The Titan disaster investigation has begun. An expert explains what might happen next

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The United States Coast Guard is now leading the investigation into the Titan submersible, looking for answers about why it imploded, and what actions should be taken next.

A multinational search for the Titan came to a halt on Thursday, when a remotely operated vehicle (ROV) found five pieces of debris sprawled across the seabed, some 500 meters from the Titanic shipwreck. The vessel experienced a catastrophic implosion at some point during its journey, with all five passengers presumed dead.

For now, details elude us—and it could be days, or even weeks, before we receive meaningful updates on the investigation's progress. Similar past events, such as the 2019 fire in the Russian submarine Losharik, have shown how sensitively the details of such investigations should be treated.

The Titan disaster happened in international waters, in a commercially operated vessel, and with victims of different nationalities. Officials will likely want to be certain about any details released—and some may not be disclosed at all.

What happens next?

The Titan, a research and exploration sub owned by US company OceanGate, lost contact with its surface vessel on Sunday morning, about one hour and 45 minutes after its departure.

Chief investigator Jason Neubauer said the US Coast Guard will receive help from Canada, France and the United Kingdom. He said authorities had already mapped the accident site, and the inquiry will aim to address several questions, including:

- what may have happened to cause the implosion?
- how can safety be improved for future submersible voyages?
- what civil or criminal charges should be laid in relation to the events, if any?

Recovery operations in remote parts of the ocean are painstakingly complex, with myriad variables to consider. We can expect the Titan investigation will cost millions of dollars.

Harsh conditions

The investigation is being carried out at depths of about 1,800m, some 600km from the nearest coastline. The same vessel that identified the initial debris—a deep-sea ROV called Odysseus 6K—is reportedly also being used to look for the vessel's remaining parts.

Manufacturer Pelagic Research Services told CNN the ROV's lifting capabilities had "been utilized and continue to be utilized," and that missions would continue for about a week. However, we don't know whether any debris has been recovered yet.

ROVs can collect vast amounts of data for deep-sea operations, including video footage and sensor readings. Ideally, an ROV will be able to reliably and quickly transmit data back to a support vessel or onshore facility, since real-time data transfer is often needed to make important decisions on the fly.

That said, even if Odysseus 6K delivers on this, some parts of the Titan may never be found. They may have disintegrated during the implosion, drifted too far away from the search area, or be obscured by other debris.

Underwater hazards, harsh weather and strong currents all add to the challenge—especially by limiting visibility. In the deep ocean, turbidity (haziness) and the absence of natural light means visibility is close to zero. Here, only sonar technology (which uses sound waves) may be used for navigation, mapping and locating objects of interest.

Any debris recovered will undoubtedly be valuable. Debris is physical evidence of the implosion, so analyzing it will provide information (such as damage patterns and fractures) that can be used to infer the source of the implosion and the forces involved.

Experts can also conduct chemical analyses of the residue on the wreckage. However, this is affected by seawater, so a prompt recovery will be important.

The Titan's remote location means investigators won't have the luxury of having the quick support offered by coastal rescue stations that can rapidly deploy search and rescue assets and diving teams.

They'll have to rely on specialized resources, such as large vessels and aircraft with extended range capabilities. Aircraft can provide an elevated platform for visual observation and aerial mapping, as well as remote sensing technologies including radar systems and thermal imaging sensors.

Finding the remains

Chief investigator Neubauer has said searching for victims' remains is on the agenda. But the chances of actually finding them will depend on various factors, including the cause of the implosion, the depth at which it happened, and the surrounding conditions.

A severe implosion may have resulted in extensive fragmentation and scattering of both the submersible's structure and human remains. Remains can be swept away in currents, or tampered with by marine life.

They also behave differently depending on whether they're recovered from non-sequestered environments (exposed in the water) or sequestered environments (enclosed in a vessel). In the former scenario,

bodies are often consumed by animals and decomposition causes disarticulation, wherein the bones gradually separate at the joints. However, garments can sometimes help to keep things together.

The effort to locate remains may involve observation from long-range aircraft and patrol vessels, or may even rely on radar, sonar or satellite imagery. If remains are located deep underwater, recovering them may involve using a specialized hoisting system designed to handle the challenges of a deep-sea environment.

Sharing responsibility

The Titan investigation will involve coordination between multiple entities, including maritime authorities, coast guard services and search and rescue organizations.

It will be subject to international agreements such as the International Convention on Maritime Search and Rescue, as well as international law such as the duty to render assistance, which is enshrined in the United Nations Convention on the Law of the Sea. This requires that all vessels, regardless of their flag, have a legal obligation to render assistance to any person in distress at sea.

For now, we can only speculate on what the Titan investigation might produce. All we can do is wait, and hope that whatever answers do emerge will be put to good use to make sure something like this never happens again.

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