Controlling by Managin

[The article that follows renews a department that used to be a regular part of Fathom. *Like its predecessor, the department is dedicated to matters of diving safety. Let us know if you like it or not. We welcome inputs from the fleet.—Ed.]*

By CUCM(SCW/MDV) William Deen, Underwater Construction Team Two, and Lt. Toben Nelson, Naval Safety Center

A team of 20 Seabee divers faced a daunting task: seal the entrance of a tunnel 12 feet in diameter, located 150 feet below the surface of Abiquiu Lake in north central New Mexico. The job involved installing two steel bulkheads, each weighing 12,000 pounds and measuring 24 feet tall by 7.5 feet wide, over the inlet. These bulkheads would allow civilian contractors to finish building emergency flood-control gates inside the 5,000-foot tunnel.

The work sounded difficult and dangerous, even without considering the usual diving hazards. Sailors from Underwater Construction Team (UCT) Two, Air Detachment Alfa, used operational risk management (ORM) and teamwork to complete the task safely and successfully, despite a nearly catastrophic event. Here's how they did it.

First, the detachment identified and assessed the hazards, most of which were obvious. The elevation of Abiquiu Lake was a concern. At 6,200 feet, standard Navy decompression tables wouldn't work for the planned dive profiles. The divers would have to use Canadian, high-altitude, surface-decompression tables, which no one had used before.

Another hazard was the dive barge. Concerns included crane operations over the water, stability, rigging methods, and the scope and tightness of the moor. The detachment's divers also identified these hazards: the weather (freezing temperatures), a lack of visibility in the water, the actual installation of the bulkheads, and communications between the

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dive team and people opening and closing the flood-control gates.

Detachment leadership made several decisions about the controls they would use to minimize the risk. Because of the high altitude and extensive decompression requirements, the Seabee divers could dive no more than four times a day. Besides using the high-altitude tables provided by Naval Sea Systems Command, the divers wore hot-water suits. To reduce the risk of decompression sickness, detachment supervisors closely monitored the suit's water temperature to maintain a comfortable, cool diver on the bottom. The water was warmed during ascent to minimize on-gassing at depth and to maximize off-gassing during decompression. An average dive of 150 feet for 30 minutes resulted in more than two hours of decompression on a 190-foot table, an hour of which was surface decompression in a transportable recompression chamber system (TRCS).

Divers spent four months researching, planning and training for this operation. Here are other controls they decided to use:

- A tight, four-point moor situated the dive barge over the tunnel inlet.
- Cold-water kits were used on emergency-gas supply regulators.
- The TRCS was housed in a heated, UCT arctic tent.

Finally, detachment leadership supervised the whole operation, monitored the risk controls, and ensured they worked as planned.

been fine, and it was for a while. A problem developed when both bulkheads were set in place, and the long tunnel was drained for an interior inspection of a watertight seal on the bulkheads. The inspection revealed damage to the rubber J-seals, which meant the bulkhead would have to be removed and repaired. A dive team would have to make one more dive to prepare the tunnel for flooding and bulkhead removal.

With both divers deployed to the top of the inlet structure at 100 feet, they quickly located a narrow shaft just above the sealed inlet. Green diver cautiously tended red diver as he slowly descended another 45 feet into a maze of 4-inch piping. Red diver was supposed to wash off several deep layers of silt from inside the shaft. This was the point when everything changed.

Both divers reported hearing a large volume of air escaping from around them. At the same time, a civilian contractor appeared from behind the barge crane and said he had just opened the two bulkhead shear gates. Flooding of the tunnel had started without permission of the dive crew. What the divers had heard was the rapid venting of air from the tunnel as pressure equalized across the bulkheads.

Red diver was able to grip the inlet ladder, essentially becoming the hold-down point to keep green diver from getting pulled. On the surface, the rapid expansion of the vented air caused a surge of water to swamp the dive barge and wash secured equipment over the side, including a 4,000-pound air compressor.

After seven minutes, the venting stopped, and the divers were able to re-evaluate their situation. They stopped the operation and applied ORM to the new scenario, starting with identifying and assessing the new hazards. Line-pull signals verified fouled umbilicals. The fate of the air compressor remained a mystery, though. Did it go straight to the bottom, or was it tangled with the divers' umbilicals? Omitted decompression was a hazard. How far had the divers ascended when the vented air came rushing out of the tunnel? It was time to make another series of critical decisions to determine what controls would be used to minimize the risk.

Working with the tenders, the divers were able to pull their way to the 48-foot decompression stop. As they worked toward the 32-foot stop, however, they noticed increased umbilical tension. The diving supervisor decided to deploy the standby diver to investigate the source of fouling. The standby diver found the air compressor dangling 15 feet beneath the surface, pinching the divers' umbilicals. Knowing the divers would be taken to the bottom if the compressor broke free, topside personnel decided to accept the necessary risk of omitted decompression to clear the divers of this dangerous situation.

Red and green divers ascended one at a time to the standby diver, unfouled themselves, and quickly returned to their 32-foot stop. Within two minutes, both divers were free and clear. In-water decompression then was adjusted for omitted decompression, and both divers surfaced to complete another two hours of decompression in the TRCS. The decision to accept the necessary risk had paid off. Both Seabee divers were OK after decompression, and the detachment was able to repair and re-install the damaged bulkheads.

When this operation ended, the detachment had completed 68 high-altitude, surface-decompression dives, with 51 hours of bottom time and 111 hours of decompression, with no injuries. By using the principles of ORM and the operations-planning information in the *U.S. Navy Diving Manual,* the divers had turned a dangerous operation into an impressive feat. The key to their success was learning to control the danger by managing the risk.

Lt. Nelson's e-mail address is tnelson@safetycenter.navy.mil.