FORMAL INVESTIGATION INTO THE COMMERCIAL DIVING ACCIDENT ABOARD THE MOBILE OFFSHORE DRILLING UNIT CLIFF'S DRILLING RIG NO. 12 ON 4 MARCH 1996, WITH LOSS OF LIFE

Second Dive Hose

30. It was argued at the hearing that caused his own death when he failed to abort his dive while knowing there was no back-up umbilical. It also was argued that should have aborted his dive when he first noticed equipment problems.[210] The same criticism could be applied to and ; they all had the opportunity to withdraw from the dive operation. Based on the testimony developed at the hearing, we know that knew that there was no second dive umbilical available. However, there is insufficient evidence to determine what other unsafe conditions he knew about, either before or during the dive. The reasoning goes that if he knew about unsafe working conditions, should have refused to work. addressed this issue comprehensively in an article. To summarize findings, workers have the right to refuse unsafe work under the Occupational Safety and Health Act, but they seldom do. In fairness, the same forces perhaps driving to go ahead with the dive in the face of identified problems also may have been driving and to complete the dive.

> Employees in the United States have a right to refuse unsafe work in cases where the employee has a reasonable belief that performance of the work constitutes an imminent danger of death or serious physical injury [29 CFR 1977.12(b)(2) (1992)]. This has proven to be a strict standard that is rarely met by the employee. The employee has the burden of showing a reasonable belief under the circumstances and that the action taken was in good faith as 'any employee who acts in reliance on the regulation falls on the employee and he runs the risk of discharge or reprimand in the event a court subsequently finds that he acted unreasonably or in bad faith.' [Whirlpool Corp. v. Marshall, 445 U.S. 1, 21 (1980)]. More importantly, the regulation 'does not require employers to pay workers who refused to perform their assigned tasks in the face of imminent danger,' [Id. At 19]... In practice, the employee is forced to choose to either remain at a task while exposed to a substantial risk of harm, or be without work for a period of time until the dispute is resolved. An employee in these circumstances has little incentive to refuse unsafe work because the slim chance of proving the reasonableness of the belief in court does not outweigh the greater potential for lost pay.
>
> In addition to the limited scope of an employee's right to refuse dangerous work, an employee in the United States fears employer retaliation by exercising this right, despite an anti-retaliation provision in the OSH Act. [29 U.S.C. 660(c) (1988)]. The anti-retaliation provision of the OSH Act only protects an employee who proves that the refusal to perform a task was both reasonable and in good faith...

[210] See USCG Investigation, Vol. 6, IO Exhibit 68, (Parties in Interest Proposed Findings of Fact)

> Few employees are successful in their claims under the anti-retaliation provision in cases where they refuse unsafe work or file a complaint with OSHA. In 1989, only 559 of the 3,342 discrimination complaints filed by employees with OSHA resulted in litigation referrals by the Secretary of OSHA in U.S. district courts, and even fewer claims were actually successful.[Cite omitted][211]

Main Airline Connection

31. testimony raised the questions of whether main airline was secured to his helmet when he began his dive and whether may have loosened the connection when he was underwater. testified that before quit talking, n said that he might have forgotten to tighten his airline.[212] The reasoning is that may have reached up to his main air connection (See figure 7) and, while trying to tighten the fitting, loosened it instead. Master Chief opined that it was "plausible" that had loosened his main airline connection near the end of his dive.[213] I disagree. The eyewitness testimony on this issue is contradictory, but some facts are undisputed. says that when he tried to pull . into the personnel basket, safety harness came free and the umbilical detached from n's helmet. on the other hand, clearly remembers the hoses being connected to helmet when reached to remove the helmet on the deck of Rig 12.[214] saw helmet underwater during the rescue and distinctly remembers seeing the line attached to the helmet and bubbles coming from the "whiskers" of helmet -- indicating that air was going through the helmet fitting to respirator.[215]

32. The most compelling undisputed fact on this question is that was apparently still alive, although unconscious, when he was brought back to the deck of Rig 12. This shows that, even at the end of his dive, received enough air to sustain life, but not enough to sustain consciousness.[216] It is possible that failed to tighten his air hose to his helmet causing enough air to leak from the connection to make him blackout. The facts though, do not support the theory. dive lasted three hours with him doing relatively light work and moving constantly around the mat of Rig 12. testified that three or four times during the dive, he noticed Compressor 2's pressure gauge slip from about 150 psi down to 90 psi. But when told to close his free flow valve, testified that the system pressure returned to 150 psi. According to , this was Compressor 2's normal operating pressure, indicating that when closed his free-

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211 "COMMENT: EMPLOYEE INVOLVEMENT IN THE ENFORCEMENT OF THE OCCUPATIONAL SAFETY AND HEALTH LAWS OF CANADA AND THE UNITED STATES", 15 Comp. Lab. L. 527, 1994

212 See FOF 42

213 See FOF 61

214 See FOF 47

215 See FOF 46

216 See FOF 63

flow valve, the system returned to its maximum pressure and inferentially, proving that the system was practically airtight.[217]

33. also did not loosen his main air connection completely at the end of his dive. All the eyewitness agreed that airline was connected to his helmet when he was brought to the surface.[218] There also is no evidence that adjusted his hose connection during his dive, prior to raising the question to . Therefore, for the loose hose connection theory to be possible, would have had to: 1) wrongly suspect his main air connection was loose, and 2) misadjust the connection allowing a fraction, but not all the air in the line to escape, resulting in an almost instantaneous blackout.

Coast Guard Marine Inspectors

34. Had the Coast Guard marine inspectors inspected the dive station on 4 March 1996, they would likely have discovered at least three violations of Coast Guard regulations.

1) 46 CFR 197.201(a) and (b) [Failure to designate dive supervisor in writing and failure to deliver designation to person-in-charge prior to diving];

2) 46 CFR 197.420(A)(1) and (2) [Failure to provide operations manual to person-in-charge and have at dive location]; and

3) 46 CFR 197.482(d)(2) [Failure to log compressor air test results].

The marine inspectors were required by Coast Guard policy to inspect the diving station. The Marine Safety Manual clearly states that "[i]nspection of diving equipment and facilities *shall* be conducted when diving operations occur on . . . vessels inspected for certification..."[219] The marine inspectors were also strongly guided to conduct dive safety inspections by NVIC 1-89. "The underwater survey should not be conducted unless the inspector is satisfied that the equipment and procedures being used by the divers will provide a safe and meaningful examination of the ship. Safety must be foremost on the minds of all those working together on the actual diving operation."[220]

35. If the Coast Guard marine inspectors had inspected the dive station, they could have made some useful judgements about the dive team's qualifications by asking whether a dive plan had been completed and a pre-dive safety checklist and job hazard analysis had been done. However, if the inspectors had looked only at the divers' qualifications, they would have had

[217] See FOF 41, 42. Note Analysis para. 19; 's testimony about Compressor 2's max pressures is extremely suspect. Nevertheless, it can be inferred that the pressure gauge indicated max pressure for Compressor 2, regardless of whether it was 150 psi or something less.

[218] See FOF 46, 47

[219] Marine Safety Manual, Vol. II, Chapter 16.E.1 (emphasis added)

[220] See FOF 2 – 8 and 29, 30, 31, 31; See too USCG Investigation, Vol. 4, IO Exhibit 30 (NVIC 1-89, enclosure 1, para. 5.f.)

trouble deciding whether they were qualified to dive safely. was a graduate of a dive school and had been a commercial diver for 12 years.[221] was a graduate of a reputable dive school in the State of Washington and had already made several shallow water dives for G&G.[222] Only . was not a graduate of a dive school, but he had dived for Cliffs on two previous occasions.[223] Since commercial divers are not required to be licensed, or even to attend diving school, the inspectors would have been hard-pressed to judge whether the Rig 12 diving job could proceed safely based solely on the divers' credentials.

Conclusions:

1. The apparent cause of the death of was drowning. inhaled water into his lungs, which disrupted gas exchange causing him to asphyxiate.

2. A contributing cause of the death of was that water entered helmet. There is insufficient evidence to determine how water entered the helmet. However, the weight of evidence indicates the most likely path of ingress was under the neckdam, drawn in as gasped for air when he suffered a loss of air pressure. In the alternative, water may have entered the helmet through the emergency air connection if opened the valve and concurrently experienced a complete loss of air pressure.

3. A contributing cause of the death of was that he succumbed to Hypercapnia (too much carbon dioxide in the blood), causing him to pass out and his face to fall forward in his helmet allowing him to inhale water.

4. A contributing cause of the casualty was fatigue, lack of nourishment, and hypothermia, which masked the symptoms of Hypercapnia.

5. succumbed to Hypercapnia because Compressor 2 produced inadequate air volume or pressure to properly ventilate and remove Carbon Dioxide from his helmet. Compressor 2 probably never produced more than 80-90 psi during the Rig 12 dive.

6. Compressor 2 produced inadequate air volume and pressure to properly ventilate helmet because its valves would not seat and its pilot valve was not working properly, preventing the compressor from pressurizing the volume tank to a pressure above 80-90 psi as air pressure in the tank was depleted by the diver.

7. Since no air quality tests were done for Compressor 2, there is insufficient evidence to prove conclusively that air mixed with oil contributed to this casualty. Nevertheless, the

[221] See FOF 21
[222] See FOF 24
[223] See FOF 11

compressor teardown conducted by , and recorded at IO Exhibit 19 indicates that Compressor 2 almost certainly produced oil tainted air as oil blew by the compressor piston rings entering the head assembly to be sent downstream to the diver. A contributing cause of the casualty may have been that , was debilitated by the early stages of Lipid Pneumonia when he breathed oil saturated air, reducing the partial pressure of air sent to him and impeding gas exchange in his lungs.

8. A contributing cause of the casualty was G&G's failure to do compressor air testing.

9. Compressor 2 produced inadequate air volume and pressure and probably tainted air because G&G had an inadequate maintenance program that did not routinely check and repair Compressor 2, allowing it to fall into disrepair.

10. G&G did not have a good maintenance and repair program because it did not have anyone exclusively responsible for equipment upkeep. Instead, claimed to have titular charge of equipment maintenance but expected all employees when they used equipment to detect and repair mechanical problems.

11. G&G did not have a person primarily focused on equipment repair and upkeep because it did not hire anyone to do that job when Mr. the former shop manager, left G&G in 1990 or 1991.

12. A contributing cause of the casualty was G&G's poor quality control practices. G&G allowed poorly maintained equipment to be sent to jobs and not enough equipment to be sent to jobs. The fact that there is a question about whether tightened the airline to his helmet before beginning his dive indicates lax pre-dive preparation by G&G employees.

13. A contributing cause of the casualty was that G&G failed to appoint a diving supervisor in writing, or in the alternative, Texas NDE failed to provide a diving supervisor.

14. A contributing cause of the casualty was that , the OIM, failed to require that a diving supervisor, appointed in writing, present to him the written appointment along with an operations and safety manual.

15. There is insufficient evidence to prove definitively that a red shop rag was ingested into the compressor air intake, but a contributing cause of the casualty may have been that a rag was ingested into Compressor 2's air intake reducing the air volume and pressure passing to

16. A contributing cause of the casualty was that axe fouled in the mat piping of Rig 12, restricting ability to be pulled to the surface.

FORMAL INVESTIGATION INTO THE COMMERCIAL DIVING ACCIDENT ABOARD THE MOBILE OFFSHORE DRILLING UNIT CLIFF'S DRILLING RIG NO. 12 ON 4 MARCH 1996, WITH LOSS OF LIFE

17. A contributing cause of the casualty was the anxiousness and confusion brought on by carbon dioxide poisoning (Hypercapnia) which debilitated ability to think and respond to directions from the dive supervisor.

18. A contributing cause of the casualty was the dive team's inability to quickly muster a coordinated rescue attempt.

19. A contributing cause of the casualty was lack of a standby diver. A ready standby diver likely would have been able to save life. Lack of a ready standby diver with his own gear and air supply created an almost 30 minute delay in the rescue attempt.

20. G&G did not supply an adequate secondary air supply when it sent a high-pressure air bottle to the dive site that was not fully pressurized.

21. There is insufficient evidence to tell whether attempted to communicate through line pulls. But, when didn't tend the umbilical in his hand, was unable to communicate to the surface through line pull signals. A contributing cause of the casualty may have been lack of communication between and the surface.

22. did not have the training or temperament to be a dive supervisor.

23. did not have the training or experience to be a standby diver or dive supervisor.

24. G&G was not in compliance with its own manning requirements as set out in its safe practices and operations manual in that a dedicated dive tender was not available.

25. A contributing cause may have been the helmet's internal adjustments made to the regulator affecting how the regulator responded to intermediate pressure. The adjustment was set in an unusual position allowing free-flow at normal operating pressures. This unusual setting indicates that had experienced inadequate compressor air volume and pressure from G&G compressors and had adjusted his second stage regulator to compensate for the low air pressures. The setting probably explains why the first high-pressure air bottle drained so quickly.

26. The fact that the Rig 12 Operations Manual that was onboard at the time of the casualty-- not the G&G safety and operations manual -- had not been approved by the Coast Guard did not contribute to the casualty or delay the emergency response, including the evacuation of to the hospital.

27. A tertiary air supply (bailout bottle) may have saved life.

28. air hose was connected to his helmet. He did not fail to tighten it prior to diving nor did he loosen it during the dive.

FORMAL INVESTIGATION INTO THE COMMERCIAL DIVING ACCIDENT ABOARD THE MOBILE OFFSHORE DRILLING UNIT CLIFF'S DRILLING RIG NO. 12 ON 4 MARCH 1996, WITH LOSS OF LIFE

29. A contributing cause of the casualty was that the Coast Guard marine inspectors failed to inspect the diving station as required by the Marine Safety Manual. Marine Inspectors should have inspected the dive station on Rig 12 in accordance with Marine Safety Manual Vol. II, Chapter 16.E.1. If they had, they likely would have determined that the diving operation lacked a dive supervisor appointed in writing, a dive operations manual, and a log with air test results for Compressor 2. This would likely have resulted in delay of diving operations and another compressor being used, increasing the chance would have survived. The marine inspectors failed to meet the expectations of Marine Safety Manual Vol. II, Chapter 16.E.1.

30. Coast Guard marine inspectors likely did not inspect the diving station because at least one of them believed that the ABS surveyor would oversee safe diving operations during the NDT portion of the hull inspection.

31. Coast Guard marine inspectors should not have relied on the ABS surveyor to oversee diving operations to ensure diving safety. That was an inappropriate attempt to delegate Coast Guard authority.

32. The Rig 12 SEILOD was governed by NVIC 12-69. NVIC 12-69 does not impose a requirement for the Coast Guard to do safety-related analysis of the diving operations before approving a SEILOD.

33. NVIC 1-89 is more generally relied on by marine inspectors than is NVIC 12-69. NVIC 1-89, although literally not applicable to the Rig 12 SEILOD, clearly established an expectation for OCMI's to analyze SEILOD proposals to ensure diving operations can be conducted safely. By the standards set in NVIC 1-89, MSO Port Arthur failed to meet Commandant expectations to analyze the ability of the diving contractors to safely carry out a SEILOD on Rig 12.

34. The liveboating diving variance requested by Cliffs for the Rig 12 SEILOD was not necessary since Rig 12 was in a bottom bearing mode and was not self-propelled. The diving variance granted by MSO Port Arthur did not contribute to the casualty.

35. There is no evidence that drugs or alcohol contributed to this casualty.

36. There is evidence that and Texas NDE, and/or and G&G Marine failed to designate a diving supervisor in accordance with 46 CFR 197.210.

37. There is evidence that G&G Marine and/or failed to provide an air compressor system with an efficient filtration system as required by 46 CFR 197.310 (c).

FORMAL INVESTIGATION INTO THE COMMERCIAL DIVING ACCIDENT ABOARD THE MOBILE OFFSHORE DRILLING UNIT CLIFF'S DRILLING RIG NO. 12 ON 4 MARCH 1996, WITH LOSS OF LIFE

38. There is evidence that G&G Marine and/or failed to provide a primary breathing gas supply sufficient to support a diver and standby diver for the duration of the planned dive in accordance with 46 CFR 197.340.

39. There is evidence that failed to carry out the responsibilities of the Person-in-Charge of Rig 12 as required by 46 CFR 197.402.

40. There is evidence that failed to carry out the responsibilities of the diving supervisor as set out in the regulations listed below. correctly pointed out that he was never appointed diving supervisor for the Rig 12 dive. However, when he began to act as the diving supervisor, he assumed responsibility for carrying out all of the dive supervisor duties, not just those he could easily accomplish.

    a. 46 CFR 197.404: Responsibilities of the diving supervisor

    b. 46 CFR 197.410: Dive procedures

    c. 46 CFR 197.420: Failure to provide ops manual

    d. 46 CFR 197.432: Failure to continuously tend diver in the water

    e. 46 CFR 197.450: Failure to conduct breathing gas tests

    f. 46 CFR 197.480 & 482: Failure to maintain a logbook

41. There is evidence that the senior marine inspector on board Rig 12, LT Julio MARTINEZ, USCG, failed to follow the requirements of Marine Safety Manual, Vol. II, Chapter 16.E.1 by not ensuring that the dive station was inspected on 4 March 1996 while diving operations were underway on a vessel inspected for certification. This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

42. There is evidence of a violation of 18 USC 1112 (Manslaughter) by G&G Marine and/or . This matter has been forwarded to the Commander, Eighth Coast Guard District for further investigation.

43. With the above exceptions, there is no evidence of actionable misconduct, inattention to duty, negligent or willful violation of law or regulations on the part of licensed or certificated personnel; nor evidence of any other failure of inspected equipment or material; nor evidence that any other personnel of the Coast Guard or of any other federal agency, or any other person contributed to this casualty.

FORMAL INVESTIGATION INTO THE COMMERCIAL DIVING ACCIDENT ABOARD THE MOBILE OFFSHORE DRILLING UNIT CLIFF'S DRILLING RIG NO. 12 ON 4 MARCH 1996, WITH LOSS OF LIFE

Recommendations:

1. Commandant should require bailout bottles for all commercial diving operations, regardless of depth. The bailout bottles should have sufficient capacity to supply a diver with an appropriate volume of air at the deepest depth being worked. The facts of this case do not strongly support a recommendation for bailout bottles. Nevertheless, all diving experts consulted by the Investigating Officer agreed that bailout bottles come in so many sizes and configurations, and are so inexpensive that every dive should begin with the presumption that a bailout bottle will be used.

2. Commandant should require all unused auxiliary gas ports on diver worn life support equipment to be capped or blanked during all commercial diving operations. This will remove the possibility of water entering a diver's helmet if he inadvertently opens an emergency valve.

3. Commandant should require a standby diver dressed out and with a separate air supply, ready to quickly deploy for all commercial diving operations regardless of depth.

4. Commandant should require diving stages for all commercial diving operations regardless of depth, except where they would be impractical. This will speed entry to the water for divers and rescue divers and remove the need for rescue operations to work from personnel baskets. In this casualty, the rescue operation was itself so slow that using a crane operated Billy Pugh basket as a rescue platform did not significantly add to the delay. Nevertheless, there is no question that a diving stage at water level would have speeded up the rescue.

5. Commandant should require the Diving Supervisor and the Master or Person-in-Charge to develop a site specific rescue plan designating the equipment and personnel that will be used for a rescue or removal of an injured diver from the water for all commercial diving operations.

6. Commandant should require that, prior to any commercial diving operation, the Diving Supervisor describe the rescue plan to all members of the diving team.

7. Commandant should require the Diving Supervisor to complete a Job Hazard Analysis before every commercial diving operation. See IO Exhibit 57, ADC Consensus Standards, pg. 3-9 to 3-10b.

8. Commandant should require Diving Supervisors to complete a pre-dive safety checklist suitable to the type of diving equipment and procedures to be used, prior to all commercial dive operations. See IO Exhibit 53, Navy Dive Manual, pg. 4 –37 to 4-49.

9. Commandant should consider changing Coast Guard regulations to ensure accountability of commercial diving contractors for maintaining records and logs for their diving equipment.

Commandant should also make minor changes to Coast Guard regulations in addition to those described above to ensure Offshore Installation Managers play a more active role in pre-dive safety preparations. Present Coast Guard diving regulations place record keeping responsibilities on diving supervisors. Diving supervisors are appointed on a job to job basis and their designation ends when the diving job they supervise ends. Many of the record keeping responsibilities, however, are continuous and must be completed between diving jobs, away from the dive site. The following recommended regulation changes illustrate how the commercial diving contractor and Offshore Installation Manager could be given a more responsible role in the record keeping and pre-dive safety processes.

a. At 46 CFR 197.204 [Definitions], Commandant should add a definition "Commercial Diving Contractor" to describe the person or business that provides commercial diving services.

b. At 46 CFR 197.484 (a) [Notice of casualty], after the words "person-in-charge", Commandant should include the words "Diving Supervisor or Commercial Diving Contractor."

c. At 46 CFR 197.486 [Written report of casualty], after the words "person-in-charge of a vessel or facility", Commandant should include the words "or Diving Supervisor or Commercial Diving Contractor."

d. Commandant should change 46 CFR 197.210 [Designation of diving supervisor] as follows:

> "The Commercial Diving Contractor shall designate in writing a Diving Supervisor for each commercial diving operation. The Diving Supervisor shall present the written designation to the Master or Person-in Charge."

e. Commandant should change 46 CFR 197.402 (2) (i) [Responsibilities of the person-in-charge] as follows:

> "Prior to permitting any commercial diving operation to commence, the Master or Person-in-Charge shall examine the Diving Supervisor's written designation to ensure it is complete as required by §197.210."

f. Commandant should cross-reference 46 CFR 109.109 [Responsibilities of master or person in charge] with 46 CFR 197.402 [Responsibilities of person-in-charge].

g. Commandant should change 46 CFR 197.480 (c) [Logbooks] as follows:

> (c) The Diving Contractor and the Diving Supervisor conducting commercial diving operations from a vessel or facility subject to this subpart shall maintain a logbook for making the entries required by this subpart.

(d) The logbook required to be maintained by this subpart shall be taken to the jobsite for every commercial diving operation and shall be available for inspection by the Master or Person-in-charge, the United States Coast Guard, or any other cognizant agency.

(e) The Diving Contractor shall retain the logbook required to be maintained by this subpart for a period of not less than three years.

h. Commandant should change 46 CFR 197.482(d) [Logbook entries] as follows:

(d) The Diving Contractor and the Diving Supervisor shall insure that a record of the following is maintained: . . .

(e) The Diving Contractor and the Diving Supervisor shall insure that copies of each of the records required under paragraph (d) are included in the operations manual required by 46 CFR 197.420. The records required under paragraph (d) must be maintained by the Diving Contractor for a period of not less than three years.

i. At 46 CFR 197.420 [Operations manual], Commandant should add the following:

(e) The operations manual must contain copies of the records required to be maintained by 46 CFR 197.482 (d) and (e).

j. At 46 CFR 197.450 [Breathing gas tests], Commandant should change the words "The diving supervisor shall ensure that" – to

The Diving Contractor shall ensure that –

k. At 46 CFR 197.450 [Breathing gas tests], Commandant should add the following:

(d) The Diving Contractor shall maintain the above stated test records for a period of not less than 3 years.

10. Commandant should require the Dive Supervisor and Master or Person-in-Charge to execute a Declaration of Inspection verifying their respective duties have been competed before any commercial dive operation begins. See 46 CFR 35.35-30 for an example of the concept as it is applied to oil transfers.

11. At 46 CFR 197.204 [Definitions], Commandant should include a definition of "Diving Tender". Commandant should consider adopting the description of Diver Tender set out in the Navy Dive Manual. See IO Exhibit 53, Section 4-8.5.3.

12. At 46 CFR 197.204 [Definitions], Commandant should include a definition of "Dive Tending" or "Tending."

13. Commandant should consider limiting the duties of a dive tender to only tending the dive umbilical during a commercial diving operation, as illustrated by the following wording.

    At 46 CFR 197.432 (c)[Surface-supplied air diving], Commandant should add the words:

    ; the person tending the diver shall have no other duties while the diver is under water;

14. At 46 CFR 197.204 [Definitions], Commandant should consider consolidating the definitions "*Commercial diver*" and "*Diver*" into one inclusive definition.

15. Commandant should establish minimum manning standards for all diving operations. Commandant should consider adopting the standards set out in the ADC Consensus Standards. See IO Exhibit 57, pg. 3-24 to 3-29.

16. Commandant should establish commercial diving qualification standards for Commercial Divers, Commercial Diving Tenders, and Commercial Diving Supervisors. Commandant should consider adopting the standards set out in the ADC Consensus Standards. See IO Exhibit 57, pg. 2-3 to 2-8.

17. In the absence of a diver qualification program, Commandant should publish criteria for OCMI's to use when reviewing SEILOD applications to evaluate qualifications of divers to safely conduct diving operations.

18. Commandant should examine NVIC 12-69 and NVIC 1-89 to determine whether the older one should be cancelled and incorporated into the newer.

19. Commandant should require dive operation inspection training for all marine inspectors.

20. Commandant should remove the diving component from the MODU Inspector PQS workbook and establish a separate Performance Qualification Standards workbook for diving operations.

21. Commandant should evaluate the adequacy of the MODU/SEILOD job aid, CG-840H-1 (9-92), to determine whether additional inspection items should be added to the diving checklist (pg. 20 – 22). See IO Exhibit 31.

22. Commandant should publish guidance emphasizing that Coast Guard marine inspectors should not attempt to delegate dive safety enforcement duties to any third party, including classification society surveyors.