Assist in Search and Rescue

This workbook is intended for Trainees seeking to attain competency as required by the NSW State Rescue Board Minimum Training Requirements for Marine Rescue Personnel (v 4 2005). It should be studied with reference to the accompanying text "The Bare Facts of Marine SAR" and the assessment documents provided by your chosen assessor.

LOG BOOKS

Trainees should maintain a Log where practical activities and experience should be recorded and witnessed. When you feel confident ask your Trainer to arrange an assessment at your squad or other suitable location. Your assessor will provide feedback on your assessment.

Assist in search and rescue operations	
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Prerequisite reading to the competency is "Participate in marine rescue operations" and "Prepare, maintain, and test response equipment".	

Introduction

The duty of a vessel's master to respond to the distress call of a fellow mariner has long been accepted as the lore of the sea. Many nations have formalised this principle into their maritime laws.

The International Maritime Organisation (IMO) has promoted excellence in Search and Rescue (SAR) by hosting international conventions to devise common practice and to draft procedures manuals. Their Merchant Ship Search and Rescue Manual (MERSAR) was complemented by the International Maritime Organisation Search and Rescue Manual (IMOSAR). The subsequent International Aeronautical and Maritime Search and Rescue Manual (IAMSAR) is now required to be carried on all vessels of over 500 tons of signatory nations of the IMOSAR convention - Australia is one such nation.

The World's best practice in ensuing safety of life at sea (SOLAS) and search and rescue (IMOSAR) is reflected for Australian flagged vessels in the National Standards for Commercial Vessels (NSCV) and the Australian National Search and Rescue Manual (NATSAR Manual). States and Territory Government's have developed their own complementary strategies, such as the NSW State Rescue Board (NSW SRB) Procedures Manual. This workbook is not intended to replace these documents, which must be consulted in their entirety, but to highlight for trainee rescuers the common references for mariners everywhere, the practice of Australian SAR agencies and the place of volunteer sea rescue in NSW.

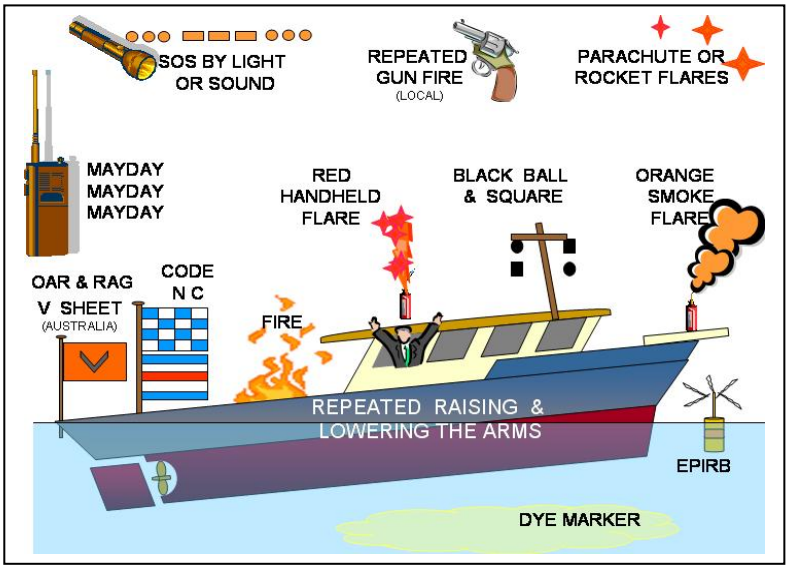
1. Assist in planning search and rescue operations

Distress and emergency signals

1.1 Distress and emergency signals and communications are recognised and evaluated in accordance with procedures and relevant Australian and/or international regulations and conventions.

Radiotelephony priority calls are the most commonly used method of raising a general alarm; the progressive levels described as distress (MAYDAY), urgency (PAN PAN) and safety (SECURITE). Advances in radio technology has greatly enhanced the capability to alert for assistance and is considered separately in element two, **"**Establish and maintain radio-communications".

International Distress signals:
The International Regulations for Preventing Collision at Sea identifies distress is a situation of grave and imminent danger to a vessel or her occupants. A variety signalling methods, used singly or in combination, are approved for vessels and aircraft that oblige a Master to assist another in distress. False or deceptive distress signals are illegal.



International distress signals.

Emergency signals:
Vessels use a dedicated signal to notify their passengers and crew of emergency. This may be practiced in drills and is commonly:

Muster at the emergency station- **7** short and **1** prolonged horn blasts.

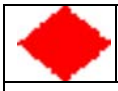
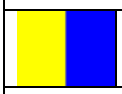
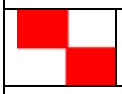
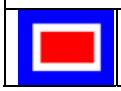
Additional signals may be used:

Fire on board- **C**ontinuous ringing of the fire bell.

Abandon Ship- **1** short and **1** prolonged blast repeated **(3** times**)**

Unsure of your intentions- **5** short blasts

Where radio is not available the International Signals Code Book (Interco) provide for signalling by groups of letters in Morse code by lights or sound, or by code flags. The simplest of the single letter code flags below include specific requests for assistance.

	**F - I am disabled, communicate with me.**
	**J - I am on fire with dangerous cargo.**
	**K - I wish to communicate with you.**
	**O - man overboard.**
	**U - you are standing into danger.**
	**V - I require assistance**
	**W - I require medical assistance.**

Evaluation of a distress signal:
Meteor showers, ball lightning and windscreens flashing in the noon sun all elicit reports of distress, just as does the real thing. The alertness and experience of informants as well as the meteorological conditions all determine the credibility of reportage, and consequent quality of task information that is gathered before initiating rescue. With the exceptions of a radio contact or EPIRB the position of a distress relies on the calibre of the witness. The position, direction and distance may be properly described in Latitude and Longitude, true bearings and nautical miles by seafarers, but can be more casually indicated by land based observers. If in doubt, rescuers must investigate further, but are ultimately obliged to respond.

Termination of a distress call and message:
When a distress is resolved the termination must be generally broadcast.

Assessing task information

1.2 Emergency is assessed and level and nature of assistance required and its practicability is established.

The components of any rescue are to:

Plan & prepare- Assess dangers -Perform rescue- Conclude rescue

Plan & prepare:
Essential to developing a plan is accurate and credible information.

Task information- is gathered to appraise the needs of the operation. It asks:

Who - The names and details of all involved parties.
What - What has happened with as much detail as can be obtained.
When - When did this all happen.
Where - Charted, natural features, bearings, soundings, distances off.
Why - Information on hazards that could recur in the rescue attempt.
Conditions - Forecast for both operational sea area and the incident scene.
Injuries - Minor or major, indicating the needs for specialist resources.

The ***word*** prompts (preceding the questions above) are an open format. Such words encourage replies uninfluenced by suggestion from the interrogator. Closed format questions (starting with ***as, do, is, are, can*** or ***have***) help to expand on their replies given when directed at particular detail of interest to the interrogator.

Operational information- is calculated for the logistics of the operation. It asks:

Distance to go - This will allow the calculation of fuel requirements to the incident.
Departure point- Relevant to trailer mounted craft.
Sea conditions - En route / at scene including traffic and nearby vessels.
Forecast - For the expected duration of the operation.
Tides - Times, heights, range and bar conditions.
Daylight - Projected arrival at the incident scene.
Hazards - Routing information to avoid dangers and ensure safe passage.

Operational Plan- is the considered method to complete the operation. It documents all the elements of the operation, providing a factual report of the rescue. It includes:

- Task information gathered.
- Briefing instructions and details of the Rescue Vessel's Crew.
- Communication frequencies and skeds (schedules) to be used.
- Incident position reports, en route and arrival (at predetermined datum point).
- Hazard assessments at the incident and response required determination.
- Position and status reports on return passage (stand down).
- Time of return, make and mend details, complete reports.
- De- briefing with outcome details / recommendations.
- SAR administration review details. (dates to review procedure and implement.)

Assess dangers:
The varied calls for assistance are often for one or more Marine Casualties, such as:

Loss of rudder or propulsion.
Collision.
Fire on board.
Founder or rescue from a stricken vessel.
Grounding or rescue from wreck.
Man overboard, abandonment or lost at sea.

Such incidents not only present their own unique hazards to the stricken vessels, (as more fully described in Section 3) but also in combination with the Operational dangers, to the rescuers.

Phases of a rescue:
A search and rescue planning will follow phases of completeness in the information as it is being received. If the SMC cannot determine the credibility of the reports, then further information will be pursued. As more information is gathered, grave concerns may increase or the phase may quickly be revised to urgent action.

Incertfa	**Alerfa**	**Detresfa**
(Uncertainty)	*(Urgency)*	*(Distress)*

Incertfa- an uncertainty phase is said to exist when there is knowledge of a situation that may need to be monitored, or to have more information gathered, but that does not require dispatching of resources. When there is doubt about the safety of a vessel, the situation should be investigated and information gathered.

Uncertainty Phase is declared when:

- vessel is reported overdue at the intended destination; or,
- person failed to make an expected position safety report.
- no immediate request for assistance but the possibility of escalation.
- an uncertainty phase relates to a safety broadcast.

Alerfa- an Alert Phase exists when a vessel, or persons are having some difficulty and may need assistance, but are not in immediate danger. Apprehension is usually associated with the Alert Phase, but there is no known threat requiring immediate action. SAR resources should begin communication searches and MRU's should be dispatched to investigate high probability locations or the crafts intended route should be considered.

An Alert Phase is declared:

- following the Uncertainty Phase, subsequent attempts to establish communication with the vessel have failed or inquiries to other relevant sources have failed to reveal any news.
- information has been received which indicates the operating efficiency of the vessel has been impaired but not to the extent that a distress situation is likely.

Detresfa- the distress phase exists when there is reasonable certainty that a vessel or persons are in imminent danger and require immediate assistance. For overdue vessels a distress exists when communication searches and other forms of investigation have not succeeded in locating the vessel. If there is sufficient concern for the safety of the vessel or the persons on board to justify search operations, the incident should be classified as being in the distress phase.

A Distress Phase is declared when:

- positive information is received that a vessel or persons are in danger and need immediate assistance.
- information is received which indicates that the operating efficiency of the vessel has been impaired to the extent that a distress situation is likely.

Practicality of operation:
MERSAR lists two categories of distress incidents, coastal and ocean. Coastal incidents are close enough to provide a variety of air or surface craft support and may result in the callout of volunteer rescue vessels. Their accreditation limits their operational sea areas as described by their State's category, which for NSW is:

Category One- *Up to 0.5NM offshore*
Category Two- *Up to 7NM offshore*
Category Three- *Up to 15NM offshore*

The long range task of reaching ocean incidents will rule out volunteer assistance and limit airborne assistance. Much more dependent on surface (and possibly requisitioned) vessels will be needed.

Establishing communications

1.3 Communications are established where possible with the parties in distress, other search vessels and/or aircraft and other organisations and persons who may be involved in the search and rescue operation.

If necessary to attract the attention of another vessel, any vessel may make light or sound signals that cannot be mistaken for any signal authorized elsewhere in these Rules, or may direct the beam of her search light in the direction of the danger (Collision Regulations Rule 36).

Current Maritime signalling procedures:	
Meaning	**Signal**
Understood	Code Pennant (red/ white stripes) close up
Understood	Flashing of T's by signal lamp in Morse code.
Understood	Changing of heading.
Understood	Aldis lamp - Green flashes.
Not understood	Aldis lamp - Red flashes.
Inability to comply	Flag N (a blue and white checked)
Inability to comply	Flashing of a succession of N's in Morse code
Australian Civil Air-Ground Code:	
I require your attention.	Aircraft orbits ground party at low level

	changing engine noise.
Follow aircraft in same direction.	Aircraft flies overhead ground party at low level and sets off in a particular direction.
Investigate object/position underneath aircraft orbit.	Aircraft rocks wings and orbits.
Investigate object/position adjacent to smoke.	Aircraft drops smoke on a particular location.
Retrieve and read instructions contained in the Canister.	Aircraft drops message canister.
International SAR Air-Ground Code (MERSAR)	
Understood	Daylight - rocking the aircraft's wings Night - flashing lights ON and OFF twice.
Not understood	Lack of the above signals.
Follow me	Aircraft circles, flying low, crosses ahead, throttles back or rocks its wings. The direction it departs is that to follow.
You are no longer required	If the assistance of the vessel is no longer needed it will repeat the manoeuvre over the vessels wake.

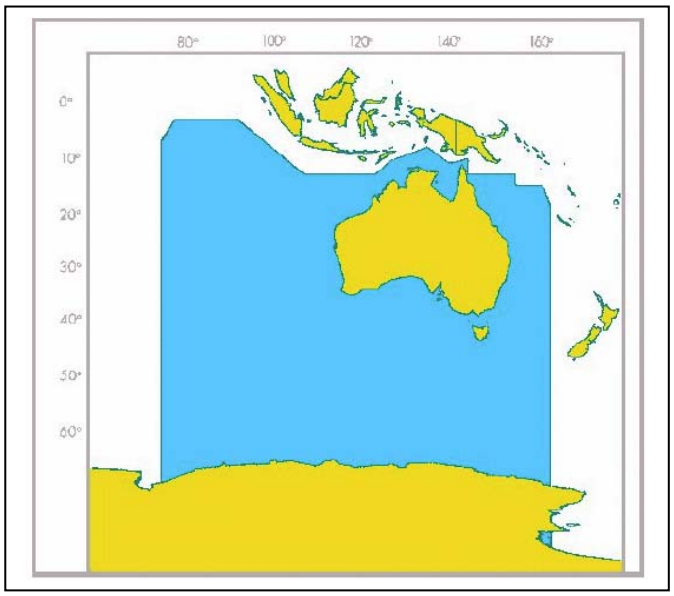
The following visual signals are internationally recognised. They are authorised for use in the Australian SRR.

Air-Ground Visual Signal Code International SAR Signals		
Ground - Air Visual Signal Code for use by Survivors		
Number	**Message**	**Code Symbol**
1	Require Assistance	**V**
2	Require Medical Assistance	**X**
3	Proceeding in this Direction	**→**
4	Yes or Affirmative	**Y**
5	No or Negative	**N**
Ground - Air Visual Signal Code for use in Civil Emergencies		
1	Require Fodder	**FF**
2	Require Evacuation	**III**
3	Power Failure	**VI**
If in doubt use international symbol – SOS		

Search and rescue command

1.5 Organisation and command chain with other stations involved in the search and rescue operation is established in collaboration with search and rescue authorities.

Authorities:
Australian Search and Rescue (AusSAR) is the primary organisation responsible for co-ordinating civil rescue response in the Australian Zone through the Rescue Co-ordination centre (RCC) Australia. The AusSAR Search and rescue mission controller is able to call on military or civil vessels and aircraft. Co-ordination responsibility may, if necessary, be transferred to or from Commonwealth and State/Territory authorities, by agreement, during the conduct of a Search and Rescue Operation.



The Australian Search and Rescue Zone
(Chart courtesy of NATSATR Manual 2003)

In NSW the State Emergency and Rescue Management Act provides for the *State Rescue Board of New South Wales,* to be the statutory body. The *SRB* members include the *Volunteer Marine Rescue Council of New South Wales*. The *VMRC* advises the *SRB* on maritime rescue, and its members include:

NSW Police (Marine Area Command)
VRCP (Royal Volunteer Coastal Patrol)
AVCGA (Australian Volunteer Coast Guard Association)
VRA (NSW Volunteer Rescue Association Inc)

NSW Water Police have control of all incidents in and around NSW waters involving pleasure craft and fishing vessels and can request the assistance of other emergency services and voluntary organisations. Volunteer Marine Rescue Units, Marine Radio Bases and Search and rescue Co-ordination Centres are responsible for over 60% of all Search and Rescue Incidents in NSW waters. The remaining is covered by NSW Water Police and ADF units.

Duties of the SAR Mission Coordinator:
The SMC is responsible for all stages of the SAR system. He/she is responsible for efficiently prosecuting SAR by obtaining and evaluating all information pertaining to the incident and assets available; duties include:

- Classifying the SAR incident into the appropriate emergency phase.
- Alerting appropriate organisations that may be of assistance.
- Confirming which Authority will exercise coordination
- Conducting a risk assessment.
- Dispatching initial SRUs if situation warrants.
- Conducting initial communications checks.
- Calculating the search area. Preparing and promulgating optimum plans.
- Obtaining past/present/forecast weather, drift and oceanographic information.
- Providing for SAR crew briefing, dispatching SRUs, or other assets.
- Organising logistical support including fuel, food and accommodation.
- Making arrangements for appropriate communications.
- Maintaining a continuous, chronological plot showing reports.
- Maintaining a continuous, chronological record or log of the search effort.
- Initiating marine distress broadcasts or marine information broadcasts.
- Arranging communication schedules when and if needed.
- Exercising overall coordination & requesting additional assets, as required.
- Maintaining liaison with the next of kin, owner or agent of the missing craft.
- Keeping authorities advised of SAR incident progress with regular numbered situation reports (SITREPs).

Duties of a Coordinator Surface Search (CSS):
The SMC may designate a CSS to fulfil his/her duties, who is nearby and best placed to coordinate the operation of SAR organisations or units.

Duties of an On Scene Coordinator:
When a number of SAR assets are working together the SMC may designate an On Scene Coordinator (OSC), surface or airborne, who is nearby and participating in the search. The OSC should be the most capable person available and assumes operational coordination of all SAR facilities on scene. Duties of the OSC include:

- receiving the search action plan from the SMC.
- developing and implementing the rescue plan (when needed).
- implementing the search and rescue plan where required.
- modifying the search action plan and keeping the SMC advised of changes.
- providing relevant information to the other SAR assets.
- monitoring the performance of other assets participating in the search.
- providing regular SITREPS to the SMC.

Duties of a Master:
Both SOLAS and the Commonwealth Navigation Act 1912 require the Master of a vessel to render all possible assistance to any persons from or on a vessel or aircraft that he/she has reason to believe are in need of assistance. State's and Territory's Acts have similar clauses. You must acknowledge and inform the distressed of your

expected time of arrival to assist. However, you could be 200 miles away - too far to be of practical assistance - but as the only vessel that has picked up the distress signal you are required to maintain that contact, relay the message to those that can help, and continue to act as a relay station for as long as required.

The obligation to render all possible assistance is only lifted when the distressed advises you that your assistance is no longer required. A release may also be given by another vessel or search and rescue body that has taken charge and has the situation under control.

However, the primary duty of the Master remains to ensure that his vessel is safe for its passengers, crew and cargo, in survey and seaworthy. The crew and passengers are obliged by law to obey any reasonable direction of the Master, and he is required to provide:

Provisions- sufficient for the passage.
Manning- appropriate to the vessel and area of operation.
Stability- not overloaded or poorly trimmed.
Security- from all dangers with effective safety equipment.
Assistance- to others in distress.

In all situations the Master must ensure that the decisions made are in the best interest of the vessel and all that sail in her. If the Master is responding to an emergency situation the priority is to ensure the safety of personnel onboard his/her vessel first, before assisting another.

Limits of responsibility - The primary aim of the Master of a vessel rendering assistance is saving life. A distressed vessel could be drifting rapidly onto a lee shore. She may need only a short tow away from the danger so that the personnel can be transferred safely. Once the immediate safety of personnel is ensured, the decision to tow the vessel to a safe haven should carefully weigh up the capabilities of the tug, her power and fuel reserves and the owner's and insurer's consent. There is no legal responsibility on the Master of the rescuing vessel to save property.

Salvage - Property can be salvaged, not life. Salvage must retrieve property from peril, must be voluntary (not a contract for payment) and must be successful (no save, no pay). If these conditions are met, the salver is entitled to claim reimbursement from the owner for the time, effort and expense of the salvage operation.

Dedicated rescue vessels - While other vessels are carting tourists, containers or coal for its owners, the rescue vessel's job is to save life as tasked by the accrediting organisation. This potentially hazardous activity needs to be risk managed with the owners, master and crew. The Rescue Skipper, however, has the same duties as any other Master, and during passage is primarily responsible for the safety of his vessel and crew. Salvage is a legal entitlement for the rescue of abandoned property, but is rarely claimed by community based volunteer rescue organisations.

Nominating an OSC – Due to its position, any vessel may be nominated as an OSC and may be expected by the SMC to implement coordination as requested.

National rescue organisational structures:

SAR- The National Authorities, AusSAR.
RCC - AusSAR maintains a rescue coordination centre.
RSC - Resue sub coordination centre.
FCP- Forward Command Post at a suitable location.
CSS- Coordinator surface search (civil vessel)
SMC - The RCC is under the authority of a SAR mission coordinator.
A/SMC- An assistant SAR mission coordinator is subordinate to the SMC.
OSC - On-scene coordinators are specifically designated by the SMC.

NSW rescue organisational structures:

SAR- State Authorities - State Rescue Board of New South Wales
VMRC- Volunteer Marine Rescue Council of New South Wales.
NSW Police- Responsible for coordination of all State SAR.
Water Police- Marine Area Command
OIC - An Officer in charge may be appointed by the SMC or police.
SRU- SAR units.
SARCC- SAR coordination centre (radio base).
MRU- Marine rescue unit (boat & crew)
AVCGA- Australian Volunteer Coast Guard Association
VRA- NSW Volunteer Rescue Association Inc
VRCP- Royal Volunteer Coastal Patrol

OVERALL COORDINATOR (See Note T1)		FUNCTION TO BE PERFORMED BY OR ON BEHALF OF THE OVERALL COORDINATING AUTHORITY					
For land, sea and air Search and Rescue	Responsible Authority	Provision and coordination of air SAR units	Provision and coordination of land SAR units	Provision and coordination of marine SAR units	Communications (other than air/surface)	Air/ground communications for land search and rescue	Aircraft/ship communications where direct communications not available
IN RESPECT OF PLEASURE CRAFT AND FISHING VESSELS AT SEA, UNREGISTERED AIRCRAFT (See Not T1), PERSONS MISSING IN A LAND OR COASTAL ENVIRONMENT, LAND VEHICLES, PERSONS AND VESSELS ON INLAND WATERS, AND ALL NON-MILITARY VESSELS IN PORT	POLICE	(a) POLICE (b) AusSAR (c) ADF when only service aircraft are involved (See Note T2)	POLICE	POLICE	POLICE	POLICE Airservices Australia	POLICE
IN RESPECT OF VESSELS OTHER THAN THOSE FOR WHICH THE POLICE AND DEFENCE FORCE ARE RESPONSIBLE	AusSAR	AusSAR	POLICE	(a) AusSAR (b) POLICE (See Note T3)	AusSAR	AusSAR/ Airservices Australia	AusSAR/ Airservices Australia
IN RESPECT OF UNIDENTIFIED DISTRESS BEACON ALERTS	AusSAR	AusSAR	POLICE	(a) AusSAR (b) POLICE (See Note T3)	AusSAR	AusSAR/ Airservices Australia	AusSAR/ Airservices Australia

The Australian Search and Rescue Co-ordination

(Tables courtesy of NATSATR Manual 2003)

Best practice in Search and rescue

1.4 Plans for search and rescue comply as closely as possible with relevant Australian and/or international regulations and conventions.

The World's best practice in ensuing safety of life at sea (SOLAS) and search and rescue (IMOSAR) is reflected for Australian vessels in the National Standards for Commercial Vessels (NSCV) and the Australian National Search and Rescue Manual (NATSAR Manual 2003).

States and Territories have their own strategies, such as the NSW State Rescue Board (NSW SRB) Procedures Manual. Elements of this are incorporated as Standing Operating Procedures (SOP's) available from the NSW State Rescue Board for accredited SAR units. They should also be used during all NSW incidents.

Search Planning and Evaluation:
As for rescue, SAR requires the building of a picture from the task information to develop an operational plan. It will involve the same phases:

Incertfa- Uncertainty phase requiring more task information.
Alertfa- Alert/Urgency phase requiring stand by.
Distressfa- Distress requiring immediate SAR.

Evaluating the situation:
Some of the clues that may indicate the survivor's location or situation include;

- Last known position.
- Survivor's intentions and post-distress movements.
- Conditions, capabilities and crew behaviour.
- On scene hazards and environmental conditions.
- Results of previous searching.

In particular SAR planning needs to:

- Use these results to estimate the most probable location (datum).
- Determine the best way to use the available search assets so the chances of finding the survivors are maximized.
- Define search sub-areas and search patterns for assignment to specific search assets.
- Provide a search plan that includes a current description of the situation, search object description, specific search responsibilities to search facilities, on scene co-ordination instructions and search asset reporting requirements.

These steps are repeated until the survivors are located or evaluation of the situation shows that further searching would be futile.

Estimating Distress Incident Location:
The first step in marine search planning is to determine the limits of the area containing all possible survivor locations. This is usually done by determining the maximum distance the survivors could have travelled between the time of there last known position (***LKP***) and the known or assumed time of the distress incident.

Three locations are possible dependant on how the distress incident is reported:

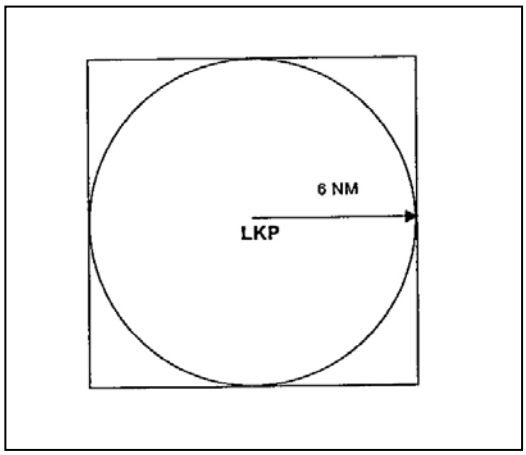
Approximate Known Position- The incident may have been witnessed, reported as a navigational fix, or computed by the SarMC (SMC) as a dead reckoning position from a previously reported and reliable position of the vessel in distress.

Approximate Track Known- The distress vessel may have filled a trip plan prior to departure that included the intended track but the vessel actual position is unknown. A single line of position, such as a flare sighting, should be treated as a TKP.

Approximate Area Known- When neither the position nor intended track are known, at least an area that the that vessel in distress was probably within is determined. The SMC should try to reduce this area to an area of high probability that can be used as the official search area or, if the area is small enough use it.

Coastal Search Planning:
Many maritime SAR incidents occur within 25nms of the coast, in under 300 mtrs. The coastal search planning model is for rapid response and should be used when the report of a distress is notified within 6 hours of the actual distress arising.
In most cases, considering the short response times to coastal SAR incidents, if the search unit proceeds to the LKP of the vessel in distress it will be found. However, the vessel in distress may not be in sight because of inaccuracies in the initial position reported or errors associated with drift factors or navigation.

Last known position:
If the time since the vessel became distressed is less than 4 hours and is not located at the LKP draw a 6 NM radius centred at the LKP. Then draw a square search area with the sides tangential to the circle. (MERSAR manual uses a 10 NM radius)

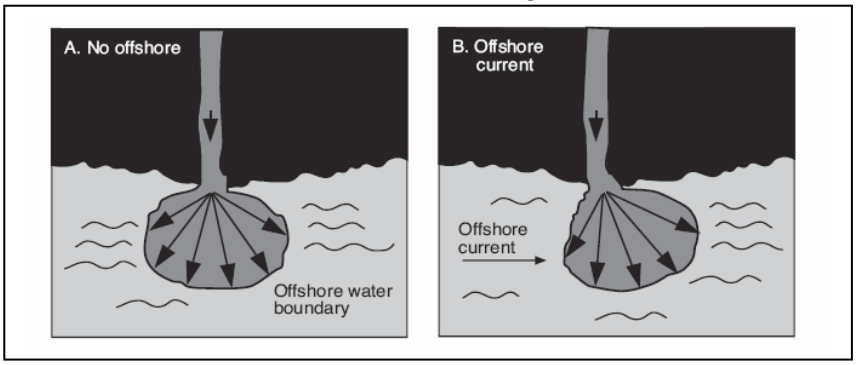


LKP search area of 144nms²
(Drawing courtesy of the NATSAR Manual)

Drift of Waterborne Targets:
The degree of displacement of the Datum from the LKP assumes increasing importance with the passing of time. The forces below MUST be calculated.

Average water current ***Average wind current*** ***Leeway***

River Current- Tides affect current speeds near the mouths of the rivers. This may be noticed several kilometres upstream or far off shore. Seasonal variations affect water volume. When estimating current in the discharge area, assume that the current direction is a straight line from the river mouth to the discharge boundary and the river current speed decreases from the river mouth to the discharge boundary. Current speed is best obtained from local knowledge or direct observation.



River discharge *(Drawing courtesy of the NATSAR Manual)*

Long Shore Current- Caused by incoming swells striking the shore at an angle.

Swell/Wave Current- May affect rafts and other small targets in calm conditions. As the current speed is low, it is used only for determining probable direction of target.

Surf Current- Surf current will move the object towards the shore perpendicular to the line of breakers unless a long shore current takes the target with it.

Rip Current- A narrow band of current flowing seaward through the surf line as a result of the long shore current building up a large volume of water along the beach line, then bursting through the incoming surf on its way back to sea. They are only a few metres wide through the surf line, but fan out and slow down in smoother water.

Tidal Streams- While the changes in direction of tidal streams have a tendency to nullify the cumulative effect, they must be considered in computing drift because:

- In reversing streams, the effect in one way can be more than the other.
- Over short periods tidal streams will cause significant changes in position.

Sea Current- Tidal and local features will affect sea currents near the coast.

Local Wind Current- Local wind current is the current generated by wind acting on the surface of the water. The velocity of a wind current is calculated from:

- Wind data for the 48 hours preceding splash time.
- Actual and forecast winds between splash time and Datum time.
- The application of coefficients taken from tables held in RCCs.

Leeway- Leeway is the movement of an object caused by it being pushed through the water by wind blowing against its exposed surfaces. The wind force is countered by water drag on the underwater hull. The drag varies with the hull shape and aspect.

Divergence- When a search object begins to drift, the wind will push the object in a downwind direction. As it continues to drift, the wind will cause it to deflect (or diverge) to the left or to the right of the downwind direction. The amount of divergence is dependent upon the shape of the "sail" area of the search object.

Calculating Leeway:
An object's leeway speed is measured as a percentage of the of the wind speed.

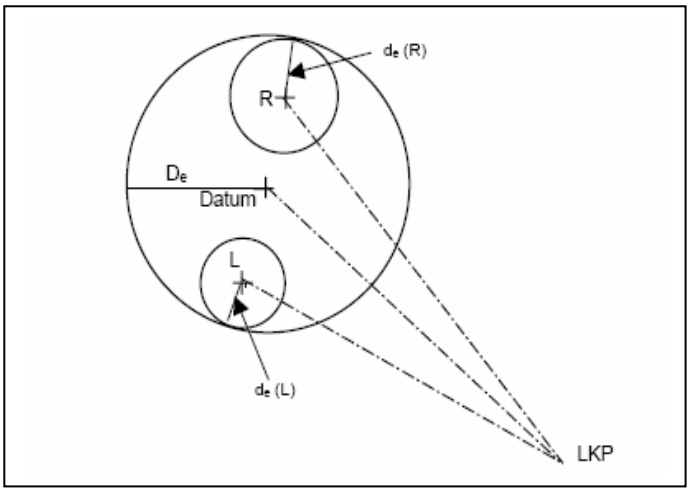
Leeway Speed (knots) = Multiplier x Wind Speed (knots) + Modifier

Wind direction is reported as the direction the wind is blowing from. For SAR we want the direction the wind is blowing to. When using downwind leeway, the leeway direction is equal to the reciprocal of the wind direction (direction + or – 180 DEG).

When directional uncertainty applies, the divergence angle (De) is both added and subtracted to the downwind direction to account for the search object's divergence to the left or right of the downwind direction.

Wind Direction +/- 180 DEG = Downwind Direction

Downwind Direction + De R= Angle to right of Downwind Direction
Downwind Direction – De L= Angle to left of Downwind Direction



Divergence in leeway
(Drawing courtesy of the NATSAR Manual)

The leeway speed is multiplied by the number of hours of drift to determine the leeway vector's length. The two leeway vectors would be added to the end of the total water current vector to determine the Right and Left Datum.
Differing vessels will have different leeway. In the example a search is planned for a missing Sports fishing Boat. The winds are blowing from 270 DEG true at 15 knots.

(270 DEG - 180 DEG) + 22 DEG = 118 DEG T
(270 DEG - 180 DEG) – 22 DEG = 068 DEG T

Leeway tables

Table I-1: Leeway speed and direction values for drift objects (kts)

Leeway Target Class				Leeway Speed		Divergence
Category	Sub Categories	Primary Leeway Descriptors	Secondary Leeway Descriptors	Multiplier	Modifier (kts)	Angle (deg)
PIW				0.011	0.07	30
	Vertical			0.005	0.07	18
	Sitting			0.012	0.00	18
	Horizontal	Survival Suit		0.014	0.10	30
		Scuba Suit		0.007	0.08	30
		Deceased		0.015	0.08	30
Survival Craft	Maritime Life Rafts			0.042	0.03	28
		No Ballast Systems	no canopy, no drogue	0.057	0.21	24
			no canopy, w/ drogue	0.044	-0.20	28
			canopy, no drogue	0.037	0.11	24
			canopy, w/ drogue	0.030	0.00	28
		Shallow Ballast Systems and Canopy		0.029	0.00	22
			no drogue	0.032	-0.02	22
			with drogue	0.025	0.01	22
			Capsized	0.017	-0.10	8
		Deep Ballast Systems & Canopies	(See Table I-2 for Levels 4-6)	0.030	0.02	13
	Other Maritime Survival Craft	life capsule		0.038	-0.08	22
		USCG Sea Rescue Kit		0.025	-0.04	7
	Aviation Life Rafts	no ballast, w/canopy Evac/ Slide	4-6 person, w/o drogue	0.037	0.11	24
			46-person	0.028	-0.01	15
Person-Powered Craft	Sea Kayak	W/ Person on aft deck		0.011	0.24	15
	Surf board	w/ person		0.020	0.00	15
	Windsurfer	w/ person and mast & sail in water		0.023	0.10	12
Sailing Vessels	Mono-hull	Full Keel	Deep Draft	0.030	0.00	48
		Fin Keel	Shoal Draft	0.040	0.00	48
Power Vessels	Skiffs	Flat Bottom	Boston whaler	0.034	0.04	22
		V-hull	Std. Configuration.	0.030	0.08	15
			Swamped	0.017	0.00	15
	Sport Boats	Cuddy Cabin	Modified V-hull	0.069	-0.08	19
	Sport Fisher	Center Console	Open cockpit	0.060	-0.09	22
Power Vessels	Commercial Fishing Vessels			0.037	0.02	48
		Sampans		0.040	0.00	48
		Side-stern Trawler		0.042	0.00	48
		Longliners		0.037	0.00	48
		Junk		0.027	0.10	48
		Gill-netter	w/rear reel	0.040	0.01	33
	Coastal Freighter			0.028	0.00	48
Boating Debris	F/V debris			0.020	0.00	10
	Bait/wharf box holds a cubic meter of ice			0.013	0.27	31
		lightly loaded		0.026	0.18	15
		fully loaded		0.016	0.16	33

Leeway or Wind Vector of a Sport Fisher:

Wind speed x Time x Multiplier (+ or – Modifier)

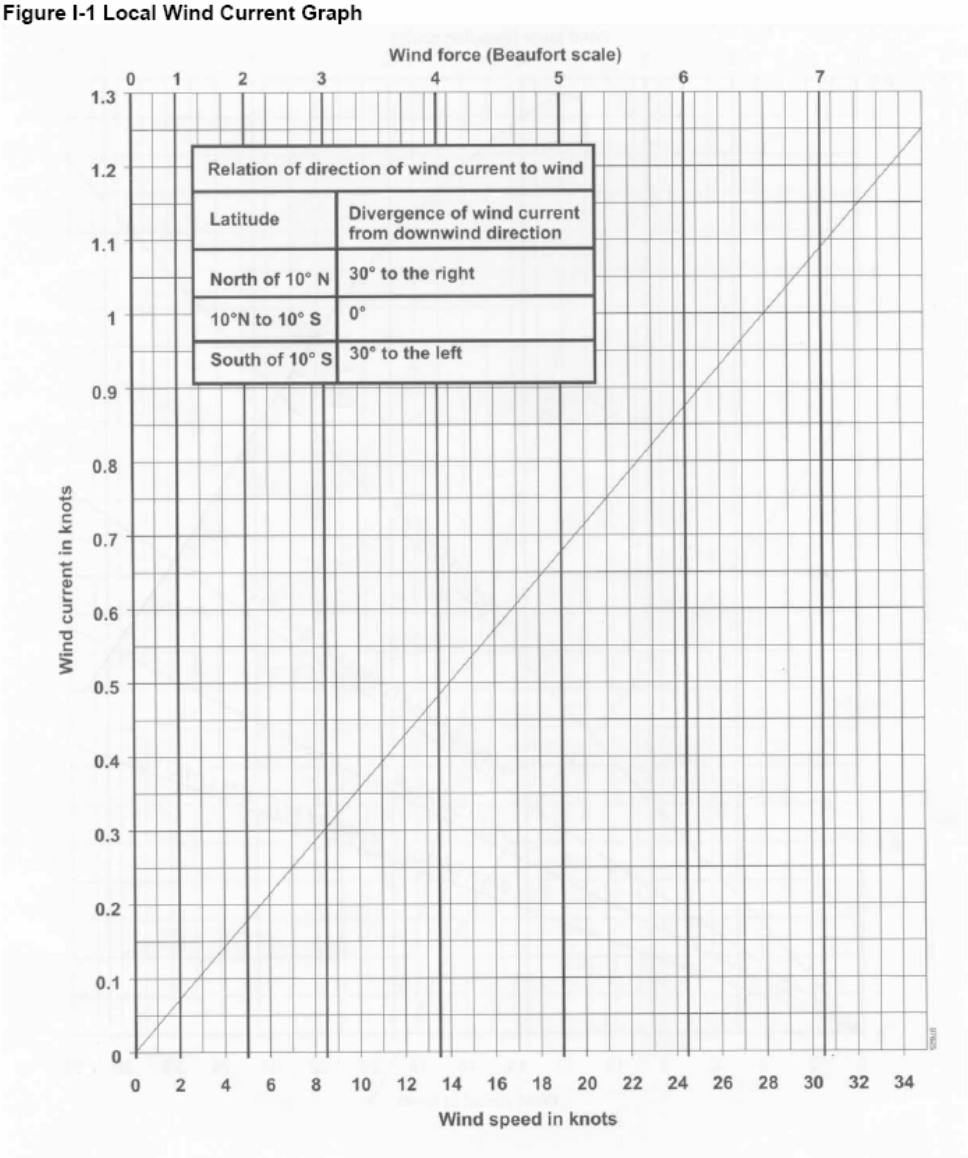
15 knots x 5 hrs x 0.06 (- 0.09) = 4.41 nm

Calculating current:

Local observation or buoy recorders can give accurate sea current information. However it may be necessary to calculate the effect of wind setting up local currents. For this a *Local Wind Current Graph can be used.*

Local Wind Current

Figure I-1 Local Wind Current Graph

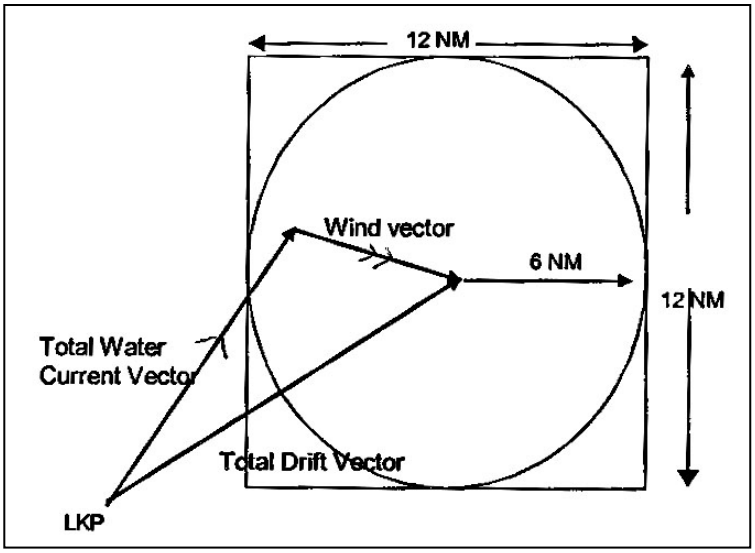


Relation of direction of wind current to wind	
Latitude	Divergence of wind current from downwind direction
North of 10° N	30° to the right
10°N to 10° S	0°
South of 10° S	30° to the left

Water Current Vector:
Time x Current = Drift
5 hrs x 2 knots south = 10 nm

Plotting drift and probable position:
If the time is greater than 6 hours, and/or the drift, based on local knowledge and/or on scene conditions, is considered to be significant, the search objects drift should be established, and the 6 NM radius applied to drift datum position.
In Coastal SAR, the initial datum is determined by calculating drift using the vessels LKP and the effects of the water current (current vector) and wind current (wind or leeway vector). Time of datum must take the underway transit time for the MRU into

consideration. Particular attention should be paid to the situation when the LKP is outside the established search area. In many cases, it should be possible to search along the drift line from the LKP to the datum during the initial search.



Plotting for drift
(Drawing courtesy of the NATSAR Manual)

Using the vector values determined for average sea current, wind current and leeway it is possible to plot a simple vector diagram and obtain a datum point. However as the leeway data is generally uncertain may be necessary to plot both a left and right drift, and to calculate drift error (De).

The direction and speed of these factors is referred to as 'SET'. Contrary to the convention of expressing wind velocity, the direction component indicates the direction of movement.

For more plotting symbols see appendix G.

Sweep width:
Search visibility, constituting sweep width, is the range within which a particular search target has a reasonable probability of being detected. Search visibility as affected by the numerous factors including; type, size, colour and shape of the target, meteorological visibility, sea conditions, search speed, factor, search aircraft height, cloud cover, position of the sun and day and night factors.

Sweep Width Tables For Visual Search Over Water

Table I-3. Uncorrected visual sweep width for vessels and small boats (NM)

SEARCH OBJECT	Height of eye 8' Visibility in kilometres						Height of eye 14' Visibility in kilometres					
	2	5	10	15	20	>25	2	5	10	15	20	>25
Person in water	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.6
Raft 1 Person	0.7	1.2	1.8	2.1	2.4	2.5	1.0	1.6	2.5	2.9	3.2	3.3
Raft 4 Person	0.8	1.5	2.3	2.9	3.2	3.4	1.1	2.0	3.1	3.8	4.2	4.4
Raft 6 Person	0.9	1.7	2.7	3.4	3.8	4.1	1.2	2.2	3.5	4.4	5.0	5.3
Raft 8 Person	0.9	1.7	2.8	3.5	4.0	4.2	1.2	2.3	3.6	4.5	5.1	5.4
Raft 10 person	0.9	1.8	2.9	3.7	4.2	4.6	1.2	2.3	3.7	4.7	5.4	5.8
Raft 15 Person	1.0	2.0	3.2	4.0	4.5	4.9	1.2	2.5	4.0	5.1	5.7	6.2
Raft 20 Person	1.0	2.1	3.5	4.4	5.1	5.6	1.3	2.6	4.3	5.7	6.4	6.9
Raft 25 Person	1.0	2.2	3.7	4.7	5.5	6.0	1.3	2.7	4.3	5.8	6.7	7.5
Power Boat <5m (15 ft)	0.5	0.7	1.0	1.2	1.3	1.4	0.5	1.0	1.5	1.8	1.9	2.0
Power Boat 5-8m (15-25 ft)	0.8	1.4	2.3	2.9	3.4	3.8	1.0	1.9	3.0	3.9	4.5	5.0
Power Boat 8-12m (25-40 ft)	0.8	1.8	3.1	4.1	4.9	5.6	1.2	2.3	4.0	5.3	6.4	7.3
Power Boat 12-20m (40-65 ft)	0.9	2.2	4.2	5.9	7.4	8.7	1.2	3.0	5.4	7.6	9.6	11.3
Power Boat 20-27m (65-90 ft)	0.9	2.3	4.6	6.8	8.8	10.6	1.2	3.0	6.0	8.7	11.3	13.6
Sail Boat 5m (15 ft)	0.8	1.4	2.2	2.7	3.1	3.4	1.0	1.8	2.8	3.5	4.1	4.5
Sail Boat 6m (20 ft)	0.8	1.6	2.6	3.3	3.9	4.4	1.1	2.0	3.3	4.3	5.0	5.6
Sail Boat 8m (25 ft)	0.9	1.8	2.9	3.9	4.6	5.1	1.1	2.2	3.8	5.0	5.9	6.7
Sail Boat 9m (30 ft)	0.9	2.0	3.4	4.6	5.5	6.3	1.2	2.5	4.4	5.9	7.1	8.1
Sail Boat 12m (40 ft)	0.9	2.2	4.1	5.7	7.0	8.1	1.3	2.8	5.2	7.2	9.0	10.5
Sail Boat 15m (50 ft)	0.9	2.2	4.3	6.1	7.7	9.1	1.2	2.9	5.2	7.9	9.9	11.7
Sail Boat 20-23m (65-75 ft)	0.9	2.3	4.5	6.5	8.3	9.9	1.2	3.0	5.8	8.4	10.8	12.9
Sail Boat 23-17m (75-90 ft)	0.9	2.4	4.7	6.8	8.9	10.7	1.2	3.1	6.1	8.9	11.5	13.8

Note: A sailboat is only a sailboat if the sails are up. If the sails are down, the craft should be classed as a powerboat.

Table I-4. Visual sweep widths for merchant ships (NM)

Height of eye correlates to bridge of a merchant ship	Meteorological visibility [km]				
Search Object	5 km	10 km	20 km	30 km	40 km
Person in water	0.4	0.5	0.6	0.7	0.7
4-person liferaft	2.3	3.2	4.2	4.9	5.5
6-person liferaft	2.5	3.6	5.0	6.2	6.9
15-person liferaft	2.6	4.0	5.1	6.4	7.3
25-person liferaft	2.7	4.2	5.2	6.5	7.5
Boat <5m (17ft)	1.1	1.4	1.9	2.1	2.3
Boat <7m (23ft)	2.0	2.9	4.3	5.2	5.8
Boat <12m (40ft)	2.8	4.5	7.6	9.4	11.6
Boat <24m (79ft)	3.2	5.6	10.7	14.7	18.1

Table I-7. Weather correction factors for all types of search facilities

	Search Object	
Weather: winds km/h (kt) or seas m (ft)	Person in water, raft or boat < 10m (33ft)	Other search objects
Winds <28 km/h (<15 kt) or seas 0-1 m (0-3ft)	1.0	1.0
Winds 28-46 km/h (15-25 kt) or seas 1-1.5 m (3-5ft)	0.5	0.8
Winds >46 km/h (> 25 kt) or seas > 1.5 m (> 5ft)	0.25	0.5

Note: Table I-7 differs from IAMSAR for other search objects in winds above 15 kts. The correction factors are based on a combination of the values previously used by AusSAR and observations of the reported effect of high winds on sweep width values in actual SAR incidents.

(Distances given in NM, Meteorological Visibility given in Kilometres)

As a searching vessel navigates a track it is able to observe sweep widths on either side. Consequently tack spacing is usually two sweep widths.

Search Area coverage:
This can be reduced to the inter-related expressions:

Coverage Factor (C) ***Sweep Width (W)*** ***Track spacing (S)***

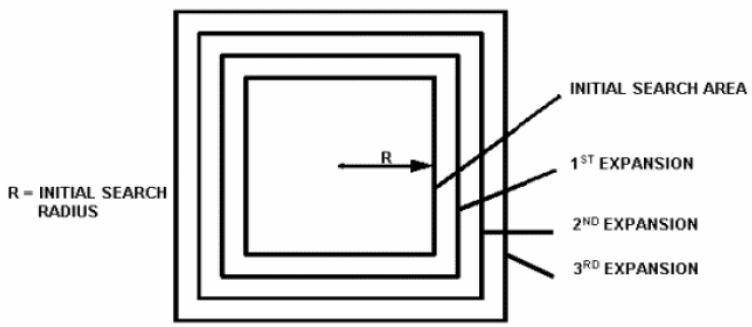
$$\text{Coverage Factor} = \frac{\text{Sweep Width}}{\text{Track spacing}}$$

Higher coverage factors indicate a more thorough coverage. Higher values of C offer a higher probability of detection, however the higher POD is not proportional to the extra search effort required. Whilst a coverage factor of 1.0 is most desirable there are occasions when this is not possible. For such occasions an alternative approach must be used that balances the factors of available search hours, size of area and C. A coverage factor of less than 0.5 is unsatisfactory in itself.

Probability of Detection (POD)
The relationship between Sweep Width and Track Spacing determines the Probability of Detection (POD).

Table 5.2 Coverage data example		
Search	**Coverage Factor 1**	**Coverage Factor 0.5**
Initial Search (R1)	78% POD	47% POD
First Expansion (R2)	95.6	71.9
Second Expansion (R3)	98.9	85.1
Third Expansion (R4)	99.7	92.1
Final Expansion (R5)	99.9	95.8

The Table 5.2 confirms that by making five searches of the initial probability area, each to a coverage factor of 0.5, the cumulative POD (95.8%) is only slightly less than if the same five searches had each been made at a coverage factor of 1.0, (99.9%). The search effort in the former case would have been considerably less in than in the latter and a significantly larger area surrounding the initial probability area would have been searched, albeit at a progressively diminished level of intensity.



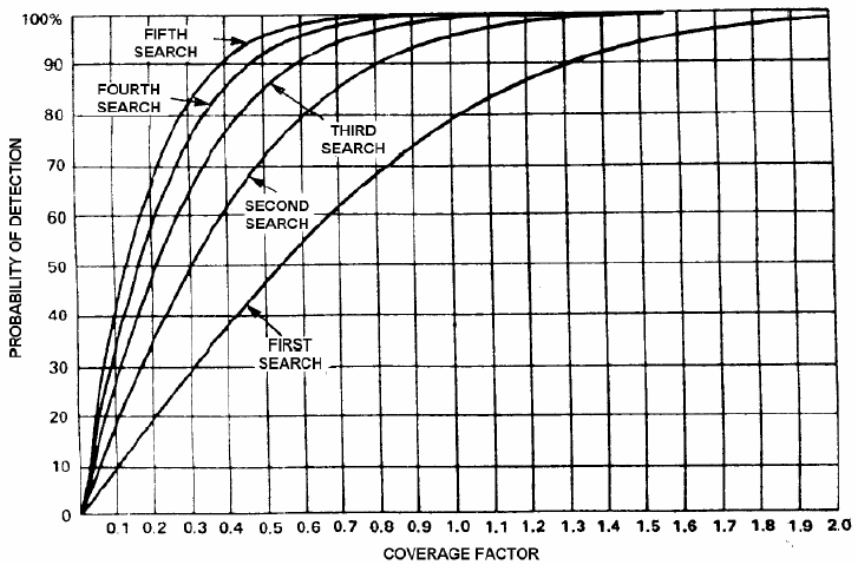
Search area expansion (not to scale)
(Drawing courtesy of NATSAR Manual)

For repeated searches of the same area, the cumulative POD is obtained by making use of the average coverage factor. The application of this concept results in a progressive increase in the POD of a target in the most likely sector of the search area by repeatedly searching the original area within progressively larger areas, a part of each overlaying the original. Thus there results an aggregate POD after successive searches of part of a probability area. For each successive search, the safety factor is increased, and the size of the probability area is enlarged.

It is not to be thought that early search effort should be restricted in anticipation of the benefits of the expanded search technique; these will take time to accrue, and time, in the rescue of survivors, is of the essence.

Probability of Detection

Figure I-12 - Probability of Detection



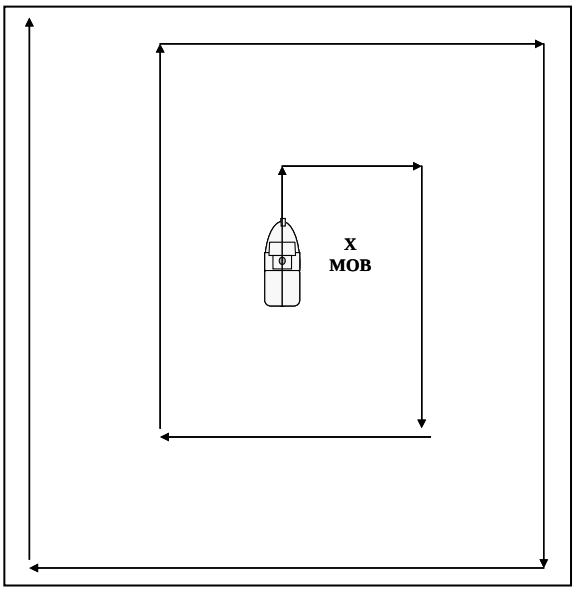
When using the Graph the POD for any particular search is obtained by reference to the appropriate Search graph line depending on the search conditions. For repeated searches of the same area, enter the graph with the average coverage factor and refer to the graph line relevant to the overall number of searches to obtain cumulative POD. The results are shown as:

1st Search	Coverage Factor 0.5
2nd Search	Coverage Factor 0.7
3rd Search	Coverage Factor 0.3
4th Search	Coverage Factor 0.2
5th Search	Coverage Factor 0.3

Over 5 searches, the average coverage factor = 0.4

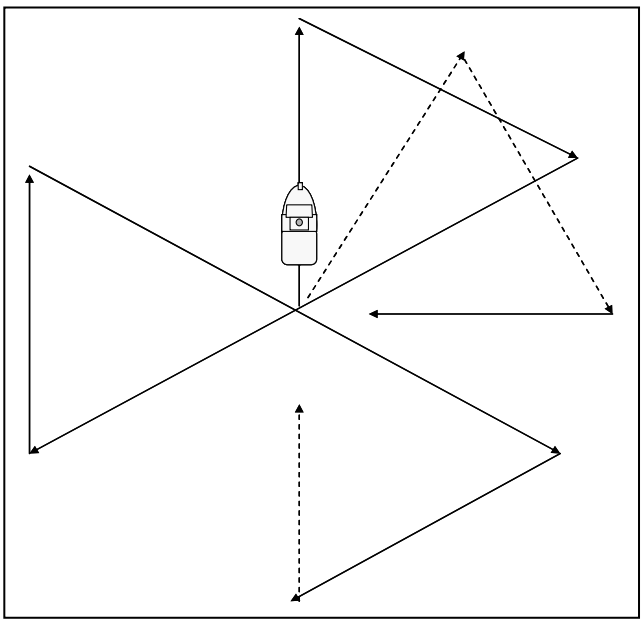
In entering Graph 2 with an average coverage factor 0.4, the cumulative POD after five searches may be read off from fifth search graph line as 92%.
The projected value of the POD may be used by a SMC in deliberation of track spacing. Use of POD may also be conveniently made in describing the results of a Search to interested persons not familiar with search planning techniques.

Search patterns:
Expanding square system - one vessel-



This system starts at the datum point established earlier. The diagram shows the pattern, distance between the tracks will depend on height of lookout and weather conditions but should be such that each sweep should double up on detection.

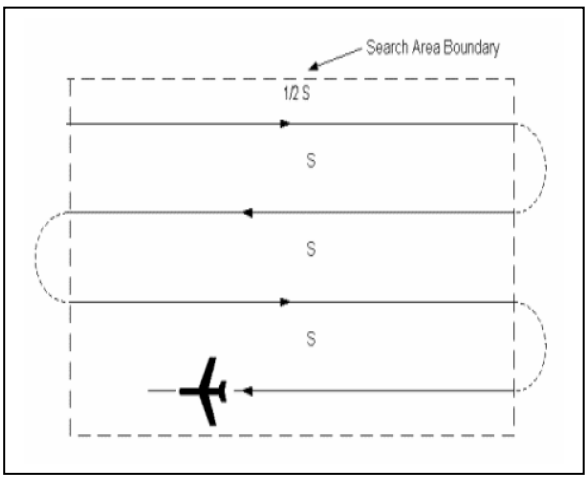
Sector searching - one vessel:
If the incident position was noted and the conditions indicate that the person may not have drifted far from that particular point, the sector search pattern may be used. Remember with this pattern, all changes in course are 120° to starboard.



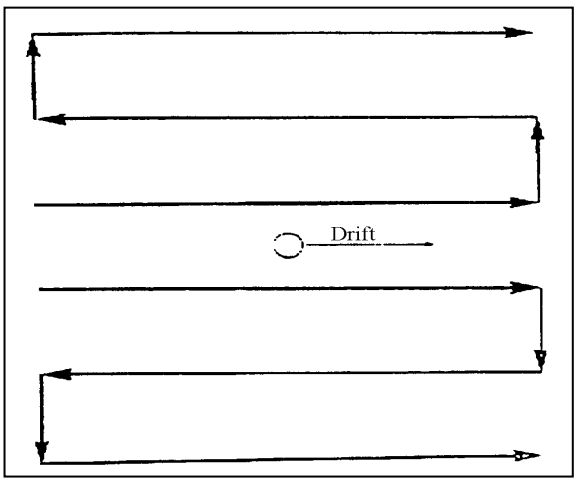
If the person has not been detected on completion of the first search adjust the original line by 30° and recommence the search pattern. Distance for each leg will vary for types of vessels but may be 1-2 nautical miles.

Parallel track search:
Parallel Track Patterns are normally used when;

- The search area is large and the terrain is level e.g. Maritime Areas.
- Uniform Coverage is required.
- The location of the target is not known with any precision.



A parallel search for one craft.



A parallel search for two ships.

Search legs are aligned parallel to the major or minor axis of the individual search area. The pattern is best used in rectangular or square areas.

A parallel search for two ships- A parallel search for two ships, the search vessels proceed from one corner of the search area maintaining parallel tracks. The first is at a distance of one–half the track spacing from the side of the area. Successive tracks are maintained parallel to each other and one track spacing apart.

A parallel search for two or more ships-The OSC on the command ship coordinates the convoy of ships, spreading them abreast of him by “radar distance off” to maintain sweep widths appropriate to the individuals observing platform. Covering a combined track width, the convoy now steams to a point of course change for the next track leg. The OSC signals each vessel of their moment to change course in order to reform the convoy on the new heading at the same track spacing.

Further information on search and rescue patterns can be found in the Merchant Ship SAR Manual (*MERSAR*) compiled by the Maritime Safety Committee of the International Maritime Organisation (IMO).

Written Activity- *Assist in planning search and rescue operations*

Describe to your assessor or write a short answer, using diagrams if required, to the following questions.

Question No.1
List twelve distress signals.

Question No.2
List five International code single letter signals.

Question No.3
How would an aircraft direct a surface craft without radio aids?

Question No.4
What are the components of a search and rescue plan?

Question No.5
What type of information is task information?

Question No.6
What type of information is operational information?

Question No.7
How is the probable position is found from the LKP (allow for wind and current)?

Question No.8
What is the relationship of coverage factor to sweep width and track spacing?

Question No.9
How would you navigate an expanding square search?

Question No.10
When can a sector search be most effective?

Question No.11
Describe two means of using two vessels in a parallel track search.

Practical Activity- Assist in planning search and rescue operations

Your Skipper will provide as many opportunities as possible to practice the previous skills during simulated rescue operations or “on the job training”. Practice activities for this element of competency include:

- Studying your Squad’s SOP’s for gathering task and operational information.
- Interrogating a simulated witness using open & closed questioning.
- Determining simulated rescue locations from task information.
- Devising a simulated search plan with LKP and probable position after delay.

Discuss as a team. Read the accompanying workbook, “Bare Facts of Marine SAR.” Remember to complete your log book.

Establish and maintain radio-communications

Radio communications

2.1 Radio communications are established and maintained with the parties in distress, other search vessels and/or aircraft, search and rescue coordination authorities and other organisations and persons who may be involved in the search and rescue operation.

It is prerequisite that trainees at this level will be qualified to at least a MROCP.

While radiotelephony remains the commonly used method of small craft communication, for larger vessels the roll out of DSC and has seen a corresponding decline in Telex (NBDP/TLX) and Radiotelegraphy (RTG) services. Advances in satellites and radio/radar beacons have additionally enhanced the capability for routine calling and emergency alerting. This workbook looks at radio systems used by SAR World wide as described more fully in the NATSAR manual. Some of these technologies are now superseded or unsupported in Australian Waters. You should consult your Radio Operators Handbook for current radio practice in Australia.

Communications facilities overview:
Some of the more extensive and readily available facilities in Australia are:

- The maritime communications stations (Wiluna and Charleville) on HF.
- State/Territory Coast radio stations on 4,6 and 8 MHz distress.
- State/Territory volunteer marine radio networks.
- State/Territory Police radio network.
- Discon - an extensive secure network linking all Defence authorities.
- Satellite communications offering voice, fax and data.
- Mobile phone and fax communications.
- SKYCOMS - communication with airborne aircraft by telephone.
- Aeronautical Fixed Telecommunications Network operated by Airservices Australia.

Maritime communications stations-

- HF DSC and 4125, 6215, and 8291 kHz with 8176 kHz, weather.

Coast Radio Stations-

- 4125, 6215, and 8291 kHz with 8176 kHz used to broadcast weather.
- 156.8 MHz (VHF CH16). Channel 16. each State/Territory
- Channel 67 is used to broadcast weather and warnings.

Limited Coast Stations- In addition, the SAR net is extended by Limited Coast Stations operated by fishing cooperatives and volunteer SAR organisations. Each

Limited station caters for a group or groups of marine craft in its local area. Depending on the capability of its equipment, a Limited station may monitor:

- 2182/2524 kHz, VHF CH16 and 27.88 MHz for pleasure craft.
- 2182/2112/4535/4620 kHz and VHF CH16 for fishing craft.

State Police radio networks- Secure private channels. Each State/Territory SAR authority maintains radio-equipped vessels with SAR capabilities.

Volunteer Organisations- Clubs with base radio stations, mainly in popular sea recreational areas around Australia. Each station is normally staffed on an ”as required” or “considered necessary” basis.

They may also operate on VHF Ch 16 and 27 MHZ Channel 88. The majority of voluntary organisations equipped with HF SSB equipment are capable of responding to calls on the 2 MHz, 4MHz and 6 MHz marine bands. However, 2524 kHz as the calling and working frequency for shore stations and pleasure craft, is still traditionally preferred.

Ship Stations:
The distinct categories of vessels of interest to marine SAR are:

- Pleasure craft.
- Fishing vessels
- Deep sea vessels (SOLAS)
- Defence vessels

Pleasure Craft- There is a general acceptance by the boating community of the need to carry some type of radio and the 27 MHz marine radio is most popular. VHF is increasingly being fitted to mid size craft.

Fishing Vessels
Some fishing vessels will carry GMDSS equipment, however the majority of fishing vessels carry a variety of radio equipment and do not maintain regular watches. Frequencies allocated to fishing vessels are normally not compatible with large ships.

Deep sea vessels- most will carry communications equipment compatible with the GMDSS. Other vessels, most of which use satellite communications, may extend this coverage. A continuous bridge listening watch may be kept on VHF Ch16, as far as is practicable.

Merchant Shipping and GMDSS:
Communications between merchant vessels in distress and SAR organisations are achieved by a satellite and radio watch system known as the Global Maritime Distress and Safety System (GMDSS). The GMDSS enables a distress alert to be transmitted and received automatically over short and long distances. The system allows SAR authorities as well as shipping in the vicinity of the distress to be rapidly alerted so that a coordinated search and rescue operation can be commenced with

the minimum of delay.

Additionally the GMDSS provides for urgency and safety communications, and the dissemination of Maritime Safety Information (MSI). Certain fishing vessels and other marine craft may also carry GMDSS equipment. AMSA is responsible for the provision of shore facilities for the GMDSS and all distress and safety traffic through the GMDSS shore infrastructure in the Australian SRR will be handled by RCC Australia. Ships operating under GMDSS requirements in the Australian SRR can be expected to carry:

- MF DSC.
- VHF radiotelephone (Channels 6, 13, 16 and 67).
- VHF DSC (Channel 70).
- Inmarsat-C or HF DSC.
- a SART.
- an EPIRB.

GMDSS equipped vessels can be expected to perform the following functions wherever they operate:

- Transmit ship-to-shore distress alerts by two independent means
- Receive shore-to-ship alerts (usually relayed by International RCCs)
- Transmit and receive
  - i Ship-to shore alerts
  - ii. SAR coordinating communications
  - iii. On-scene communications
  - iv. Locating signals
  - v. Maritime safety information
  - vi. General radio communications to and from shore
  - vii. Bridge to bridge communications

International Distress Frequencies - Guarded by Royal Australian Naval Ships:
A distress watch is maintained as follows by naval ships at sea:
Major warships- HF/VHF DSC, VHF Channel 16.
.
Minor warships- Vhf Channel 16 Continuous loudspeaker watch.

Air Wings:
States and Territories have air units with appropriate communications equipment.

Communications Aircraft- A dedicated communications aircraft should be used when communications are expected to be poor in the search area and:

- HF is the only means of communication;
- It is a large scale search;
- It is necessary to improve information feedback into the RCC;
- It is necessary to improve information flow to SAR units;

- Search aircraft are operating without contact with a ground station; or
- It is the best method of maintaining communications with survivors/ground search units and ground rescue units.

A communications aircraft will normally be a suitably equipped SAR Unit aircraft or a Military aircraft, have a minimum crew of pilot and radio operator, and have good on scene endurance.

Inmarsat Aero- Subscribers to the INMARSAT Aeronautical System may make telephone and facsimile calls while airborne.

Use of frequencies:
Distress traffic includes all messages relating to immediate assistance required by persons, aircraft, or marine craft in distress. It may also include SAR communications and on-scene communications. Distress calls take absolute priority over all other transmissions; anyone receiving a distress call must immediately cease any transmissions that may interfere with the call and listen on the frequency of the call.

Some frequencies are protected, in that they have no authorised uses other than for distress and safety. SAR personnel should be particularly not to cause interference, and should co-operate with authorities to report and stop them.

SAR communications must allow for:

- rapid transmission of distress messages.
- rapid communication of distress information to the rescue authorities.
- coordination of the operation of the various SAR units.
- liaison between controlling/coordinating authorities and SAR units.

Priority Calls:
Radiotelephony priority calls are the most commonly used method of raising a general alarm; the progressive levels described by as distress (MAYDAY), urgency (PAN PAN) and safety (SECURITE).

Marine Radio Alarm Signal- With the full implementation of the GMDSS the automatic 2182 kHz alarm devices are no longer required. However, some maritime communications stations may still use the distinct warbling sound voice alarm signal to draw attention to a distress broadcast. Merchant shipping complying with the SOLAS now guard the Digital Selective Calling (DSC) distress frequencies.

RTF Distress Signal- The distress signal is used to indicate that a craft or person is threatened by grave and imminent danger and requires immediate assistance. It has precedence over all other communications. The distress message is preceded by the word MAYDAY spoken three times.

RTF Urgency Signal- The urgency signal is used to indicate that the calling station has a very urgent message to transmit covering the safety of a ship, aircraft or

person. It has precedence over all other communications, except distress traffic. The urgency message is preceded by the words 'PAN PAN' spoken three times.

Safety Signal- The safety signal indicates that the station is about to transmit a message concerning the safety of navigation or providing an important meteorological warning. The safety message is preceded by the word 'SECURITE' spoken three times. All stations hearing either the urgency or safety signals shall not make any transmissions that might interfere with those signals.

Radiotelephony Distress/Emergency Frequencies:
The following frequencies have been designated for distress or emergency:

2182 kHz- The international MF voice distress frequency primarily for ship-to-ship communications. It is used for follow-on communications after an initial DSC distress alert on 2187.5 kHz for GMDSS shipping.
In Australia 2182 kHz is monitored by a number of Limited Coast Radio Stations operated by Volunteer Marine Groups. The two-tone alarm may still be used on 2182 kHz to draw attention but auto alarms are no longer a Radio Regulation.

4125, 6215, 8291, 12290 and 16420 kHz- These frequencies have been authorised for common use by ships and Coast Stations using the HF frequencies for single sideband radiotelephony on a simplex basis for calling, reply and safety purposes.

121.5 MHz- The international aeronautical emergency frequency for aircraft and those aeronautical stations primarily concerned with the safety and regularity of flight and having equipment in the 118-136 MHz VHF band. Ships fitted with the capability are authorised to communicate on this frequency with aircraft for safety purposes.

156.8 MHz (Marine VHF Channel 16)- The international distress, safety and calling frequency for the Marine VHF bands. State and Territory Limited Coast radio stations, port authorities, merchant ships, fishing craft and pleasure craft use VHF Ch 16. Merchant ships maintain a continuous bridge listening watch on VHF channel 16 to the maximum extent practicable (voluntary) when at sea (review by IMO 2005).

156.3 MHz- (Marine VHF Channel 6) is the secondary distress and safety frequency in the VHF band and is used for coordination at the scene of an incident.

243MHz- 243 MHZ is the international military aeronautical emergency frequency.

Safety Frequencies:
156.375 MHz- (Marine VHF channel 67) Marine safety, Australia only.
27.88 MHz- (Marine 27 MHz Channel 88) pleasure craft, Australia only.
2524 kHz- (Marine MF) pleasure craft, volunteer SAR organisations.

GMDSS Distress/Emergency Frequencies:

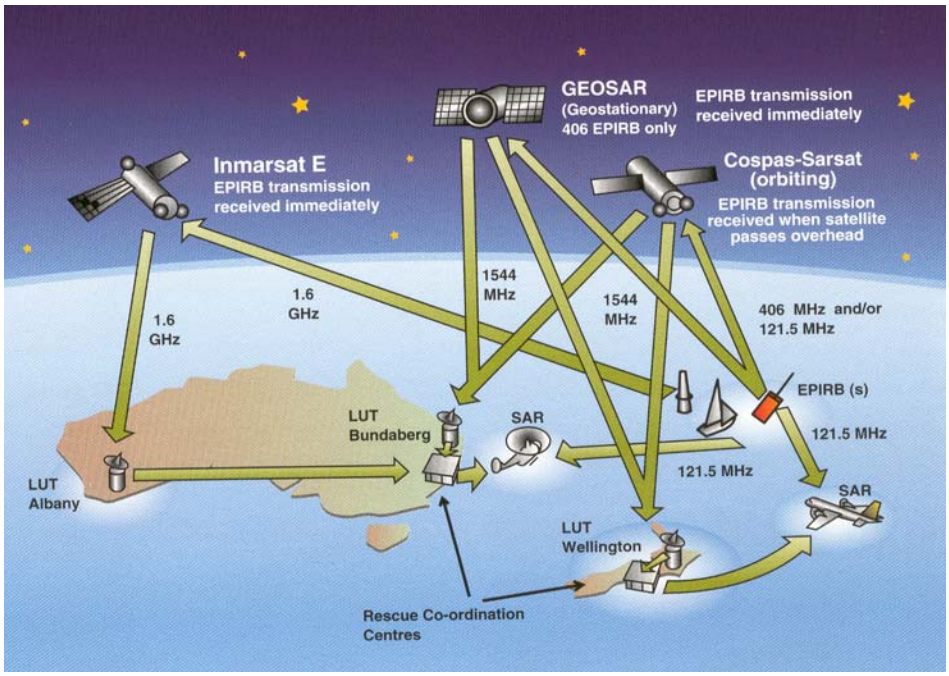
MF/HF Radio Telephone	DSC	NBDP (TELEX)
2182	2187.5	2174.5
4125	4207.5	4177.5
6215	6312.0	6268.0
8291	8414.5	8376.5
12 290	12 577.0	12 520.0
16 420	16 804.5	16 695.0
The AMSA HF DSC network monitors DSC in the 4 – 16 MHz bands.		

Ships operating under GMDSS requirements in the Australian SRR can be expected to monitor MF DSC, VHF DSC (Channel 70) and VHF (Channels16, 67, 13, and 6).

Radar/IFF/SSR:
Besides the obvious radar target of the distressed craft itself, IFF (Identification Friend or Foe) may be used not only to indicate distress but also to increase the detectable range by radar. The basic equipment consists of an interrogator and a transponder. Secondary Surveillance Radar (SSR) is the name used to describe similar equipment in use by Airservices Australia and civil aircraft.

COSPAS-SARSAT Distress Beacon Detection System Overview:
COSPAS-SARSAT is a satellite system designed to provide distress alert and location data to assist SAR operations, using spacecraft and ground facilities to detect and locate the signals of distress beacons operating on 406 MHz or 121.5 MHz. The responsible Cospas-Sarsat Mission Control Centre (MCC) forwards the position of the distress and other information to the appropriate SAR authorities.

The Cospas-Sarsat System provides distress alert and location data to RCCs for 121.5 MHz beacons within the coverage area of Cospas-Sarsat ground stations Local User Terminals (LUTs), and for 406 MHz beacons activated anywhere in the World. In the Australia/New Zealand region, the Australian Mission Control Centre (AUMCC) controls the three LUTs located at Albany, Bundaberg and Wellington.



World wide system:
The worldwide system comprises:

- Low orbiting satellites in near polar orbits.
- Satellites in geostationary orbit.
- Local User Terminals (LUTs), (ground stations that receive satellites).
- Mission Control Centres (MCCs) which process beacon detections.
- 406 MHz beacons, each with a unique identification code, capable of transmitting for 24 or 48 hours.

Satellites- The satellite constellation is made up of search and rescue satellites in low earth orbit (LEOSAR) and geostationary orbit (GEOSAR).

Each LEOSAR satellite makes a complete orbit of the earth around the poles in about 100 – 105 minutes. The satellite views a "swath" of the earth of approximately 4000 km wide as it circles the globe, giving an instantaneous "field of view" about the size of a continent. When viewed from the earth, the satellite crosses the sky in about 15 minutes, depending on the maximum elevation angle of the pass.

Satellites are not equally spaced and hence do not pass over a particular place at regular intervals. In view of this, pass schedules are computed for each LUT every day. On average a satellite will pass over continental Australia every 90 minutes but, there could be up to 5 hours between passes.

Not all LEOSAR satellites have a global detection capability for 406 MHz beacons and only some are able to detect transmissions on 243 MHz. 121.5 and 243 MHz distress signals may only be passed to the MCC when the satellite views the transmitting beacon and the receiving LUT simultaneously. The current GEOSAR constellation is composed of two satellites provided by the USA, GOES 8 and GOES 10, and one satellite provided by India (INSAT-2B). These satellites provide continuous global coverage for 406 MHz beacons with the exception of the Polar Regions. To take full advantage of the real-time alerting capability the beacon must be designed to transmit, in its distress message, position data derived from a satellite navigation system such as GPS.

Radio and Distress Beacons:
In addition to the obvious uses of standard radio for transmitting emergency signals and messages, there are a variety of types of emergency equipment designed for use by survivors. These include:

- Hand held VHF transmitters found in life rafts.
- 406 MHz distress beacons (GMDSS approved).
- Inmarsat E (L-Band) EPIRBS (GMDSS approved).
- 121.5 MHz distress beacons.
- 9 GHz SAR Transponders.

Cospas-Sarsat distress beacons-

- Emergency Locator Transmitters (ELT) used by aviators;
- Emergency Position Indicating Radio Beacons (EPIRB) used by mariners;
- Personal Locator Beacons (PLB) used on land.

Aviators and mariners often carry PLBs as personal back up to ELTs and EPIRBs.

Because 406 MHz beacons transmit an extremely stable frequency, positions calculated by the LUT usually fall within a radius of 5km from the actual beacon position. On the other hand, 121.5/243 MHz beacons do not have the same frequency stability that results in less accuracy with positions within a 20 km radius. All 406 MHz beacons sold in the Australian region are required to transmit on 121.5 MHz to facilitate homing.

406 MHz beacons use digital technology that allows an identifier to be sent when the beacon is activated. This identifier correlates to a registration database held at the MCC and allows additional information to be gained about the target. 406 MHz beacons should be coded with a country code and registered in the country that maintains the database for that country code. It is therefore important that all Australian 406 MHz beacons are registered with RCC Australia.

Satellite processing of 121.5 MHz alerts will cease from 1 February 2009.

Beacon detection- With the exception of the GEOSAR, the position of a distress beacon is calculated by using Doppler shift, which is caused by the relative movement between a satellite and a beacon. As a satellite approaches a beacon there is an apparent rise in the beacon frequency and as the satellite moves away the frequency appears to fall.
When a satellite is at its closest point to a beacon the received frequency is the same as the transmitted frequency (the point of inflection) and provides the “Time of Closest Approach” (TCA).

This method of calculation produces two possible positions for each beacon (labelled A and B), either side of the satellite’s ground track; one is the true position and the other is its mirror image. The ambiguity is due to the equipment only being able to determine the distance between a satellite and a beacon and not the direction. Position ambiguity is subsequently resolved by using data obtained by the same LUT from the next satellite pass which “sees” the beacon or Data from another satellite pass observed by a different LUT.

Inmarsat-E (L-Band) EPIRB Overview:
The INMARSAT-E EPIRB is an approved alternative to the 406 MHz beacon for carriage by merchant ships, in compliance with the Global Maritime Distress and Safety System (GMDSS).
These beacons are designed for detection by the International Maritime Satellite Organisation's (INMARSAT) geostationary satellites. These satellites are located over the Indian, Pacific and Atlantic Oceans and cover the world except for the high Polar Regions.

At present vessels operating in the European area have mainly purchased the Inmarsat-E EPIRB. This beacon is coloured high-visibility yellow or orange, has retro reflective tape, is equipped with a flashing light (48 hour battery life) and is designed to remain afloat in heavy seas. It transmits a distress alert that contains the vessel identity, position and additional information such as the nature of the distress.

This beacon must have a built-in SAR Transponder (SART) for final homing, (see next section). If the beacon has an in-built GPS receiver, it will transmit the distress alert 120 times during the first ten minutes and then will transmit a message with the updated position every 4 hours for a further 48 hours. This beacon is not required to have a SART for final homing, but may have one fitted.

Radar SAR Transponder (SART) Overview:
The SAR transponder (SART) developed which will respond to the normal 3cm X-band radar fitted to merchant ships. It will NOT respond to l0cm S-band radar. It is a short-range homing device, which enables ships and other suitably equipped craft to home on the source of the signal.

Tests have shown that the operation of a SART inside the canopy of a liferaft will significantly decrease its detection range, so every effort should be made to operate it from outside the canopy and as high as possible.

Communications in support of SAR operations Overview:
The SMC is responsible for designating specific primary and secondary frequencies for on-scene use during SAR operations, and establishing reliable communications with adjacent operations centres. When appointed, the CSS or OSC is responsible for establishing reliable communications between all search units and the RCC.

The following frequencies have been authorised for use in SAR operations:

2182, 3023, 4125, 5680 kHz.- for mobile & land SAR stations.

123.1 MHz.- international SAR on-scene frequency.

123.2 MHz.- supplementary continental use in on-scene coordination.

282.8 MHz.- military ships and aircraft.

Ship Reporting Systems:

AUSREP- The Australian Ship Reporting System, is operated by AusSAR for the Australian Maritime SRR. It enables assessment of approximate positions, courses and speeds of vessels near a distress by means of a surface picture (SURPIC).

Participation is mandatory for certain categories of ships in the Australian SRR but most vessels transiting Australian waters voluntarily participate. Vessels submit regular reports of entering or leaving the area - sailing plans, and arrival and departure reports when entering or leaving Australian ports. Vessels are required to carry either Inmarsat or HF DSC communication equipment to participate.

Examples of a Long SURPIC-
SURPIC FOR 072128 MAY 00 50 miles around 2407 15242

PALMERSTON/VNQL + 36701DWT TANKER 179M AUS
2357 15303 ETA in 8 hours Currently on course 135
LKP 2154 15051 VAR 12.0K 070703 MAY 00 BRISBANE 2739 15306

SUCHADA NAREE/HSPA2 + 23732DWT BULK CARRIER 151M THA
2415 5322 ETA in 3.2 hours Currently on course 315
LKP 2756 15351 357T 11.1.5K 070100 MAY 00 MACKAY 2108 14922

AGAMEMNON/C6PC6 + 23443DWT GENERAL CARGO VSL 164M BAA
2420 15327 ETA in 3.3 hours Currently on course 315
LKP 2820 15400 358T 13.0K 070201 MAY 00 OOA 0832 12800

Examples of a Short SURPIC-
SURPIC PREDICTION FOR 072128 MAY 00 50 miles around 2407 15242
VNQL/PALMERSTON 2357 15303 135 12.0 BOUND BRISBANE
HSPA2/SUCHADA NAREE 2415 15322 315 11.1.5 BOUND MACKAY
C6PC6/AGAMEMNON 2420 15327 315 13.0 BOUND OOA 18

Small Craft Reporting Systems- Marine volunteer organisations maintain logs of recreational vessels in their areas and operate a small craft reporting system similar to AUSREP. They can also report their positions through the State and Territory Coast Radio Stations, volunteer marine organisations and private operators such as Penta Comstat. The State and Territory Police provide liaison with volunteer groups in their jurisdictions.

MAREC - Maritime SAR Recognition Code- The purpose of this Code is to facilitate the communication of descriptive information regarding vessels. The MAREC Code is in two parts:

- ***Part 1 - Merchant vessels***
- ***Part 2 - Small craft.***

All messages should be preceded with the prefix MAREC followed by a local serial number. The message should contain all the lettered identification groups as

separate paragraphs. If the information is not known the symbol UNK should be inserted or alternatively the symbol NA, where the lettered group is not applicable. Use should be made of the Merchant Vessels description code to report the description of fishing vessels.

Part 1 - Merchant Vessels -The Merchant Vessels MAREC message is composed of the following identification groups (A-G) transmitted in the following sequence:

MAREC CODE	**Table F1. - Local serial number**
A	Type of vessel - name - call sign
B	Superstructure - location - colour
C	Hull profile - colour
D	Sequence of uprights
E	Length
F	Condition of loading
G	Other characteristics.

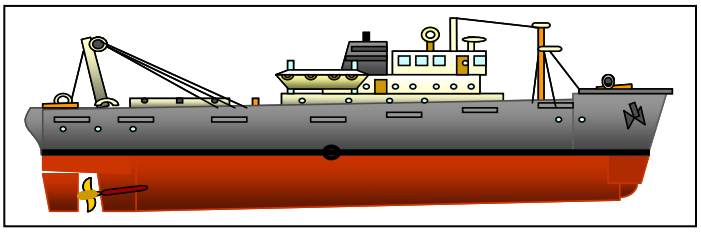
The Mership classifications for group A are shown below.

A - VESSEL TYPE	**Table F.2- Mership classifications**
VOICE	**TLX/RTG**
Passenger ships	PAX
Ferry	FERRY
Tankers	TANK
Bulk carriers	BULK
General cargo ships	GEN
Coaster	COAST
Fishing vessels	FISH
Container ships	CONT
Specialised ships, gas carrier, tug, icebreaker, etc.	SPEC

Groups B to G are described in the code (see NATSAR Manual 2003 Appendix F).

Example of General cargo ship “Arafura”:

VOICE	**TLX/RTG**
MAREC 5/03 RCC AUSTRALIA	MAREC 5/76 RCC AUSTRALIAN
ALFA, GENERAL CARGO SHIP, ARAFURA, VICTOR ROMEO ROMEO YANKEE	**A**/GEN/ARAFURA/VRRY
BRAVO, SUPERSTRUCTURE MIDSHIP, CREAM	**B**/MID/CREAM
CHARLIE, PROFILE ONE, BLACK	**C**/1/BLACK
DELTA, MAST, MAST, FUNNEL, CRANE	**D**/M M F C
ECHO, EIGHT ZERO METRES	**E**/LOA 80
FOXTROT, FULLY LOADED	**F**/LOAD
GOLF, NOT APPLICABLE	**G**/NA.



Part 2 - Small Craft - A Small Craft MAREC Message is composed of the following identification groups and will be transmitted in the following sequence:

MAREC CODE	**Table F.4 - Local serial number**
A	Type, configuration /superstructure /number of hulls, name, call sign & use
B	Make- distinctive markings
C	Motor installation or rigging
D	Construction – material - colour
E	Stern - Stem
F	Type of bottom
G	Length
H	Other characteristics.
I	Number of persons on board

A – SMALL CRAFT TYPE	**Table F.5 Type of Small Craft**		
PROPULSION	**TYPE**	**VOICE**	**TLX/RTG**
Motor	Motor boat	Motor	MOT
Sail	Sailing boat	Sailing	SAIL
Oars	Rowing boat	Rowing	ROW
Paddles	Canoe	Canoe	CAN
Motor and sail (equal)	Motor/sailer	Motorsail	MOTSAIL
Various	Inflatable	Inflatable	INFLAT

Example of Motor boat “Gallant” overleaf:

VOICE: ALFA, MOTOR, GALLANT, VICTOR KILO 180.
TLX/RTG: A/MOT/ GALLANT/VK180
Similarly groups B to I are described in the code (see NATSAR Manual 2003 Appendix F). A full example of a Small Craft MARIC message is shown below:

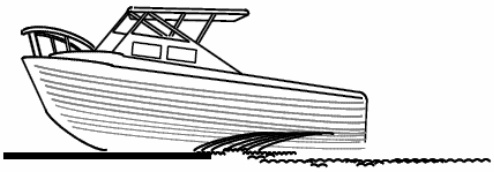


Figure F.12 Complete example: Motor Boat

Voice:
MAREC 7/03, RCC AUSTRALIA
ALFA, MOTORBOAT PART CABIN,
GALANT, VICTOR KILO ONE EIGHT
ZERO, PLEASURE
BRAVO, MAKE SOLO TWO FIVE
CHARLIE, INBOARD MOTOR
DELTA, CLINKER, GLASS FIBRE,
WHITE
ECHO, FALLING STEM, SQUARE
STERN
FOXTROOT, V-BOTTOM
GOLF, SEVEN AND A HALF METRES
HOTEL, PULPIT FORWARD,
WINDSCREEN ONE AFT EDGE OF
CABIN WITH A RED DODGER
INDIA, TWO

TLX/RTG
MAREC 7/76 RCC AUSTRALIA
A/MOTPC/GALANT/VK180/PLEASURE
B/SOLO/25
C/INB
D/CLINKER/GRP/WHITE
E/FALL/SQUARE
F/VBOT
G/LOA 7.5
H/PULPIT FORWARD, WINDSCREEN
ON AFT EDGE OF CABIN WITH RED
DODGER
I/2

Operational radio log

2.2 Records are accurately kept of all communications made during the emergency including frequencies and content of messages.

It is a requirement that all distress radio traffic is logged. As a legal document the logs must be factual (not contain opinion, observations or course language), the date, time, details and author must be identified. If an error is made it must not be erased, but crossed out and initialled. As tempting as it may be to include a humorous comment, this may not be appropriate if the document is later read out in court and may lead to unintended consequences for the squad or the author. Additional scribble notes during incidents must be stored with the logs.

SARCC log- This will record date, time and detail of all communications in and out at the SARCC (radio, phone, fax, email, persons in and out). An SRB incident report form should be forwarded to the NSW Police Marine Command as soon as is practical after the conclusion of a rescue.

Vessel Radio traffic logs-

- The date and time.
- Traffic in or out and frequencies used.
- Detail of own vessels diversion to SARCC directed activities.
- Names of persons/vessel assisted.
- Detail of the message and any supporting notes.
- The difficulties encountered and their resolution.
- The names recording officer and signatures.

Written Activity- Establish and maintain radio-communications

Describe to your assessor or write a short answer, using diagrams if required, to the following questions.

Question No.1
List five radio communication facilities supported in the Australian SRR?

Question No.2
What are the 27MHz, VHF and MFHF distress frequencies?

Question No.3
What frequency would you use on HF to contact Charleville?

Question No.4
What do you understand by “secure” on Police radio?

Question No.5
What are the comparative detection accuracies of 121.5MHz and 406MHz EPIRBS? Why is the later a more preferable EPIRB for distant voyagers in the South Pacific?

Question No.6
Explain the small craft MAREC report below?

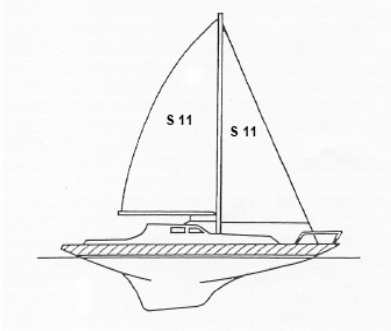


Figure F.13 Complete example: Sailing Boat

Voice:
MAREC 8/03, RCC AUSTRALIA
ALFA, SAILING PART CABIN, FAMILY OF MAN, VICTOR KILO SEVEN FOUR EIGHT TWO, OFF SHORE RACING
BRAVO, MAKE PETERSON FOUR ZERO, SAIL MARKINGS SIERRA ONE ONE
CHARLIE, MASTHEAD SLOOP RIG
DELTA, CARVEL, WOOD, BLACK WITH WHITE CABIN
ECHO, FALLING STEM, NEGATIVE TRANSOM STERN
FOXTROOT, KEEL
GOLF, EIGHT METRES
HOTEL, PULPIT FORWARD
INDIA, TWO

TLX/RTG
MAREC 8/03, RCC AUSTRALIA
A/SAILPC/ FAMILY OF MAN/NAVIS 12/PLEASURE
B/PETERSON 40/S 11
C/SLOOP
D/CARVEL/WOOD/BLACK WITH WHITE CABIN
E/FALL/NTRANS
F/KEEL
G/LOA 8
H/PULPIT FORWARD
I/2

Practical Activity- Establish and maintain radio-communications

Your Skipper will provide as many opportunities as possible to practice the previous skills during simulated rescue operations or “on the job training”. Practice activities for this element of competency include:

- Send a DSC routine message.
- Send simulated priority calls and messages.
- Complete a simulated radio logbook entry and incident report.

Discuss as a team. Read the accompanying workbook, “Bare Facts of Marine SAR.” Remember to complete your log book.

Assist in search and rescue operations

Operational information

3.1 Information concerning the emergency is regularly collected from all vessels, aircraft and other parties involved in the search and rescue operation.

Effective management of the SAR event requires regular on scene sitreps. These should not only detail the immediate events, but also relevant changed factors such as tides, currents and winds. *SKEDS (*scheduled transmissions *at 20-30 minute intervals)* enable economic use of airtime. Seafarers who suffer a marine casualty are trained to minimise the dangers by the process of damage control. Murphy"s law of the sea ensures that anything that can go wrong will do so, and as a consequence will start an inevitable spiral to disaster unless halted by targeted and timely action. The damage control will be also a priority in the planning of the rescuers and may be simplified as a process to FIRM up the deteriorating situation.

F	find the problem.
I	inspect and isolate the fault.
R	report, repair or remove to safety.
M	monitor for effectiveness of actions.

Rescuers can anticipate that casualties are likely to have initiated their own damage control measures (more fully described in the accompanying workbook "Respond to Navigational Emergencies") and should notify the search controller of such preparations.

The Operational plan

3.2 Decisions on action taken during the search and rescue are made after analysis of all available information and after consultation with others in the established chain of command.

The Operational plan (Section 1.2) and Chain of Command (Section 1.5) has been examined earlier. The list below highlights the various structures in SAR in Australia.

National SAR command structures:

SAR-	The National Authorities, AusSAR.
RCC -	AusSAR maintains a rescue coordination centre.
RSC -	Resue sub coordination centre.
FCP-	Forward Command Post at a suitable location.
CSS-	Coordinator surface search (civil vessel)
SMC -	The RCC is under the authority of a SAR mission coordinator.
A/SMC-	An assistant SAR mission coordinator is subordinate to the SMC.
OSC -	On-scene coordinators are specifically designated by the SMC.

NSW SAR command structures:

SAR-	State Authorities - State Rescue Board of New South Wales
VMRC-	Volunteer Marine Rescue Council of New South Wales.
NSW Police-	Responsible for coordination of all State SAR.
Water Police-	Marine Area Command
OIC -	An Officer in charge may be appointed by the SMC or police.
SARCC-	SAR coordination centre (radio base).
MRU-	Marine rescue unit (boat & crew)
AVCGA-	Australian Volunteer Coast Guard Association
VRA-	NSW Volunteer Rescue Association Inc
VRCP-	Royal Volunteer Coastal Patrol

Delegation

3.3 Directions are given to others involved in the search and rescue operation in accordance with the agreed plan and the established chain of command.

The first (skipper) to arrive at an incident scene would normally take on the role of OSC assuming operational coordination of all SAR facilities on scene. He/she would implement the search and rescue plan, where required, while providing regular SITREPS to his/her SMC. If more SAR assets or initial searches failed, then an OSC with greater authority and access to more assets would be delegated.

This chain of command has been looked at in the Introduction and in Sections 1.2, 1.5 and 3.3.

Briefing and manoeuvres

3.4 Manoeuvres of vessel as part of search and rescue operations are made in accordance with the agreed plan.

See the next section.

Operational briefing

3.5 Vessel's officers and crew are briefed on their role during the emergency and are deployed to the required stations.

SAR Crew Briefing General:
Comprehensive briefing and de-briefing of search crews is a vital component of search planning. Many personnel enlisted for search operations are neither trained for nor experienced in the search role so instructions for the SAR operation shall be clearly and precise. The officer appointed to the briefing task, must be thoroughly familiar with the overall plan and individual search unit tasks. A briefing shall include the following factors:

- Full description and nature of the distress.
- Communication procedures, SAR and casualty radio frequencies.
- Search area, task and any clues of the presence of the target.
- Routing to and from the search area.
- Details of equipment or supplies to be carried.
- Action to be taken on sighting the target.
- Present and forecast weather conditions.
- Other SAR assets in or near the area;
- Distress signals and visual codes.
- Plan for debriefing, including details of required information.

Search area descriptions:
Search patterns and the boundaries of search areas are usually described by:

- Geographical Coordinates defined by latitude and longitude.
- Universal Grid Reference overprinted on all charts of the JOG series
- Track Line together with the width of coverage, for example:
  "Search a track 1 NM each side of a line from 16° 20’ S 135° 15’ E to 17° 50’ S 137° 28’ E.

- Landmarks- vague descriptions such as "7 NM SSW of..." shall not be used. Proper direction in this case would be by way of positive bearing and distance, i.e. "bearing 202° (T) from Dixon Island at 7 NM".

Maritime Search Crews- In marine SAR the police or military, may brief the search crews. The coordinating SAR authority will require copies of briefing forms.

A systematic search of an area with no visual reference points requires a dead reckoning (DR) plot of the last known position of the target, its own position, and the position of other ships and aircraft in the vicinity. The plot should also show date, time and possible drift of the target/survivors. Areas searched should be plotted on a chart.

To attract the attention of survivors, a surface unit should, if practicable, periodically make its presence known by making smoke during daylight and, at night, by rotating a searchlight beam around the horizon or, if clouds are low, by directing the searchlight vertically. When visibility is restricted, the engine should be stopped periodically to listen for shouts or whistles from the survivors. Observers should be stationed as high as possible to increase the sighting range.

Briefings for marine units will cover similar topics to those given to air, but there may be less opportunity for face-to-face briefing contact. Briefing Officers should be aware of the difficulties inherent in briefing indirectly and the increased potential for misunderstanding.

Search Aircrew Briefing- The Search Briefing Form provides a written record of all briefings and is given to aircrew and other units.

When the task for a search aircraft is amended, a hard copy amended briefing will

be sent. In any case, where it is not possible to provide a pilot with a map or reproduction thereof, the briefing officer shall determine the maps and editions available to the pilot and ensure that the crew is totally aware of the areas, locations, and features that the RCC requires it to search. The briefing officer shall make every effort to eliminate any possibility of errors due to differences in data on the respective maps. Flight De-brief Form should be supplied with the Aircraft Search Briefing Form.

Search Aircraft Operations- Before beginning a search, the aircraft should be flown at search height for a time to familiarise observers with the apparent size and appearance of known objects on the surface. Observers may also develop an appreciation of distances at height, bearing in mind the planned limit of scan.
Aircraft that are engaged on a beacon search should start the search procedure at the highest practicable cruising level unless a small probability area has been defined when a search may start at a lower level. Pilots or navigators should log all areas, heights and appropriate times.

Conditions and limitations

3.6 Manoeuvres of vessel are made safely with due regard to the limits of propulsion, steerage and vessel stability and the prevailing weather and sea conditions.

Maritime units must be capable of carrying out the operation safely in the prevailing and forecast sea and weather conditions in the area. All search preparations should be completed before the surface units enter the search area.

Rescue at sea
The SMC is responsible for the coordination of surface vessels engaged in the rescue of survivors in or on the sea except that in-shore rescue may be arranged and coordinated by the police.

The RCC shall make flotation equipment available for use by survivors whilst awaiting transportation to the shore. Details of the availability and types of equipment held by SAR Resources and Training (AusSAR) may be obtained from RCC Australia.

When an aircraft has ditched or a vessel is in danger of sinking, or sunk, it is imperative that rescue action is taken immediately. The time that a craft will float may be very limited, entry to life rafts is difficult, especially for aged or infirm personnel in rough seas, and the sea is a hostile survival environment.

When both maritime rescue units and helicopters are dispatched to the same distress scene, it may be advisable to transfer survivors to the helicopters for a more rapid delivery to medical facilities.

Use of rescue boats and vessels
Specialised rescue boats are available only in scattered localities and their capacity is small. Each boat dispatched to a distress scene should, if possible, carry additional life-saving devices to enable those survivors, who cannot be immediately rescued, are able to stay afloat while awaiting the arrival of another boat.

If neither specialised rescue boats nor rescue vessels are available, merchant vessels may be the only means of implementing an early rescue. However, if possible, support or alternative rescue units should be considered because merchant ships have significant limitations as a rescue platform, including:

- generally not readily available.
- relatively slow speed.
- restricted manoeuvrability.
- high freeboard, making retrieval of survivors difficult.
- small crew numbers.
- language difficulties if foreign crewed.

It is desirable that SAR vessels be equipped to lift survivors from the water without expecting any help from the survivors.

Use of aircraft for rescue
When considering the use of aircraft to bring about the recovery of survivors, care must be taken to ensure that the rescue aircraft and crew are not exposed to inordinate danger.

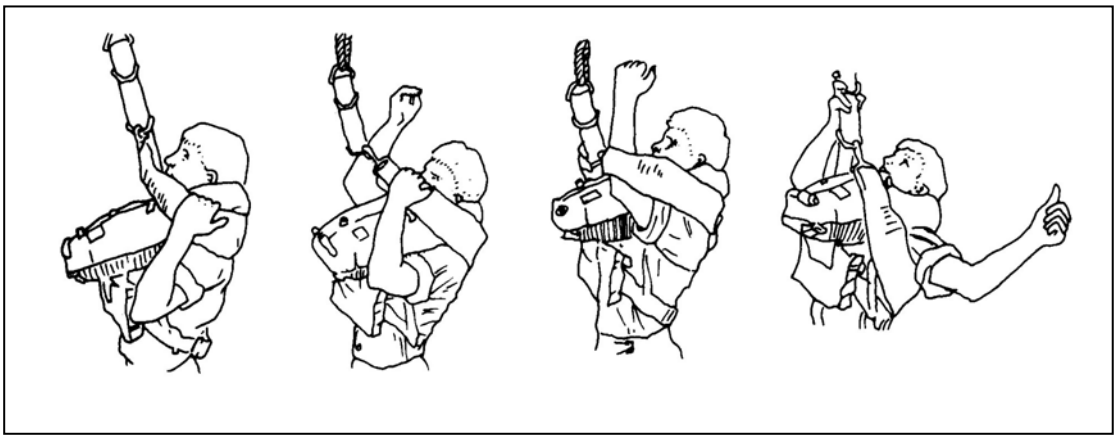
Fixed wing aircraft should only be used to retrieve survivors when there is significant advantage over the use of surface transport and when there is a suitable aerodrome or landing area near the scene. Pilots shall be discouraged from attempting to land at other than prepared landing areas to pick up survivors. However, should this prove to be the best or only viable option, all available specialist advice concerning the operation shall be obtained. It may be possible to have a qualified person lowered or parachuted in to survey the area. Helicopters may be employed to shuttle survivors from a distress site to a suitable fixed-wing landing area.

Use of helicopters for rescue
When available, helicopters should be considered for rescue work. While eminently suited to the task in many respects, helicopters do have specific limitations that may be summarised as:

- the adverse effects of turbulence.
- the need for a level, or near level, landing area.
- a cleared landing area of specific dimensions to avoid rotor blade damage.
- a requirement for safe approach and take-off paths.
- potential for adverse effects on certain serious injuries.
- limited endurance.
- inability to hover with loads at high altitudes.
- limited accommodation.

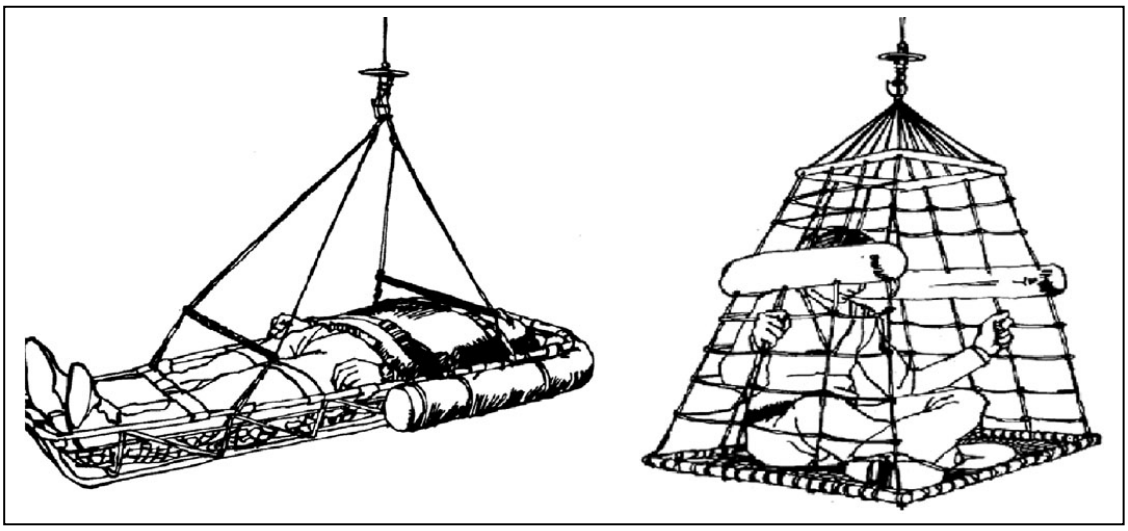
Owing to their unique flying characteristics, helicopters should be considered for use as a rescue unit as a matter of course. However, operations by surface parties may be hampered by the noise and rotor wash produced by helicopters. To avoid damage to rotor blades, the landing site should

Removing by helicopter - The helicopter will communicate on VHF Ch 6 or Ch 16. On approach to an incident scene at sea they will make a hazard reconnaissance. They may ask the RV to maintain a heading into the wind, or provide smoke to assist in their hover plan. The helicopter will not allow any chance of ground attachment of their hi-lift wire which could cause them to crash. They often will not want to approach a high masted vessel and may ask for casualties to take to a life raft streamed behind or transfer into an attending inflatable RV. The wire can give a static electrical shock if not dunked in the sea.



Attaching a strop for a hi-lift
(Drawing Dept Transport Marine Information Manual)

A thumbs down hand signal indicates you are not ready for the lift; thumbs up that all is ready to go. These same signals are used if a stretcher or basket is used for the lift. A basket can be used to pick up several persons from the water. Climb in and hold on tight.



Stretcher and basket.
(Drawing Dept Transport Marine Information Manual)

Concluding the operation

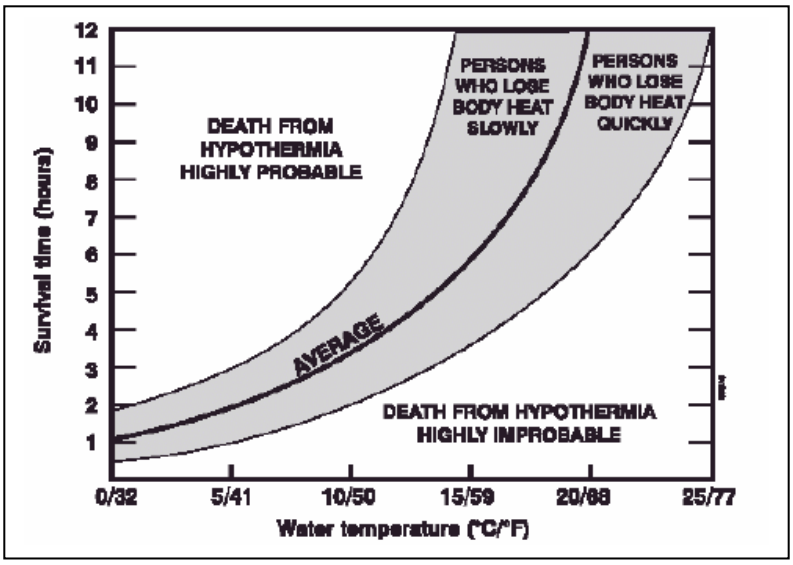
3.7 Duration of the search and rescue operations is appropriate to the level of the emergency and complies with instructions from the company and search and rescue authorities.

SAR Operations enter the conclusion stage when:

- the target is located and the survivors are rescued.
- information is received that the target is no longer in distress.
- all persons are accounted for, or there is no longer a chance of survival.

The SMC Authority may determine that further searching has no significant chance of succeeding and downgrade from the distress phase, suspend or terminate the search. This cannot occur without the specific concurrence of the SAR Authority.

The decision to suspend a search shall not be made until a thorough review of all the intelligence material to ensure no information had been overlooked and that all reasonable means of obtaining information about the target have been exhausted. The review will focus on the probability of there being survivors from the initial incident, the probability of survival after the incident, the probability that the survivors were in the search area, and the effectiveness of the search. Re-examining datum computations and data calculations must not be overlooked.



Water chill and hypothermia.
(Drawing courtesy of NATSAR Manual)

A major factor that will persuade an SMC to stand down an operation is the temperature and time that the casualties are in the water. When the decision is made, all people and organisations involved in the SAR action must be advised by their RCC to stand down and the next of kin must be fully informed.
Shipping should be notified of any hazard caused by abandoned vessels and arrangements made for the recovery of response equipment.

Completion of documentation

3.8 Records of the incident are made in the vessel's log and other documentation is completed as required by relevant Australian and/or international regulations and conventions.

Records and reports:
Whether the SAR is successful or not, full details of the vessel's operation must be logged. The times, signals, search pattern navigation and observations should be clearly recorded and signed by the recording officer. It should be remembered that to make false statement is illegal and that errors should not be erased, but crossed through and initialled. The Vessel log along with the Radio log will be of great value at debrief or if the search is to be resumed following new information, and will be required by the RCC in completing its documentation of:

- all maps, worksheets, notes, messages in chronological order and file on a SAR incident file must be collected and initialled.
- that administrative and financial procedures must be completed.
- reports for Coroners Inquiries, management and training purposes.

Incident debriefs:
Incidents worthy of debrief may include those where:
- lives have been lost unexpectedly;
- large and complex searches have been conducted;
- where coordination, communication or response challenges were experienced

Records relating to search and rescue operations must be retained for periods as required under the relevant legislation and regulation, nominally seven years.

SAR crew debriefing:
All SAR operators in the operation should attend after their sortie for de-briefing. Included in the briefing shall be instructions on the de-briefing procedure to be followed on completion of the search task.

Reports are required on anything that the search teams themselves consider pertinent, and may include:

- Report on actual weather conditions.
- Positions at which sighting investigations were made.
- Descriptions of items which were investigated.
- Results of monitoring of radio frequencies.
- Any operational difficulties encountered.
- Accurate description of searched and not searched areas with an assessment of the effectiveness of the search.

Written Activity- Assist in search and rescue operations

Describe to your assessor or write a short answer, using diagrams if required, to the following questions.

Question No.1
Write a short Sitrep describing in detail of your last rescue mission at arrival at the incident scene for the benefit of an OSC.

Question No.2
Which agency does the overall responsibility for SAR in Australia rest with?

Question No 3
Which agency does the responsibility for SAR in States and Territories rest with?

Question No.4
What role in the chain of command does the first rescue vessel to arrive at the incident scene assume? Explain why.

Question No.5
List three situations in which a Rescue Skipper would request that an OSC of greater authority be requested to take over the immediate rescue coordination.

Question No.6
Write the position of a known inshore feature in your operating area in a manner suitable for clear and concise radio communication.

Question No.7
How might a Rescue Vessel notify its presence in the area to survivors by day?

How might a Rescue Vessel notify its presence in the area to survivors by night?

Question No.8
List two advantages and two disadvantages in enlisting the assistance of a merchant vessel at a SAR incident.

Question No.9
What should never be done with a rescuing helicopters winch wire?

Question No.10
What is the signal to a helicopter that the casualty is ready to be lifted in rescue strop?

Question No.11
Describe two common forms of helicopter rescue apparatus.

Question No.13
List three situations that would result in a rescue operation being concluded.

Question No.14
What records would be made available at a de-brief?

Practical Activity- Assist in search and rescue operations

Your Skipper will provide as many opportunities as possible to practice the previous skills during simulated rescue operations or “on the job training”. Practice activities for this element of competency include:

- Studying Squad SOP’s for gathering task and operational information.
- Determining simulated rescue locations.
- Practice of emergency procedures.
- Collection of records for a de-brief.

Discuss as a team. Read the accompanying workbook, “Bare Facts of Marine SAR.” Remember to complete your log book.