Produced: July 2013

COLD WATER OPERATIONS



Overview

1. History
2. Physiological response to cold water
3. Surviving open waters
4. Region specific weather & environment (Southern Pacific Ocean / Southern California Coastal Waters)
5. Regulations and guidelines applicable to overwater operations

HISTORY

Internationally over the last half of the 20th century, there has been considerable human experimentation in cold water physiology. The pioneering work was done in the mid-1940s and 1950s, but by the 1960s, it appears to have been forgotten and needed to be relearned. The advent of the offshore oil industry created a demand for more research to produce better immersion suits. This created a flurry of experimentation in the 1980s and 1990s.

The layperson and accident investigators are often surprised that some people do not survive a lengthy immersion. Theoretically they are within the "safe" boundaries of one or more of the survival curves that have been developed to predict death from hypothermia. These people do not die of hypothermia per se. They die from a variety of problems in which moderate hypothermia is enough for them to lose their physical ability and mental determination to keep their backs to the waves. They thus inhale the next wave and die from drowning in-spite of wearing a life jacket. In regard to immersion suits, Eskimos have used "spring pels" to protect themselves from sudden cold water immersion since they took to the water. Crude suits have been available to mariners since the mid 19th Century. A concentrated effort to produce a practical, commercially available suit did not occur until post 1945. Between the 1950s and the late 1970s, the suits were criticized due to poor design, poor fit, leakage and quality control in the manufacturing process. In the last 20 years, with the introduction of several standards, including the 1983 IMO SOLAS standard, improvement in fabrics, zips and better inspection procedures, the water tightness of the suits has improved, and acceptance has improved.

From all the combined research on cold water accidents and scientific research, it has become clear that sudden immersion in cold water, (below 68°F) is very dangerous. It should be avoided if at all possible. Furthermore, a conscious decision to swim (and rescue oneself) or stay floating still in the water should not be taken lightly without assessing the pros and cons. It has now been shown that a person's swimming ability in warm water bears no relationship to that in cold water.

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COLD WATER IMMERSION

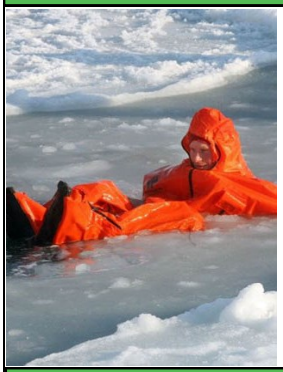
Four Stages in which death may occur in cold water accidents

1. Cold Shock (Kills within 3-5 minutes after immersion)-Drowning, heart and respiratory problems.
2. Swimming Failure (Kills within 30 minutes after immersion)-Exhaustion an inability to self-help.
3. Hypothermia (Kills after 30 minutes of immersion)-Deep body cooling.
4. Post rescue collapse (kills at the point of rescue or up to several hours afterward)-cardiac arrest or failure to recover from hypothermia onset.

Scientific Information since 1975

It has now become clear that over half of the immersion-related deaths occur during the first two stages of immersion, i.e. cold shock and swimming failure. However, investigators still concentrate on the cause of the marine accident and not the precise cause of an individual's death. It is still hard to accurately document at what stage of the immersion death occurred. This is because little history has been gathered from survivors or by investigators. It is only possible, to a limited degree, to estimate the cause of death from a newspaper report or the scant information in the accident investigation. The problem is further compounded by the fact that such a good job has been done educating people on the dangers of cold water, immersion and hypothermia, that even the pathologists now list the cause of death as hypothermia, even though the cold, wet body on their autopsy table actually died from cold shock or swimming failure and drowning. For those with a potential heart conduction defect, the heart is likely to be very susceptible to sudden immersion in water of 10ºC, resulting in a cardiac arrest or death. Sudden immersion in cold water to the neck makes the heart much more susceptible to arrhythmias, due to an increase in output of the stress hormones (i.e. Adrenaline, Noradrenaline). The frequency of these arrhythmias is higher when the face is immersed

Surviving cold waters at the basic level



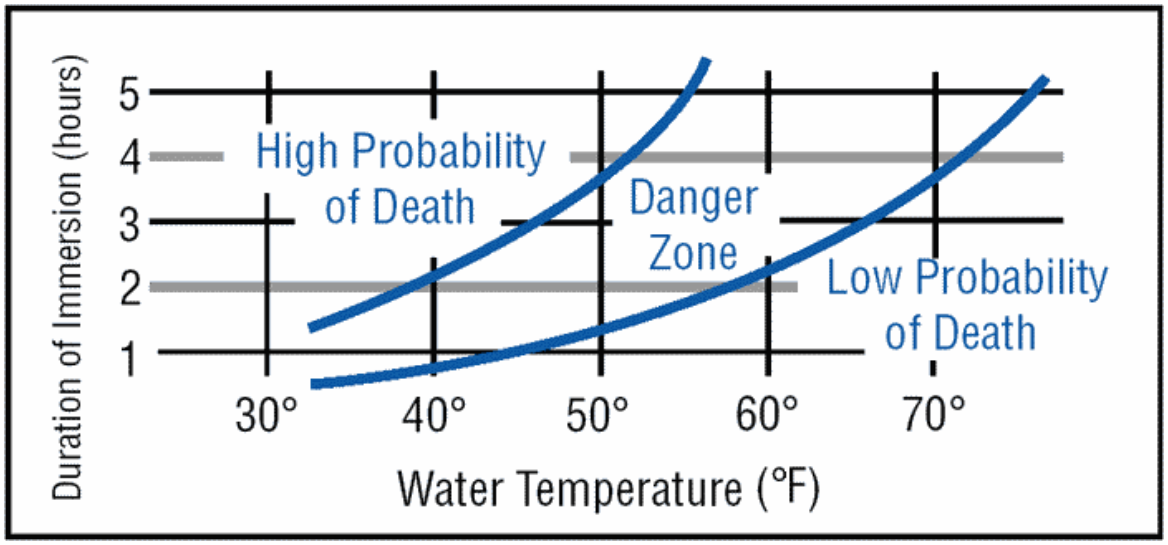
The basic principle of protection is to prevent contact of the cold water with the skin. The areas of the body that are particularly important with regard to cooling on immersion in water are, for different reasons, the head, back of torso and limbs. The head has only a weak vasoconstrictor response, thus blood continues to perfuse this area even in the cold.

REFERENCES

- Transport Canada, Surviving in cold waters: Staying Alive. (TP13822E)

COLD WATER OPERATIONS

SURVIVING THE COLD WATERS



Wearing of life preservers increase the predicted survival time. Just getting into a raft will greatly increase life expectancy in a cold water environment. The following table shows predicted survival times for an average person in 50-degree water temperature:

No Floatation

Survival Time	Projected
Drown proofing	1.5 Hours
Treading water	2.0 Hours

With Floatation

Survival Time	Projected
Swimming	2.0 Hours
Holding still	2.7 Hours
HELP (fetal position)	4.0 Hours

Cold water survival recommendations

Single Survivor– A survivor should pull their knees into the chest and wrap arms underneath the knees to maintain as much heat as possible. It is possible to extend the life expectancy as much as 40% by performing the HELP position. Heat Escape Lessening Posture (HELP) Reduce the flow of cold water over the vital organs.

Group Survivors– If in a group situation huddle together to preserve as much heat as possible

REFERENCES

- AFR 64-4, Vol I, Survival Training and S-V86-A training material.

COLD WATER OPERATIONS

SURVIVING OPEN WATERS

PRE-MISSION PREPARATION IS THE KEY TO SUCCESS-

Initially and most important, is the realization that IT CAN HAPPEN TO YOU. You must not allow yourself to be lulled into the false sense of security believing that it always happens to the other person.

ENVIRONMENTAL IMPACT ON SURVIVORS-

Winds- Winds can both help and hinder survivors. Prevailing winds, which constantly blow in the same direction, can aid in travel while floating at sea. They can also act like an air conditioner on hot days by reducing body heat 25 times faster or cooling a body 25 times faster on a cold day.

Temperatures– Temperatures can reach severe extremes in the open ocean, because the ocean spans such a vast portion of the earth. Survivors should expect, depending on their operational area, water temperatures from the extremes of heat in excess of 75 degree F to extreme cold temperatures as cold as 29 degree F or colder. Southern Pacific coast average water temperatures range from 61 degrees Fahrenheit in January up to 71 degrees in some areas in the month of July .

Limited Natural Resources– Food, water, and materials for a conducive survival environment is almost non-existent.

SURVIVORS BASIC NEEDS ON THE OCEAN

1. **Personal Protection–** On the ocean there is little or no natural protection. Available protection is generally provided by the equipment the survivor entered the situation with.
2. **Sustenance–** Food is normally available from the largest supermarket in the world locate un der the raft. Drinking water may be limited by the resources in the survival kit and by nature. One caution to all open water survivors on the ocean is to NEVER DRINK SEAWATER. This is the second leading cause of death of survivors at sea.
3. **Medical–** By looking at the size of a survival medical kit, a survivor will soon realize that medical supplies are limited and will have to be used to their fullest potential.
4. **Travel–** Travel depends on a survivors ability to adjust raft components, their knowledge of the winds and currents in the area, and the wind and currents at the time.
5. **Signaling / Communication–** Prior to ditching in the ocean a pilot should make every effort to send out a mayday call and activate their ELT. Satellite phones in waterproof cases should be looked at for communication on the ocean along with rudimentary devices like flares and mirrors.

REFERENCES

- AFR 64-4, Vol I, Survival Training and S-V86-A training material.

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SURVIVAL VEST CONSIDERATIONS FOR CREW-MEMBERS

Presently the biggest proponent of survival vests is the US Department of Defense. The purpose of a Survival vest is to aid crewmembers in the survival phase during a unplanned event and to provide a location to secure mission specific items like a aviators personnel weapon. It has been found that survival aids can be very complementary and increase the likelihood of recovery. Out of all of the pieces of equipment that can aid a surviving aviator none can be more important then the communication device. In todays world almost every pilot has a cell phone and in most parts of the US we can get reception. Notice the word most, operators should always have secondary communication devices such as Beacons, Satellite phones, and /or radios that can use repeaters to make contact with a operators flight operations department.

BEST PRACTICE

If an operator issues survival vests to crewmembers the operator should have a training program and appoint a Aviation Crewmember Equipment Manager or Aviation Life Support Equipment (ALSE) Manager. It is imperative that flight crewmembers understand the proper wear and functions associated with their equipment. A 12 to 18 month inspection program should be established and managed for the survival vests due to the medical supplies and associated batteries that are perishable . Every operator should develop a standard for the location of generic items such as the first aid kit so that each crewmember can easily locate these items in an emergency situation. Certain items may be environment specific such as HEEDS bottles or emergency breathing systems which require additional training and consideration. A suggested Survival vests to use is the Tac Air G2 from Aerial Aviation-Safety-Tactical at http://aerialmachineandtool.com

RECOMMENDED COMPONENTS OF A SURVIVAL VEST

1. Built in: extraction harness, weapon holster, flotation device & adjustable pockets.
2. Vacuum seal internal survival components
3. Fire starter kit
4. Compass
5. MS 2000 Strobe light
6. Signaling devices (Mirror, Flares, Whistle, dye)
7. Survival Knife (ASEK from Ontario Knife)
8. Emergency Radio / GPS Radio Beacon
9. Flash Light

Survival Vest First Aid Kit-

A. 2 pair of rubber patient gloves

B. 1 bottle of iodine

C. Israeli tourniquet bandage

D. Band-Aids, gauze, trauma wrap

E. Tylenol 10 Ea

F. Bacitracin 1 tube

G. Lopermide 10 Ea

H. Doxycyclene 10 Ea

I. 1 role of Medical tape

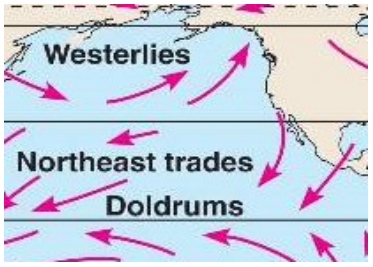
REFERENCES

- Interagency Helicopter Operations Guide-Dated: June 2009
- US Army TC 3-04.72, FM 3-04.500, AR95-1 & the US Army Air Warrior Program

COLD WATER OPERATIONS

SOUTHERN PACIFIC COAST FACT SHEET

Overall statement-California usually lies under the eastern portion of the subtropical Pacific High. This feature influences the local weather by seasonal variations in intensity and location. The mean position of the high-pressure center at the surface moves northward near 40 degrees N in the summer and retreats southward in the winter to the vicinity of 30 degrees N. The oceans are in constant motion due to wind-driven currents. The California current, carrying water cooled by its passage through the northern latitudes, flows southward along the shore from the Washington-Oregon border to Southern California. This basic current is modified by seasonal variations in wind direction that give California's near shore region its three or more less distinct "oceanic seasons." Beginning in March, prevailing westerly winds, combined with the effects of the earth's rotation, drive surface waters offshore. These waters are replaced by deep, cold water that flows up over the continental shelf to the surface. This process, known as upwelling, is restricted mainly to west coasts of continents, and is responsible for the high productivity of California's near shore waters. The upwelling period continues until September when northwesterly winds die down and the cold upwelling begins to sink. This period, characterized by relatively high surface temperatures, is known as the oceanic period, and last through October. In winter, changes in atmospheric conditions over the Pacific Ocean bring southwesterly wind to the California coast. In response to these winds, a northward surface current begins and flows along the coast inland of the California Current. This current called the Davidson Current, generally lasts through February, when the prevailing winds shift again and the cycle begins anew. Every few years this pattern is disrupted by a phenomenon known as El Nino. The El Nino baths near shore areas in unusually warm, nutrient poor water from the south.



Southern Pacific Average Water Temperatures

Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Dana Point CA	57	57	59	60	62	65	67	68	67	65	61	58
Gaviota CA	57	57	56	56	57	58	62	64	64	62	61	58
Los Angeles CA	58	58	60	60	61	62	65	68	67	66	64	60
Newport Beach CA	58	60	60	60	63	66	69	70	69	68	64	61

References

- http://www.oceanweather.com/data/
- http://ceres.ca.gov/ceres/calweb/coastal/waters.html

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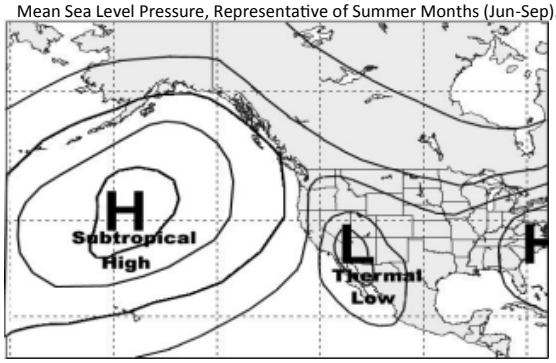
SOUTHERN PACIFIC COAST SEASONAL CHARACTERISTICS

Summer. During this season the Pacific High is well developed to the west of California and a thermal trough lies over this station. There are no fronts of consequence and polar outbreaks are virtually unknown. Maximum temperatures are normally the highest in July and August. Diurnal temperature variations reach their highest values during this season. "Thermal winds" become a significant part of the weather pattern during this time of the year. The pressure gradient between the cool pacific and the warm desert increases and diurnal winds. The important weather phenomena to be noted is the occasional strong, gusty winds produced by afternoon convection from intense surface heating. The circulation at 700 mb is rather weak from the Gulf of Mexico bringing on shower conditions.

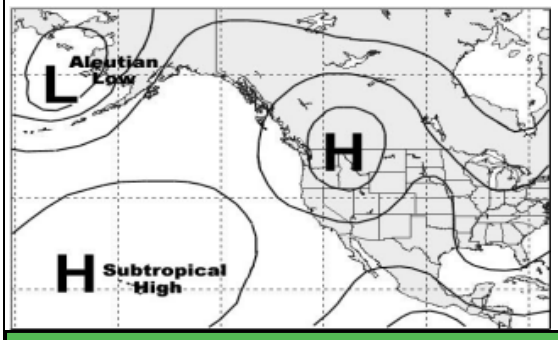
Mean Sea Level Pressure, Representative of Summer Months (Jun-Sep).



Spring and Fall. During the transition periods between winter and summer, forecasting emphasis must be placed upon the daily synoptic situation rather than climatology. The transition between summer and winter is marked by a change from a relatively static synoptic situation to a rapidly changing one. Both temperatures and winds are significantly moderated during the Fall with the transition from hot to cool weather conditions. During the Spring season, although temperatures moderate, the polar front is still well south of its Summer position. Polar outbreaks continue to make their way into the area until the Pacific High re-establishes itself.

Winter. During this season Southern California is covered by a moderately strong anticyclone, except during periods of frontal activity. The Pacific high retreats southwestward allowing cyclones to enter the California coast. Twenty to thirty frontal systems will pass this station during the winter months. Fast-moving, cold fronts frequently produce sustained surface winds of 20 to 30 knots and occasionally 45 knots or more. Slow moving cold fronts typically produce light to moderate intermittent precipitation with little wind. When moist, unstable maritime air is forced against the mountains to the south, southwest, and west; a continuous line of towering cumulous clouds is formed along the mountains. Well-developed cold lows, southwest of the station, produce moderate to heavy precipitation of long duration. Mountain-Valley breeze conditions exist to some extent in winter, but because the winds are lighter than in the summer, their directions are more variable. Maximum temperatures normally occur between 1300 and 1400 PST, and minimums between 0600 and 0700 PST. The first obvious frontal passage usually occurs during the middle of October. The average length of the frost period is five to six months.

Mean Sea Level Pressure, Representative of Winter Months (Dec-Feb).



References

- http://www.oceanweather.com/data/
- http://ceres.ca.gov/ceres/calweb/coastal/waters.html
- http://www.navair.navy.mil/nawcwd/weather/

REGULATIONS / GUIDELINES

- FAR part 91.509
- FAR part 91.511
- FAR part 136.11
- OGP Aircraft management guidelines #390 updated August 2011

FAR 91.509 Survival Equipment for Aviation Overwater Operations

(a) No person may take off an airplane for a flight over water more than 50 nautical miles from the nearest shore unless that airplane is equipped with a life preserver or an approved flotation means for each occupant of the airplane.

(b) Except as provided in paragraph (c) of this section, no person may take off an airplane for flight over water more than 30 minutes flying time or 100 nautical miles from the nearest shore, whichever is less, unless it has on board the following survival equipment:

(1) A life preserver, equipped with an approved survivor locator light, for each occupant of the airplane.

(2) Enough liferafts (each equipped with an approved survival locator light) of a rated capacity and buoyancy to accommodate the occupants of the airplane.

(3) At least one pyrotechnic signaling device for each life raft.

(4) One self-buoyant, water-resistant, portable emergency radio signaling device that is capable of transmission on the appropriate emergency frequency or frequencies and not dependent upon the airplane power supply.

(5) A lifeline stored in accordance with § 25.1411(g) of this chapter.

(c) A fractional ownership program manager under subpart K of this part may apply for a deviation from paragraphs (b)(2) through (5) of this section for a particular over water operation or the Administrator may amend the management specifications to require the carriage of all or any specific items of the equipment listed in paragraphs (b)(2) through (5) of this section.

(d) The required life rafts, life preservers, and signaling devices must be installed in conspicuously marked locations and easily accessible in the event of a ditching without appreciable time for preparatory procedures.

(e) A survival kit, appropriately equipped for the route to be flown, must be attached to each required life raft.

(f) As used in this section, the term shore means that area of the land adjacent to the water that is above the high water mark and excludes land areas that are intermittently under water.

FAR 91.511 Communication and navigation for overwater operations

(a) Except as provided in paragraphs (c), (d), and (f) of this section, no person may take off an airplane for a flight over water more than 30 minutes flying time or 100 nautical miles from the nearest shore unless it has at least the following operable equipment:

(1) Radio communication equipment appropriate to the facilities to be used and able to transmit to, and receive from, at least one communication facility from any place along the route:

(i) Two transmitters.

(ii) Two microphones.

(iii) Two headsets or one headset and one speaker.

(iv) Two independent receivers.

(2) Appropriate electronic navigational equipment consisting of at least two independent electronic navigation units capable of providing the pilot with the information necessary to navigate the airplane within the airspace assigned by air traffic control. However, a receiver that can receive both communications and required navigational signals may be used in place of a separate communications receiver and a separate navigational signal receiver or unit.

(b) For the purposes of paragraphs (a)(1)(iv) and (a)(2) of this section, a receiver or electronic navigation unit is independent if the function of any part of it does not depend on the functioning of any part of another receiver or electronic navigation unit.

(c) Notwithstanding the provisions of paragraph (a) of this section, a person may operate an airplane on which no passengers are carried from a place where repairs or replacement cannot be made to a place where they can be made, if not more than one of each of the dual items of radio communication and navigational equipment specified in paragraphs (a)(1) (i) through (iv) and (a)(2) of this section malfunctions or becomes inoperative.

FAR 91.511 Communication and navigation for overwater operations Continued-

(d) Notwithstanding the provisions of paragraph (a) of this section, when both VHF and HF communications equipment are required for the route and the airplane has two VHF transmitters and two VHF receivers for communications, only one HF transmitter and one HF receiver is required for communications.

(e) As used in this section, the term *shore* means that area of the land adjacent to the water which is above the high-water mark and excludes land areas which are intermittently under water.

(f) Notwithstanding the requirements in paragraph (a)(2) of this section, a person may operate in the Gulf of Mexico, the Caribbean Sea, and the Atlantic Ocean west of a line which extends from 44°47'00" N / 67°00'00" W to 00" N / 67°00'00" W to 38°30'00" N / 60°00'00" W south along the 60°00'00" W longitude line to the point where the line intersects with the northern coast of South America, when:

(1) A single long-range navigation system is installed, operational, and appropriate for the route; and

(2) Flight conditions and the aircraft's capabilities are such that no more than a 30-minute gap in two-way radio very high frequency communications is expected to exist.

FAR 136.11 Helicopter floats for over water

(a) A helicopter used in commercial air tours over water beyond the shoreline must be equipped with fixed floats or an inflatable flotation system adequate to accomplish a safe emergency ditching, if—

(1) It is a single-engine helicopter; or

(2) It is a multi-engine helicopter that cannot be operated with the critical engine inoperative at a weight that will allow it to climb, at least 50 feet a minute, at an altitude of 1,000 feet above the surface, as provided in the Rotorcraft Flight Manual (RFM).

(b) Each helicopter that is required to be equipped with an inflatable flotation system must have:

(1) The activation switch for the flotation system on one of the primary flight controls, and

(2) The flotation system armed when the helicopter is over water and is flying at a speed that does not exceed the maximum speed prescribed in the Rotorcraft Flight Manual for flying with the flotation system armed.

(c) Fixed floats or an inflatable flotation system is not required for a helicopter under this section if:

(1) The helicopter is over water only during the takeoff or landing portion of the flight, or

(2) The helicopter is operated within power-off gliding distance to the shoreline for the duration of the flight and each occupant is wearing a life preserver from before takeoff until the aircraft is no longer over water.

d) Air tour operators required to comply with paragraphs (a) and/or (b) of this section must meet these requirements on or before September 5, 2008.

OGP 9.13 Survival equipment

9.13.2 Over-water flights

Over-water operations require special considerations for safety and survival equipment such as life jackets, immersion suits and emergency rafts.

9.13.3 Decision to use exposure suits

Immersion suits certified for use by the regulatory authority should be provided to crews and passengers for helicopter overwater operations in cold water hostile environments. In the event that local regulatory controls do not address the issue of wearing exposure suits, all necessary details and requirements should be stipulated by the OGP Member. These requirements should be reviewed and a decision made prior to commencement of operations. Several studies and regulatory documents providing information on estimated survival time based on water temperatures versus survival time in varying kinds of dress can be used as background material for making decisions on use of survival suits. OGP Members should be able to access these documents through their respective Aviation Advisors.

9.13.5 Life jackets

On over water flights all aircrew and passengers will be provided with inflatable life jackets approved for aircraft use. They will have a survivor locator light and each life jacket must be stowed in a position easily accessible from the seat or berth of the person for whose use it is provided. For offshore helicopter flights, these jackets will be fitted with constant wear covers, and will be worn at all times unless exposure suits are equipped with integral vests.

REFERENCES

OGP 10.3 Helicopter Equipment

10.3.2 Life rafts

All life rafts should be equipped with an emergency radio/beacon. All life rafts should be equipped with an approved offshore survival kit and be attached to the raft with a lanyard.

Exception: Single piloted helicopter survival kits may be located separately in the front cabin area to provide easy access by the pilot or front seat passenger.

Helicopters having a seat capacity for 10 or more passengers should have two life rafts; each should be certified for 50% overload to enable any one life raft to be used by all occupants.

Helicopters having a seat capacity for 9 or less passengers should have a minimum of one life raft certified to carry all occupants.

Where available by helicopter model, externally mounted life rafts are preferred over those internally mounted. The OGP recommends a helicopter installation whereby:

- Primary deployment is by single action from the normal crew positions
- Secondary deployment is from the passenger compartment with the cabin in an upright attitude, and
- Deployment is possible from outside the helicopter when in either an upright or inverted attitude. In this case the life raft is mounted externally on the helicopter. This is the preferred installation on long-term contracts.
- Emergency exit marking systems (*i.e.* EXIS or HEEL path lighting) should be available on night flights and be automatically activated following the flooding of the cabin.
- Seat rows should be aligned with windows.

OGP 10.3 Helicopter Equipment

10.3.3 Helicopter flotation gear

If helicopters are to be operated over the water, they should be capable of alighting on the surface of the water, either by virtue of inherent design features, e.g. boat hull, fixed floats, *etc.* or with the aid of flotation gear. It is a requirement that all offshore helicopters be fitted with flotation gear and it is recommended that this be automatically inflated on contact with water. For all new long term contracts, automatically operated flotation gear is mandatory where a suitable modification is available for the helicopter type on contract.

10.3.4 Cabin push-out windows, emergency lighting & seating layout

As a result of a series of underwater egress trials conducted on representative offshore helicopters, OGP has identified additional requirements on all offshore helicopters:

- All apertures in passenger compartments suitable for the purpose of underwater escape shall be able to be opened in such an emergency. Push-out rubber mounted windows are the preferred standard where available for the aircraft model.
- Emergency exit marking systems (*i.e.* EXIS or HEEL path lighting) should be available on night flights and be automatically activated following the flooding of the cabin.
- Seat rows should be aligned with windows.

Audit Checklist for Flights Over Water Helicopters

- Are helicopters engaged in offshore operations further than 25 nm from land fitted with a permanent, or rapidly deployable, means of flotation so as to ensure a safe ditching of the helicopter?
- Are helicopters operating with:

  a. lifejackets with illumination for each person on board,

  b. life rafts in sufficient number to carry all persons on board the helicopter,

  c. with the life raft equipment providing means of sustaining life as appropriate to the to the operations being undertaken,

  d. pyrotechnical distress signals equipment?
- Does the operator have procedures for helicopter occupants to wear ether survival suits or life jackets when offshore operations are being conducted?
- Does the operator have procedures for survival suits to be worn by all occupants when the sea temperature is less than 10°C or when the estimated rescue time exceeds the calculated survival time, except when temperature conditions on the flight deck make the wearing of survival suits a hazard?
- Does the operator have a procedure to ensure that life jackets are available to all on-board when helicopters are taking off or landing over water and there is a risk of ditching?
- Are all helicopters operating over water equipped with at least one ELT(S) in a raft or life jacket?
- Are crew members trained in Helicopter Underwater Egress? (Dunker / HUET)

REFERENCES

- NBAA Audit standards
- IS-BAO