

## Case Study #1

### Diving Mishap, Class A

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CASE STUDY

## SYNOPSIS

On 17 August 2006, USCGC hove-to in position N W for planned ice liberty while deployed for Arctic West Summer 2006. The Dive Team, consisting of LT Diving Officer (DO), ENS SCUBA Diver (DV1), BM2 SCUBA Diver (DV2) and three volunteer diver tenders, planned to conduct an Arctic familiarization dive staged from the ice approximately 60 ft forward of the bow. The three divers were outfitted with dry suits, SCUBA, and AGA masks and were each attached by independently tended lines. The dive plan called for two dives, each to 20 ft for 20 minutes and no decompression. Upon entering the water, DV1 discovered several dry suit malfunctions, aborted the dive, and returned to the ship briefly to secure dive gear. DO and DV2 continued with the dive.

Both divers completed in-water checks and left the surface. Approximately 10 minutes later, the line tenders had each paid out roughly 200 ft of line which were taut and tending up and down. Line tenders were directed by DV1 to commence hauling up the divers after line-pull signals went unanswered. Divers were retrieved by their tending lines. Once the divers came into view, they appeared lifeless. DV2 was recovered onto the ice first. DV2 was not breathing and had no pulse. The maximum depth of DV2's depth gauge was in excess of the gauge's markings, which stopped at 200 ft. DO was recovered onto the ice immediately after DV2. DO was not breathing and had no pulse. The maximum depth recorded by DO's depth gauge was 185 ft. CPR was immediately administered and all attempts to resuscitate both divers proved futile.

## MISHAP INFORMATION

### A. History

30 April 2006	CGC underway from ISC for Phase One of Arctic West Summer (AWS) 2006 under the command of Captain.
05 June 2006	Completed Phase One of AWS 2006. Moored AK. Captain (1) relieved Captain (2).
06 June 2006	CGC departed Harbor en route WA for Tailored Ship's Training Availability (TSTA).
06 July 2006	CGC completed TSTA; sailed en route AK.
18 July 2006	Arrived vicinity of AK. Embarked a total of 36 scientists and other crewmembers commencing Phase Two of AWS 2006.
17 August 2006	CGC underway in the Arctic Ocean in support of AWS Phase Two.

All times +8 Uniform.  
“~” indicates approximate time.

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Other times verified by digital photo stamp or by log entry.

- 1555 Hove-to N W for planned ice liberty.
- ~1600 LT (DO) routed Dive Plan to OPS/XO/CO.
- 1630 Ice Liberty granted. Commanding Officer (CO) briefed by DO on dive.
- 1730 Dive Team (Divers and Tenders) staged along ice edge.
- ~1745 DO held dive brief with all divers and tenders.
- 1752 All divers suited up ready to enter water.
- ~1754 BM2 (DV2) returned to ship to replace malfunctioning glove.
- ~1800 DV2 back on the ice and donned dive gear.
- 1804 All divers suited up ready to enter water.
- ~1805 All divers entered water.
- ~1810 ENS (DV1) aborted dive due to leaks in dry suit and inability to maintain buoyancy.
- 1811 DO and DV2 in the water on surface. DV1 exited the water and returned to ship to secure dive gear.
- 1813 Surface checks conducted between DO and DV2.
- ~1815 DV2 exited the water to warm hands under the arm pits of shipmates. DO remained in the water on the surface.
- ~1825 DV2 entered water.
- ~1827 DO requested and received an additional 8 lbs of weight. DV2 requested and received an additional 10 lbs of weight.
- 1829 DO on surface prior to descending.
- ~1830 DO/DV2 conducted in-water checks. Line tenders (DC3, LTJG) received positive line-pull signals from DO and DV2 respectively.
- ~1831 CO at the dive side. DO/DV2 submerged. Line tenders pay out line.
- 1832 DO and DV2 below surface with lines tending out at a shallow angle.
- ~1840 DV1 returned to dive side.
- ~1842 BMCS (unassociated with planned diving operations) arrived at dive side and informed DO's tender he was almost out of line. BMCS indicated to DV1 that the divers need to come up. DV1 directed tenders to communicate with divers via line-pull signals. Repeated line-pull signals go unanswered.
- 1845 Tenders pulling up slowly on tending lines which were taut and leading straight down over the ice edge.
- ~1847 DV2 recovered onto ice first, depth gauge pegged beyond 200 feet. DO recovered on ice, depth gauge reading 185 feet. Commenced resuscitation efforts.

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- 1848 All dive equipment recovered intact with weights in Buoyancy Compensator (BC) pockets and emergency weight releases not activated.
- 1854 Divers transported onboard CGC to sickbay. Resuscitation efforts continued.
- 1910 Established initial communications with AREA and Flight Surgeon.
- 1920 CGC making way at best possible speed toward AK.
- 1935 Emergency Evacuation Hyperbaric Stretcher (EEHS) was assembled and tested successfully.
- 2001 DO and DV2 pronounced dead.

## **B. The Incident**

On 17 August 2006 at 1555U CGC hove-to in position N W (approximately 500 miles northwest of AK) in 4600 ft of water for planned ice liberty. CGC was 31 days into a scheduled 42 day Phase Two of AWS 2006. While hove-to, CGC maintained relative position to adjacent ice floes by keeping approximately 8 RPMs ahead on each shaft. The ship's sonar equipment remained energized.

The three-person dive team, consisting of DO, DV1, and DV2, intended to use the hove-to opportunity to conduct "cold water familiarization" dive training while the ship's crew and science team enjoyed ice liberty. DO had completed an estimated 20 dives, including seven surface supplied ice dives since arriving onboard CGC in June 2004. DV2 graduated from dive school in March 2006 and completed two dives on 10 April 2006 while inport. DV1 graduated from dive school in July 2005 and completed 4 dives on 20 October 2005. In late July 2006, the divers began preparing the dive locker for a possible training dive opportunity. At that time the dive team noted some gear had not been used for several months and they needed to assemble equipment from several sources. Additionally, leaking or damaged equipment was inventoried and labeled. The dive team was unable to dive in late July due to operational commitments but team remained eager to dive given any window of opportunity.

DO routed a dive plan to the Commanding Officer (CO), via the Operations Officer (OPS) and Executive Officer (XO), to conduct familiarization in dry suit and ice diving with CGC's new divers. The stated purpose was preparation for potential Arctic dive operations in 2007. It was also reported that DV2 intended to re-enact and film his re-enlistment ceremony under the ice. The dive plan presented to and approved by the CO called for two 20 minute dives no deeper than 20 feet. The CO understood the initial dive was intended to be equipment familiarization and that the dive team would operate under the open water and would not venture beneath the ice pack. The CO understood the second planned dive would entail a dive not to exceed 20 feet for 20 minutes but would allow the divers to move under the ice. The CO received a verbal brief of the dive plan from DO, during which he inquired whether it was appropriate to execute the dive with all three divers in the water and that this was in accordance with the Diving Manual. The CO reported that DO responded in an affirmative manner to his inquiry. This was the first dive brief received by the CO since assuming command of CGC. No plans were made or communicated to secure active sonars, tag out equipment, or secure ship's

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propulsion. The Officer of the Deck (OOD) reported a general understanding that a dive would be occurring but no specifics were passed to him or the bridge and he never inquired further about diving operations.

Around 1730, the dive team commenced staging on the ice 60 ft forward of the bow in open water. DO recruited three shipmates (LTJG, ENS, and DC3) to assist the divers and to act as tenders. The dive tenders indicated an interest in the CG Diving Program but none had completed the required line tender JQR. DO briefed the dive team, including the tenders, that the divers would enter the water, complete appropriate safety checks, and descend no deeper than 20 ft. The divers were outfitted in dry suits wearing standard AGA full face masks, single steel 100 cubic foot (100) SCUBA tanks, BC's, and 40 lbs of soft weight each. DO and DV2 wore split fins and DV1 wore standard CG-issue dive fins. Each of the divers was independently tended by tending lines. At or about 1805, the three divers (DO, DV1, and DV2) entered the water and were tended by DC3, ENS, and LTJG, respectively. The divers commenced surface checks. Approximately two minutes later, DV1 detected a leak in her poorly fitting dry suit and stated an inability to maintain buoyancy due to the malfunctioning dry suit purge valve. DV1 was assisted out of the water by ENS. DO indicated that DV1 should return to the ship to secure from dive operations. DV1 and ENS left the dive side to secure gear. DV2 also exited the water to readjust leaking gloves and warm his hands. This took approximately 10 minutes, all the while DO remained in the water breathing from her SCUBA equipment. After warming his hands, DV2 re-entered the water.

With both divers in the water, each requested more soft weight to be placed in their BC pockets, in addition to the 40 lbs already there. DO received 8 lbs and DV2 took 10 lbs. DO and DV2 completed in-water checks and then descended just below the surface and completed equipment checks again. The divers moved out away from the dive side and under the ice with tending lines initially at a shallow angle. Line tenders reported a constant strain and continued to pay out line to the divers. Tenders only stopped paying out line after they were made aware by a passerby (BMCS) that DO's tender was almost out of line. At this point, the lines tended straight down over the ice edge under tension. DV1, who had returned to the dive side, directed the line tenders to give the divers a line-pull signal of "four" several times, but all signals went unanswered. DV1 instructed the tenders to haul-up the divers at a rate of one foot per second. When the divers came into view, they appeared lifeless. Both divers were immediately hauled to the surface. DV2 was recovered onto the ice first with his mask full of bloody foam. DO was pulled onto the ice with white foam filling her mask. Neither diver was breathing nor had a pulse.

Resuscitation efforts were initiated and diving equipment was removed. Stretcher bearers and HSC Anderson were piped to lay to the ice. A pipe was made requesting the Automatic External Defibrillator (AED) to be brought to the ice. The AED was attached to DO and "No Shock" was advised during several AED treatment cycles. Both divers were loaded into separate litters and carried onboard CGC to sickbay. DV2 was transported onboard first, immediately followed by DO.

Once in sickbay, resuscitation efforts continued on both divers, including continued use of the AED and injection of emergency medicines. The AED continued to show "No Shock Advised" for both divers. The Emergency Evacuation Hyperbaric Stretcher (EEHS) was assembled in the hanger and tested successfully. The crew

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reported difficulty in the assembly due to unfamiliarity with the system. CGC established intermittent communications with AREA and the designated flight surgeon (CDR). After consultation, the flight surgeon pronounced both divers dead.

**C. Injuries to Personnel**

	<b>Crew</b>	<b>Passengers</b>	<b>Operator</b>	<b>Other</b>
<b>Injuries</b>	0	0	0	0
<b>Fatal</b>	2	0	0	0
<b>Non-Fatal</b>	0	0	0	0
<b>None</b>	0	0	0	0
<b>Total</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>

Note: Cause of death in both victims was determined by the autopsies to be asphyxia with pulmonary barotrauma with possible air embolism.

**D. Equipment**

**1. Equipment Used for Dive:**

- a. All diving equipment used in this incident was sent to the Navy Experimental Diving Unit (NEDU) in Panama City, FL, for evaluation and testing. Tests indicated all equipment was functioning properly. Air sample tests were normal. See Appendix I.
- b. The table below lists the required equipment for conducting cold-water diving operations in accordance with the USN Diving Manual, Revision 5.

<b>Equipment</b>	<b>Required</b>	<b>Optional</b>	<b>Available</b>	<b>Utilized</b>	<b>Type/Model Used</b>
Wetsuit/Variable Volume Drysuit	Y		Y	Y	Whites Drysuits
ANU Approved Cold Water Regulator	Y		Y	Y	Apeks ATX-50
ANU Approved Face Mask	Y		Y	N	AGA Divator MK-II
Weights as required		Y	Y	Y	Soft / Ankle Weights
Weight Belt as required		Y	Y	N	BC was used to hold weights instead of weight belt
Knife & Scabbard	Y		Y	Y	
Swim Fins	Y		Y	Y	Apollo Bio Split Fins
Depth Gauge	Y		Y	Y	
Submersible Scuba Bottle Pressure Gauge	Y		Y	Y	
Integrated Diving Vest (IDV) or Harness	Y		Y	N	Zeagle Ranger BC
Lifelines	Y		Y	Y	½" polypropylene

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					line
Lifeline Markings		Y		N	
Stainless Steel Ice Screws	Y		N	N	
Double SCUBA Bottles	Y		Y	N	Single SCUBA Tank
Wrist Watch	Y		Y	Y	Casio G-Shock
Octopus	Y		Y	Y	Apeks ATX-50
Diving Manual	Y		Y	N	N/A
Oxygen	Y		Y	N	N/A
Recompression Chamber Access	Y		Y	Y	EEHS
Wireless Thru-Water Comms		Y	Y	N	

- c. The SCUBA equipment, fully charged, used by the divers would have provided a maximum of three to eight minutes at a depth of 200 ft.
- d. Equipment discrepancies are listed below.
  - i. Divers were not using double SCUBA tanks. Each mishap diver was using only a signal SCUBA tank.
  - ii. No USN Diving Manual present at dive side.
  - iii. No oxygen kit present at dive side.
  - iv. Ice screws were not available onboard or used to secure tending lines to ice.
  - v. An Integrated Diving Vest (IDV) or Harness was not used. BCs are authorized for use with dry suits, however does not meet the requirement of the IDV or harness.
  - vi. Soft weights were not in a belt but in various BC pockets. Only 20 lbs of total weight worn by each diver was in designated emergency release pockets and could be jettisoned easily using the emergency weight release mechanism. A weight belt should have been used for the 30 lbs of weights not in the designated emergency release pockets.

**2. Dive Locker**

- a. The overall condition of the dive locker was fair. All BC's, wet suits, and dry suits were neatly hung and stowed. Regulators and facemasks were stored in a storage locker and in good condition. Several dry suits were damaged and not in working order. DO had contacted Coast Guard Liaison Officer (CGLO) at the Naval Diving & Salvage Training Center (NDSTC) the day before this incident requesting smaller, properly fitting dry suits for two small members of the dive team, DO and DV1, noting that all dry suits present onboard were too large or damaged. The dive locker head was used as a spare gear locker. Old dive records, spare parts, and other miscellaneous items were strewn on the deck and disorganized.

**3. Equipment Maintenance:**

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- a. There were no dive gear maintenance or PMS records with the exception of SCUBA tanks and surface supplied umbilical hoses.
- b. All SCUBA bottles and surface supplied umbilical hoses were current on hydrostatic tests and visual inspections.

**E. Meteorological Information**

- 1. The on-scene weather observations were reported as follows:

<b>Sky:</b>	10 nm visibility / Scattered Cirrus Clouds
<b>Winds:</b>	250T / 10kts
<b>Air Temperature:</b>	28F
<b>Sea Temperature:</b>	29F
<b>Seas:</b>	9/10 Ice Coverage
<b>Ice Thickness:</b>	3-5 feet
<b>Tidal Currents:</b>	0.2kts Easterly
<b>Depth of Water:</b>	1420 meters / 4600 feet