Q&A: Underwater habitat operations director considers worst-case scenarios surrounding the missing Titan submersible

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Credit: Florida International University

The world remains riveted by the story of the lost vessel carrying five people to see the remains of the Titanic at the bottom of the North Atlantic Ocean. A massive search operation continues for the submersible, named Titan, which lost communication with its mother ship soon after diving toward the famous wreck on Sunday. Scheduled to resurface later the same day, it has not been heard from since.

FIU's Aquarius Reef Base is similarly a pressure vessel designed for underwater research. The habitat is stationary on the ocean floor, 62 feet below the surface, five miles off Key Largo, and supports ongoing research. Aquarius operations director Rogelio Garcia, also the university's diving safety officer, is in a unique position to answer questions about what might have gone wrong with Titan, even as he and experts around the world have yet to understand the full picture of the vessel's construction and the conditions that might have led to onboard failures.

We've all heard and read many theories about why communication was lost. What do you think is plausible?

There are a lot of things that can go wrong. The porthole windows can crack or come out of their mounting. You can have a slow leak or a catastrophic one where water comes in really fast. They could have had a fire on board. The vessel could have gotten tangled [in debris].

Chances are the submersible has on board batteries that provide power for lights, for communications, for maneuverability. That power supply, of course, has wires, cables, things like that that go from the power source to the actual components. It could spark and light something on fire. Even if you put the fire out, the smoke is going to fill the small space very quickly with carbon monoxide, which we all know is toxic.

Are there any safety protocols that would have or should have been in place to avert all this?

That's tough to answer because I don't know exactly how this thing was constructed. But the New York Times had a recent article about whistleblowers that were saying this sub wasn't being built to a standard

for those types of depths. I don't know enough about it, but I can tell you two things.

One, if the primary way to drop the ballast [which would allow the sub to rise on its own to the surface of the water] required a power source and that power source failed, you'd want a manual backup. If they didn't have that, then, in my opinion, they failed to cover all the bases.

The other thing I don't know is if they have the ability to remove carbon dioxide from the space. That's typically a normal thing to have in a submersible. The primary way to do that requires a power source. Batteries would power what is known as the scrubber, and there's a fan that pulls the ambient air through the scrubber and it removes the carbon dioxide. Now if the power fails, there's actually a different way to do it, a backup using air instead of power.

So as we and the rest of the world continue to hear about the dwindling oxygen supply on board, should we worry instead about carbon dioxide?

Everybody is fixated on the oxygen. A lot of times, though, it's the carbon dioxide that's the real problem. If they lost power and don't have the capability to remove carbon dioxide, it is going to get to a toxic level. Regardless of the size of the space, when carbon dioxide levels get up to 5%, or 50,000 parts per million, humans will start to get a headache, maybe feel dizzy. The heart rate will increase. Respiration will increase. And once you start getting to 7% and 10%, there may be some individual variation, but in general people are going to start going unconscious and even death can occur.

In Aquarius, to give you an example, the main space is 1,400 cubic feet for three people, and we have three carbon dioxide scrubbers that

constantly run.

I heard the company that custom built Titan did not have an outside inspection. I've also heard that some people believe regulations and standards aren't keeping pace with such innovations, designed to push the envelope, so to speak. Is this a concern?

I see people trying to skirt safety issues all the time, not necessarily just speaking about submersibles. I can tell you, regardless of whether it's a submersible, an underwater habitat, a different pressure vessel, there are industry standards, there are laws, there are regulations that a submersible could be tested under to make sure that all the bases are covered. It's not like there isn't an option to make sure the hull is tested accordingly and windows are tested properly and built from the right material. They could have done it. If it's innovative, if it's new material, it doesn't matter. The testing and the guidance is out there.

Aquarius gets tested by a third party every year. We're required, up to a point, but then there are other best industry practices that are not required, so why not follow them if you're really concerned about protecting human life in an extreme environment?

Anything else that strikes you about this case of a sub missing at sea?

On Aquarius, if we lose primary communications, we have a backup. And if we lose the backup, we have a tertiary way to communicate. And if we lose the primary air source, we have a secondary air source. If we lose the primary way of scrubbing carbon dioxide, we have a secondary.

The company knew they lost communications [on an earlier expedition, last year]. Did they really, truly explore another option? I'm not saying it's easy at that depth, but technology is pretty good these days. My question would just be, "Did you do due diligence once you found out that was a problem? Did you explore a backup to ensure that everything was okay?"

Is there anything that could have been done to assist with finding the vessel in a timely fashion, like the ping in an airplane's black box?

They could have easily had a device for if something goes wrong. Worst case scenario, it could have been a manual release of something that goes straight up to the surface and sends a signal right away. From that first location, crews would know where to start the search.

Provided by Florida International University

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