubtful that life rafts stowed adjacent to the companionway below deck could be deployed to the lifelines within 15 seconds as per the requirements in the RRS, Addendum A 4.19. A life raft, which was stowed on deck on the yacht Gundy Grey, was washed overboard. In at least one yacht, a 'canister'

type life raft was stowed below decks during the storm.

- Whilst the colour of the canopy on all life rafts was distinctive, the colour of the inflatable tubes and life raft floor is generally black, which is difficult to see in severe sea conditions.
- None of the crews who were dependent on survival utilising a life raft, had received basic training or education in the deployment or use of life rafts or had knowledge of the safety equipment carried.

9.6.2 Size of Storm Sails

Forty-two percent of yachts reported that storm sails may have been too big. In the extreme wind and sea conditions it is difficult to determine if storm sails were in fact too big. Further investigation is required. Yachts reported various problems using their standard sheets with mechanical clips on their storm sails.

9.6.3 Other Safety Equipment

Prescribed safety equipment performed, as required.

Exceptions were:

- "Jonbuoy" brand inflatable Danbuoys, where 16 were washed overboard by wave action. It is estimated that this is more than one third of all Jonbuoys in the fleet.
- Seven horseshoe buoys and attachments was lost overboard due to wave action.
- Four harnesses slipped over people's heads while in the water and being lifted. All crew were recovered.

  One harness strop failed when stitching on the webbing tether failed. Manufacturers confirmed that sunlight and poor care reduce the life of webbing and stitching on harnesses.
- Five crew from yachts that were inverted reported difficulty in undoing harness clips.

Moving around the deck, coming on deck or going below (when harnesses had to be unclipped) created a short-term risk of being washed overboard.

Length of harness lanyards created problems for some wearers, in that users reported being "washed" to the full length (approximately 2 metres) by waves. Some crews overcame this by "shortening" the lanyard by wrapping it round a winch. Others used more than one strop. At least one yacht reported having harness tethers with three clips, one at each end and one in the middle.

- Webbing jacklines stretched when wet and under load and were regarded by crews as suspect. One jackline failed.
- A number of automatically inflating life jackets auto-inflated accidentally. At least two reports, one from Brindabella and one from Aera, claimed that the inflation created unnecessary risks for the wearers.
- A number of crew reported that the additional buoyancy provided by PFD 1s made wearing them on deck dangerous.

  While racing, crews were reluctant to wear PFD 1s because they restricted movement and made it difficult to function effectively.
- John Quinn, after spending 5 hours in the water in the 1993 SHYR, attributed his survival to the wearing of a flotation vest. Comparison tests carried out by the Committee of PFD 1s, inflatable life jackets and flotation vests led the Committee to the view that wearing such a vest in any conditions is a positive move. Such vests are not endorsed by Australian Standards as PFD 1s.
- EPIRBs – 121.5/243 MHz EPIRBs provide a position within a 20km radius. With 9 EPIRBs deployed in a limited geographical area, AMSA had considerable difficulty locating them by satellite and on board SAR aircraft due to clutter. The 406 MHz EPIRB beacon used by B52 was more accurate (5km radius) but SAR nonetheless had

some difficulty locating it because the yacht was underway. The advantage of the 406 MHz beacon is that it identifies the yacht and gives a more accurate position.

We were unable to find evidence that any crew in the water at any time wore a personal EPIRB. Personal EPIRBs have the same characteristics as those mentioned above.

The crew from two yachts that were rolled through 360° reported being affected by fumes from the ship's battery acid.

One yacht reported a fire extinguisher accidentally discharging.

Three yachts were towed during the course of SAR. Each had to prepare makeshift towing apparatus to connect to tow lines. These separated on two occasions.

- Yachts that were rolled and/or severely knocked down related that loose gear and yacht equipment presented risks to crew safety.

9.7 Crew Experience

The RRS prescribe that 50% of the crew should have competed in at least one event of the same race category or a similar distance. The SHYR stipulate 3 crew per yacht. Eighty four percent of the 1998 SHYR crew had competed in at least one previous SHYR or equivalent, with 60% competing in between 2 and 5 SHYR (or equivalent) with 6 to 9 years offshore racing experience.

Eighty four percent of yachts claim to have had at least one crew member on board who had experienced similar conditions to 1998.

Crews met eligibility requirements with respect to experience. There was no significant difference between the experience level of crew that finished the race and those that retired, showing that crew experience was not a determining factor.

Crew Experience Scale	Total	Yacht Retired	Yacht Finished
Total	948	562	386
	100%	59%	41%
Extremely Experienced	189	101	88
	20%	18%	23%
Moderately Experienced	140	74	66
	15%	13%	17%
Experienced	235	142	93
	25%	25%	24%
Moderately Inexperienced	250	167	83
	26%	30%	22%
Inexperienced (Novice)	134	78	56
	14%	14%	15%

Crew experience was rated on a 5-point scale with 5 being extremely experienced and 1 being inexperienced. Yachts that retired averaged 2.92 on this scale, while yachts that finished scored a slightly higher average of 3.12.

The overall quality of experience is backed up by the exceptional level of seamanship displayed by crews that experienced major difficulties and were forced to use high levels of self-sufficiency and ingenuity.

It is reasonable to expect and it was borne out of the evidence, that yachts had a variety of experience, including novices in the SHYR. In addition, there was a number of minors in the race.

9.8 Administrative Procedures

The CYCA's administrative processes are mainly manual and rely heavily on the diligence of staff. Systems are not well cross-referenced creating unnecessary administrative issues for staff. There are formal procedures that are followed but these are not well documented and rarely audited. The opportunity for administrative oversight is, as a result, a problem. The failure to detect Business Post Naiad's ineligible IMS certificate is an example of this.

In the process of gathering information with respect to all aspects of this Review, the Committee was, with very few exceptions, able to locate complete and accurate documentation. This applied equally to data from the 1998 race and as far back as 1977. This demonstrates that the Club's administrative systems work effectively, if not as efficiently as they might.

The details supplied on crew lists were found to be incomplete and inaccurate when relatives needed to be contacted. Contacts were often not at the numbers nominated because of the holiday period and in some cases, because of the crisis on the water, they had gone to a friend's or relative's place.

While there is a well established set of procedures for the running of a SHYR, there is no documented race management plan nor a documented disaster plan. The benefits of a formal disaster plan would have been realised in Sydney and Eden and with the Organiser's relationships with third parties, particularly relatives and friends of crew. Communication between Hobart, Sydney and Eden would have also benefited greatly.

Race Organisers were not equipped to cope with the number of inquiries from relatives, friends and media received at the CYCA and the RYCT. Neither Clubs' premises had appropriate assets or personnel. Communications between Clubs were not able to form an adequate appraisal of current or accurate information on yachts and crews.

The ISAF Race Management Manual is primarily directed at regatta style races and does not provide detailed and sufficiently robust directions for the organisation and management of long offshore races. As a result the responsibilities of the Race Committee were not well or adequately defined and the Race Committee was unclear of some of their responsibilities.

The ISAF Manual prescribes that a Race Committee may shorten, change the course or abandon a race entirely. These options are included primarily for the management of regatta style racing where wind shifts or lack of wind for example make racing 'unfair". In practice it is unusual for a Race Committee to do any of these things in a major passage race.

The Race Committee did not exercise its power to abandon the race. It was the Race Committee's view that Rule 4 ("Decision to Race") should remain in each skipper's hands, particularly because of the fact that each yacht was in the best position to evaluate its own circumstances fully in the conditions.

9.9 SAR

Many crews, despite having high levels of ocean racing experience were poorly informed on many aspects of safety equipment and SAR. These include:

- the inability to deploy flares, particularly parachute flares,
  the lack of awareness of SAR retrieval techniques, such as what would happen when a helicopter arrived, how to get into a sling etc., and
  the deployment and efficient/effective use of life rafts, including righting and use of the raft's equipment.

Getting SAR assets to stricken vessels quickly was hampered by:

- the number of EPIRBs activated in a small geographic area,
  the inability of 121.5/243 MHz EPIRBs to accurately locate positions,
- 121.5/243 MHz EPIRB signals not discriminating one yacht from another,
- stricken vessels losing communications and not being able to appraise SAR of their position or condition,
- lack of capability to communicate with SAR aircraft, and
- the difficulty AMSA had in prioritising emergencies as incidents were not well discriminated or AMSA was not appraised of yacht details.

SAR was hampered by:

SAR Aircraft having some difficulties identifying yachts,

- the inability of yachts to communicate with SAR Aircraft due to loss of VHFs, the lack of knowledge by yachtsmen of the SAR process and techniques/procedures,
- fixed wing aircraft not (usually) being fitted with marine VHF frequencies, the inability of yachts to communicate with SAR aircraft to discuss retrieval procedures,

the use of different rescue/retrieval procedures by different SAR authorities, and

difficulties to see crew in the water, especially at night.

9.10 Communications

The RRV was not operating at optimum because:

- it had to cope with very high volumes of SAR traffic, as well as regular race traffic on the same frequency,

  it was limited to only one HF radio set and had no back up,

  it was limited to one radio crew,
- the radio operator did not impose strict enough control on the use of the frequency,
- other users (Penta Comstat, Sydney-Coffs Harbour race) were also operating on the 4483 kHz frequency,

  competing yachts did not use or were not directed to use other frequencies for non-distress traffic, and
- there were some low quality and intermittent communications making it difficult to hear transmissions.

Communications between the RCC-RRV-fleet were unreliable (or had the potential to be) because:

- geographical remoteness of RCC (Hobart),

Yachtcoms operating through Brisbane (VIB) and not being continuous, and

RCC had difficulty from time to time in contacting the RRV due to the volume of traffic and other problems already mentioned.

There was no back-up plan in the event of a failure of the RRV and the RCC did not have the capability to take over while the fleet was north of Tasmania.

9.11 Fatalities

The manner of death of the six sailors that lost their lives will be determined by the NSW State Coroner at a Coronial Inquest at a date to be announced.

RECOMMENDATIONS

The CYCA has a clear responsibility to implement or ensure the implementation of the recommendations herewith. As the first order of business, the Club must develop a mechanism to ensure that recommendations are implemented prior to the 1999 SHYR or are planned to be when technically feasible. In addition, the CYCA should institute an audit process to ensure implementation is timely and efficient. The CYCA should make its findings and recommendations available to the local and international boating community in the interest of promoting safer sailing and boating generally.

The recommendations have been developed in two sections:

- **Section A** details actions that can be taken to have yachts appraised of conditions and assess their ability to meet them.

  Section B details actions that can be taken to better prepare yachts and crews to deal with extreme conditions.

The recommendations have been drafted by the Committee on the basis of the evidence presented in this report and are classified as either "compulsory" or "recommended".

SECTION A

A1. WEATHER

Compulsory

- The CYCA needs to develop a weather strategy, which includes working with its nominated race forecaster to:

  generate (close to) real-time forecasting,

  - educate yachtsmen on the forecasting/interpretation,
  - provide easily understood/layman forecasts, and

  develop forecasting assets in Eastern Bass Strait, including accessing information from the Bass Strait oil rigs.

- The CYCA must provide yachts with a practical interpretation of the weather forecast. This should include:

  indication of maximum wind speeds and wave heights expected,

  - duration of bad weather/storms,
  - indication of the movement/direction/pattern the centre of the storm will most likely take, and
  - inclusion in the Race Management team of a full-time adviser from its nominated forecaster.

- In winds of 40 knots (true) or more, yachts will be required to report wind strength, direction and wave height at Radio Skeds if asked to do so by RRV. Yachts should be encouraged to report wind strengths in excess of 40 knots (true) at <u>any</u> time and should not be penalised under RRS Rule 41 for doing so. The RRV should relay weather reports received at the next Sked.

Recommended

- Barometer as a part of yacht's equipment

  The Sailing Instructions should include an Addendum detailing all stations and times weather forecasts are available for the race area.

A2. GATE/EQUIPMENT CHECK

Compulsory

Skippers must be encouraged to consider their particular circumstances and whether their yacht, equipment and crew are in a satisfactory condition to enter and cross Bass Strait and complete the race.

To achieve this, the Sailing Instructions should prescribe a line of latitude at 37°15'S (Green Cape). As yachts cross this line, it will be compulsory for skippers to make a declaration to the Race Committee though the RRV or RCC confirming:

- HF radio is in working order,
- life raft(s) are on board,
- yacht and crew are in a satisfactory condition to continue, and
- engine and batteries are operational.

Failure to report or meet any of the stipulated requirements should result in a yacht's disqualification.

SECTION B

B1. ELIGIBILITY

Compulsory

Stability:

- Conform with IMS stability recommendations for Cat 1 Races of 115° for all classes, IMS, CHS and PHS, with no further "grandfathering" of previously accepted yachts.
- CHS and PHS yachts must demonstrate compliance to stability by any of the following means:
  - IOR Certificate (may be lapsed),
  - IMS Certificate (may be lapsed),
    letter or other certification from the designer,
  - documentation from any other national or international authority used for this purpose, or
    different yachts from the same mould or class or type will be accepted on the basis of one yacht of that mould, class or type meeting one of these requirements.
- Owners/Owners' Representatives of CHS and PHS yachts must sign a declaration to the effect that no changes have been made to the yacht's rig, sailing configuration, hull and/or appendages that affect stability as declared by the documented methods.

Compulsory

Crew experience:

- The number of "experienced" crew should be increased to 50% of total crew as per RRS, AYF Addendum A, AYF Special Regulation Item 2.4.
- As the number of "experienced" crew is an eligibility requirement and crew is subject to change between entry and the actual race, a mechanism must be developed to ensure that the integrity of crew experience is maintained with crew changes.

Each Application for Entry must be reviewed by a Sub-Committee of the CYCA Sailing Committee and be approved.

An age limit of 18 years should be set and no crew under that age will be eligible for the SHYR.

Recommended

- Cabbage Tree Island Race (180 nautical miles) in November should be made a compulsory pre-requisite (or equivalent local race for interstate yachts). 50% of the SHYR crew must be on board for this event.
- For yachts unable to compete in such a race, the Race Committee should have the discretion to review a yacht's preparation and allow it to race, if in the opinion of the Race Committee the yacht and crew are adequately prepared.
- New yachts must complete a minimum non-stop passage or race of not less than 200 nautical miles, to be eligible for the SHYR.

  The process for determining stability of non-IMS measured yachts should be reviewed by the Sailing Committee.

B2. CREW EXPERIENCE - EDUCATION & TRAINING

Compulsory

CYCA should conduct Training Seminars prior to the SHYR with components on:

- weather forecasting & interpretation,
- life raft deployment, use and survival techniques,

  SAR techniques, including flight search patterns, communication, rescue techniques,
- MOB strategies,

  heavy weather sailing techniques/strategies, and
- flare deployment.

Certificates of attendance should be issued to all participants and all yachts must have at least 30% of crew with certificates to meet eligibility requirements.

The CYCA should provide a Safety Booklet based on the education & training mentioned above and append it to the Sailing Instructions.

The CYCA should comply with the RRS AYF Addendum A, AYF Special Regulation Item 2.4 (Crew Experience), where it is recommended that the Skipper or Sailing Master have a recognised AYF certificate (or equivalent) appropriate to the race category.

Recommended

- All crew members should attend the Training Seminars.
- The Safety Booklet should be made available to all competitors.

  A "Flare Day" (for training on flare deployment, a one hour period on the last day of the winter series for example) should be arranged where crews can practice using flares on Sydney Harbour. (Note: Consideration needs to be given to the risks of such an exercise).

B3. YACHT SAFETY EQUIPMENT

Compulsory

Safety Harnesses:

Introduction of a "replace by" date of 7 years from date of manufacture.

Stowage in a watertight container. This location should be inspected as part of the Annual Safety Inspection and SHYR spot checks.

The ease of operating harness clips and the appropriateness of existing clips needs to be investigated further in the light of experiences in the 1998 SHYR

Each yacht shall carry additional harness tethers for1/3 of the declared crew number for use in heavy weather. The additional tethers should be used for dual clipping of crew members or to facilitate safe movement.

Compulsory

Life rafts:

The AYF should be requested to review the requirements for the stowage of life rafts. A review should be conducted into the appropriateness of stowage below deck, the maximum weight of "soft packs" and methods of securing below deck. Standards should be developed for deck stowage.

The AYF should be requested to review the relevant AYF prescription on the construction of life rafts with the recommendations:

the colour of life rafts should be of a highly visible colour on all parts where this will assist detection,

the diameter of drogues employed in life rafts should be increased,

- the diameter of painters, lifelines and drogue tethers should be increased in size, but not in breaking strain,
- the life raft equipment bag should be secured in a manner such that it cannot easily be undone from the life raft,

  the opening on the equipment bag should be secured by Velcro or a self-closing device, and
- a more accessible means for securing canopy flaps (combination of Velcro/eyelets and ties) should be investigated.

Compulsory

Other safety equipment:

- A review of the size of storm jibs and trysails should be undertaken, and referred to the International Technical Committee of the ORC.
- Sheets should be sewn/spliced on and permanently attached on storm jibs and trysails.

  Webbing jacklines must be as specified in the RRS (Rule 4.3a) and should not be left on deck between races. Spectra should be considered as an alternative.

  One waterproof hand held VHF, in addition to ship's VHF.
- Kapok filled PFD 1s should not be accepted for future SHYR.

- 'Jon Buoy' brand 'Danbuoys' should be excluded from the SHYR until the manufacturer can satisfy the CYCA that its stowage features can be modified to preclude accidental deployment from wave action.
- The yacht's primary EPIRB should be a 406 MHz, GPS type preferred, in place of 121.5/243 MHz EPIRBs.
- One EPIRB per life raft carried which may be 121.5/243 MHz, and which may be packed into the life raft or carried on board.
- The CYCA should request that the AYF develop a protocol for the use of EPRIBs in consultation with AMSA.
- Four white parachute flares, in addition to current flare requirements.
- At least one of the ship's batteries should be the gel or closed cell battery type for the purpose of starting the engine or operating radios after being inverted.

Recommended

- One waterproof Grab Bag for each yacht containing handheld waterproof VHF, waterproof torch, "V Sheet", signalling mirror, knife, EPIRB and flares. This equipment is part of and not additional to the yacht's equipment. It is recommended that the Grab Bag be prepared in winds over 40 knots.
- One waterproof Grab Bag for each life raft, containing handheld waterproof VHF, one 121.5/243 MHz type EPIRB, additional flares, strobe light/s, cyalume sticks, dye marker, waterproof torch, harness tethers, duct tape.
- Fifty percent of a yacht's crew competing in the SHYR, to have carried out a 'Survival at Sea', 'Marine Survival Course', or similar course, which includes abandoning ship, life raft survival skills and a SAR recovery section.

  Ship's batteries - gel or other closed cell type

  Towing bridles - purpose made

  Drogues or sea anchors or para anchors as alternative to improvised methods
- Identification number should be placed on the foredeck of each yacht for identification by SAR aircraft.

A request for an Australian Standard should be made with respect to life raft construction for racing and cruising yachts. An ISO standard is currently being developed.

B4. PERSONAL SAFETY EQUIPMENT

Compulsory

- Personal strobes or high intensity lights

  Personal dye markers

These items may be supplied by the crew. The owner or owner's representative must sign a declaration that each crew member has a personal strobe and personal dye marker and that it will be on board at the start of the race. The CYCA must carry out random "spot checks" for this equipment on the morning of the start of the race.

- The CYCA should brief the manufacturers of PFD 1s to develop an Australian Standard certified PFD 1 that enables crew to move and work freely. The device should take into account the need to wear harnesses.

Recommended

- Buoyancy vests should be part of personal kit and should be worn at all times.
- Personal EPIRBs
- Inflatable PFD 1s with integrated harness
- Personal flare packs (the Committee notes that sale of these devices is illegal in some states)

  Extensive use of retro-reflective tape on crew's personal clothing.

B5. YACHT SAFETY INSPECTIONS

Compulsory

- Yachts should deploy storm jib and trysail for recognition & reporting at the race start

Recommended

- CYCA should assume responsibility for the conduct of all Cat 1 inspections for yachts competing in the SHYR, and
- CYCA should set and enforce deadlines for safety inspections.

YACHT CONSTRUCTION

Compulsory

- The design and construction requirements for decks, hatches and windows should be referred to the International Technical Committee of the ORC for review.

COMMUNICATIONS

Compulsory

- The Race Committee must enforce Sailing Instructions provisions that retiring yachts provide position, destination, ETA and details of the condition of the yacht/crew.

  Yacht names should be limited to two words maximum for the purpose of radio communications.
- 24hour listening watches on VHF channel 16.

  RCC-Fleet:

  RCC suffers from basic HF/VHF connectivity problems with the fleet. It needs to have an installation at its disposal, that offers very high quality transmit and receive capability.

  The installation needs to be accessible to the primary RCC centre (currently located in Hobart) and, most importantly accessible to the Race Director. The antenna farm needs to be located in an interference free area (outside a metropolitan or built up area). The transceivers need to be high power (400-1000Watt) with RF gain amplifiers capable of detecting weak signals.

- Satellite phone on the RRV:

  It is vital that high quality, reliable communications be available between RCC and the RRV. There is only one technology available to address the intermittent and low quality communications currently in place. This is a satellite based telephone system that supports voice, fax and data transmissions.

  The CYCA should acquire either a MiniSat or MobileSat service which should be installed on the RRV for the duration of the race. Further, this terminal should be connected to a Notebook PC for sending and receiving both fax and data traffic as well as voice traffic.

  The Sailing Instructions should include information that indicates that the communications may be taken over by RCC and that an alternate channel/frequency may be used for distress and SAR traffic.

Recommended

- Satellite phones on yachts
- RRV-Fleet:

  The RRV installation needs to be above normal power to ensure that the entire fleet, regardless of the quality of their own installations, is capable of hearing the RRV in all weather conditions.

  The CYCA should install at least two HF transceivers on the RRV. Each of these radios should be fitted with linear amplifiers capable of increasing the transmitted output power to 400Watt PEP.

  The CYCA should install a HF receiver with a received signal amplifier system (RF gain), separate to the HF transceivers. Alternatively, a separate RF gain amplifier should be fitted to one of the HF transceivers on the RRV for the purpose of receiving weaker signals.

  The CYCA should install a linear amplifier for its VHF transceiver, capable of increasing the transmitted output power to 100Watt PEP.

The RRV should have at least two radio operator crews available to independently manage regular and distress traffic.

- Real Time Tracking:

  The CYCA should investigate the potential for the inclusion of full-time, real-time tracking devices to be installed on board all yachts.

  Full-time, real-time tracking of the fleet will give Race Organisers and SAR authorities accurate positions for all yachts for the duration of the event. This knowledge enables SAR to deploy appropriate assets faster and more accurately. An additional benefit would be to provide better information for media coverage.

  Major considerations in using this type of facility are coverage, cost of individual terminals, cost of the service, amount of power required (on board), installation issues (antennae & connections) and operator issues.

B8. ADMINISTRATION & PROCEDURES

Compulsory

Race Management needs to develop formal, documented protocols and systems that facilitate efficient and effective control of all race/yacht documents. This system needs to operate in perpetuity regardless of the nature of/changes to management structure or personalities.

- The CYCA should provide a SHYR Race Management Manual that covers every facet of race administration from the issuing of the NOR to the Post-Race Review.
- The CYCA/RYCT must develop a Crisis Management Plan to be in place before the 1999 SHYR. A draft structure appears in Appendix 20.
- The Race Management Manual and the Crisis Management Plan must incorporate strategies for Eden, Hobart, Sydney, management of inquiries from NOK, press and public, and auditing.

  Efficient administration will be influenced by the adherence to deadlines set for the lodgement of the various certifications by yachts with race

management. An ineligible yacht must not be able to start the race because of an administrative oversight. As a result, deadlines for the lodgement must be enforced.

- Authority and responsibility of the Race Committee must be clearly defined, documented and understood by each member of the Committee. In the event of a crisis, the Race Committee's responsibilities must be confined to managing the race and assisting SAR authorities. Ancillary matters, such as dealing with media or NOK should be handled by other means.
- The CYCA/RYCT must develop a robust system for responding to inquiries from relatives and friends of crews and other interested parties with accurate up-to-date information.

  A computer disk containing yacht details (including a colour photograph of each yacht) must be provided to AMSA to assist with SAR and should also be made available to other authorities.

GLOSSARY

	American Bureau of Shipping
AMSA	Australian Maritime Safety Authority
	Australian Yachting Federation
	Bureau of Meteorology
Boxing Day	26 December
BPN	Business Post Naiad
	Category 1 (a class of safety requirement for yachts racing offshore)
CHS	Channel Handicap System
ColRegs	International Rules for the Prevention of Collisions at Sea
CYCA	Cruising Yacht Club of Australia
EPIRB	Emergency Positioning Indicator Radio Beacon
	Estimated Time of Arrival
	Global Positioning System (a navigation system using satellites)
	Glass Reinforced Plastic (a material used in the construction of many modern yachts)
HF	High Frequency (radio)
IMS	International Measurement System
IOR	International Offshore Rule
ISAF	International Sailing Federation
ITC	International Technical Committee
IYRU	International Yacht Racing Union
	Kiloherz
Knots	= nautical miles per hour (a measure of speed)
	Length Overall
	Limit of Positive Stability (a measurement of the righting ability of a vessel)
May Day	internationally recognised distress call
Mb	Millibar (a measure of pressure)

	Megaherz
MOB	Man Over Board
MSL	Mean Sea Level
NOK	Next of Kin
NOR	Notice of Race
ORC	Ocean Racing Club
PAN PAN	internationally recognised urgency call
	Personal Flotation Device (life jackets which fall into various classes depending on their rated buoyancy and operational characteristics)
PFD 1	Personal Flotation Device Type 1 as specified by the Australian Standards
	Performance Handicap System
POB	People on board
RCC	Race Control Centre
	Radio Frequency
RORC	Royal Ocean Racing Club
	"ISAF Racing Rules of Sailing for 1997-2000" published by AYF
RRV	Radio Relay Vessel
RVCP	Royal Volunteer Coastal Patrol
RYCT	Royal Yacht Club of Tasmania
	Search and Rescue
	Solo Globe Challenger
SHYR	Sydney Hobart Yacht Race
SHRRC	Sydney Hobart Race Review Committee
SI	Sailing Instructions
	Schedule (a set program of radio communications)
	Sword of Orion
Spectra	a type of braid used on yachts for halyards
Telstra Control	name of the Radio Relay Vessel in the 1998 SHYR
VCOS	VC Offshore Stand Aside

	Very High Frequency (radio)
	Brisbane Radio
	Hobart Radio
	Sydney Radio
	Melbourne Radio
	Winston Churchill
Yachtcom	Telstra Yacht Communication System
	Yacht Racing Association