Raising the COSTA CONCORDIA

A Crowley Maritime Corporation Publication

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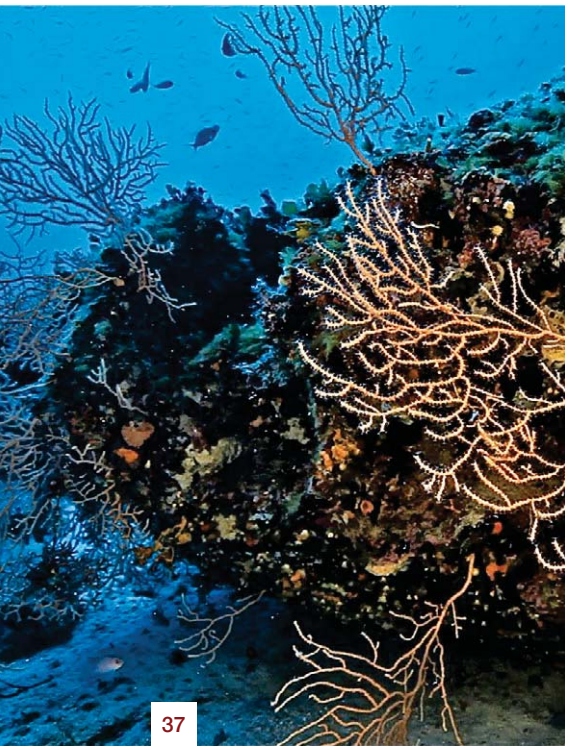

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Raising the Co

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osta Concordia

Described as the largest, most technically demanding wreck removal operation ever attempted on a ship of its size, the wrecked *Costa Concordia* cruise liner was successfully removed from an idyllic slice of Italian shoreline in July 2014. For two and a half years, the gnarled cruise liner sat in protected marine waters, glowering at tiny Giglio Island, a quiet community connected to Tuscany only by colorful ferries.

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When the incident occurred in January 2012, the ship smashed into the rocky coastline where it heeled over starboard and came to rest suspended on two underwater granite knuckles. Though the rocky protrusions crushed portions of the starboard hull – in addition to additional damage on the port side – and left a 160-foot gash from the initial impact, they also prevented the wreck from sliding down the steep sea slope. TITAN Salvage was on site within 48 hours of the incident, ready to assist.

The accident is now considered the largest passenger shipwreck by tonnage in history. But the great lengths required for its refloat and removal are perhaps even more epic, as was the talented team behind the salvage effort.

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1. The *Costa Concordia* remained in Giglio's waters from January 2012 until it was towed away by the TITAN/Micoperi team in July 2014.
2. The wreck landed in the Tuscan Archipelago National Park and "Pelagos" Whale Sanctuary, which is famous for the biodiversity of its habitat and frequent sightings of sea mammals.
3. TITAN Salvage was on site within 48 hours of the incident, ready to assist.

The Project:

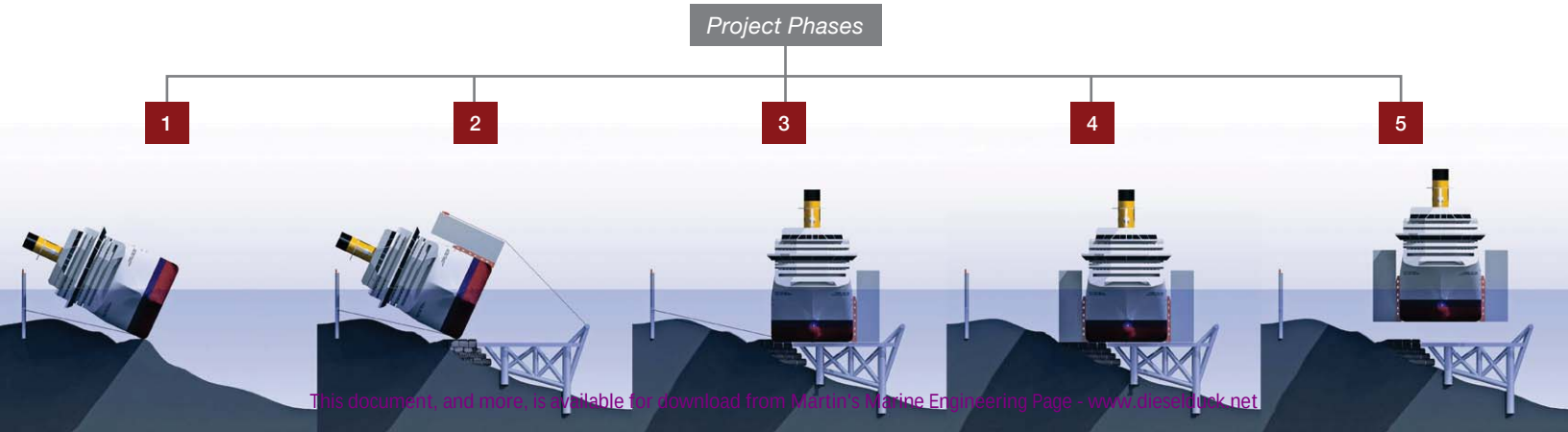
Largest Maritime Wreck Removal Project in History Begins

1. Rich Habib
2. Nick Sloan
3. A view of the wreck's bow and work site

With the stakes high and a ship twice the size of the *Titanic* laying precariously on its side in protected waters, vessel owners Costa Crociere (a unit of Miami-based Carnival Corp. & PLC.), alongside others on a specially appointed review board, immediately began evaluating proposed salvage plans from more than 10 of the most experienced wreck removal and maritime salvage companies from around the world. After an exhaustive search, they selected Italian offshore service provider Micoperi and Crowley Maritime's internationally based TITAN Salvage.

Chosen for their ability to fulfill the main objectives – which included removing the wreck in one piece with minimal risk and environmental impact, while maximizing the protection of Giglio's economy, tourism industry and safety – the TITAN/Micoperi team set forth with a complex plan to remove the stricken vessel at a cost of more than what it took to build the vessel in 2004.

The duo complemented one another well: TITAN brought valuable experience in salvaging some of the toughest marine disasters on earth, and access to highly specialized personnel and equipment. Additionally, through fellow subsidiary Jensen Maritime, Crowley's Seattle-based naval architecture and marine engineering firm, TITAN was able to also provide sophisticated support, including project management specialists, procedure writers, designers, project control engineers, and heavy logistics managers, to aid in a successful project execution. Micoperi brought with it a long history as a specialist provider to the offshore construction and engineering sector, as well as critical heavy lift assets. The companies'



The operation was led by TITAN's Nick Sloane, senior salvage master and South African salvage expert, with the help of 10 others, including TITAN colleague Capt. Rich Habib, managing director, aboard a command and control barge.

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combined talents brought forth a mind-boggling plan that deployed five stages of work that have never been attempted on a scale of this magnitude.

The operation was led by TITAN's Nick Sloane, senior salvage master and South African salvage expert, with the help of 10 others, including TITAN colleague Capt. Rich Habib, managing director, aboard a command and control barge.

"We nicknamed them the 'Magnificent Eleven'," said Franco Gabrielli, the Italian official in charge of the project.

By the time the TITAN/Micoperi team began their work on site in May 2012, Costa Cruises had already taken measures to protect and secure the environment. Immediately after the incident, they established several perimeters of boom around the wreckage and hired contractors to remove more than 2,300 tons of bunker oils and other pollutants.

"Our multi-phase plan started with the establishment of the holdback system and stabilization of the vessel," said Habib. "Two and a half years later, the job successfully ended with the vessel being rotated upright in one piece, refloated and towed away for final demolition and recycling by the client."

TO SEE A VIDEO DESCRIBING THE *COSTA CONCORDIA* SALVAGE PLAN, VISIT:

titansalvage.com/parbuckling

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Phase One:

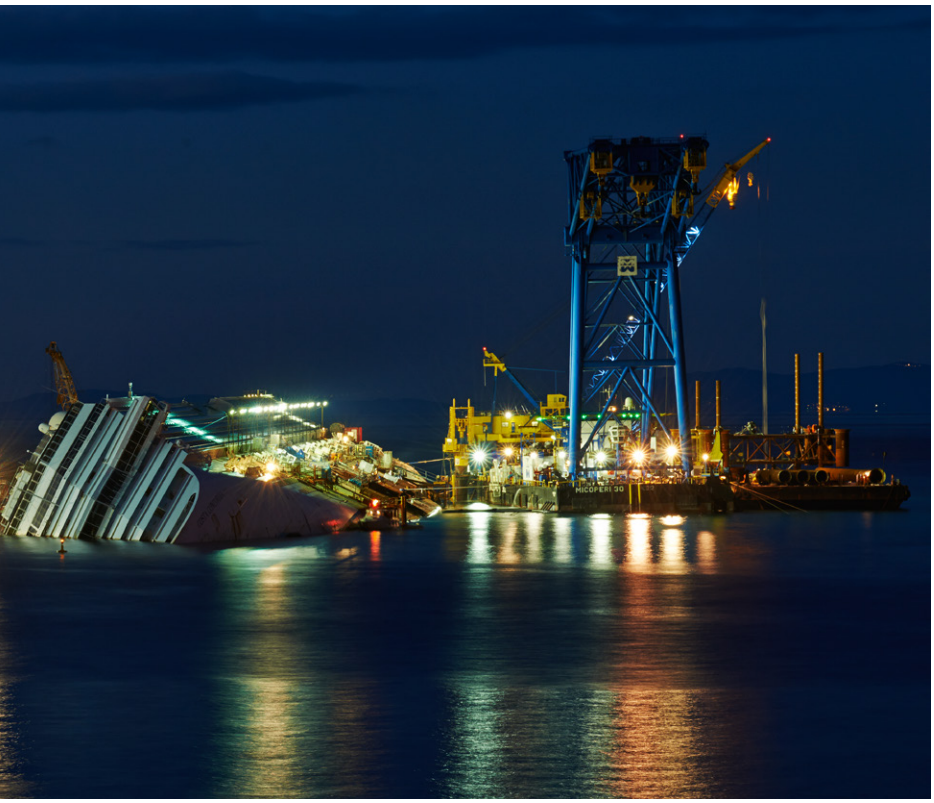
Holdback System and Stabilization

1. Workers took mountain-climbing classes to safely traverse the *Costa Concordia*.
2. Wreck removal operations continued around the clock.
3. The crews installed and positioned a series of anchor blocks to support the platforms.
4. The TITAN/Micoperi crew's make-shift locker and mess rooms aboard the ship

The *Costa Concordia*, which measured three U.S. football fields in length, required the crucial first step because, as Habib explained it, "It anchored and stabilized the ship onto the granite seabed to prevent slipping or sinking along the steep sea floor, which dropped off sharply nearby. Doing so also made it possible to work safely – even in bad weather."

The initial holdback lines consisted of 16 heavy wires that connected to four submarine anchor blocks. Each block weighed 35 tons and was pinned into the sea bottom between the center of the wreck and the coastline. Installation of the remaining holdbacks brought the total number of anchor blocks to 11. Multiple towers – each holding two independently controlled hydraulic strand jacks – were fitted to the blocks and were attached to 22 chains. The chains were so massive that each link measured 27 inches and weighed 900 lbs. The chains eventually were threaded beneath the hull to prevent the ship from sliding down the slope as the opposing righting force was applied in phase three.

But working aboard the ship proved to be a feat unto itself. The cruise ship initially rested at a 70-degree angle in 65 feet of water. As an example of Crowley and TITAN's commitment to safety, traversing such a sharp slope required



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"Whether you were talking about the weight of the ship, the high center of gravity, the vessel construction, the topography of the seabed, the massive damage … all of those things just drove the size of the project."

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the salvage workers to take a four-day course in mountain climbing. Each trek up required harnessing and strapping, and rigging back-up lines, and every shift was monitored for safety by rescue climbers sourced from the Italian Dolomite Mountains.

Nothing came easy on a job this size.

"Whichever way you looked, whether you were talking about the weight of the ship, the high center of gravity, the vessel construction, the topography of the seabed, the massive damage … all of those things just drove the size of the project," said Habib.

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Phase Two:

Underwater Support and Portside Sponsons

In the fall of 2012, phase two began and kept TITAN/Micoperi busy preparing the false bottom that the wreck would rest on after its parbuckling, or rotation to an upright position.

Because the ship was suspended at the bow and stern by the two underwater ridges, the center of the ship had to be supported by a platform, or a "false bottom," to allow the ship to rest upright on the steeply sloping bottom. To create this stable foundation in an uneven terrain, TITAN/Micoperi's dive team hand-placed hundreds of eco-friendly, cement-filled grout bags – nearly 15,000 cubic meters worth – between the two spurs of rock under the ship. The bags, each the size of a residential swimming pool, were designed with straps for easy removal at the end of the project.

"That's equivalent to about 24,000 tons of cement," said Habib. "Every component, every way you look at this project, you're talking about massive numbers."

"The finish had to be as perfect as your bed mattress so the force of the parbuckling would be transferred from the ship, through its turn of the keel, onto the mattress," said Sloane. "And it had to be spread perfectly. If any of the grout had collapsed, the ship would have collapsed in a 'domino effect.' The risks were very high."

During this labor-intensive stage, the more than 120 specialized divers, who represented 11 different countries, worked around the clock to help keep the project on schedule. Together, they logged around 100 dives per day, amounting to more than 22,000 total dives by the end of the project – the largest dive operation ever in history. Their job was perhaps one of the toughest: being submerged at 150 feet for only 45 minutes at a time and then making the quick transition to a hyperbaric chamber for decompression was taxing. And for every diver underneath there were five workers on land to support him. The surface team provided direction and monitored the diver's depth and air continuously, helping him stay focused and safe as he worked in short bursts.

The installation of these layers of grout and cement bags had been commenced just as the winter of 2012 came on scene. Arriving with

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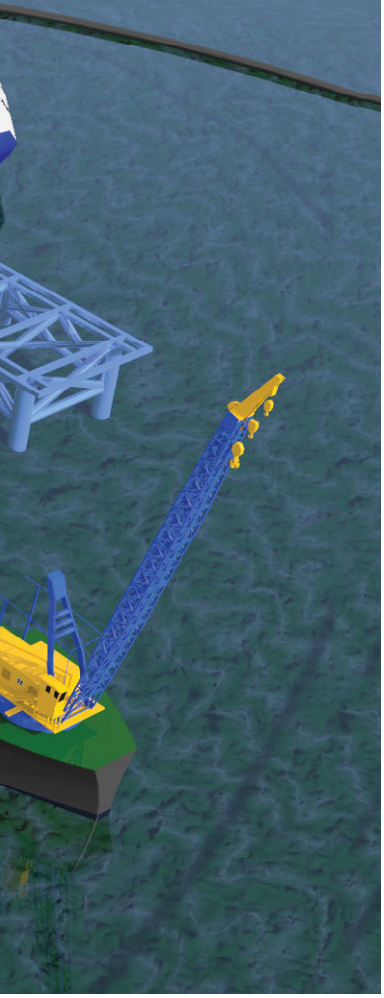

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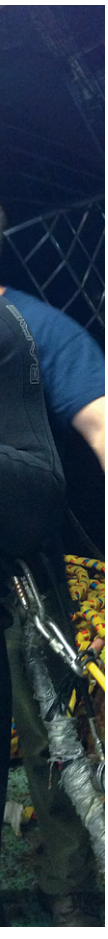
During this labor-intensive stage, the more than 120 specialized divers, who represented 11 different countries, worked around the clock to help keep the project on schedule.



no mercy, that season turned out to be the worst on record in Giglio in 45 years, causing the project to fall significantly behind schedule. Sloane remembered the weather, including two 10-year storms that hit in just a couple of weeks in late October, well.

"As a result of the 'Halloween Storms,' the ship actually collapsed a couple of meters," said Sloane. "She just sighed and went down six-and-a-half, seven feet." But, the resultant condition was favorable. "If she had distorted or buckled before we put down the 'grout mattresses,' that would have been the end of the game right up at the start. So, fortunately, when she did collapse, she collapsed evenly, which was quite amazing. When we went back on board, there was hardly any structural change to the ship itself."

Butting up against the grout bags were the six steel platforms, the largest of which weighed 1,000 tons, constructed at three different fabrication yards around Italy.

Micoperi's Sergio Girotto, project manager, commented during a CBS News '60 Minutes' interview, "It is a gigantic project. If you simply take the quantity of steel [used in the platforms], it is three times the weight of the Eiffel Tower."

Simultaneously, the piles that anchored the massive platforms into the seabed were installed alongside the grout bags. Each required a 6.5-foot diameter hole to be drilled through over 40 feet of solid granite and cemented into place.

"We had to drill large-diameter piles into the side of an underwater granite mountain," Sloane said, describing the challenge. "That had never been done before. It's normally something you'd avoid doing, but we were constrained by the location and the desired footprint of the platforms. So, we had no choice but to find a solution for drilling into the bedrock."

The difficulties continued.

"You imagine drilling into a piece of glass at a 45-degree angle with a hand drill: the drill just wants to slide down the whole time. We had to drill all the holes in exactly the right locations so that when the platforms arrived they fit the holes and there was only a tolerance for 1 percent margin of error," Sloane said. "There were also some last-minute problems with the profile

1. A rendering illustrating the platforms or "false bottom"
2. TITAN's divers logged around 100 dives per day, amounting to more than 22,000 total dives by the end of the project – the largest dive operation ever in history.
3. TITAN's dive team hand placed hundreds of eco-friendly, cement-filled grout bags – each the size of a residential swimming pool – between the two spurs of rock under the ship.

of the bedrock, which meant that we had to modify some of the platforms two, three weeks before they were going in."

To complete the surface-breaking granite drilling, the team created innovative sub-sea templates with hydraulic rams that matched the footprint of the platforms. This aided in the bedrock breakthrough and also helped to provide a level template on the sea bottom. The weight of the small template totaled 75 tons, with the larger of the two templates weighing over 270 tons.

Another challenge was transporting the sponsons from the shipyards to the worksite during the weather window when they were needed so as not to delay the project further. Sponsons are metal boxes – the largest was 800 tons and the tallest 11 stories high – that were filled with water and affixed to the sides of the vessel to ballast the wreck to the platforms. Later, compressed air was used to displace the water and create buoyancy during the refloating phase.

"I think the logistical challenge of supplying the sponsons on demand at just the right time proved to be a challenge and that's what the logistics team did fantastically well," said Sloane.

Crowley had responsibility for the interyard and cross-country deliveries of the newly built sponsons and platforms. The sponsons were

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constructed at five different shipyards around Italy and when each was completed, they were transferred to a marshalling site at a container yard in Livorno before being shipped to the project site via barge.

"Each sponson had a special role and place on the wreck," explained Crowley's Michael Johnson, project logistics. "They weren't interchangeable. That meant they all had to be organized and delivered at a special time. It was similar to Just-in-Time shipping, which is a very challenging program when you're delivering from one side of the country to the other via tug and barge."

1. Sponsons under construction at Fincantieri Shipyard in Genova
2. Platform 2 is towed out for installation. This platform, which was built at the Rosetti shipyard in Marina di Ravenna, weighed about 1,000 tons and measured 40 meters wide by 22 meters high. It was secured to the granite seabed about 10 meters deep.
3. Strand jacks are hydraulic jacks used to tension the cables and give the wreck more stability. This salvage project used more strand jacks than any other in history.

1. Specially trained divers carefully relocated protected underwater species to a safe area for the duration of the salvage operation.
2. A view from the hills of the sponson installation work
3. Installation of the initial portside sponson took around six hours.

Once in Livorno, Habib pointed out that the challenges weren't over: "We were rotating these things in different directions so we could finish the outfitting on them. Then we moved them back to the dock and then put them aboard barges to be brought to the site in the correct order and in the correct orientation."

Once the pieces were delivered and the drilling was complete, the hollow legs of the platforms slid easily over the piles to hold them in place – another job requiring absolute precision.

Sloane explained, "The margin of error that we could allow for was less than six inches over the whole length of the platform. If it was any more than that, the legs wouldn't fit."

To protect the environment during the drilling, the drill head was enclosed in a closed-circuit system – an eight-foot pipe running from the seabed to the surface – to contain the drill cuttings, mud and sediment. Marine biologists from Rome's Università La Sapienza also temporarily relocated more than 280 giant mussels (*Pinas Ignoblis*) from the meadows of Neptune Grass (*Posidonia Oceanica*) for protection.

After the platforms were installed, a crane aboard the *SAL Svenja*, a specialized heavylift ship, was deployed to perform the installation of 11 parbuckling and refloating sponsons on the portside of the wreck.

"[The sponsons were] outfitted with

sophisticated hoses and air pumps to create buoyancy," explained Girotto to "60 Minutes." "The space from one sponson to the other, it [was] less than two inches. So, they [were] fabricated within a very strict tolerance."

Sloane added, "To get that tolerance was quite amazing."

"Between the platforms, sponsons and all the other heavy steel structures required for the project, it means that 33,000 tonnes of steel was fabricated to add on – enough to build two ships," said Habib.

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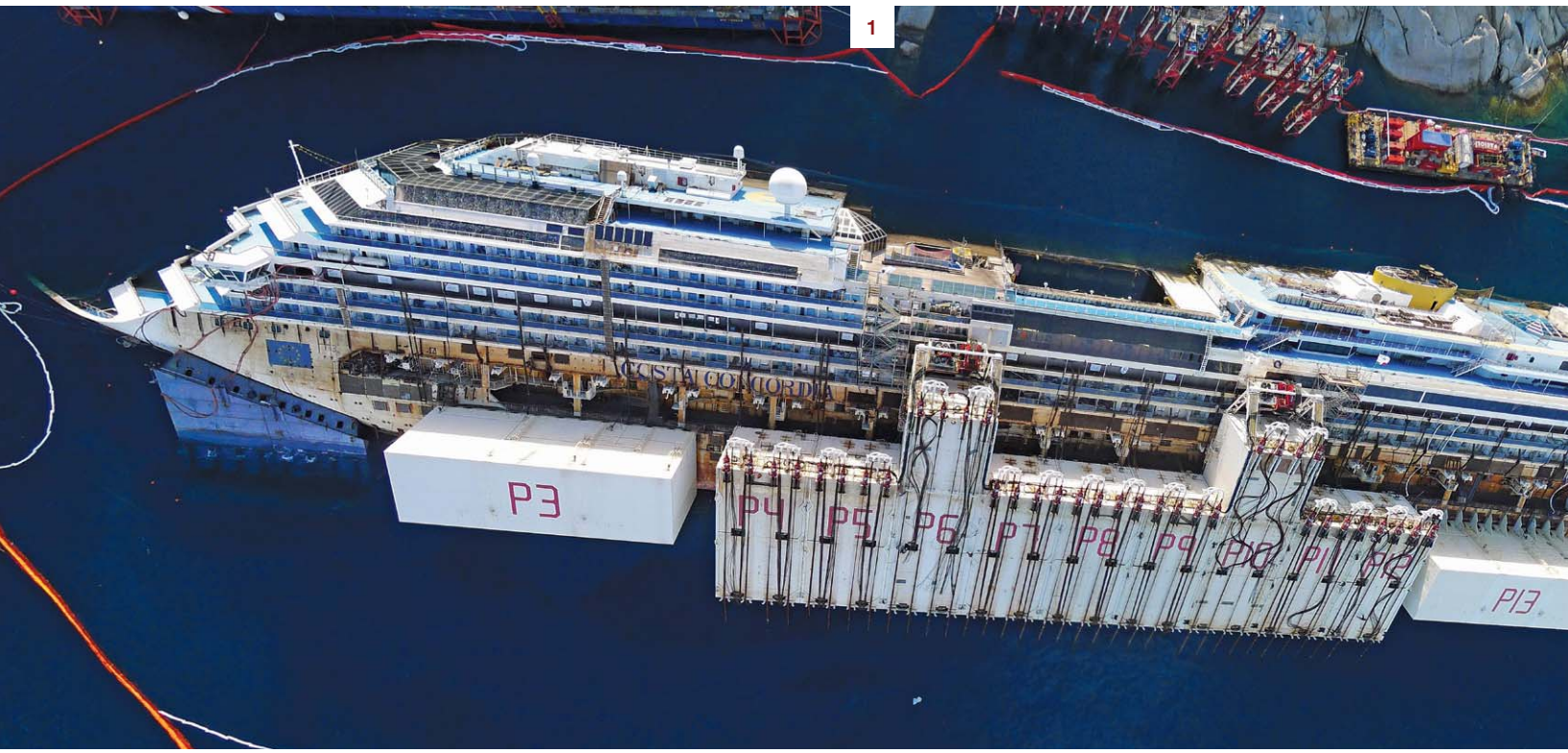

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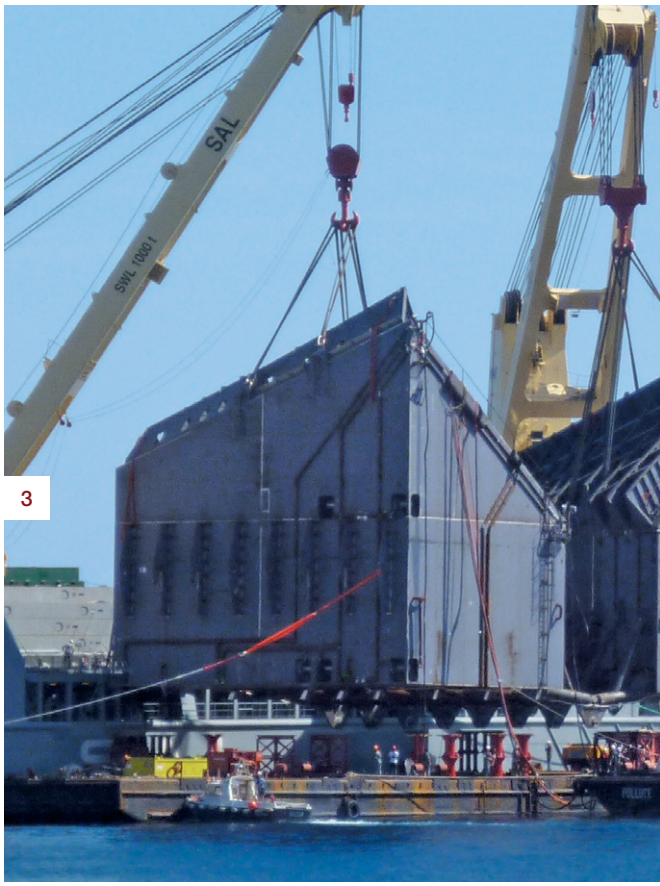

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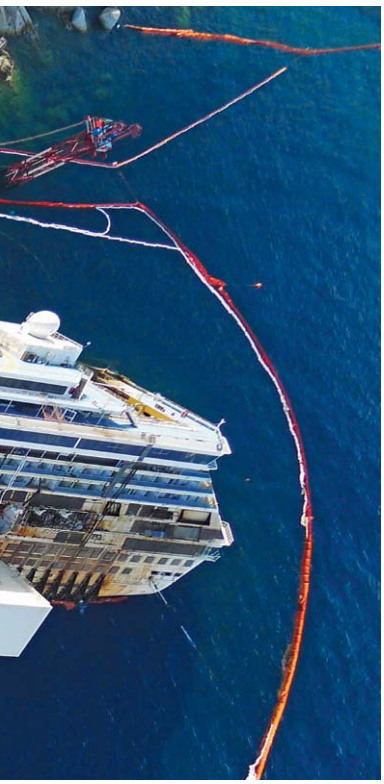
1. A view of the 114,000-tonne wreck, fully outfitted with portside sponsons, just days before it was to be parbuckled.

2. The day before the parbuckling, the salvors "pre-tensioned" the wreck, a process involving an initial exertion of force to let it "soak through" the steel and prepare it for the event.

3. The "blister sisters" were special sponsons that provided a net buoyancy of about 4,000 tons and supported the bow during the parbuckling, the resting of the wreck on the artificial seabed and the refloating stage.



Phase 3:

Ready to Roll: Parbuckling

With the foundation secured, platforms in place and 11 of the 15 portside sponsons installed, the next step was the parbuckling.

Surprising to some, this technique is nothing new. It was used, for example, to right the *USS Oklahoma* after the battleship was sunk at Pearl Harbor and also to salvage the *Herald of Free Enterprise* ferry after it capsized at Zeebrugge in 1987. But the location and sheer scale of the *Costa Concordia* made the technique challenging, as did the vessel's internal structure and positioning.

"This [was] brand new technology, brand new methodology," said Girotto. "To lift a vessel in this way … it [was] the first time ever."

Even before the delicate third stage began in the summer of 2013, it brought many uncertainties for the team. No one could predict how much force would actually be required to pull the ship upright, if it had the structural integrity to withstand the pressure of the rotation, or what the damage would be on the starboard side. Every possible outcome was considered and the plans were painstakingly reevaluated. As a result, it became clear to the TITAN/Micoperi team that the bow of the vessel would need additional support during the parbuckling.

"The bow was in deep water so we couldn't put support platforms there. We had three large platforms under the ship's belly and three baby ones under her stern, but there was almost a football field's worth of the bow hanging over the forward reef suspended," explained Sloane. "We knew there was a good chance when we parbuckled, the bow would twist and break … so, we used the 'blister sisters'."

Not part of the original plan, the "blister sisters" were two additional steel tanks that TITAN/Micoperi installed on the *Costa Concordia*'s suspended bow to provide support during and after the parbuckling, as well as during the refloating phase. The tanks, which were fixed to the hull by means of three anchor pipes installed in the bow-thruster tunnels, collectively weighed 1,500 tons and each measured 23 meters long and 20 meters high. Much like a cervical collar/neck brace used on patients with spinal injuries,

Not part of the original plan, the "blister sisters" were two additional steel tanks that TITAN/Micoperi installed on the *Costa Concordia*'s suspended bow to provide support.

"It was an amazing accomplishment by the project team to have them designed, built and delivered on time."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they provided a net buoyancy of 5,000 tons to the front of the ship, reducing the chance of further damage.

"Once it was conceptually determined that the installation of the blister tanks were needed, it was an amazing accomplishment by the project team to have them designed, built and delivered on time," said TITAN's Simon Forrest, manager, accounting, who worked on the project's finance team.

The installation of the "blister sisters" was completed in August 2013.

But the TITAN team had one more unexpected challenge to overcome before they could parbuckle the wreck: authorities required the salvors to remove 4,000 tons of sediment from the seabed, a task that took nearly a month to complete.


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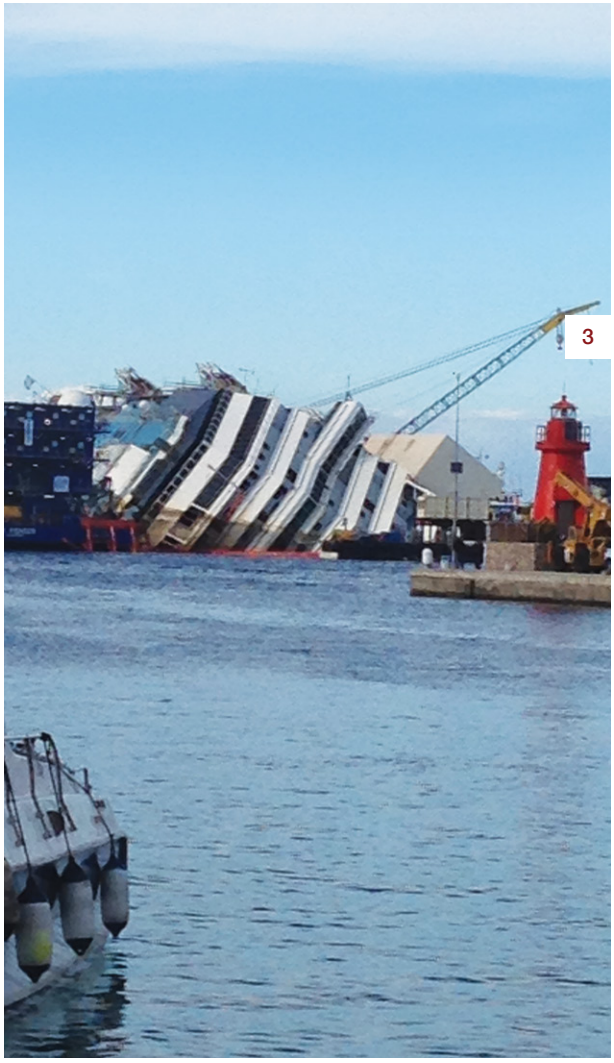

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"It was basically like manually vacuuming the seabed," explained Sloane. "Walking around with a vacuum pump connected to the surface and you have big sediment traps on the surface. You let the water go through some filtration systems to make sure the water that comes out of there is perfect and then dispose of the sediment. We finished just in time for the parbuckle, so it was perfect timing."

The night before the rotation was to begin, Sloane and his colleagues pre-tensioned the wreck, a process that involved an initial exertion of force to let it "soak through" the steel and prepare it for what was to come. This was an important first step because once the parbuckling began, it could not be stopped.

Then, on the morning of Sept. 16, after a brief delay due to thunderstorms, parbuckling operations began. The TITAN/Micoperi team sat directing the show in their highly technical control room aboard the barge *Polluce*, positioned on the *Costa Concordia*'s bow. With the orders given, 36 hydraulic strand jacks, with the combined capacity of 13,000 tons of force, began the job of pulling the massive vessel upright.

"At the start it was very tense. We had got to 6,000 tons [of force] and she hadn't moved," said Sloane. "People were nervous. We had to use 6,800 to 7,000 tons to get her off the rocks. That was the most crucial moment."

"The forces needed to pull the ship upright were greater than expected," added Habib. "It needed a bit more oomph. The strand jacks had to go slower than we'd originally thought."

Just after noon, TITAN/Micoperi announced that the initial steady pulling force of 6,800 tons from the jacks had rotated the vessel by three full

1. The "blister sisters" in production in Palermo, Italy.
2. Commonly working in groups under computer control, strand jacks use hydraulic grips to pull steel cables a few inches at a time - in this case to raise the *Costa Concordia*.
3. The dirty waterline marks the slow progress of the parbuckling.
4. The salvage team observes the parbuckling operations carefully from the remote control room.

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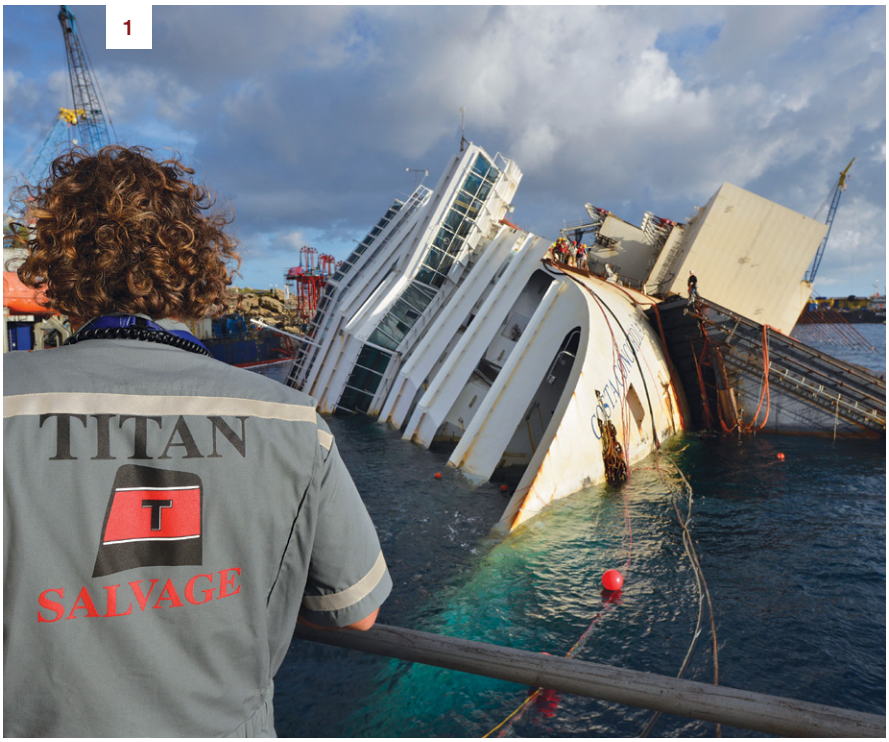

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Sloane announced that the *Costa Concordia* was raised and his wife initiated the first vessel horn, which was echoed by others in unison.

degrees. While not enough to warrant sighs of relief just yet, it was evidence that the plan was indeed working and that the pulling forces could be decreased gradually as rotation progressed due to the weight of the sponsons, which would help to roll it upright. Meanwhile, the computer-operated ballast-control system of the sponsons fostered an elegant counterbalance to prevent over-rotation.

As the uprighting progressed in excess of 10 degrees, operations were interrupted to address some of the pulling cables that had begun to entangle. The TITAN/Micoperi team had prepared for this issue and addressed it via the mobile salvage technicians, which quickly allowed the procedure to begin again.

By midnight, the vessel had reached a point where artificial pulling was no longer warranted. Then rotated by about 35 degrees, the sponsons were slowly flooded and gravity assisted in completing the roll-over. Averaging six degrees an hour, the vessel finally sat fully upright – with no environmental spills – after 19 hours of work at 3:59 a.m.

Sloane announced that the *Costa Concordia* was raised and his wife initiated the first vessel horn, which was echoed by others in unison, along with a thunderous applause that erupted from the team that echoed through the island's hills. As the church bells rang, the people of the island of Giglio, Italian authorities, hundreds of members of the media and the TITAN/Micoperi team gathered to eagerly greet the rest of the on-site team who had tirelessly labored to complete this incredible feat. It was a momentous occasion for all and a proud moment for TITAN.

Franco Porcellacchia, project manager for Costa Cruises, said the operation was faultless: "We completed the parbuckling operation the way we thought it would happen and the way we hoped it would happen. A perfect operation, I must say."

TO SEE A SHORT TIME-LAPSE VIDEO SHOWING THE RIGHTING OF THE *COSTA CONCORDIA*, VISIT:

titansalvage.com/timelapse

"Nick and his team did a really superb job," said Habib, managing director. "It was nearly perfection and that is a very hard thing to come by in a wreck removal. It's a testament to their skills and hard work."

Denny Hoffschlag, a diver from the Netherlands, said: "This is a once in a lifetime job. "There's a lot of joy, seeing the ship finally upright. It gives me goosebumps. It's an experience I'll never forget."

Upon her righting, the true damage to the vessel could finally be seen. Huge crater-like indentions where she came to rest on her side were now brazenly on display. Crushed steel, broken windows, shifted furniture and strewn belongings were now also visible for on-lookers.

And while its port side was still a pristine white, the ship's starboard side, which had been submerged for over 20 months, was coated in a dirty brown scum, giving the vessel a surreal, half-and-half appearance.

With the project 60 percent completed at this stage, the vessel was finally safely upright, resting on its artificial seabed at a depth of approximately 32 meters, a reassurance that brought needed relief to the TITAN team.

But the challenges weren't over. The starboard damage still had to be inspected and stabilized, and the vessel needed to be winterized once more to preserve it until work could begin again in the spring.

1. A TITAN salvor monitors parbuckling operations on scene.
2. A view of the damaged starboard side of the *Costa Concordia*
3. Reporters lined the shore to film and broadcast the parbuckling live. From this vantage point, they had an incredible view of the submerged side as it slowly rose from the water.

Upon her righting, the true damage to the vessel could finally be seen. Huge crater-like indentions where she came to rest on her side were now brazenly on display.

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Phase 4:

Starboard Sponsons

Winterization of the vessel began soon after the parbuckling, in October 2013.

TITAN's main objective in doing so was to protect the vessel and environment from further damage during the difficult coming winter months.

This was done in three steps: first by positioning an additional hold-back system to avoid further movement of the bow. Second, the TITAN/Micoperi team installed additional removable grout bags in the area between the wreck and the shoreside rocks. Finally, to further stabilize the wreck, they positioned sea-side tubular pipes that braced the underwater platforms to the top of the sponsons. Structural surveys on the damaged starboard side were also completed, which helped to define the repair operations that would later allow for the positioning of the 15 starboard sponsons required for the refloating phase. Throughout all of it, environmental monitoring continued to assess Giglio's sea water quality.

The work TITAN/Micoperi did in preparing for winter was successful; the wreck made it through the harsh months unscathed and in April 2014, installation work for the starboard sponsons began. Once again presenting challenges, the *Costa Concordia*'s dingy right side had to be completely reconditioned to create a flat, even surface to allow the sponsons to be installed in perfect alignment and to transfer the refloat forces into the hull of the ship.

"We had to create very heavy steel beams with bumpers at the end," explained Sloane. "We had to recreate them underwater, inside all the damaged areas so it would fit the exact external profile of the damaged side of the ship. That was done very well. Very impressive; the fabrication team did an incredible job."

Additionally, the establishment of the electrical-pneumatic ballast-control systems for the functioning of the sponsons during the refloating phase also began.

By late April, after two-and-a-half days of work, TITAN completed the installation of the first sponson on the wreck's starboard side. The inaugural sponson, which was the largest by height and weight, had been towed around to the inshore side and precisely ballasted for positioning against the starboard hull via a rotating heavy-lift crane aboard the pontoon barge *Conquest MB1*. Strand jacks pulled against the massive chains running beneath the hull to hold it tight to the wreck once pressurized.

Simultaneously, the air-filled sponsons on the port side were ballasted with water to hold the *Costa Concordia* firmly to the false bottom as the work commenced.

Slowly, one by one, the 15 new sponsons – plus an additional four to the portside – were added to the wreck, a feat completed by early July 2014. Described as time consuming and meticulous, the multi-month stage brought together more than 350 technicians, of which 120 were divers, who helped to prepare the wreck for the final stage.

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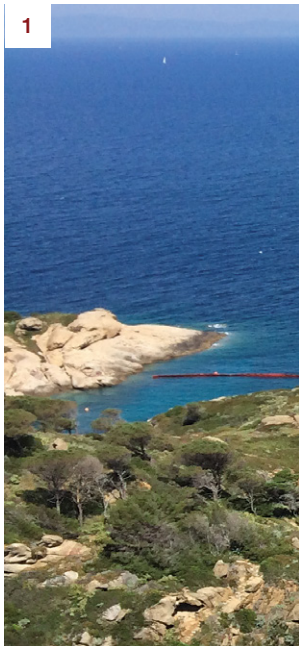

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1. A sophisticated crane barge, the *Conquest MB1*, arrived at Giglio Island to carry out operations related to the installation of the starboard sponsons.

2. The starboard sponson installation crew is ferried to the worksite.

3. The first of the 19 starboard sponsons, the S13, was installed. The structure weighed 10 tons and measured 33.5 meters wide by 11.5 meters high.

The *Costa Concordia*'s dingy right side had to be completely reconditioned to create a flat, even surface to allow the sponsons to be installed in perfect alignment and to transfer the refloat forces into the hull of the ship.

3

Phase 5: Refloating and Tow

Mid-July, Costa Crociere CEO Michael Thamm issued a statement that read, “Everything is in place and ready [for the refloat], the salvage team has successfully completed the technical tests … It is a complex operation never attempted before, but we know we can count on the best technicians in the world.”

After two and a half years, the final stage of work had arrived.

“The plan was to partially refloat the vessel,” said Habib. “In other words, just get it up a few meters off the platform and then move it out about 30 meters. At that point the inshore sponsons would be in deep water and we could pull – using the strand jacks on top – them down to the final depth in their final position. At that point we could get to our contract draft of 18.5 meters.”

“We knew it would be a challenge, so we gave ourselves seven days,” said Sloane. “It took 10.”

At 6:00 a.m. on July 14, the refloating operation began. Sloane, Habib and the TITAN/Micoperi team arrived at the remote control room and the salvage crews began the first step of

lightering the vessel, freeing it of 30,000 tons of ground reaction, via the buoyancy in the ship’s sponsons.

Several hours later, Sloane gave the order to start up the powerful pneumatic blow-down systems, which were mounted on the ship, to gradually begin emptying water from all the sponsons. This displacement gently lifted the vessel from the false bottom, leaving 60 feet of the hull beneath the water. The team also began the task of tightening the massive chains connected to the sponsons.

But the salvors couldn’t have anticipated that they would have absolutely no excess buoyancy to spare during the refloat. In fact, had the team not installed the “blister sisters” on the bow of the wreck, Habib confirmed that the ship would have been difficult to rise up off the platforms. Ultimately, the situation required the salvage team to perform a risky ‘pull full’ maneuver with the tugboats.

“I have to tell you, as an experienced salvage master, I can’t begin to imagine what was going through Nick’s head,” said Habib. “Because when you’re pulling something hard and


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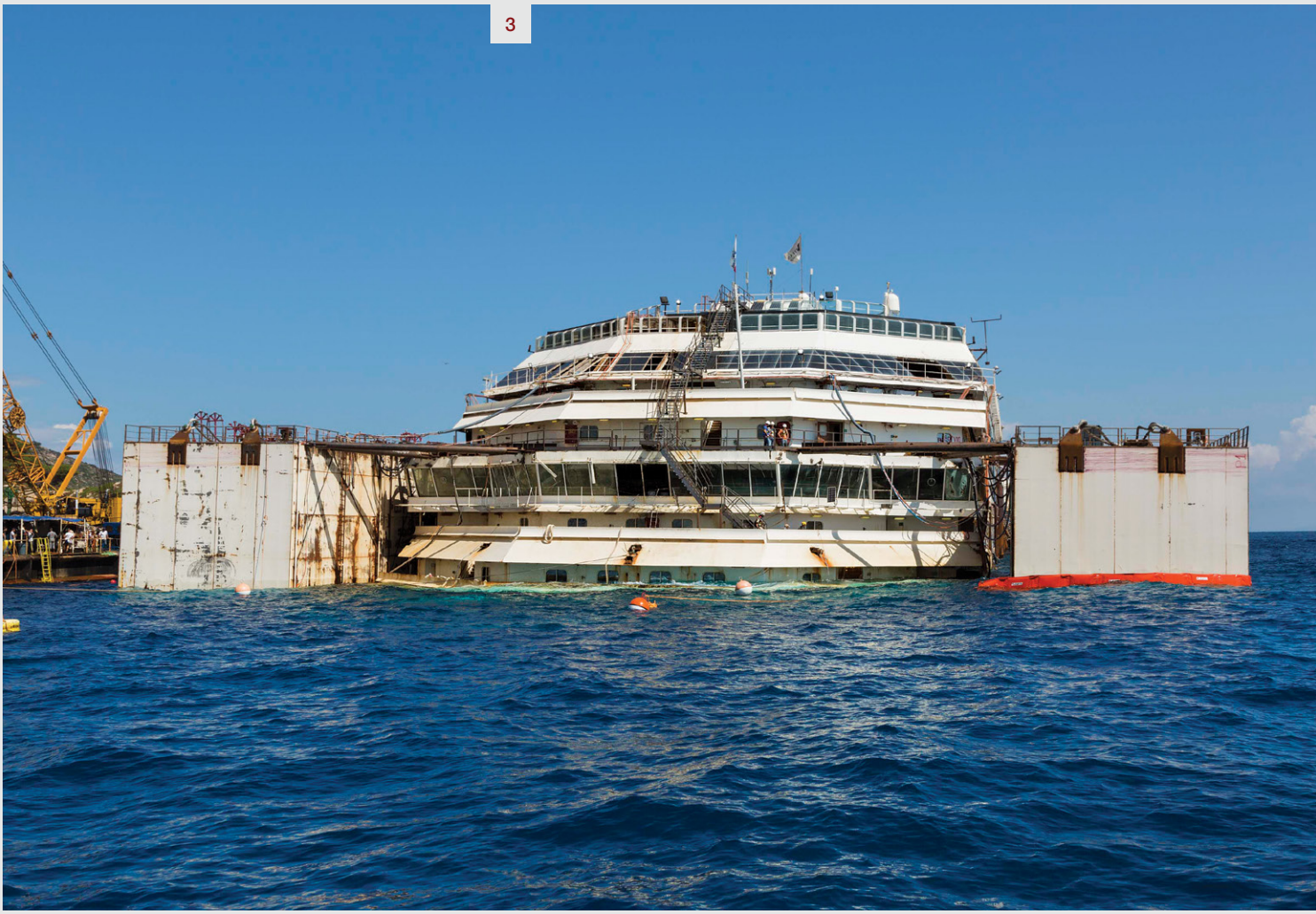

it's aground – and this was aground on the platforms – what often happens is it starts to move very slowly, but within a few seconds, it will increase speed very quickly. We often see as salvage masters ships come off much faster than we'd like to and then we have to get control of the ship."

Regaining control of a vessel after a 'full pull' isn't always a problem, especially if there is space to do so.

"But Nick only had 30 meters," said Habib, "which is nothing! And yet he still 'pulled full.' If I'd have had an engineer as a salvage master, I don't think we would have come off. I think the project would have failed right then and there. It takes a guy with a lot of instinct to be able to take the risk to do that and 'pull full' like he did with hardly any room to maneuver. In the end she came off – I mean, it was a struggle, but she came off – in a very stately manner. She came off very slow and grudgingly. So, that was just a really exhilarating moment for all of us."

Once off the platforms and floating in deeper waters 30 meters offshore, the TITAN/Micoperi team saw for the first time the light at the end of the tunnel.

"We knew then that we could bring the sponsons down to their final positions," explained Habib. "We really felt very confident that we could get it to the design draft and also tow it up to Genoa. That was really the moment when we all felt like we had won the project."

1. The salvage team mans the remote control room.
2. Nick Sloane and several members of the TITAN/ Micoperi team head to the work site on the morning of the parbuckling.
3. The *Costa Concordia* is ready for refloating.

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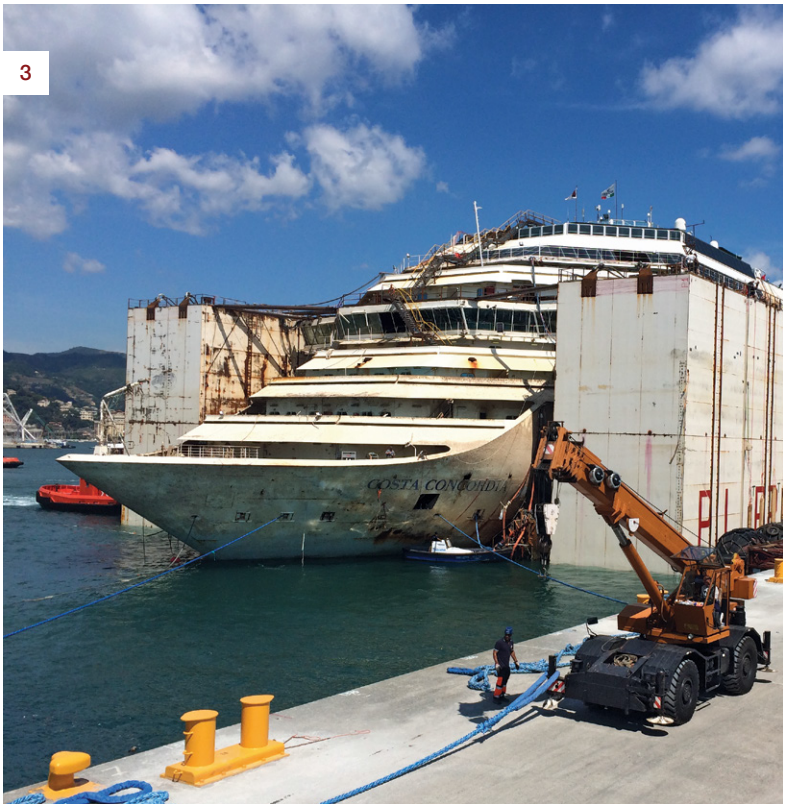
Over the next four days, TITAN/Micoperi deballasted the sponsons and connected and tensioned the last four chains and six cables. Water was sampled continuously to maintain the integrity of the environment throughout the process.

On July 22, after many days of upward movement by only meters at a time, it was announced that the vessel had been fully refloated and was at her contractual draft. The next morning, she was scheduled to be towed away from Giglio waters forever.

The morning arrived with perfect weather. After final inspection, the wreck's mooring lines were cut and, like a chariot lead by a

1. Fully refloated, the *Costa Concordia* is towed away from Giglio forever
2. A TITAN salvor watches the *Costa Concordia* arrive at Genoa's Voltri Port, where it was returned to the owner.
3. The *Costa Concordia* docked at Genoa's Voltri Port.



team of gleaming horses, the *Costa Concordia* began its final voyage via a convoy of more than a dozen support vessels. The parade included two tugboats with a combined 24,000 horsepower and 275 tons of bollard pull at the bow for the hull, and two additional auxiliary tugs positioned aft.

"I had the opportunity to watch it sail away," said Forrest. He had climbed the hill towering over the site of the accident and waited as the ship made its grand exit. "It was very emotional. At one point all of the ships' horns were going and water cannons were firing into the air. The feeling was celebratory, especially for all the workers."

The *Costa Concordia*'s forward progress was made at the speed of a golf cart. Sloane and Habib were some of the few who remained onboard the disabled vessel to provide constant monitoring of its list, ballasting and speed, among other vitals. Additionally, divers and underwater Remotely Operated Vehicle (ROV) operations were available should an intervention be required on the sponsons, cables, chains and tow wires.

"The first day we had some bumps and noises due to inherent friction between the sponsons on the starboard side and the damaged areas of the ship. As that friction was overcome, the whole ship would rumble," said Sloane of the final, rough ride to Genoa. "We weren't sure if

Costa Concordia by the Numbers

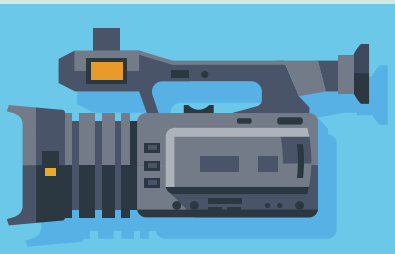
Costa Concordia **was three American football fields in length.**

The project required 48,000 engineering man hours and 1,200 total workers.

More than 22,000 dives were deployed, totaling 30,000 hours.

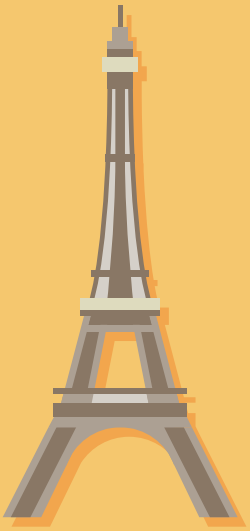
22 vessels and eight barges were involved in project activities. 12+ support vessels were involved in the final tow to Genoa, which took five days at a speed of 2.3 miles per hour.

Over 33,000 tons of steel, four times the weight of the Eiffel Tower, were used in the construction/ fabrication of all components used for the parbuckling and refloating plans.



Over 50,000 hours of ROV video footage recorded – the single biggest ROV project in history.

The blister tank structure weighed 1,500 tons, about seven-and-a-half times the weight of the Statue of Liberty, and provided buoyancy of 6,500 tons – more than most small coaster ships' cargo capacity.



the chains were failing or whether the sponsons were just settling down. If they moved three, four inches, the whole ship shook. It kept you on your toes."

Then, on July 27, the *Costa Concordia* approached its final destination. Harbor pilots boarded the vessel and one of the towing tugboats was disconnected as a harbor tug was connected to its stern.

Also boarding the ship was Thamm, who shared in a statement: "I wanted to personally thank Nick Sloane and the whole team for the extraordinary commitment they have always demonstrated throughout the project and wish them good work at the beginning of an important day of complex mooring operations."

And then, after five days under tow, the former palace at sea arrived in Genoa. There it was returned to the owners for final disposition.

"Ten, 20 ago, you would have just cut the ship up. I mean, there was no other choice," said Sloane, reflecting on the job. "But with the engineering and modeling, we were able to overcome the challenges."

"Our team's goal was to accomplish the project with safety, ingenuity and detail," said Chris Peterson, TITAN vice president. "We truly believe that we have done just that. Over the past two years, every aspect of this project was handled with the utmost professionalism and an inordinate amount of calculation and planning."

TO SEE FOOTAGE OF THE ENTIRE PROJECT, FROM EARLY PREPARATION STAGES TO FINAL TOW AWAY, VISIT:

titansalvage.com/projectcomplete

"Our team's goal was to accomplish the project with safety, ingenuity and detail. We truly believe that we have done just that."

1

Restoring Order

Costa Crociere has pledged to do whatever it takes to restore the seabed to its former, pristine state.

Costa Crociere has pledged to do whatever it takes to restore the seabed to its former, pristine state.

"We will deliver, you can rely on that," said Thamm.

While under tow, divers and salvors began removing the tower structures left behind. The piles will eventually be cut flush with the seabed and all debris will be recovered from the seabed. Marine biologists will also carefully monitor the health of the environment, helping to restore the Neptune Grass, coral and marine life that were evacuated. Slowly and surely, life will return to a state of normalcy for this ecosystem.

In the coming months, many of the ship's parts – such as engine components, plumbing structures, anything else that's waterproof – will be recycled. Estimates indicate that it will take around 125 workers and up to two and a half years. The front and the back will be dismantled first, leaving the external buoyancy system for last.

The job will be done, according to Costa Crociere, "Using a method that offers the best solution in terms of certainty of outcome, environmental and workplace safety standards, in accordance with national and international legislation."

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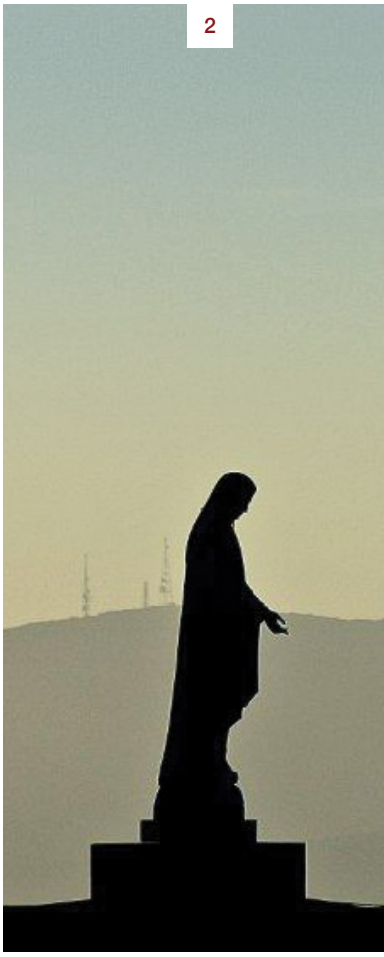

1. The *Costa Concordia*'s anchor resting on the seabed

2. One of two memorials to commemorate the lives lost as a result of the incident.

1

Commanding Respect

Costa Concordia Commands Respect in Many Ways

It's easy to be awe-struck when considering the size and scale of a salvage job like the *Costa Concordia*. By the end, the job of removing the wreckage required more than 500 specialists from 26 countries working around the clock, seven days a week.

However, the loss of 32 people from eight countries who were aboard the ship at the time of the accident, plus the tragic loss of TITAN diver Israel Moreno, never escapes the TITAN team. On the one-year anniversary of the wreck, the TITAN team on site observed a moment of silence and lit 32 lanterns in honor of those who passed on.

Additionally, two lasting memorials on the island were put into place to continue to commemorate each life lost. The first is a plaque with the victims' names engraved on it, located at the pier closest to the wreck. The second is a statue of the Virgin Mary whose neck is adorned with rosaries left by passengers and survivors' families who have come to pay their respects on the island.

Even the local Catholic church, which served as a respite for stranded passengers, houses a small, unofficial museum that includes keepsakes from the ship, including hardhats, life jackets, a piece of the rock that gashed the ship's side, a vial of oil from the engines, and thank-you cards and letters to islanders from the passengers. The memorial also displays the crucifix and communion tabernacle from inside the *Costa Concordia*'s chapel.

1. Immediately following the incident, more than 4,200 passengers and crewmembers were rescued and taken to the island and mainland. Giglio's residents rushed to help, providing hot drinks and blankets, and many opened their homes to the victims.

Giglio Changed Forever

Before the *Costa Concordia* was towed away, it was a striking sight for nearly 30 months against an otherwise tranquil blue-on-blue slice of undisturbed Italian coastline.

According to Giglio's Mayor Sergio Ortelli, tourists came to camp and bird watch, but none of them left much of an impact.

"We were a perfect place, a best kept secret," he told CNN.

Yet, in the months following the incident, the scenic island became flooded with foreign salvage workers, mariners, engineers, scientists, tourists and members of the media from all over the world. The influx of "outsiders" deeply affected the local dynamics.

Giglio's dive bars and restaurants expanded their menus and hours to accommodate international palates and workers' around-the-clock schedules. No longer is cappuccino and croissant standard fare. Rather, serving chicken salad sandwiches with pickles, hot dogs and hamburgers, omelets with ham and cheese, Tabasco sauce and American beers is now, perhaps permanently, part of the local flavor. The once-sleepy island quite literally became abuzz with activity overnight.

"At first, we were the 'new kids on the block'," explained TITAN's Sandra Goranovic, senior accountant, who was based in Giglio off and on for the duration of the project. "But over time, the culture of the island changed. The people of Giglio accepted it for what it was: there was

Continued on page 32

TITAN Recognized with Maritime Casualty Response and NAMEPA Awards

In recognition of the company's spectacular work in removing the *Costa Concordia* from Giglio, Lloyd's List, a maritime-focused media group, presented TITAN's Vice President Chris Peterson with the prestigious 2014 Maritime Casualty Response Award during its North American Maritime Awards ceremony and dinner, held in Houston in February. The honor, which was bestowed before more than 300 people from Canada, the U.S., Mexico, and the Caribbean, was given to TITAN after meeting the award criteria of representing an incident that threatened life, the environment and property. When selecting TITAN for the honor, the judges considered the actions that directly attributed to protecting the marine environment during the project, including the team's success in avoiding any additional damage to the wreck site during the parbuckling; the proactive steps taken to restore local flora and fauna; the partnership with the University of Rome to document the environmental, technical and engineering efforts, and more.

"It was a true privilege to accept this award on behalf of the TITAN/Micoperi team and the hundreds of people who have worked tirelessly on this project," said Peterson. "The recent successful parbuckling was special for so many reasons and to so many involved, including the residents of Giglio and Italy, our talented team, and the passengers who were impacted. And while we celebrate this, it is also important for those of us who represent an industry that responds to disaster to remember those who have lost their lives as a result of incidents such as this one, and that we honor and respect their families."

Additionally, in Sept., TITAN was honored by the North American Marine Environment Protection Association (NAMEPA) with the Marine Environment Protection Award, which recognized the company's proactive approach towards protecting and preserving the oceans. Peterson again accepted the award in Oct. during the organization's annual conference in New York City.


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an accident and we all made the best of it. The shops even stayed open at odd hours and through the winter for us. And they served us first so we could get back to work and gave us a credit system to pay for our meals."

Even five hours to the northeast in Ravenna, where much of the project's financial and administrative work was completed, locals felt the change. "After a while, we knew the restaurants and shop-owners by name and they knew us," said Crowley's Ray Andersen, director, finance. "At this one little restaurant in Ravenna, the staff frequently wore TITAN t-shirts. It seemed like everyone was on team TITAN."

"Our whole perspective changed," Rosalba Brizzi, owner of Bar Fausto in the center of the Giglio port – a favorite spot for the TITAN Salvage crews – also told CNN. "No one ever challenged our way of doing things before. We were set in our ways and then suddenly our little island had to adjust to one of the most diverse populations anywhere in Italy. Can we go back to how we were before? I don't know how to do that."

And though many of the workers never learned the native language beyond "buongiorno" and "grazie," many of the friends made will be life-long.

"All of us were surprised by the depth of emotion everyone – the workers, the people of Giglio – felt as a result of this project. In most other wreck removal projects, hardly anyone knows we're there," said TITAN's Lindsay Malen, director, business development. "But this one was so public. It was such an incredible moment for everyone. The emotion and gratitude was something we were completely unprepared for."

"There were tears when the project ended and people started leaving," added Goranovic.

"Our lives have been so enriched by this experience, and I don't mean monetarily. I've met people from Samoa, from South Africa, from places I had never heard of," Brizzi told CNN. "They've brought their families; they show us pictures from home. And now we will lose them all. They won't come back."

3

1. TITAN's Sandra Goranovic
2. Crowley's Todd Busch (L) and Nick Sloan (R) during the winterization phase following the parbuckling.

3. TITAN's Ravenna team accomplished much of the project's financial and administrative work.

The Team:

Crowley, TITAN and Jensen Joined Forces to Support Project

So, what makes a company able to successfully execute a seemingly impossible project flawlessly?

"The people," explained Malen. "We brought together the best in engineering and innovation, and we brought imagination to the table. We made history in combining techniques and working together so smoothly. We proved that no matter how complicated the project is, we can make it happen."

"The core management brought different assets or factors of the salvage and offshore industry … so we had one of the most powerful teams in salvage anywhere in the world," added Sloane.

Malen reported that the team ran smoothly because Habib and Sloan brought together employees, contractors and vendors under a shared vision.

"The *Costa Concordia* project has been the most challenging job in TITAN's 33-year history," said Crowley's Todd Busch, senior vice president and general manager, technical services. "But it has been satisfying to watch professionals from so many countries come together and complete something that has never been accomplished, particularly when so many people said it wasn't possible."

"This was the dream team of salvage guys, from top to bottom," said Jensen's Patrick Sperry, project controls manager. "And the Italian engineers were some of the most out-of-the-box thinkers I'd ever had the pleasure of working with. It was just an amazing amount of talent. Amazing."

"Ultimately we needed continuity of people," Sloane said of the project's success. "That was one of the biggest challenges. So you had to get the right people for the right part of the project, and it was important that we kept the same team with the same focus throughout … which I think we managed to do."

This was no small feat considering TITAN was asking the industry's top salvage workers to stay on the job for two years or more. Their effectiveness in leadership is further evidenced by the incredible fact that TITAN was able to execute nearly 40 other successful wreck removal, salvage, disaster relief and emergency response jobs around the world in tandem with the *Costa Concordia* project.

"TITAN has a reputation and we're very proud of it. We are the cowboys of the salvage business," said Habib. "There was a lot of doubt in the industry that we could pull a project off like this in terms of the project management because that's completely the opposite of being cowboy. But to be a great salvor, it takes a little bit of both. You've got to be able to shoot from the hip but you have got to be able to put the top technical/project management people together into a team. And I think with the *Costa*

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Concordia, we showed that TITAN put together a team that could pull this project off."

Despite having a "cowboy" reputation, TITAN took safety very seriously on the job. Working closely with top Health, Safety and Environmental (HSE) individuals, marine chemists, atmospheric monitoring specialists, medical personnel, trained climbing experts and others, the team created the safest possible working environment.

"When the ship was on its side, these guys floored in across the angle of the deck to make a flat surface to walk on. There were first-aid stations strategically located all over the ship. All the guys were trained in climbing and in atmospheric hazards. We had paramedics on every shift and a hyperbaric-qualified doctor on site at all times. Every place we worked was well lit with safety railings and a temporary fire main. Then, when we put the ship back upright, they tore everything out and put it back together again. When we were getting ready to refloat it, we held abandon-ship drills, we held casualty heli-evacuation drills – just like you would on a normal ship to handle any type of emergency," described Habib. "We would not have been able to finish our job without the safety team."

"From a safety perspective, this was probably one of the safest operations ever carried out," said Sloane.

In addition to the combined talents on site, there were countless support teams working long hours behind the scenes to ensure the project ran smoothly. Crowley's project control group, for example, had responsibility for scheduling all operational activities at the site of the wreck, including winterizations, sponson installation preparation, ballast control system remediations and commissionings, pre-float and tow-away check-lists, and many other ancillary functions. Their important work helped to ensure that the salvage workers could start their jobs without delays.

Another critical team working in conjunction with the project controls team was the Jensen engineering and heavy logistics coordinators, who managed the project schedule and transportation services for equipment between the shipyards and project site. One of those

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"This team was responsible for delivering 32 sponsons, six platforms and many smaller pieces equipment in a short window of time."

coordinating the fabrication and delivery schedules was Patrick Sperry. Sperry's six-week stint in Italy morphed into a year-long assignment with time split between a shipyard in Livorno and Giglio. Originally a construction manager for Jensen, this was Sperry's first planning or salvage role. He excelled.

"My job was to put a schedule together that ensured the sponsons could be on site on time, taking weather into account," Sperry explained. "Our team also helped to make sure the TITAN logistics team had the equipment they required – tugs, barges, whatever they needed."

"Planning was incredibly important. We had this constantly shifting schedule. Watching our planning and logistics guys manage that was incredible," credited Habib. "We also used some of Crowley's tug guys, including Capt. Bruce Fox, and they went into the logistics side of things. Now, we were essentially doing module moves, but we were doing them day after day, week after week. And so they came in with their ability to do a module move, but they ramped up to doing them very rapidly under very changing circumstances. This team was responsible for delivering 32 sponsons, six platforms and many smaller pieces of equipment in a short window of time."

Another important group was the Italy-based finance team, comprised of around 12 Crowley-, TITAN- and Jensen-sourced accountants responsible for everything from invoicing to billing, tracking equipment costs, logging taxes paid, negotiating rates, paying vendors and contractors in a variety of currencies, and reporting expenses by the day.

"We were responsible for anything that had a dollar sign next to it," said Goranovic, who started in internal audit at Crowley before joining the project's finance team. "This was the biggest marine salvage project in history, so we knew we needed people with company history. We did an excellent job of providing transparency and tracking the project's costs honestly. And even though it was stressful at times – we were working 12-plus hour days, seven days a week – when we saw the product, we got to see the value we added to the project."

1. The TITAN team celebrates at a Ravenna restaurant
2. Crowley's Ray Andersen at the Microperi campus
3. Crowley's Patrick Sperry at a construction yard in Livorno, Italy

Supporting the finance team abroad also was the network of experts working from Crowley and TITAN's domestic offices. This international team knew no limits.

"Our success in Italy hinged on the stateside support we had from the Crowley finance teams, too. They did a very good job of making our requests a quick priority. They knew we were on deadline," said Andersen. "They knew that our doing a good job kept the workers and vendors on scene to do their jobs."

"We arranged over 50 different vessel charters during the course of the project," remembered Forrest. "That required tremendous support from Crowley's legal and risks teams. And we got a lot of support from the U.S. and the company's depot in the U.K, moving not only equipment, but people."

"I was involved from the beginning and saw how the group was. It didn't matter the personalities or what company people came from; the commitment was there from everyone involved," said Goranovic.

Supporting the finance team abroad also was the network of experts working from Crowley and TITAN's domestic offices. This international team knew no limits.

1. The TITAN/ Micoperi team shortly before the parbuckling.
2. Pristine Giglio has become well known around the world because of the *Costa Concordia*, but before the incident it was perhaps one of Italy's greatest kept secrets.

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2

Partnering with Biologists at Università La Sapienza in Rome

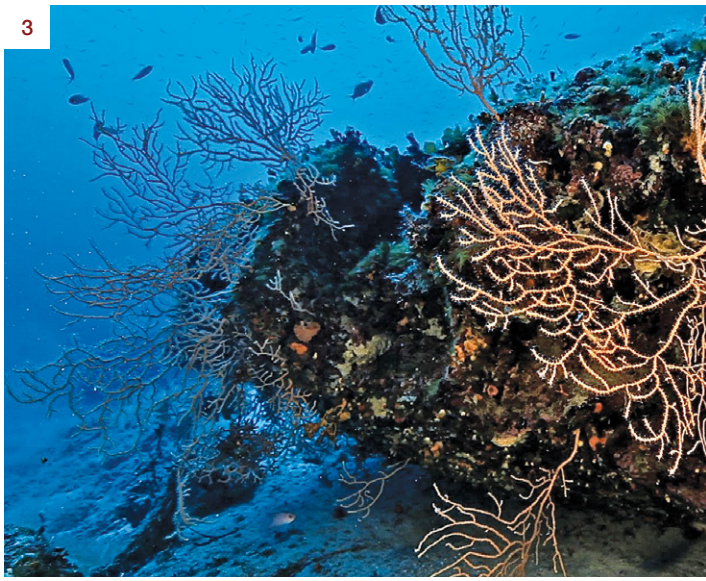
From the very beginning, the TITAN team also formed a close working relationship with the Department of Environmental Biology at the Università La Sapienza, one of the oldest educational institutions in the world and the entity responsible for ecological monitoring during the salvage of the *Costa Concordia*.

In fact, it was this highly trained group, led by the University's Giandomenico Ardizzone, a full professor-emeritus in marine biology, that assisted TITAN/Micoperi in developing a salvage plan that made protecting the undersea environment and its inhabitants a priority during the bidding process.

"Partnering with the university was crucial because the biologists had already done research in the central Tyrrhenian Sea and were very familiar with monitoring and surveying the marine environment and marine protected areas," explained Malen. "And for TITAN, we wanted to document the work being done so we could learn what worked and what didn't from an environmental standpoint for future use."

Before the salvage work began, the academic team worked with TITAN/Micoperi to conduct a baseline study on the health of the environment. Doing so helped to define optimum project solutions for TITAN/Micoperi and, as the work continued, to monitor the on-going environmental impact. Of particular focus was the well-being of marine mammals, especially dolphins; *Pinna nobilis* (fan shell); *Posidonia oceanica* (Neptune grass) meadows and coralligenous formations; and all organisms considered protected by environmental agencies. Several maps in 1:1,000 scale were also produced and used as reference points throughout the project.

3. A bionomic cartographic map of the sea bottom was prepared to protect priority habitats in the area, including coral formations.



4. Researchers aboard an oceanographic vessel performed ecotoxicological, hydromorphological and biological chemical tests performed on the water column, sediment and biota in the area around the wreck to ensure quality.

1. About 200 specimens of *Pinna Nobilis* (fan shells) found near the wreck were catalogued and temporarily transferred to another area for safe keeping while the salvage work was completed.
2. Giglio's *Posidonia Oceanica*, or Neptune grass, grows at depths between one and 30 meters, forming thick meadows with a high level of biodiversity.
3. Cutting-edge technology helped biologists trace dolphins, whales and other sea life around the wreck in real time.

"The participation of the university in the project was important because we furnished the picture … of the sea bottoms and its communities at the very beginning of the works," said Ardizzone. "On this base the more dangerous activities for the environment were better localized and opportune mitigation measures adopted. For example, about 200 fan shells, a protected species, were directly saved [by] the personnel of the university, moving them from the yard area to a more safe area."

The fragile worksite was monitored frequently via Remote Operated Vehicles (ROVs) and cameras that logged more than 28,000 hours of underwater footage at depths up to 80 meters, including hundreds of hours of diver footage using rebreathing SCUBA techniques and 3D camera technology in deeper waters. Multi-beam surveys made detailed maps of the sea bottom. Sediment samples gave the opportunity to complete the frame of the morphologic characteristics. Plankton surveys monitored the smaller species living in the water column and data was collected to monitor the fishery production.

In total, the university completed nearly 20,000 tests of the water inside and outside of the hull and 3,000 ecotoxicology analyses of the water, sediments and marine organisms. Additionally the researchers conducted 750 marine mammal watching campaigns covering more than 6,000 km, and took more than 450 noise measurements to protect marine mammals.

From start to finish, around 15 marine ecologists, zoologists and botanists from the University of Rome; 10 specialists from different universities in Genoa, Torino, Florence, among others; and several private organizations, were involved.

Ardizzone reported that, as a result of all of this research, "In any tiny part of seas of the world there is not so much knowledge on the marine environment as in Giglio's island."

"The university played a huge role," Habib specifically pointed out. "The refloat was critical in terms of the water quality. First we sampled [inside the] ship, where we thought there could be hazardous water. And whenever we found an area where the water exceeded the limits by the government, we pumped that water out into tankers and disposed of it and replaced it with fresh sea water. So, by the refloat, the water was almost as clean – in some cases even more so – than the water outside of the vessel."

When it came time to tow the vessel away, 10 biologists from the university joined the TITAN team onboard to ensure environmental health from project site to scrap yard.

Because the project was unprecedented in so many ways, the TITAN/Micoperi team joined the university in documenting the environmental, technical and engineering efforts involved in removing the wreck and protecting the area surrounding it.

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“That was probably the most environmentally monitored seawater on the planet,” said Sloane. The university was very helpful and I think was very pleased with the results. The water was pristine.”

“The documents will be a valuable resource for future marine salvage projects, as well as natural disaster recoveries, around the world,” said Malen. “TITAN is a huge supporter of education and these are findings that future generations can use to avoid similar incidents and protect the environment.”

“On the other side, the university team learned to work in a technical and operative world that is not common in the scientific contests, with the necessity to combine the ‘theory’ with the ‘practice;’ the ‘protection’ with the ‘operability.’ And in a such multicultural and multiethnic context! The good results reached at the end of the project confirm the goodness of the methodological approach: from the adopted monitoring parameters to the mitigation measures, to the adopted technical methodologies,” added Ardizzone.

Now that the ship has been removed, the university’s work continues in restoring the environmental conditions, including the monitoring of the cleaning of the sea bottom and returning the displaced flora and fauna to the area.

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“The outcome of the project was what we hoped for,” agreed Ardizzone. “[Despite] the huge and dangerous works carried out, the deteriorated areas were just limited to the [wreck site]. The [loss] of habitats was very limited and mainly due to the physical presence of the ship on site.”

4. Even after the wreck was removed from Giglio, scientists remained on site to monitor the environmental conditions and restore the displaced flora and fauna.

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Crowley's TITAN Salvage and Italian partner Microperi successfully refloated the *Costa Concordia* in July 2014, in preparation for towing to Genoa, Italy, for scrapping. The ship salvage was the largest most technically demanding project of its kind in history.

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