Issued February 2, 2023 MIR-23-03

Loss of Crane on board Construction Barge *Carolyn Skaves*

On February 8, 2022, about 0725 local time, the construction barge *Carolyn Skaves* was spudded down in the Willoughby Bay area on the south side of the Hampton Roads Bridge Tunnel in Norfolk, Virginia, when the crane operator shifted the position of the onboard crawler crane toward the stern, and the crane toppled off the barge into the water.[1] The crane was later recovered and declared a total constructive loss. An oil sheen was visible after the casualty; there were no injuries reported. The value of the crane was estimated at $2 million.

Figure 1. *Carolyn Skaves* moored before being leased to Seaward Marine Corporation. (Source: Sterling Equipment.)

[1] (a) In this report, all times are eastern standard time. (b) Visit ntsb.gov to find additional information in the public docket for this NTSB investigation (case no. DCA22FM010). Use the CAROL Query to search investigations.

Casualty type	Ship/Equipment/Cargo Damage
Location	Willoughby Bay, Norfolk, Virginia 36° 57.72' N, 076° 16.5' W
Date	February 8, 2022
Time	0725 eastern standard time (coordinated universal time –5 hrs)
Persons on board	4
Injuries	None
Property damage	$2 million est.
Environmental damage	Oil sheen, diesel fuel, 75 ft by 75 ft
Weather	Visibility 5 mi, cloudy, winds west 6 kts, seas less than 1 ft, air temperature 37°F, water temperature 39°F, sunrise 0701
Waterway information	Bay, depth 5-10 ft

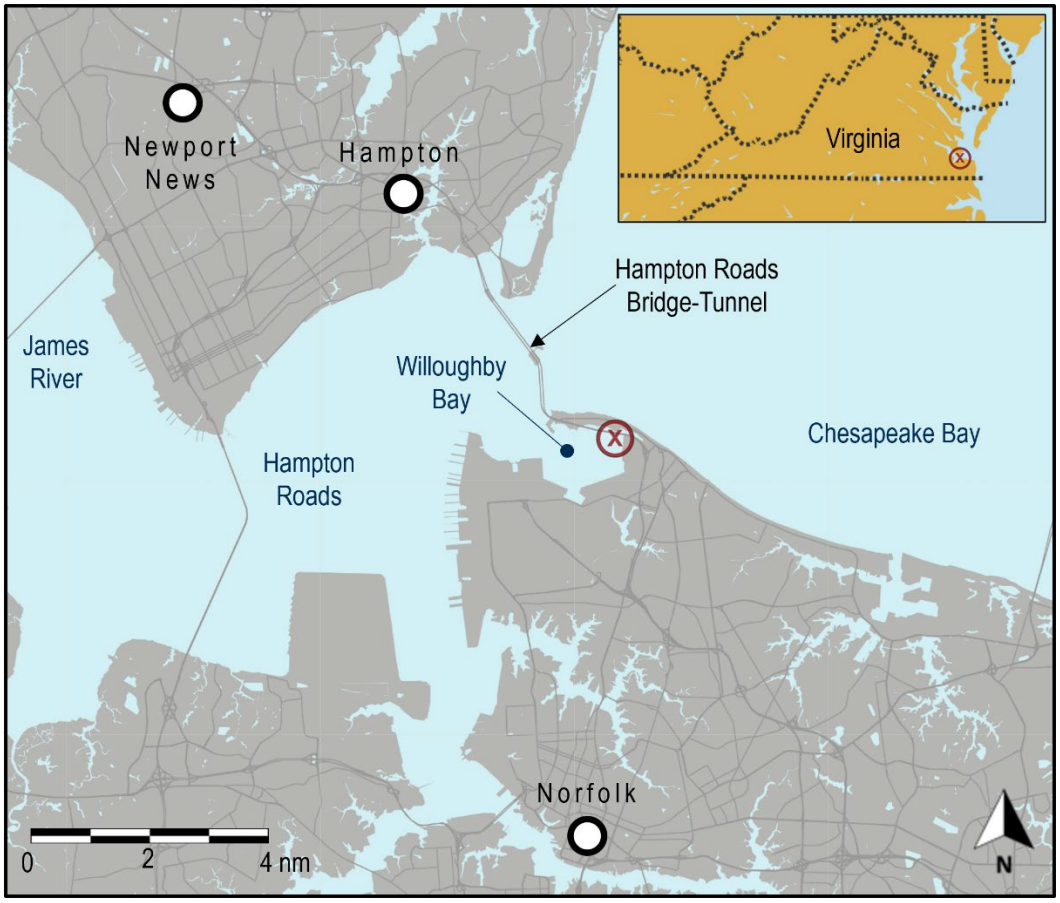

Figure 2. Area where the crane toppled off the deck of the barge Carolyn Skaves as indicated by a red *X*. (Background source: Google Maps)

1. Factual Information

1.1 Background

The *Carolyn Skaves* was a 180-foot-long construction barge built in 2019 and owned by Sterling Equipment.[2] In 2021, Seaward Marine Corporation (Seaward Marine) leased the barge and purchased a Liebherr 1300.1SX model mobile hydraulic lattice boom crawler crane, which was operated from the deck of the barge.

1.2 Event Sequence

Beginning in September 2021, the Virginia Department of Transportation contracted Seaward Marine to install bridge substructure components for the Interstate 64 Hampton Roads Bridge-Tunnel in Norfolk, Virginia, as part of an expansion project for the bridge-tunnel. The company supplied the *Carolyn Skaves* and its onboard crawler crane to complete the work. At the end of each workday, all employees departed the spudded-down barge (no one stayed on board the barge overnight).

The crawler crane on board the *Carolyn Skaves* weighed about 320 tons and had a lifting capacity of 300 tons. The crane and its tracks measured 31 feet 9 inches long and 26 feet 3 inches wide. The crane could be moved forward and backward on a mat—constructed of 12-inch-by-12-inch hardwood timbers and measuring 72 feet long and 30 feet wide—positioned at the aft end of the barge. The mat protected the deck of the barge and spread the load (weight) of the crane. Occupational Safety and Health Administration (OSHA) regulations required that the deck be marked to identify the permitted areas for positioning, travel, and operation of the crane.[3] To fulfill this requirement, there was a stop mark painted on the mat aft on the port side (40 feet forward of the barge's stern).

The crane was affixed to the barge using a centerline cable system that allowed longitudinal (fore and aft) movement of the crane; the cable system, required by OSHA, prevented the crane from moving laterally or rolling off the barge. The centerline cable (wire rope) ran the length of the mat. The cable ends were formed into loops (eyes) that were connected to shackles that were in turn connected to brackets welded on the deck of the barge forward and aft of the mat. The loops were created by securing the cable's

[2] A *construction barge*, sometimes referred to as a *deck barge*, is a manned or unmanned barge that has a continuous, flat main deck. Deck barges are employed to carry deck cargo and are also used in the marine construction industry for such work as pier or bulkhead construction, dredging, and marine oil service. Deck barges that operate on inland waters are not inspected by the US Coast Guard.

[3] Title 29 *Code of Federal Regulations* 1926.1437(n)(6)(iv).

bitter (dead) ends with cable clips (clamps). The centerline cable passed through shackles hanging from loops of wire rope on the underside of the crane, allowing the crane to move along the cable.

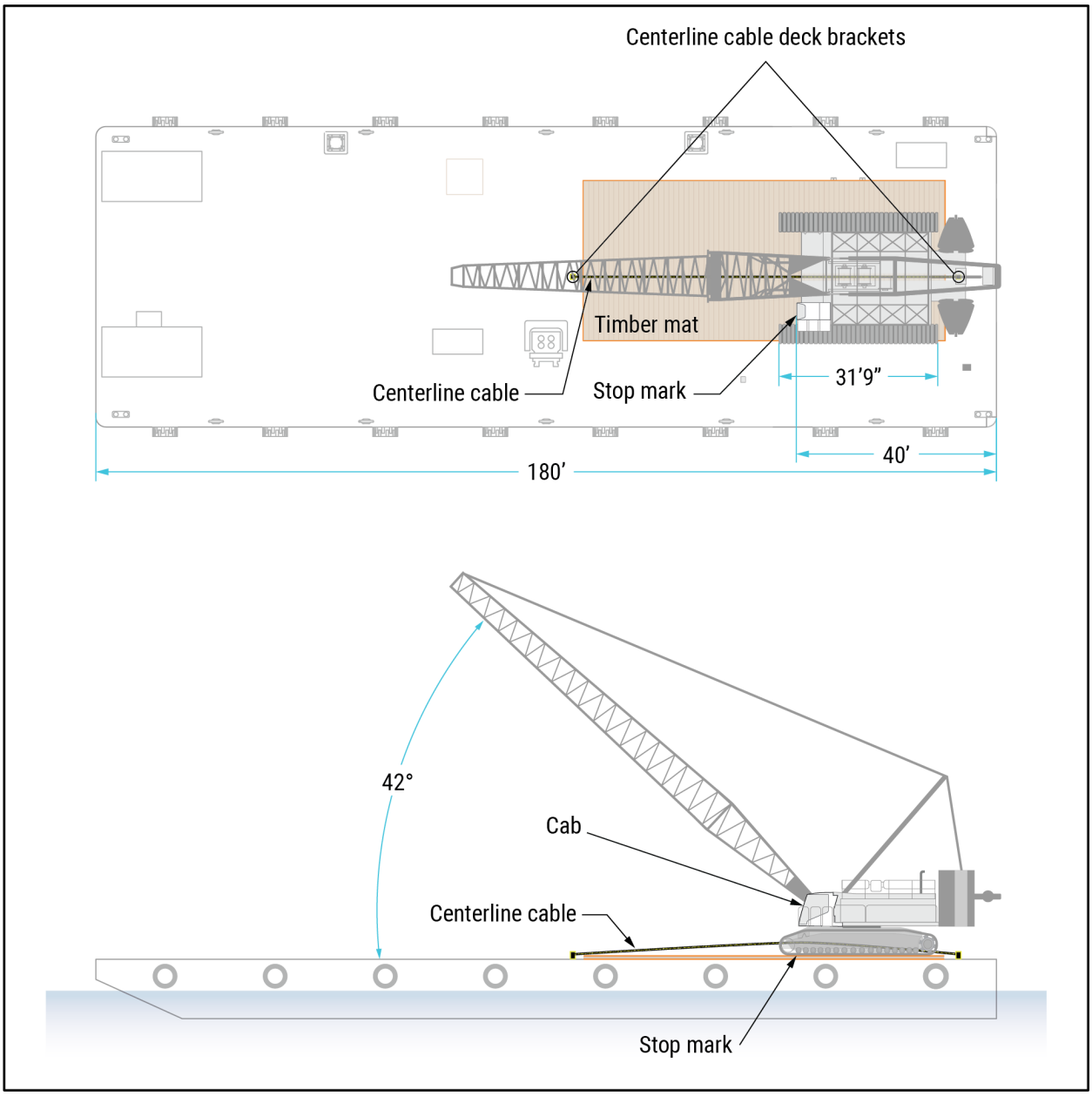

Figure 3. Plan and portside views of the *Carolyn Skaves* and the Liebherr 1300.1SX model crawler crane.

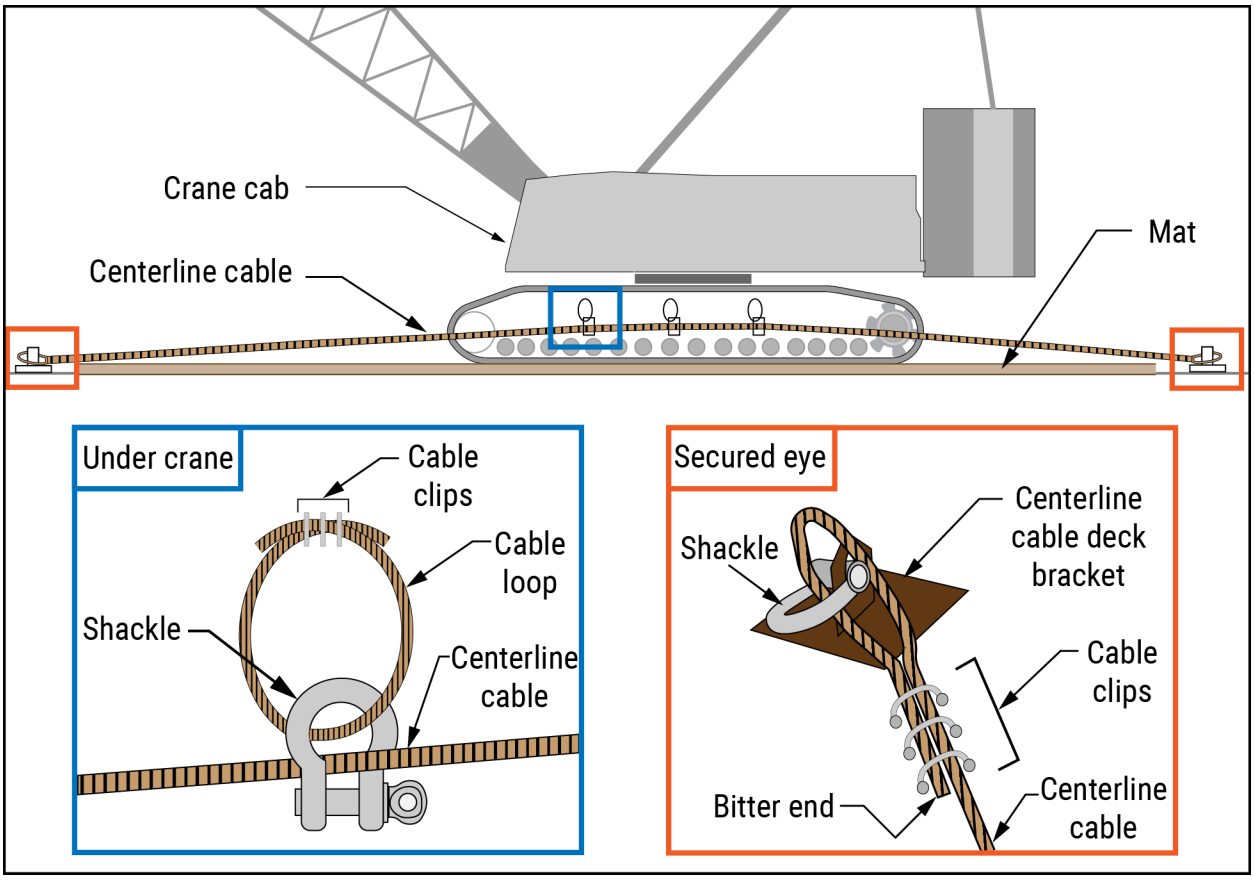

Figure 4. Depiction of centerline cable system, including cable loops securing the centerline cable to the underside of the crane and the two eyes, each secured to the barge's deck bracket with a shackle and cable clips (not to scale).

The crane could move at a speed of up to 18.7 meters (61 feet) per minute. Two pedals were used to move the crane's tracks: one pedal moved the left track and one the right. Each pedal could be pushed at the front to move the crane forward or at the back to move in reverse. If no pressure was applied to a pedal, the gears were in neutral. The crane could be turned by operating each track at a different speed or direction. An emergency stop was adjacent to the operator's seat in the crane cab. Pushing down on the emergency stop button would place the gears in neutral. There were no brakes for the crane's tracks.

On February 8, 2022, four Seaward Marine workers, including a crane operator, boarded a crew boat at 0630 at Willoughby Harbor Marina in Norfolk, arriving about 0700 on board the *Carolyn Skaves*, which was spudded down by the Hampton Roads Bridge-Tunnel near Norfolk. The crane operator told investigators that once on board the barge, all four workers participated in the pre-work risk assessment that focused on crane operations such as swinging the boom and lifting. The discussion did not include shifting the location of the crane. The crane operator and one of the workers then

prepared the crane to begin operations to set bridge girders—large 62-foot-long concrete beams, each weighing 22 tons—all day.

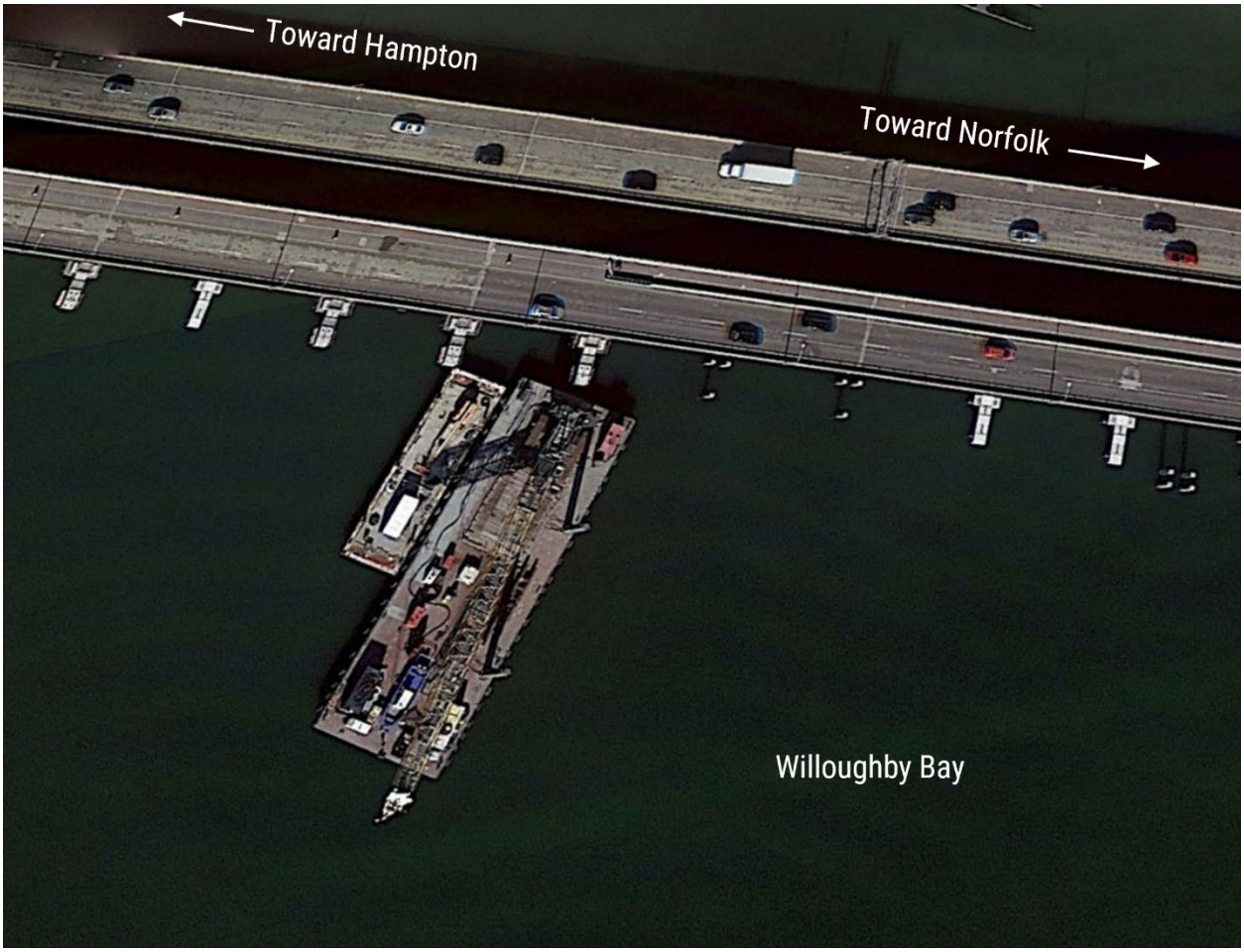

Figure 5. *Carolyn Skaves* spudded down near the Hampton Roads Bridge-Tunnel in November 2021. (Background source: Google Earth)

The first task of the day was to attach special rigging to the crane boom, which was necessary to lift bridge girders from a barge that had not yet arrived but would be positioned adjacent to the *Carolyn Skaves*. The crane operator decided to move the crane—which faced the barge's bow and was situated near the aft end of the mat—farther aft in order to attach the rigging.

The crane operator and the worker began preparing the crane for the movement. With the crane boom's position at a 42° angle, the operator began lowering the block, which had been raised and secured to the crane boom the previous evening, in order to attach the special rigging. On each side of the crane, there was a set of two turnbuckles, which had been installed to prevent the crane from moving or tipping over, especially when engaged in lifting operations (each turnbuckle was connected to a bracket on the deck of the barge and could be connected to the crane). The worker detached the

turnbuckles before joining the other two workers inside a conex box (a shipping container used for storage/shelter) located at the bow of the barge, where they sheltered from the cold as they waited to begin their tasks, leaving the crane operator alone to move the crane.

Figure 6. Location of turnbuckles near timber mat and stop mark painted orange on the mat. (Background source: US Coast Guard)

After lowering the block to its desired height, the crane operator began moving the crane aft, using the pedals to move each track. The operator told investigators that as he moved the crane aft, he heard a noise on his left and thought the crane's steps had hung up on something. He quickly looked to his left and right and then looked for the aft stop mark painted on the timber mat near the forward end of his left track. He stated that he saw that he was beyond the stop mark and released the pedals that he used to move the crane aft. He felt the crane was "light in the toes," meaning he could see the tracks "were starting to come up a little bit," so he immediately pushed the pedals to move the crane forward. However, the crane continued to travel aft, and he felt the crane "tipping over," so he opened the cab door and jumped from the crane as it "went over backwards off the barge" into the bay.

Diesel fuel from the crane was released into the surrounding water, and an oil sheen about 75 feet by 75 feet was observed. The workers used oil absorbent pads stored on the barge to soak up some of the sheen, which dissipated. The crane operator was not injured. The crane was recovered on March 24 and declared a total constructive loss.

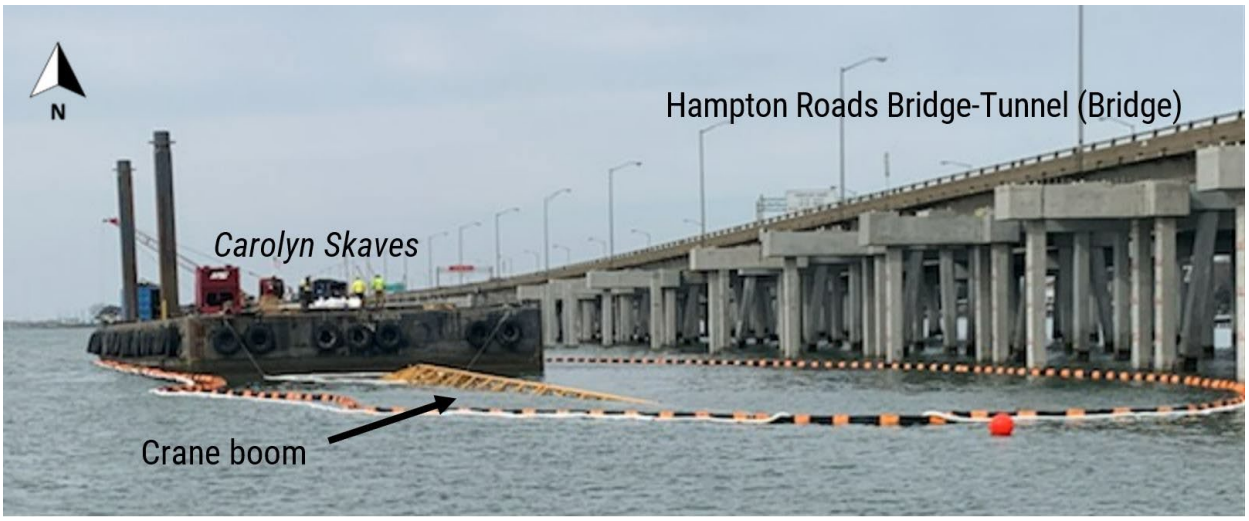

Figure 7. The *Carolyn Skaves* and its crawler crane (in the water), surrounded by a turbidity curtain (silt barrier), after the casualty about 0930 (crane boom is visible aft of the barge). (Background source: Coast Guard)

1.3 Additional Information

The crane operator began working for Seaward Marine in October 2021 and stated he had operated a Model LR 1300.1SX crane before joining the company. The crane operator was current in OSHA-required crane operator training. After the casualty, he tested negative for alcohol and other drugs. Investigators also reviewed the operator's work/rest history; no issues were identified.

After the casualty, investigators found the cable eye that secured the centerline cable to the aft deck shackle and bracket had opened. The bitter (dead) end of the wire rope had slipped through three cable clips and out of the shackle. OSHA regulations required the centerline cable system, which included the method and components used to secure the cable to the barge deck, to be of sufficient strength to keep the crane on the barge.[4] OSHA issued Seaward

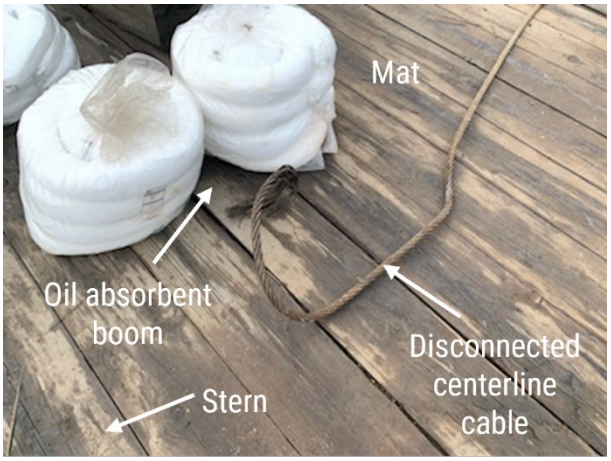

Figure 8. End of centerline cable, which had been secured to the aft deck bracket, after the casualty. (Background source: Coast Guard)

[4] 29 *Code of Federal Regulations* 1926.1437(n)(5).

Marine a citation for not complying with OSHA regulations requiring adequate physical attachment of a crane to a barge.

In accordance with company policy, Seaward Marine's Safety/Environmental Director prepared an incident investigation report for the casualty. Written company policy required that a signal person or spotter be used "at any time the crane is traveling," and the report noted that the crane operator should have called on one of the deck workers to serve as a spotter (signalman). The report also stated that the centerline cable system was insufficient to keep the crane from falling from the barge; other means to prevent the crane from falling off the barge, such as barricades or stops, were not put in place; and the supervisor (foreman) was not present at the pre-work risk assessment (according to the crane operator, the foreman normally would have been on board the barge to lead the risk assessment but was not present because he was scheduled to attend a company meeting ashore). The director learned during his investigation that the employees working on the *Carolyn Skaves* had not always assessed hazards nor had they always used a spotter for previous crane movements.

Following the casualty, Seaward Marine met with its employees to discuss the lessons learned from the *Carolyn Skaves* casualty and emphasize the company's written procedures that 1) before beginning crane operations, a pre-work risk assessment must take place; 2) the supervisor must attend the pre-work risk assessment; and 3) cranes should not be moved without a spotter/signalman. Additionally, Seaward Marine outfitted its crane barges with stops and barricades to construct a "corral" system to prevent movement. New company policy, added following this casualty, required that the corral system be in place when the turnbuckles were disconnected from the crane, including when the crane operator moved the crane forward or aft on the barge.

2. Analysis

OSHA regulations required the *Carolyn Skaves* to have a centerline cable (wire rope) system of sufficient strength to keep the crane on board the barge. However, after the casualty, investigators found the centerline cable's aft eye (loop) had opened, disconnecting it from the aft deck bracket, causing the cable system to fail. The cable disconnected due to the tension exerted on it as the crane moved aft, causing the bitter end of the cable to slip through the cable clips that closed the loop (the noise the crane operator heard as he was moving the crane aft was likely the centerline cable striking the underside body of the crane as it disconnected). A centerline cable system of sufficient strength, per OSHA regulations, would have prevented the crane from being driven off the barge (as occurred in this casualty). Measures to secure the crane on the barge such as the cable system (or the corral system that the operator will now use because of this incident) are the last line of defense to keep a crane on board a barge.

A stop mark, which defined the permitted crane area, was painted aft on the timber mat, as required by OSHA regulations; however, the operator told investigators that he was behind the stop mark by the time he noticed it, just before he jumped from the tipping crane. Investigators found that, sitting in the cab, the crane operator's height of eye was about 10.5 feet. From his line of sight, the operator would not have seen the stop mark until the crane tracks were about 8 feet from the stern and had traveled about 2 feet off the 12-inch-high timbers of the mat (as estimated by investigators based on barge drawings) (see Figure 9). Company policy required the use of a spotter to monitor the crane's position in relation to the stop mark. In addition to not being able to see the stop mark until the crane tread was off the mat, the operator was looking forward and monitoring the position of the crane's block (relative to the rigging on the deck) as he moved the crane aft. He did not assess the crane's position in relation to the permitted area on the barge. With no spotter, it is likely that the crane operator lost situational awareness by becoming fixated on the task at hand: maneuvering the crane block into position above the special rigging.

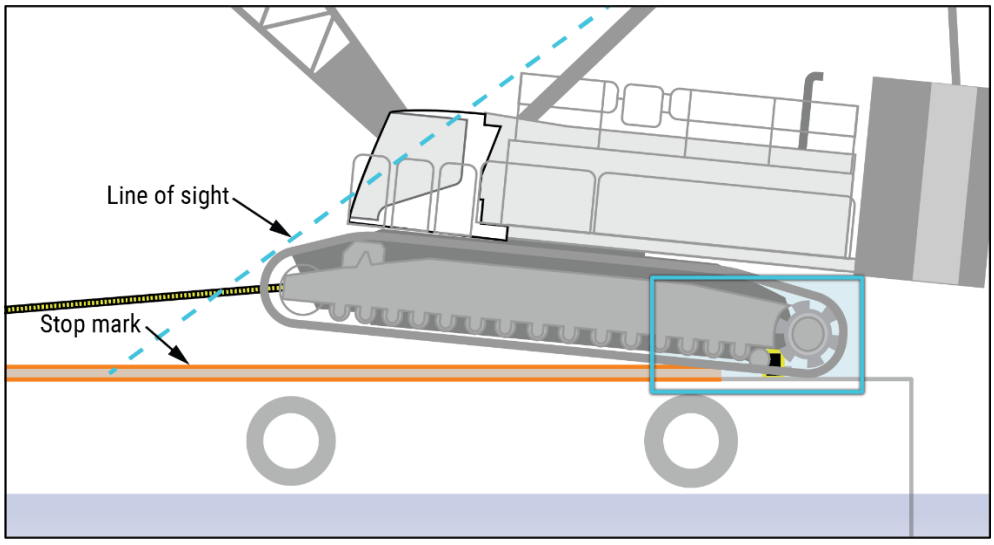

Figure 9. Simple representation of the *Carolyn Skaves* crane operator's line of sight from a seated position in the crane cab as the crane moved off the mat and began to topple (not to scale).

Company policy required a pre-work risk assessment before crane operations. The workers did not include crane movement in their February 8 risk assessment. Had they done so, the workers may have realized a spotter was needed (per written company policy) to monitor the crane's movement. Following the incident, Seaward Marine found that the *Carolyn Skaves*'s crane had been shifted without a complete risk assessment or a spotter in other instances. The company was unaware that the crane operator and other workers were not following the company's written policy, as they did not directly observe the workers' performance or have other processes in place to ensure compliance. With more effective oversight, the company could have ensured that management policies

and procedures were followed, thereby improving the safety of its crane barge operations.

3. Conclusions

3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the crane toppling off the deck of the construction barge *Carolyn Skaves* was the lack of a spotter during a crane movement and the failure of the centerline cable system used to secure the crane to the barge. Contributing was ineffective company oversight of barge operations.

3.2 Lessons Learned

Construction Barge Crawler Crane Movement

All repositioning of a crawler crane on a construction barge—no matter how routine—should be adequately planned and risk-assessed. All personnel involved in movement operations should be clearly identified and their duties understood, including spotting. A method such as a cable system or other physical attachment to prevent the crane from falling off the barge must also be in place before moving the crawler crane as required by Occupational Health and Safety Administration regulations.

Vessel	*Carolyn Skaves*
Type	Towing/Barge (Construction barge)
Owner/Operator	Sterling Equipment (Commercial)
Flag	United States
Port of registry	Boston, Massachussetts
Year built	2019
Official number (US)	1300430
IMO number	N/A
Classification society	American Bureau of Shipping
Length (overall)	180.0 ft (54.9 m)
Beam	60.0 ft (18.3 m)
Draft (casualty)	4.5 ft (1.4 m)
Tonnage	1,088 GRT
Engine power; manufacturer	N/A

NTSB investigators worked closely with our counterparts from **Coast Guard Sector Virginia** throughout this investigation.

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For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID DCA22FM010. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting–

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, SW
Washington, DC 20594
(800) 877-6799 or (202) 314-6551