



UNITED STATES COAST GUARD

**REPORT OF INVESTIGATION
INTO THE
FIRE THAT OCCURRED ONBOARD
CUYAHOGA (O.N. 243772)
ON MARCH 15, 2024, WHILE MOORED AT KINDER
MORGAN PINNEY DOCK IN ASHTABULA, OHIO**





16732/IIA # 7881082
31 August 2026

**FIRE ON BOARD THE CANADIAN FLAGGED BULK CARRIER CUYAHOGA
(IMO# 5166392) RESULTING IN THE TOTAL CONSTRUCTIVE LOSS OF THE
VESSEL WHILE MOORED AT THE KINDER MORGAN PINNEY DOCK IN
ASHTABULA, OHIO ON MARCH 15, 2024**

ACTION BY THE COMMANDANT

The record and the report of investigation completed for the subject casualty have been reviewed. The record and the report, including the findings of fact, analyses, conclusions, and recommendations, are approved subject to the following comments. This marine casualty investigation is closed.

ACTION ON RECOMMENDATIONS

Recommendation 1: Recommend that the Commandant evaluate the dangers internal rubber conveyor belts pose to merchant mariners serving on board self-discharging bulk carriers. Self-discharging bulk carriers are equipped with rubber conveyor belts that pose a significant fire risk due to their potential to spread fire rapidly; however, current fire safety standards for rubber conveyor belts are insufficient. Although the fire onboard CUYAHOGA did not originate with the conveyor belt, both conveyor belts on CUYAHOGA ignited and burned, and one belt re-flashed, exacerbating the fire and complicating firefighting efforts. The length and movement of conveyor belts can increase these dangers by allowing fires to travel quickly over great distances within a ship. In addition to the fire on board CUYAHOGA, several significant maritime casualties have highlighted the fire risk posed by rubber conveyor belts, including ROGER BLOUGH in 2021, Incident Investigation Activity (IIA) #7139261, and ST. CLAIR in 2019, IIA #6630678. These incidents involved large-scale vessel fires and substantial damage resulting from the spread of fire through cargo unloading belt systems, where the system arrangements did not allow for effective structural fire protection installations along the beltways. The U.S. Department of Labor, Mine Safety and Health Administration (MSHA) has long recognized the increased risk and lethality of belts that are not fire resistant. MSHA developed standards to address these concerns, requiring the use of fire-resistant belts proven through approved testing. The recurrence of conveyor belt fire casualties, along with the significant financial losses in those cases, indicates a need for further evaluation of regulatory standards and consideration of requirements similar to MSHA's conveyor belt fire-resistance requirements.

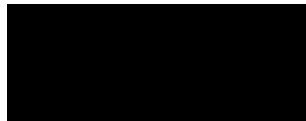
Action: I do not concur with this recommendation. The CUYAHOGA is a Canadian flagged vessel to which the International Convention for the Safety of Life at Sea (SOLAS), 1974, does not apply. Modification to either international or U.S. regulations would be unable to effect change and require compliance if updates are made.

31 August 2026

Additionally, Sections 5.1, 5.3, and 5.4 of the investigation demonstrate that the fire onboard the CUYAHOGA started and spread as a direct result of inadequate safety procedures during ongoing repairs. While the vessel's cargo conveyor belts exacerbated the fire, appropriate fire watch personnel and safety procedures required by the Occupational Safety and Health Administration's existing fire protection in shipyard employment regulations in Title 29 Code of Federal Regulations (CFR) Sections 1915.53, 1915.503, and 1915.504 should have extinguished the fire in its incipient stage. Furthermore, initial firefighting efforts were hindered as the vessel's shipboard firefighting equipment was off station for winter layup. To raise awareness of these risks, the U.S. Coast Guard's Great Lakes District previously published the USCG Ninth District Work Instruction – Great Lakes Layup Safety (D9DPI-WI-DOM-(008)(1)), which specifically requires watch standers to ensure compliance with 29 CFR § 1915, Subpart P (§ 1915.501 through § 1915.509) Fire Protection in Shipyard Employment. Adherence to these existing regulations and policy would have significantly reduced the likelihood of this incident. Pursuing new domestic or international standards for fire resistant cargo belts would have been ineffective in this case due to the lack of applicability to non-SOLAS, foreign flagged vessels, such as the CUYAHOGA, and because fire resistant belts fail to address the primary causal factors to this incident.

Recommendation 2: Recommend U.S. Coast Guard Sector Eastern Great Lakes formally recognize the Ashtabula Fire Department for their rapid response to the fire onboard CUYAHOGA. The Ashtabula Fire Department's swift actions limited the spread of fire and quickly extinguished the fire with no reported injuries. Without their efforts, the marine transportation system could have suffered a tremendous loss to shoreside infrastructure and nearby ships.

Action: This recommendation was issued to Sector Eastern Great Lakes. The Sector Eastern Great Lakes Officer in Charge, Marine Inspection concurred and formally recognized the Ashtabula Fire Department – Fire Prevention Bureau in April 2026 for their swift and courageous actions during the response to the fire onboard CUYAHOGA.



D. H. COST
Captain, U.S. Coast Guard
Director of Inspections & Compliance (CG-5PC)



16732
April 15, 2026

**FIRE THAT OCCURRED ONBOARD *CUYAHOGA* (IMO 5166392) MARCH 15, 2024,
WHILE MOORED AT KINDER MORGAN PINNEY DOCK IN ASHTABULA, OHIO.**

ENDORSEMENT BY THE COMMANDER, GREAT LAKES DISTRICT

The record and the report of the investigation convened for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments. It is recommended that this marine casualty investigation be closed.

COMMENTS ON THE REPORT

1. This casualty is another major fire aboard a Great Lakes self-unloading bulk carrier, following the losses of the M/V ST. CLAIR (2019) and M/V ROGER BLOUGH (2021). The investigation identifies the vessel's conveyor belt systems as a primary factor in the rapid spread of the fire, leading to the constructive total loss of the vessel. These recurring incidents highlight the significant fire risk posed by the cargo handling systems on these vessels due to the lack of fire-resistant materials.
2. The response to this fire underscores the value of the Great Lakes Marine Firefighting Task Force. The established collaborative framework between the U.S. Coast Guard and local fire departments, built upon joint training and strategy development, proved essential in mitigating the extent of the fire. The coordinated actions of all responding agencies were critical in managing the incident and preventing a worse outcome, demonstrating the importance of these ongoing partnerships in protecting vessels, crews, and the marine environment on the Great Lakes.

ENDORSEMENT/RECOMMENDATIONS

Safety Recommendation 1. Recommend Commandant evaluate the dangers internal rubber conveyor belts pose to merchant mariners serving onboard self-discharging bulk carriers. More specifically, self-discharging bulk carriers are equipped with rubber conveyor belts, which pose a significant fire risk due to their rapid spread potential; however, standards for rubber conveyor belt fire safety are insufficient. While the fire onboard Cuyahoga did not originate with the conveyor belt, both conveyor belts on the Cuyahoga ignited, burned, and one belt re-flashed exacerbating the fire and firefighting effort. The conveyor belt's length and movement could increase the dangers, allowing fires to quickly travel great distances within a ship. In addition to the fire onboard Cuyahoga, several significant maritime casualties have highlighted the fire risk rubber conveyor belts pose, to include the Roger Blough (IIA 7139261) in 2021 and St. Clair (IIA 6630678) in 2019. These incidents involved large-scale fires onboard the vessels and substantial damage due to the spread of fire through cargo unloading belt systems where their arrangements do not allow for effective structural fire protection installations along the beltways.

The U.S. Department of Labor Mine Safety and Health Administration (MSHA) has long been aware of the increased risk and lethality of belts that are not fire-resistant. MSHA developed standards to address these concerns, requiring the use of fire-resistant belts proven through approved tests. The recurrence of conveyor belt fire casualties, and the significant financial losses in those cases indicate a need for further evaluation of regulatory standards and consideration of requirements similar to MSHA conveyor belt fire resistance requirements.

Endorsement: I CONCUR with this recommendation. This incident further demonstrates that conveyor belts are a primary vector for fire spread, regardless of the initial cause. Minimum standards for the fire-resistant properties of conveyor belts should be established. The nearly four dozen U.S. flagged self-unloading bulk carriers on the Great Lakes, and others in U.S. waters, will continue to present a high fire risk without adequate regulations for shipboard conveyor belt systems.

Administrative Recommendation 1. Recommend Sector Eastern Great Lakes formally recognize the Ashtabula Fire Department for their rapid response to the fire onboard Cuyahoga. The Ashtabula Fire Departments swift actions limited the spread of fire and quickly extinguished the fire with no reported injuries. Without their efforts, the Marine Transportation System could have suffered a tremendous loss to shore side infrastructure and nearby ships.

Endorsement: I CONCUR with this recommendation. The Ashtabula Fire Department's swift response to this fire mitigated the impacts to the port, personnel, the marine environment, and other vessels. Recognizing their vital contribution is not only appropriate but essential for reinforcing our critical inter-agency partnerships. I fully endorse the initiative to formally commend their courageous actions.

Administrative Recommendation 2. Recommend this investigation be closed.

Endorsement: I CONCUR with this recommendation.



K. A. BROYLES
Captain, U.S. Coast Guard
Chief, Prevention Division
By Direction



16732
January 27, 2026

**FIRE THAT OCCURRED ONBOARD *CUYAHOGA* (O.N. 243772) ON MARCH 15, 2024,
WHILE MOORED AT KINDER MORGAN PINNEY DOCK IN ASHTABULA, OHIO**

ENDORSEMENT BY THE OFFICER IN CHARGE, MARINE INSPECTION

The record and report of the investigation convened for the subject casualty have been reviewed. The record and report, including the findings of fact, analysis, conclusions, and recommendations are approved. It is recommended that this marine casualty investigation be closed.

COMMENTS ON THE REPORT

Thank you to our federal and local partners and first responders – National Transportation Safety Board (NTSB), Bureau of Alcohol, Tobacco, Firearms and Explosives' Fire Research Laboratory, and Ashtabula Fire Department – Fire Prevention Bureau for assisting the Investigating Officer during the marine casualty response, witness interviews, and fire investigation. This outstanding interagency collaboration highlights the vested interest in keeping our ports and waterways safe.

ENDORSEMENT/ACTION ON RECOMMENDATIONS

Recommendation 1. Recommend Commandant evaluate the dangers internal rubber conveyor belts pose to merchant mariners serving onboard self-discharging bulk carriers. More specifically, self-discharging bulk carriers are equipped with rubber conveyor belts, which pose a significant fire risk due to their rapid spread potential; however, standards for rubber conveyor belt fire safety are insufficient. While the fire onboard Cuyahoga did not originate with the conveyor belt, both conveyor belts on the Cuyahoga ignited, burned, and one belt re-flashed exacerbating the fire and firefighting effort. The conveyor belt's length and movement could increase the dangers, allowing fires to quickly travel great distances within a ship. In addition to the fire onboard Cuyahoga, several significant maritime casualties have highlighted the fire risk rubber conveyor belts pose, to include the Roger Blough (IIA 7139261) in 2021 and St. Clair (IIA 6630678) in 2019. These incidents involved large-scale fires onboard the vessels and substantial damage due to the spread of fire through cargo unloading belt systems where their arrangements do not allow for effective structural fire protection installations along the beltways. The U.S. Department of Labor Mine Safety and Health Administration (MSHA) has long been aware of the increased risk and lethality of belts that are not fire-resistant. MSHA developed standards to address these concerns, requiring the use of fire-resistant belts proven through approved tests. The recurrence of conveyor belt fire casualties, and the significant financial losses in those cases indicate a need for further evaluation of regulatory standards and consideration of requirements similar to MSHA conveyor belt fire resistance requirements.

Endorsement: Concur. I concur with the safety recommendation made to the U.S. Coast Guard Commandant. There are numerous U.S. and foreign flagged self-discharging bulk carriers operating in U.S. waters nationwide. Marine casualties involving conveyor belt fires will

continue to present challenges to effective shipboard firefighting without adequate standards or regulations for shipboard conveyor belt systems.

Administrative Recommendation 1. Recommend Sector Eastern Great Lakes formally recognize the Ashtabula Fire Department for their rapid response to the fire onboard Cuyahoga. The Ashtabula Fire Department's swift actions limited the spread of fire and quickly extinguished the fire with no reported injuries. Without their efforts, the Marine Transportation System could have suffered a tremendous loss to shore side infrastructure and nearby ships.

Endorsement: Concur. The Ashtabula Fire Department's swift and courageous actions significantly contributed to the U.S. Coast Guard's core mission of protecting life and property. Acknowledging their efforts honors their bravery and professionalism. I have initiated the process to recognize the courage and contributions of the local first responders' actions during the response to this marine casualty.

Administrative Recommendation 2. Recommend this investigation be closed.

Endorsement: Concur. I agree with the analysis and conclusions of the Investigating Officer. This marine casualty investigation should be closed.



MATTHEW J. WALTER
Captain, U.S. Coast Guard
Officer in Charge, Marine Inspection

Enclosures: (1) Executive Summary
(2) Investigating Officer's Report of Investigation



16732
January 27, 2026

**Fire that occurred onboard *Cuyahoga* (O.N. 243772) on March 15, 2024,
while moored at Kinder Morgan Pinney Dock in Ashtabula, Ohio**

EXECUTIVE SUMMARY

On March 15, 2024, at approximately 1:10 p.m. local time, the 604.8' Canadian flagged self-discharging bulk carrier *Cuyahoga* (O.N. 243772), which was owned and operated by Lower Lakes Towing LTD, was moored in Ashtabula, Ohio at the Kinder Morgan Pinney Dock when a fire broke out in Cargo Hold No. 2.

Cuyahoga had been in winter layup and moored at Kinder Morgan Pinney Dock since January 2024. The ship's crew had recently reported aboard and were in the process of transitioning from winter layup to fully operational. *Cuyahoga*'s firefighting equipment (e.g., fire hoses and nozzles, portable extinguishers, etc.) was stowed in a central location in the ship's aft fire locker, and the lifesaving equipment (e.g., emergency suits, life jackets, life rings, etc.) was stowed in a central location in the ship's portside passenger room. *Cuyahoga* was scheduled to depart Kinder Morgan Pinney Dock on the evening of March 17, 2024, and arrive at Donjon Shipbuilding and Repair's drydock in Erie, Pennsylvania around 8:00 a.m. on March 18, 2024. *Cuyahoga* was scheduled for its five-year drydock, various repairs, and maintenance.

Lower Lakes Towing LTD contracted Conneaut Creek Ship Repair, Inc. to perform hot work aboard *Cuyahoga* in Cargo Hold No. 2 and Conneaut Creek Ship Repair, Inc. subcontracted South Marine Systems, LLC to perform the hot work. South Marine Systems, LLC assigned a welder to weld an access ladder to the forward bulkhead of the hold, assigned a fitter to remove and replace seven safety chains throughout the centerline of the hold, and assigned a fire watch to monitor hot work performed by the welder and fitter. In addition, employees from Lower Lakes Towing LTD were employed onboard the ship to complete hot work on gate channels in the portside cargo tunnel at the forward end of gate 22, which is located below Cargo Hold No. 2.

On March 15, 2024, at 9:30 a.m., Lower Lakes Towing LTD employees completed hot work in the portside cargo tunnel and observed a 30-minute cool down period. The employees departed from their worksite at 12:00 p.m. for lunch and returned at 12:30 p.m.

At 11:30 a.m., South Marine Systems, LLC employees stopped hot work in Cargo Hold No. 2 and observed a 30-minute cool down period. At 12:00 p.m., the employees departed Cargo Hold No. 2 for lunch and returned at 1:00 p.m. to resume hot work.

At 1:10 p.m., while setting up equipment in *Cuyahoga*'s Cargo Hold No. 2, South Marine Systems, LLC employees observed a fire on the hold's forward bulkhead that quickly accelerated in size and intensity. The fire watch attempted to extinguish the fire using two immediately accessible water canister fire extinguishers. After depleting these fire extinguishers and with the fire intensifying, South Marine Systems, LLC employees evacuated Cargo Hold No. 2.

Cuyahoga's audible fire alarm was energized and personnel throughout the ship were notified of the fire. Firefighting efforts were attempted with the use of various portable fire extinguishers, and the Ashtabula Fire Department was notified at 1:20 p.m. As the fire intensified beyond the crew's capability to fight and contain it, and as the fire spread to the ship's cargo boom conveyor belt and cargo tunnel, *Cuyahoga's* master ordered all personnel to evacuate the ship to shore. *Cuyahoga's* crew lowered the ship's forward ladder, and all *Cuyahoga* crewmembers, South Marine Systems, LLC, and Lower Lakes Towing LTD employees safely evacuated the ship to shore. Evacuation routes were via *Cuyahoga's* forward ladder and a gangway that was welded amidship along the ship's port side.

The Ashtabula Fire Department responded and suppressed the fire using 350,000 gallons of water that was dispersed through *Cuyahoga's* Cargo Hold No. 2 and through a 10 feet by 10 feet machinery hatch located forward on the ship. The fire aboard *Cuyahoga* was overhauled with the use of approximately 75,000 gallons of finished F-500 foam.

As a result of this investigation, the Coast Guard determined the initiating event of this casualty was the ignition of a fire on the forward bulkhead in *Cuyahoga's* Cargo Hold No. 2. The fire subsequently resulted in substantial damage to Cargo Hold No. 1, Cargo Hold No. 2, the spar deck (upper continuous deck), hatch coamings and hatch covers, the cargo boom and the boom's conveyor belt structure, and the port side and starboard side conveyor tunnels and their associated equipment. *Cuyahoga* was declared a constructive total loss estimated at \$11 million.

The causal factors that contributed to this casualty include: (1) an electrical arc from the flux-core welding unit or an extension cord; (2) nut coke residue from previous cargo combined with the Amerthane 490 epoxy coating on the bulkhead; (3) the lack of firefighting equipment immediately available in the vicinity of hot work; and (4) an ineffective firefighting technique used by the fire watch when initially combatting the fire.



16732
January 27, 2026

**Fire that occurred onboard *Cuyahoga* (O.N. 243772) on March 15, 2024,
while moored at Kinder Morgan Pinney Dock in Ashtabula, Ohio**

INVESTIGATING OFFICER'S REPORT

1. Preliminary Statement

1.1. This marine casualty investigation was conducted, and this report was submitted in accordance with Title 46, Code of Federal Regulations (CFR), Subpart 4.07, and under the authority of Title 46, United States Code (USC), Chapter 63.

1.2. In accordance with 46 CFR Subsection 4.03-10, the following were designated as a party-in-interest in this investigation: Lower Lakes Towing LTD, the owner/operator of *Cuyahoga*; Conneaut Creek Ship Repair, Inc. and South Marine Systems LLC, companies that performed ship repairs onboard *Cuyahoga*; along with ABL USA Inc., the marine surveyor and engineer supporting Lower Lakes Towing LTD.

1.3. Canada was designated a substantially interested state in this investigation in accordance with Part II, Chapter 5, of the International Maritime Organization's (IMO) Casualty Code, as implemented by the U.S. Coast Guard's Navigation and Vessel Inspection Circular (NVIC) 05-17 Ch.1, *Reporting and Investigation of Marine Casualties Where the United States is a Substantially Interested State (SIS)*. Canada declined to participate in the investigation but offered their assistance as needed.

1.4. The U.S. Coast Guard was lead agency for all activities involved in this investigation. The National Transportation Safety Board (NTSB) and the Ashtabula Fire Department – Fire Prevention Bureau conducted parallel safety investigations. The U.S. Coast Guard, the NTSB, and the Ashtabula Fire Department – Fire Prevention Bureau acted as a cohesive team during the entirety of the fact-finding portion of the investigation. Their investigators were a critical factor in the success of this investigation. The U.S. Coast Guard investigation team extends their sincere appreciation to the NTSB and the Ashtabula Fire Department – Fire Prevention Bureau for their professionalism and dedication to ensuring positive cooperation, and their partnership in enhancing safe maritime operations. Additionally, the Bureau of Alcohol, Tobacco, Firearms and Explosives' Fire Research Laboratory provided critical support with fire protection analysis of epoxy coating and technical assistance with assessing its ignition propensity.

1.5. All times listed in this report are approximate and in local time format. The Incident Investigation Activity Number for this investigation is 7881082.

2. Vessel Involved in the Incident



Figure 1. Undated Photograph of *Cuyahoga* (U.S. Official Number 243772). Source: www.vesselfinder.com

Official Name:	<i>Cuyahoga</i>
Identification Number:	U.S. Official Number 243772
Flag:	Canada
Vessel Class/Type/Sub-Type:	Bulk Carrier/General/Self-Discharging
Build Year:	1943
Gross Tons (GRT):	10,532
Length:	604.8'
Beam:	60'
Depth:	35'
Main/Primary Propulsion (Configuration/System Type, Ahead Horsepower):	Diesel Reduction
Owner:	Lower Lakes Towing LTD 517 Main Street PO Box 1149 Port Dover, ON N0A 1N0
Operator:	Lower Lakes Towing LTD 517 Main Street PO Box 1149 Port Dover, ON N0A 1N0

3. Deceased, Missing, and/or Injured Persons

Name (First, MI, Last)	Sex	Age	Relationship to Vessel	Status
None	N/A	N/A	N/A	N/A

4. **Findings of Fact**

4.1. The Incident:

4.1.1. [REDACTED] was the Master onboard *Cuyahoga* on March 15, 2024, and for the remainder of this report will be referred to as *Cuyahoga*'s Master.

4.1.2. [REDACTED] was the First Mate onboard *Cuyahoga* on March 15, 2024, and for the remainder of this report will be referred to as *Cuyahoga*'s First Mate.

4.1.3. [REDACTED] was the Chief Engineer onboard *Cuyahoga* on March 15, 2024, and for the remainder of this report will be referred to as *Cuyahoga*'s Chief Engineer.

4.1.4. [REDACTED] was employed by South Marine Systems, LLC onboard *Cuyahoga* on March 15, 2024, as a Foreman, and for the remainder of this report will be referred to as SMS' foreman.

4.1.5. [REDACTED] was employed by South Marine Systems, LLC onboard *Cuyahoga* on March 15, 2024, as a fitter in Cargo Hold No. 2, and for the remainder of this report will be referred to as SMS' fitter.

4.1.6. [REDACTED] was employed by South Marine Systems, LLC onboard *Cuyahoga* on March 15, 2024, as a welder in Cargo Hold No. 2, and for the remainder of this report will be referred to as SMS' welder.

4.1.7. [REDACTED] was employed by South Marine Systems, LLC onboard *Cuyahoga* on March 15, 2024, as a fire watch in Cargo Hold No. 2, and for the remainder of this report will be referred to as SMS' fire watch.

4.1.8. [REDACTED] was employed by Lower Lakes Towing LTD onboard *Cuyahoga* on March 15, 2024, as Head of Cargo Maintenance, and for the remainder of this report will be referred to as Head of Cargo Maintenance.

4.1.9. [REDACTED] was employed by Lower Lakes Towing LTD onboard *Cuyahoga* on March 15, 2024, as Cargo Maintenance, and for the remainder of this report will be referred to as Head of Cargo Maintenance's Assistant

4.1.10. The 604.8' Canadian flagged self-discharging bulk carrier *Cuyahoga* (O.N. 243772) transitioned into winter layup in January 2024 and berthed at Kinder Morgan Pinney Dock in Ashtabula, Ohio as shown in Figure 2.

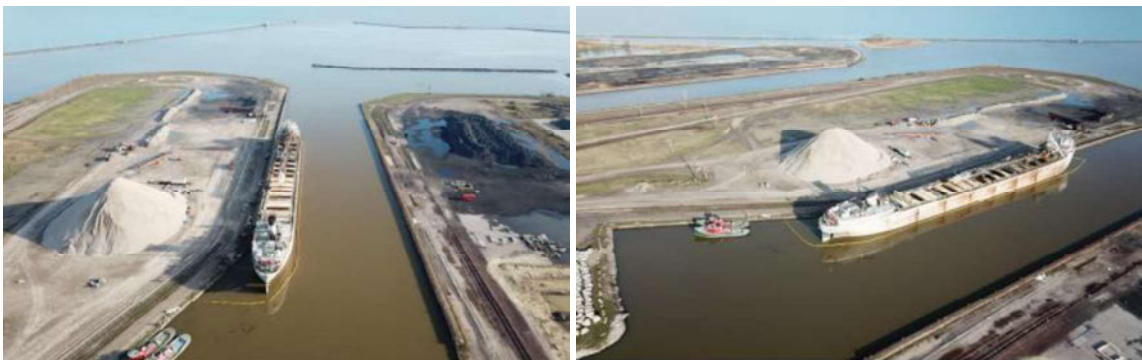


Figure 2. Photographs of *Cuyahoga* while moored at Kinder Morgan Pinney Dock. Source: Ashtabula Fire Department.

4.1.11. As part of *Cuyahoga*'s winter layup preparations, *Cuyahoga*'s crew performed an internal washdown of the ship's cargo holds to remove residual cargo from the ship.

4.1.12. *Cuyahoga*'s firefighting equipment (e.g., fire hoses and nozzles, portable extinguishers, etc.) was stowed in a central location in the ship's aft fire locker, and the ship's lifesaving equipment (e.g., emergency suits, lifejackets, life rings, etc.) was stowed in a central location in the ship's portside passenger room.

4.1.13. *Cuyahoga* was deballasted, all equipment was shutdown, shore power was connected, and a security sweep was completed.

4.1.14. *Cuyahoga* was scheduled to depart Kinder Morgan Pinney Dock the evening of March 17, 2024, and arrive at Donjon Shipbuilding and Repair's drydock in Erie, Pennsylvania around 8:00 a.m. on March 18, 2024. *Cuyahoga* was scheduled for its five year drydock, various repairs, and maintenance.

4.1.15. South Marine Systems, LLC was contracted by Conneaut Creek Ship Repair, Inc. to perform hot work onboard *Cuyahoga* in various cargo holds. Hot work in Cargo Hold No. 2 consisted of replacing and welding an access ladder on the forward bulkhead of the cargo hold, and removal and replacement of seven safety chains throughout the centerline of the hold.

4.1.16. *Cuyahoga*'s Master reported aboard on March 14, 2024. Although *Cuyahoga*'s Master was not aware of the exact hot work being performed on the vessel by third-party companies, he was aware work was being performed in *Cuyahoga*'s aft starboard ballast tank and cargo holds.

4.1.17. *Cuyahoga* was designed with multiple lift-away hatch covers for each of the ship's four cargo holds. *Cuyahoga* Cargo Hold No. 2's four hatch covers had been removed prior to March 15, 2024, by a hatch crane and stowed in the ship's bay. *Cuyahoga* Cargo Hold No. 1's forward hatch covers had also been removed prior to March 15, 2024; however, Cargo Hold No. 1's two aft hatch covers remained in their respective place as shown in Figure 3.



Figure 3. Photograph of *Cuyahoga*'s hatch covers taken post-fire. Source: Ashtabula Fire Department.

4.1.18. *Cuyahoga* was fitted with a straight metal boarding ladder near its bow that was connected to a winch and could be lowered or raised as needed. On March 15, 2024, the boarding ladder was located aboard the ship and was not placed over the side as shown in Figure 4. *Cuyahoga* was also fitted with a gangway that was welded amidship along the ship's port side as shown in Figure 4.

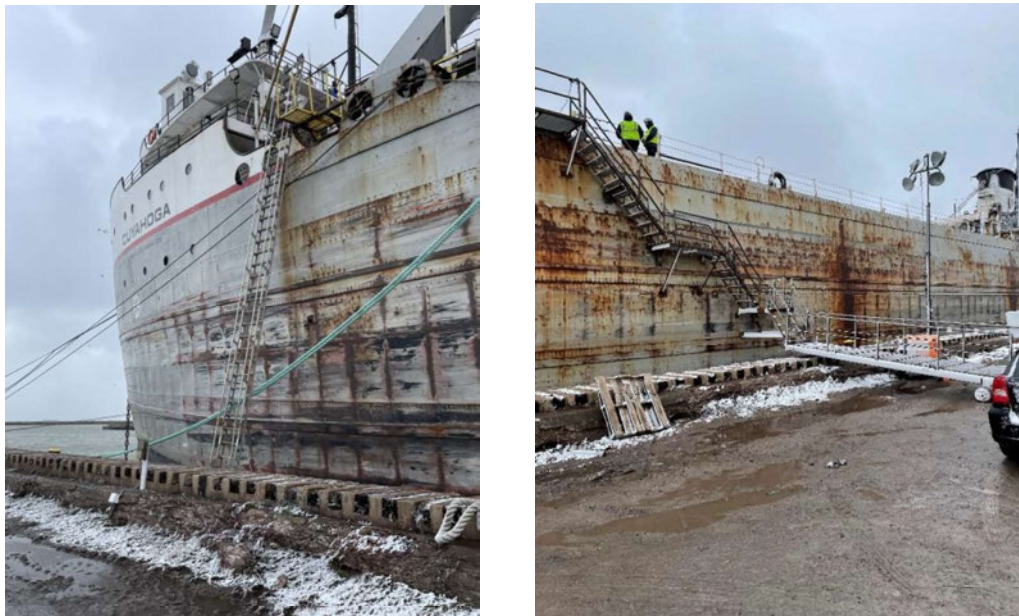


Figure 4. Photographs of *Cuyahoga*'s forward ladder (left) and amidship gangway (right). Source: U.S. Coast Guard.

4.1.19. *Cuyahoga* was self-discharging, and the equipment onboard consisted of a two-belt gravity fed system with hydraulic gates and a forward-mounted 250' discharge boom that could be swung to port or starboard. Gates are located at the bottom side of each cargo hold and can be opened or closed to allow cargo to pass from cargo holds onto the cargo tunnel belts. *Cuyahoga* was also designed with port and starboard cargo tunnels and an unloading tunnel. There are no door or bulkhead separations in these tunnels. The conveyor belt relocates product from selected cargo holds and transfers product to the forward part of the ship where the product is dumped onto the elevator. The elevator is a series of buckets on a rail system that relocates the product onto the ship's unloading boom/conveyor belt where product is transferred ashore.

4.1.20. On March 15, 2024, *Cuyahoga* Cargo Hold No. 2's gates on the port and starboard sides were in the closed position.

4.1.21. *Cuyahoga* was designed with a booby hatch at the forward and aft ends of Cargo Hold No. 2. Booby hatches are small hatches giving access to a ladder from the weather deck to the interior of a cargo hold. On March 15, 2024, Cargo Hold No. 2's forward and aft booby hatches were in the open position as seen in Figure 5.

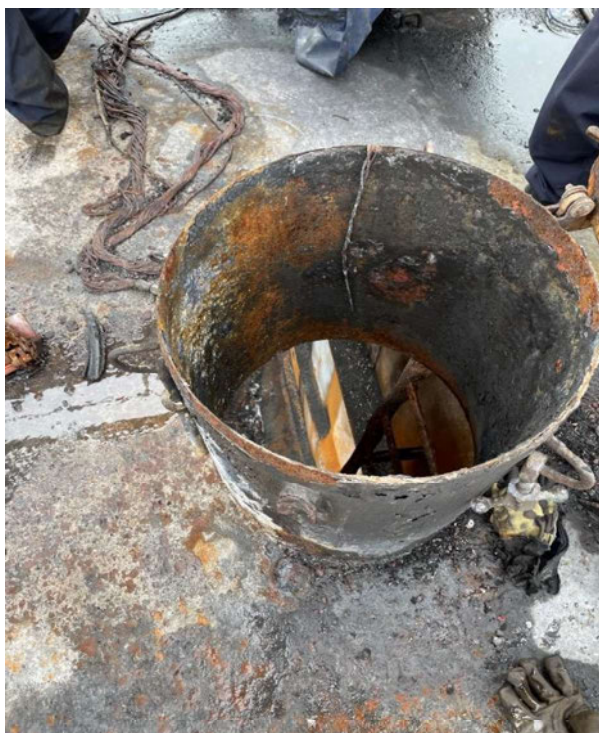


Figure 5. *Cuyahoga's* Cargo Hold No. 2 forward booby hatch. Source: U.S. Coast Guard.

4.1.22. On March 15, 2024, *Cuyahoga's* intercom system was not fully functional and was not amplifying sound properly. *Cuyahoga's* Master and Chief Engineer were aware of the situation, and the Chief Engineer was in the process of diagnosing the issue.

4.1.23. On March 15, 2024, at 7:30 a.m., *Cuyahoga's* Chief Engineer met with his crew to discuss details of work to be performed that day.

4.1.24. At 8:00 a.m., two Lower Lakes Towing LTD employees, Head of Cargo Maintenance and his assistant, worked on gate channels in the portside cargo tunnel at the forward end of gate 22 as shown in Figure 6. The work consisted of removing existing I-beams along with fitting and aligning new I-beams using a cutting torch. The I-beams are designed to reinforce the cargo belt under the gates. Welding the new I-beams was to be completed by Conneaut Creek Ship Repair, Inc. and South Marine Systems LLC employees. Gate 22 is located below Cargo Hold No. 2.



Figure 6. Photographs of *Cuyahoga*'s portside cargo tunnel at the forward end of gate 22. Source: U.S. Coast Guard.

4.1.25. At 9:30 a.m., the I-beam had been removed and associated hot work concluded. A 30-minute cool down period was observed, and the Head of Cargo Maintenance and his assistant departed the tunnel for their morning break.

4.1.26. Head of Cargo Maintenance and his assistant returned to gate 22 and continued to align gate 22 into position to set the gate's pin, which was set in place.

4.1.27. *Cuyahoga*'s fire hoses were not positioned at their respective stations and were in the fire locker located on the ship's aft upper deck. Throughout the morning, the ship's crew prepared for sailing by beginning the process of placing safety gear back in their respective locations, such as fire-extinguishers, firehoses, etc.

4.1.28. *Cuyahoga*'s crew was aware that Conneaut Creek Ship Repair, Inc. and South Marine Systems LLC were performing hot work in various locations throughout *Cuyahoga*, to include Cargo Hold No. 2.

4.1.29. South Marine Systems LLC's foreman met with company employees in their dockside trailer to discuss the scope of work to be performed and assigned three employees to *Cuyahoga*'s Cargo Hold No. 2. A welder was assigned to weld an access ladder on the forward bulkhead of the hold, a fitter was assigned to remove and replace seven safety chains throughout the centerline of the hold, and a fire watch was assigned to the hot work being completed by the welder and fitter. Safety chains were fastened to the deck with a screw and coupling. The screws, couplings, and existing chain were cut with a grinder and an oxygen/gas cutting torch. New chain was cut to size with existing chains, and the new chain was installed with a new screw and coupling. Figure 7 depicts the location of safety chains and ladder in Cargo Hold No. 2.

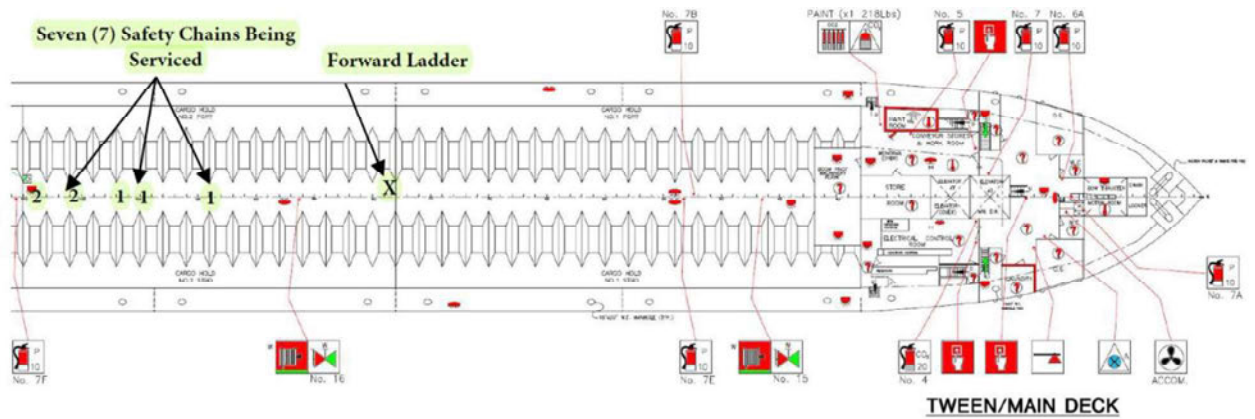


Figure 7. *Cuyahoga's* Cargo Hold No. 2 with location of safety chains and ladder replacement. Source: U.S. Coast Guard.

4.1.30. South Marine Systems LLC had 25 employees onboard *Cuyahoga* performing various work throughout the ship.

4.1.31. South Marine Systems LLC's work efforts were monitored by a designated foreman who also served as a competent person. This person was known as SMS' foreman, and he assigned two additional fire watches to *Cuyahoga's* cargo tunnels to observe hot work activity being performed in the cargo holds above.

4.1.32. SMS' fitter used a torch in *Cuyahoga's* Cargo Hold No. 2 that was supplied with oxygen/gas from a source onshore with smaller connected tanks located on *Cuyahoga's* weather deck. An oxygen/gas line was connected to the small tanks and the line led into Cargo Hold No. 2 through the aft booby hatch down along the aft ladder.

4.1.33. The flux core welding unit used by SMS' welder in Cargo Hold No. 2 consisted of a Lincoln LN-25 Pro MAG 300 Wire Feeder, a Lincoln Invertec V350 Pro 4-pack welder, a CEP 480V Distribution Panel, and a CEP 15KVA Stepdown Transformer. The welding unit was grounded to *Cuyahoga's* main deck, and a separate local ground was made in Cargo Hold No. 2 at the site of hot work and control box. The cable lines supporting the flux core welding unit led into Cargo Hold No. 2 through the forward booby hatch along the forward ladder.

4.1.34. SMS' welder grinded and removed a three-to-four-inch radius of paint on Cargo Hold No. 2's forward bulkhead for each ladder bracket that was being welded to the bulkhead. Another spot, approximately two-hands width, was grinded and paint removed on a nearby I-beam for the grounding electrode cable as seen in Figure 8.

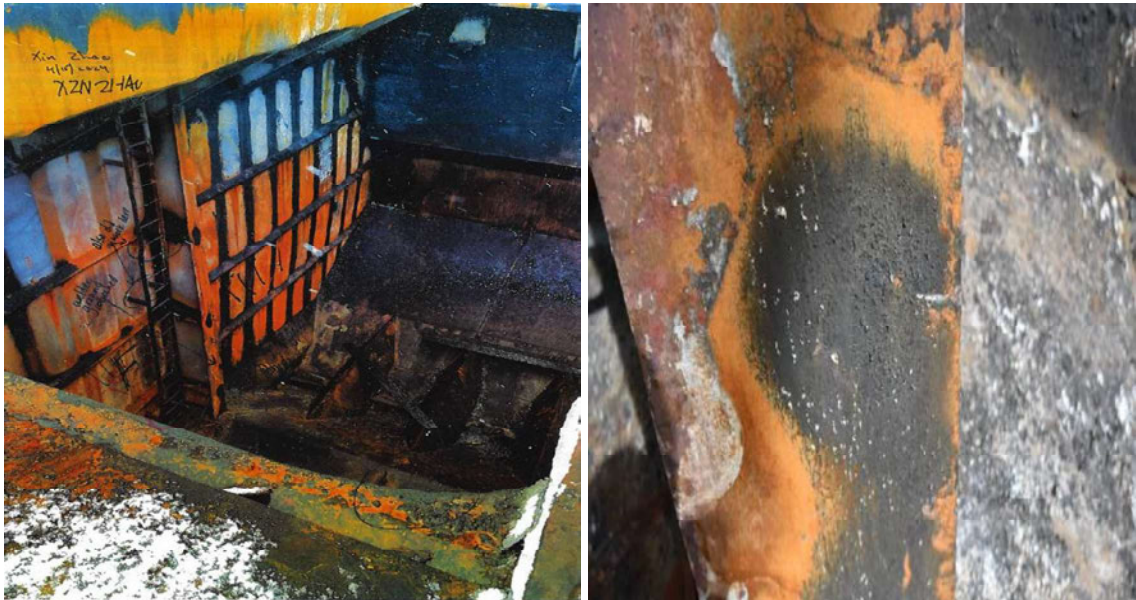


Figure 8. *Cuyahoga*'s Cargo Hold No. 2 with location of the forward ladder (left) and location of grounded electrode clamp on the I-beam (right). Source: U.S. Coast Guard. Diagram obtained during an interview on April 15, 2024, with SMS' welder..

4.1.35. Between 8:00 a.m. and 9:00 a.m., SMS' fire watch in Cargo Hold No. 2 used water as a precautionary measure from one of the two designated water canister fire extinguishers to support hot work being performed by SMS' fitter. The extinguisher was used to cool safety chains after the torch was used on the chain and before grinding commenced due to the chain's high heat level. It was not known how much water remained in the extinguisher that had been used.

4.1.36. At 10:00 a.m., while welding on the forward ladder in Cargo Hold No. 2, SMS' welder experienced a loss of power with his welding equipment. Upon investigating the situation, SMS' welder discovered a power source connector outside the cargo hold on *Cuyahoga*'s main deck was not properly connected. SMS' welder rectified the issue, reentered Cargo Hold No. 2, and resumed welding on the forward bulkhead.

4.1.37. At 11:30 a.m., hot work in Cargo Hold No. 2 stopped and SMS' welder, fitter, and fire watch observed a 30-minute cool down period.

4.1.38. Lunch onboard *Cuyahoga* was served to vessel crew in the ship's galley between 11:30 a.m. and 12:30 p.m.

4.1.39. At 12:00 p.m., SMS' welder, fitter, and fire watch exited Cargo Hold No. 2 for lunch. SMS' welder turned his welding machine off at the unit located on *Cuyahoga*'s main deck. The lower section of the forward ladder was not completely welded in place and required additional welding on the ladder's bottom brackets.

4.1.40. At 12:00 p.m., Head of Cargo Maintenance and his assistant departed their worksite for lunch and returned to their worksite in the portside cargo tunnel at the forward end of gate 22 at 12:30 p.m. Upon returning, they began aligning the gate and installing gears, but no hot work was performed. No other personnel were in the portside cargo tunnel space.

4.1.41. At 1:00 p.m., SMS' fitter, welder, and fire watch returned to *Cuyahoga's* Cargo Hold No. 2 via the hold's aft ladder. SMS' fitter prepared his tools for ongoing work in the aft section of the hold, SMS' welder prepared his welding unit for ongoing work in the forward section of the hold, and SMS's fire watch positioned himself between the welder and fitter with two water canister fire extinguishers to support his fire watch duties.

4.1.42. Before entering *Cuyahoga's* Cargo Hold No. 2, SMS' welder turned on his welding machine at the weld unit located on *Cuyahoga's* main deck. After entering Cargo Hold No. 2, SMS's welder was unable to get power to the welding gear and began to visually inspect the equipment by examining the grounding clamp, which was connected, and the welding gear. The welding gear's voltmeter indicated no power. With no obvious signs of what caused the malfunction, SMS' welder believed one of the weld gear connectors on the main deck may not have been properly connected.

4.1.43. Between 1:05 p.m. and 1:10 p.m., SMS' fire watch, who was located approximately in the center of Cargo Hold No. 2, turned toward the forward bulkhead and discovered a flame at the base of the forward bulkhead in proximity to the forward ladder. SMS' fire watch yelled "fire" in English to alert SMS' fitter and welder. See Figures 9 and 10 for location of the initial fire and location of SMS' welder, fitter, and fire watch at the onset of the fire.

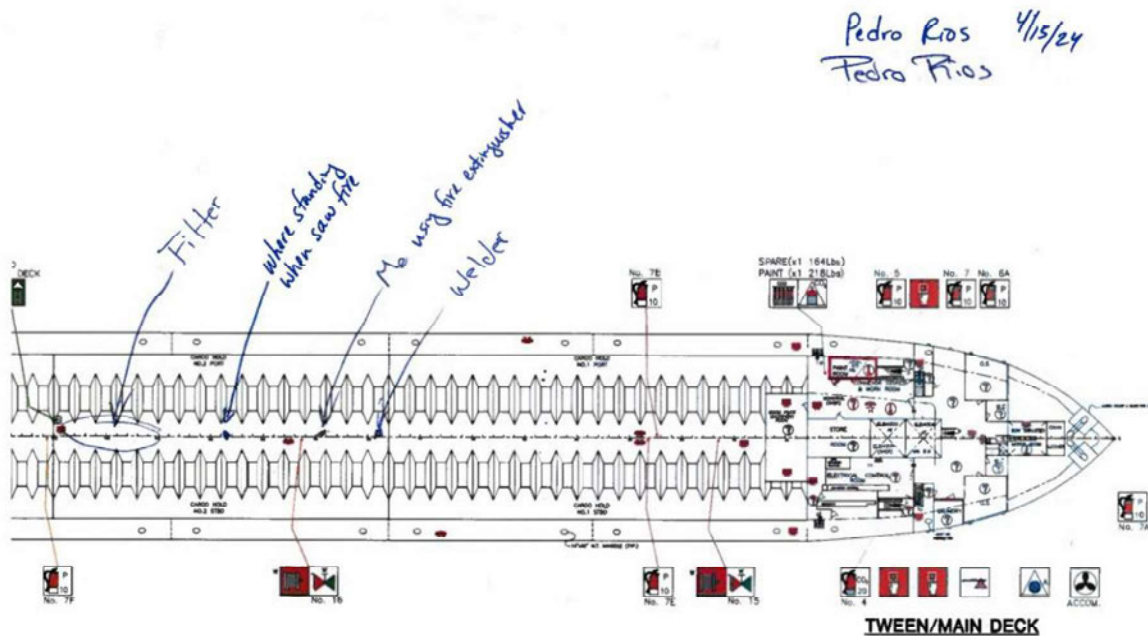


Figure 9. Location of SMS' welder, fitter, and fire watch when the fire was discovered in *Cuyahoga's* Cargo Hold No. 2. Source: U.S. Coast Guard. Diagram obtained during an interview on April 15, 2024, with SMS' fire watch.

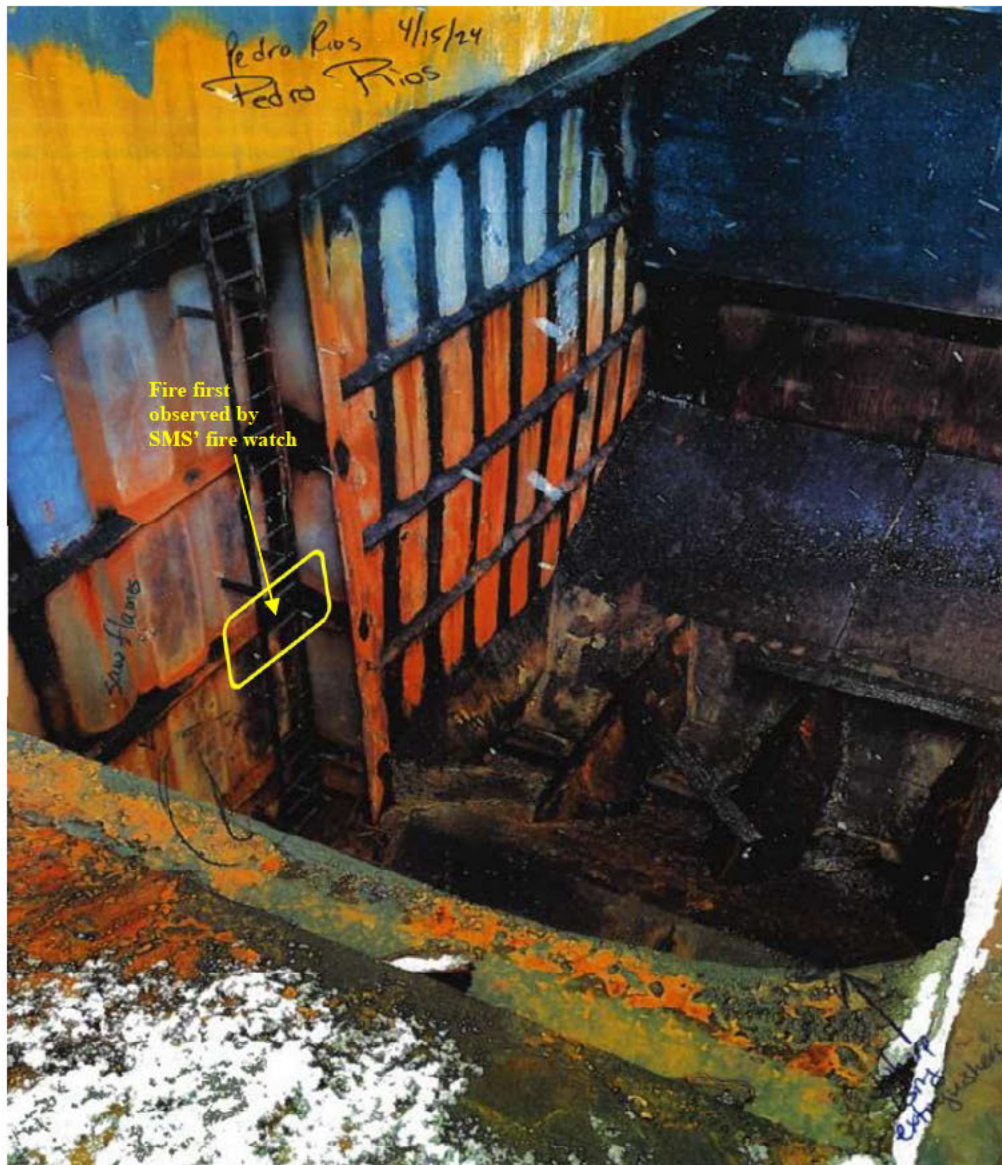


Figure 10. Location where SMS' fire watch discovered the initial flames in *Cuyahoga*'s Cargo Hold No. 2.
Source: U.S. Coast Guard. Diagram obtained during an interview on April 15, 2024, with SMS' fire watch.

4.1.44. SMS' fitter, who was located nearby and facing Cargo Hold No. 2's aft ladder, heard SMS' fire watch yell "fire" and turned towards the forward bulkhead. Simultaneously, SMS' welder, who had his back towards Cargo Hold No. 2's forward ladder, sensed heat emitting from the forward bulkhead. SMS' welder turned towards the forward bulkhead and discovered flames on the bulkhead as shown in Figure 11. SMS' welder turned and proceeded towards the aft ladder and quickly exited Cargo Hold No. 2.

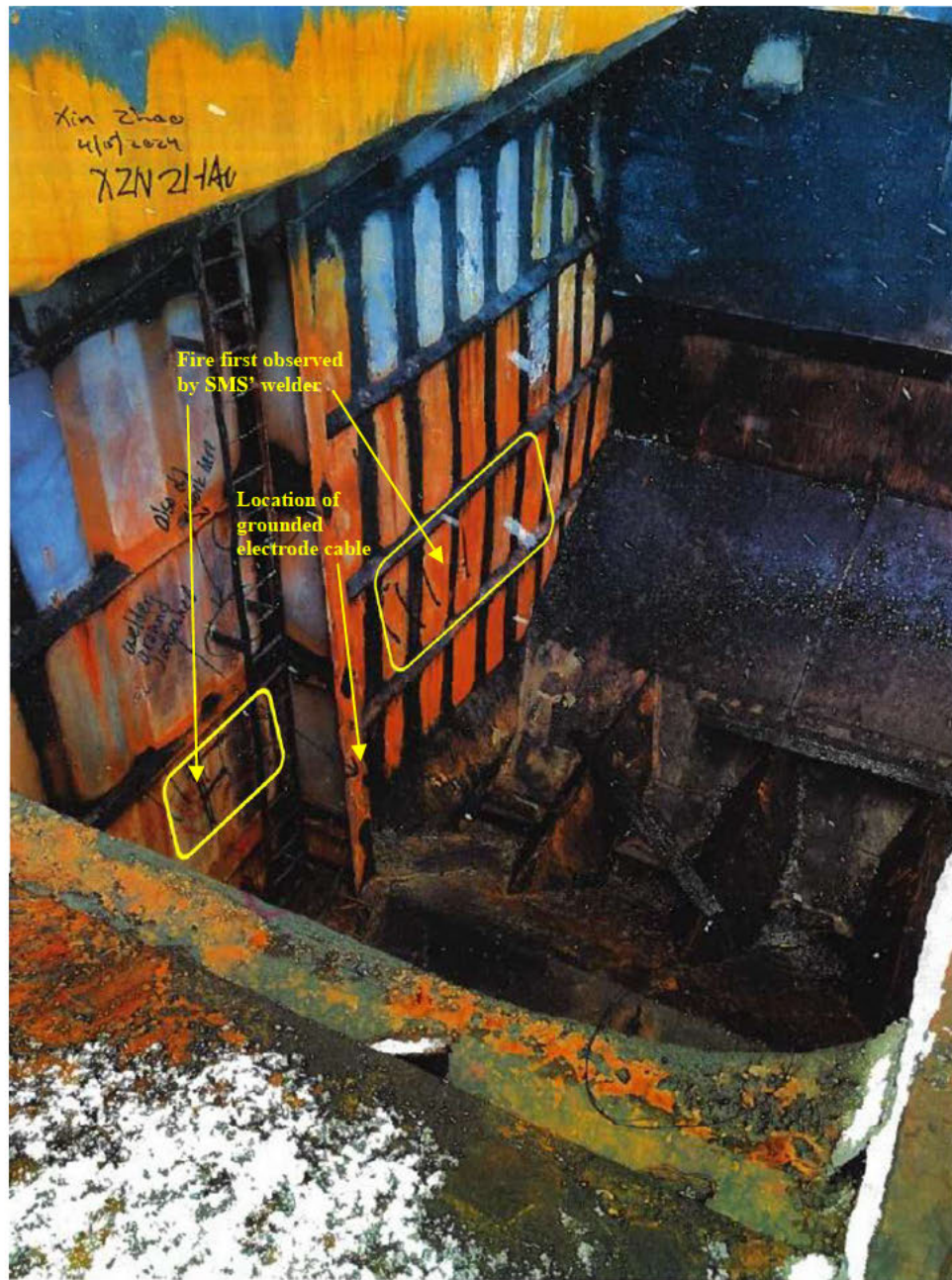


Figure 11. Location where SMS' welder discovered the initial flames in *Cuyahoga's* Cargo Hold No. 2.
Source: U.S. Coast Guard. Diagram obtained during an interview on April 15, 2024, with SMS' welder.

4.1.45. SMS' fitter observed smoke and a blazing fire that appeared to have started underneath Cargo Hold No. 2's forward ladder. The fire appeared large with flames approximately five feet high from the base of the bulkhead that quickly grew. The fire appeared out of control and beyond the fire extinguishers capability.

4.1.46. SMS' fire watch proceeded toward the fire and attempted to extinguish it by spraying water at the center of the fire and then moving the water stream toward the top of the fire. The fire continued to grow upward and spread to the sides at a fast pace. After depleting both water canister fire extinguishers, SMS' fire watch extracted the fire extinguishers from the hold using a rope and evacuated Cargo Hold No. 2 via the aft

ladder. Upon arrival on the main deck, SMS' fire watch continued to battle the fire from above using various fire extinguishers that were available on deck.

4.1.47. At 1:20 p.m., the Ashtabula Fire Department was notified of the fire onboard *Cuyahoga* and arrived at *Cuyahoga*'s location at 1:30 p.m. to commence firefighting.

4.1.48. *Cuyahoga*'s audible fire alarm was energized by an unknown source.

4.1.49. An SMS employee ran through the portside cargo tunnel alerting personnel of the fire.

4.1.50. After hearing *Cuyahoga*'s audible alarm and being alerted to a fire by a subcontractor, the Head of Cargo Maintenance and his assistant proceeded to evacuate the cargo tunnel moving forward to the main deck. Prior to the ship's audible alarm energizing and being notified of the fire, the Head of Cargo Maintenance heard an unknown material dripping above him in Cargo Hold No. 2, similar to the sound of small stones or dirt falling on the gates. During the evacuation, paint drippings and sparks were observed dropping into gate 21, but no smoke was detected inside the tunnel. Personnel working in the cargo tunnel safely evacuated *Cuyahoga* by using the ship's forward ladder.

4.1.51. SMS' fitter evacuated Cargo Hold No. 2 via the hold's aft ladder with an empty water canister fire extinguisher to retrieve another fire extinguisher and did not return to the hold. As SMS' fitter arrived on *Cuyahoga*'s weather deck, he walked to the stern of the ship to retrieve additional fire extinguishers. He encountered a *Cuyahoga* crewmember who gave him two fire extinguishers of an unknown type. SMS' fitter returned to the fire and gave a fire extinguisher to an unknown person and discharged the other fire extinguisher from above the forward bulkhead, close to Cargo Hold No. 2's forward booby hatch as shown in Figure 12.



Figure 12. Location where SMS's fitter discharged a fire extinguisher into *Cuyahoga*'s Cargo Hold No. 2.
Source: U.S. Coast Guard. Diagram obtained during an interview on April 15, 2024, with SMS' fitter.

4.1.52. *Cuyahoga's* Chief Engineer had been working on paperwork in his office when he heard *Cuyahoga's* fire alarm. *Cuyahoga's* Chief Engineer attempted to contact the ship's crew via a handheld radio but did not receive a response. He observed through the forward office window smoke emitting from the forward section of the ship. *Cuyahoga's* Chief Engineer proceeded to the engine room where crew gathered fire extinguishers.

4.1.53. *Cuyahoga's* First Mate, who was on the ship's poop deck, a deck that forms the roof of a cabin in the aft section of *Cuyahoga*, heard a person make an alarming remark that caused him to shift his attention. *Cuyahoga's* First Mate immediately observed smoke and sensed heat in the area. *Cuyahoga's* First Mate yelled, "fire, fire, fire, fire" and proceeded to the nearest firehose station that was not yet equipped with a firehose.

4.1.54. *Cuyahoga's* Master, who was in his office completing administrative paperwork, heard someone yelling, "fire." *Cuyahoga's* Master observed *Cuyahoga's* First Mate running and notifying others of the fire. *Cuyahoga's* Master exited his office to the ship's main deck and observed flames coming up from *Cuyahoga's* Cargo Hold No. 2. *Cuyahoga's* Master proceeded toward Cargo Hold No. 2 to provide firefighting assistance. He observed a crewmember donning a fire suit and attempting to locate firefighting hoses, which were still stored in the ship's aft fire locker and were in the process of being distributed to their respective stations prior to the fire.

4.1.55. *Cuyahoga's* First Mate proceeded to the starboard side of Cargo Hold No. 2's forward booby hatch. *Cuyahoga's* First Mate discharged a dry chemical fire extinguisher into Cargo Hold No. 2's that was aimed toward the forward bulkhead ladder. He retrieved another fire extinguisher and discharged the fire extinguisher on the starboard side of Cargo Hold No. 2's forward bulkhead.

4.1.56. *Cuyahoga's* Master called down to the engine room using a nearby telephone located inside a weathertight door that led into the starboard main deck hallway next to the ship's boom control and requested *Cuyahoga's* Fourth Engineer activate the general service pump to supply water to the ship's fire hydrants.

4.1.57. *Cuyahoga's* Chief Engineer, in consultation with *Cuyahoga's* Second Engineer, shut a breaker off securing power to the forward section of the ship.

4.1.58. The flames emitting from the top of Cargo Hold No. 2 increased in size and began to impact *Cuyahoga's* cargo boom conveyor belt. *Cuyahoga's* First Mate retrieved another dry chemical fire extinguisher, climbed up the side of the boom, and discharged the extinguisher on the burning cargo boom conveyor belt. The fire appeared to extinguish but quickly reignited within seconds and spread out of control along the conveyor belt, aiding in the rapid spread of fire. Damage to *Cuyahoga's* cargo boom conveyor belt is depicted in Figure 13.

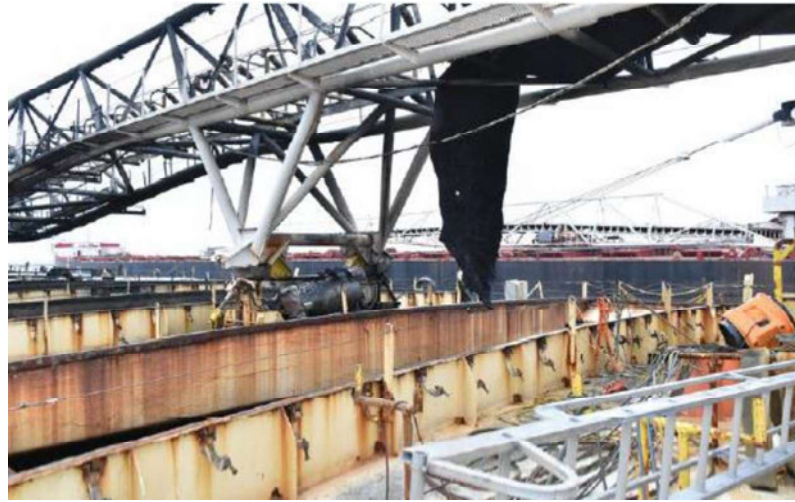


Figure 13. Photograph of *Cuyahoga*'s cargo boom conveyor belt taken post-fire. Source: Ashtabula Fire Department.

4.1.59. *Cuyahoga*'s Master, who was not aware whether the ship's boom was operational, contacted *Cuyahoga*'s Chief Engineer and asked if he could have the ship's boom lifted. By the time *Cuyahoga*'s Chief Engineer confirmed the boom could be lifted, the boom's conveyor belt had been engulfed in flames and not able to be raised. Additionally, *Cuyahoga*'s Chief Engineer had concerns whether he could safely make it to the boom controls due to the fire and smoke.

4.1.60. *Cuyahoga*'s Chief Engineer searched for personnel in the engine room, the second deck, main deck, operational deck, boiler room, janitor room, and closed doors as spaces were deemed clear of personnel.

4.1.61. The fire emitting from Cargo Hold No. 2's forward booby hatch funneled up "like an after burner on a fighter jet."

4.1.62. A fire extinguisher was discharged into Cargo Hold No. 2's forward booby hatch and the booby hatch cover closed.

4.1.63. Approximately four *Cuyahoga* crewmembers and several South Marine Systems, LLC employees attempted firefighting efforts from the weather deck into Cargo Hold No. 2 discharging eight to ten water and dry chemical fire extinguishers in total. Some of the fire extinguishers were in place at their respective stations, and others were transported to the fire by the ship's crew from *Cuyahoga*'s aft fire locker and forward locations on the ship.

4.1.64. The fire in *Cuyahoga*'s Cargo Hold No. 2 spread to Cargo Hold No. 1, and the heat emitted from these spaces prevented personnel from safely walking forward or aft on *Cuyahoga*'s weather deck as shown in Figure 14.

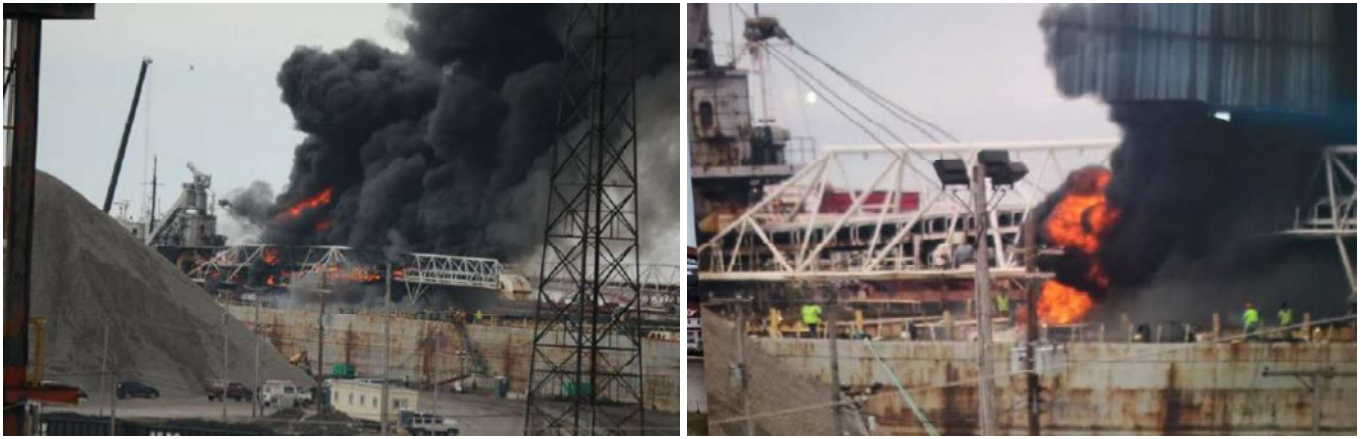


Figure 14. Photographs of fire onboard *Cuyahoga*. Source: Ashtabula Fire Department.

4.1.65. *Cuyahoga*'s Cargo Hold No. 1 was ablaze.

4.1.66. *Cuyahoga*'s Master recognized the spread of fire on the boom's conveyor belt and cargo holds exceeded the ship's capacity to fight the fire. The fire also impeded the ability to pass by the fire due to its size and the heat being emitted. *Cuyahoga*'s Master ordered all personnel to evacuate *Cuyahoga*.

4.1.67. *Cuyahoga*'s Master lowered the ship's forward ladder, authorized crewmembers to quickly retrieve personal effects (e.g., passports, wallets, etc.), and called *Cuyahoga*'s Chief Engineer in the engine room to direct him to evacuate all personnel aft of the fire. *Cuyahoga*'s Master was the last person to evacuate after approximately 10-12 crewmembers and South Marine Systems, LLC employees evacuated via the forward ladder.

4.1.68. An unknown number of *Cuyahoga* crewmembers and South Marine Systems, LLC employees evacuated the ship via *Cuyahoga*'s midship gangway.

4.1.69. *Cuyahoga*'s First Mate and other crewmembers who safely evacuated to the dock assisted personnel with evacuations from the ship's forward ladder.

4.1.70. A total of 15 *Cuyahoga* crewmembers safely evacuated the ship and were accounted for by *Cuyahoga*'s Master.

4.1.71. A total of 25 South Marine Systems, LLC employees safely evacuated *Cuyahoga* and were accounted for by South Marine Systems, LLC's management.

4.1.72. Ashtabula Fire Department suppressed the fire using 350,000 gallons of water that was dispersed through *Cuyahoga*'s Cargo Hold No. 2 and through a 10' by 10' machinery hatch located forward on the ship. The fire aboard *Cuyahoga* was overhauled with the use of approximately 75,000 gallons of finished F-500 foam. The fire officially extinguished at 11:26 p.m. on March 15, 2024.

4.2. Additional/Supporting Information:

4.2.1. Damage to *Cuyahoga* was estimated to be \$11 million, and the vessel was deemed a constructive total loss. The investigation found extensive structural distortion, buckling, and fractures throughout *Cuyahoga*'s Cargo Hold No. 1, Cargo Hold No. 2,

the spar deck (upper continuous deck), and hatch coamings and hatch covers. In addition, *Cuyahoga's* cargo boom's main structure buckled and distorted, and the boom's conveyor belt structure burnt and was distorted from the boom pivot up to frame 115, which included components such as the belt, rollers, frames, pulleys, hoisting cables, and electrical raceway. The port side and starboard side conveyor tunnels and their associated equipment were charred and sustained substantial damage.

4.2.2. *Cuyahoga's* previous cargoes before entering winter layup in January 2024 consisted of furnace coke, which was loaded on December 21, 2023; potash, which was loaded on December 24, 2023; and nut coke, which was loaded on December 31, 2023.

4.2.3. Lower Lakes Towing LTD's Layout Instruction, Company Policy Code 6.05.1, required the vessel's decks and tunnels to be "absolutely clean before the vessel arrives at the lay-up dock."

4.2.4. During this investigation, a white residue similar in appearance to potash was located inside *Cuyahoga's* Cargo Hold No. 1. Black residue similar in appearance to carbon or coal dust as expected from the residue of nut coke was located inside Cargo Hold No. 3, providing evidence of residue remaining from previous cargoes. An attempt for laboratory conformation of the residue from both Cargo Holds No. 1 and No. 3 was hindered by a lack of an exemplar for comparison.

4.2.5. *Cuyahoga's* Cargo Hold No. 2 was coated with 60 mil Amerthane 490 paint and cure. According to the Bureau of Alcohol, Tobacco, Firearms and Explosives' Fire Research Laboratory, testing on Amerthane 490 epoxy material taken from *Cuyahoga's* cargo holds showed direct contact with metal during flux core welding and the open flame from a butane torch can produce flaming combustion on the epoxy material. Despite numerous pieces of molten slag landing on the epoxy material, no evidence of smoldering or flaming combustion was observed during controlled testing. For a piece of molten slag to become a competent ignition source on a specific fuel, it must have sufficient energy and temperature to raise the fuel to its ignition temperature and be capable of transferring that energy to the fuel.

4.2.6. According to the Amerthane 490 Safety Data Sheet, the flashpoint of the product in liquid form is 201° Fahrenheit (F). However, the ignition temperature of the product in its cured form is not given. According to the Bureau of Alcohol, Tobacco, Firearms and Explosives' Fire Research Laboratory, the ignition temperature of polyurethane products can range anywhere from 600° F - 1100° F. This wide range is indicative of the many different forms and uses of polyurethane products. Maximum temperature associated with flux-core welding is expected to be around 6,000° F, which is significantly higher than any expected ignition temperature for Amerthane 490.

4.2.7. Arcelor Mittal, located in Hamilton, Ontario, Canada, who was the supplier of nut coke loaded onboard *Cuyahoga* on December 31, 2023, provided the following information regarding nut coke from its facility: "To make steel in a blast furnace, coal must first be turned into coke. Coke has a dual role in the steelmaking process. First, it provides the heat needed to melt the ore, and second, when it is burnt, it has the effect of 'stealing' the oxygen from the iron ore, leaving only the pure iron behind. In the coking plant, coal is heated in the absence of oxygen to 1,250° Celsius. This removes any impurities in the coal, resulting in coke, which is a porous substance that is nearly all carbon."

4.2.8. The Ignition Handbook, an authoritative treatise that encompass the entire field of ignition and was published in cooperation with the Society of Fire Protection Engineers, claim, “Coal, coke, char and other materials composed mostly, but not wholly of carbon have a wide spectrum of ignition response since some non-carbon material is present and consequently there is an ability to pyrolyze and to release combustible gases at moderate temperatures.”

4.2.9. National Fire Protection Association (NFPA) 921, titled Guide for Fire and Explosion Investigations (5.8.1.3 – Fire Spread on Sloped Surfaces) notes, “fires on sloped surfaces, such as sloping combustible walls, ramps, or stairs, display the effects of concurrent flow fire spreads. The sloped fire spread is a combined effect of the preheating of the combustible surface above the flame by conductive, convective, and radiant heat transfer mechanisms and the exponentially increased radiant effect on the surface above the flame by the concurrent air entrainment from the side facing the slope “bending” the flame down toward the surface.”

4.2.10. NFPA 921 (5.7.4.2 – Piloted Flaming Ignition of Solid Fuels) notes, “for solid fuels to burn with a flame, the substance must either be melted and vaporized (e.g., thermoplastics) or pyrolyzed into gases or vapors (e.g., wood or thermoset plastics). In both cases, heat must be supplied to the fuel to generate the flammable vapors. In piloted ignition, these flammable vapors are ignited by a pilot source, in the form of a small flame, a spark, an ember, or a hot surface.”

4.2.11. The remains of welding equipment and extension cords were traced back to *Cuyahoga* Cargo Hold No. 2’s forward access booby hatch and ladder. Two electrical conductors were traced back to their respective sources. The welding electrode cable was traced back to a bank of four welders on the port aft side of the vessel. The cable was supplied by the welder on the lower left of this bank. The remains of the extension cord were traced back to a “Sunbelt” distribution panel located midship on the port side of the ship. This cord was plugged into a Ground Fault Circuit Interrupter (GFCI) duplex receptacle identified with the “B19”. The status of this GFCI outlet was not determined due to concerns of spoliation. At the time of investigation, all circuit breakers (including B19) were in the “on” position.

4.2.12. NFPA 921 (9.9.4.4 and 9.9.4.4.1 – Parting Arcs) notes, “a parting arc is a brief discharge that occurs as an energized electrical path is opened while current is flowing, such as by turning off a switch or pulling a plug.” Additionally, “ordinary parting arcs in electrical systems are usually so brief and of low enough energy that only combustible gases, vapors, and dusts can be ignited.” Furthermore, “a welding arc involves enough power to ignite nearly any combustible material.”

4.2.13. Occupational Safety and Health Standards for Shipyard Employment, 29 CFR 1915.53(c) (Welding, Cutting and Heating in way of Preservative Coatings), requires precautions to be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition, or, where shipbreaking is involved, the coatings may be burned away under controlled conditions. A 1½ inch or larger fire hose with fog nozzle, which has been uncoiled and placed under pressure, shall be immediately available for instant use in the immediate vicinity, consistent with avoiding freezing of the hose.

4.2.14. SMS' welder was certified and had completed a Flux-Cored Arc Welding qualification process at Conneaut Creek Ship Repair, Inc. on January 9, 2024. SMS' welder had approximately fifteen years of welding experience in both the United States and China. SMS' welder had used the welding machine involved in this incident approximately fifty times prior to March 15, 2024.

4.2.15. Wood scaffolding planks were in Cargo Hold No. 2 along the starboard side and locations along the portside. Scaffolding planks closest to the origin of fire were burned during the fire, and charred remnants can be seen in Figures 15 and 16.



Figure 15. Photograph of charred (portside) and uncharred (starboard side) wood scaffolding planks located inside *Cuyahoga*'s Cargo Hold No. 2. Source: Ashtabula Fire Department.



Figure 16. Close up photograph of charred wood scaffolding planks located inside *Cuyahoga*'s Cargo Hold No. 2. Source: Ashtabula Fire Department.

4.2.16. SMS's fire watch possessed limited experience with having only completed the duties and responsibilities as fire watch for two to three days. Prior training was limited to on-the-job training where instructional videos were viewed, and water-based extinguishers were discharged to simulate the extinguishment of a fire.

4.2.17. NFPA promotes a Pull, Aim, Squeeze, and Sweep (PASS) technique when combating small fires while using a portable fire extinguisher. To operate a portable fire extinguisher, pull the pin, aim low, squeeze the lever slowly and evenly, and sweep the nozzle from side-to-side.

5. **Analysis**

5.1. ***Combustible Materials*** – Based on a visual examination and available information in paragraphs 4.2.2., 4.2.5., 4.2.6., 4.2.7., 4.2.8., and 4.2.13., it is likely that any remaining contaminate from the last load of nut coke would have served as a fuel source and aided in initial ignition of this fire. All witnesses described a rapidly growing fire that was beyond the ability of fire extinguishers to contain. The ignition of the combined nut coke and epoxy coating on *Cuyahoga* Cargo Hold No. 2's forward bulkhead supports this theory. The vertical nature of the bulkhead would have accelerated the rate of growth due to the preheating effect of the fuel above the flame by conductive, convection and radiant heat transfer. This preheating effect would have resulted in a significantly faster fire spread when compared to a horizontal surface. This further supports the hypothesis of ignition of a readily combustible surface material at the lower portion of the forward bulkhead.

A competent ignition source for piloted ignition of a solid must be of sufficient temperature and duration to pyrolyze the solid to produce flammable vapors. Vessels such as *Cuyahoga* are designed with minimal, if any, competent ignition sources in the cargo holds. The point of origin had no designed shipboard source of heating or piloted ignition. The elimination of any normal ship functions as a competent ignition source leaves the work being conducted at the time of ignition as the only possible competent source.

5.2. ***Electrical Arc*** - As indicated in paragraphs 4.2.10., 4.2.11., and 4.2.12., the remains of welding equipment and extension cords were traced back to *Cuyahoga* Cargo Hold No. 2's forward access booby hatch and ladder. Two electrical conductors were traced back to their respective sources. The welding electrode cable was traced back to a bank of four welders on the port aft side of the vessel. The cable was supplied by the welder on the lower left of this bank. The remains of the extension cord were traced back to a "Sunbelt" distribution panel located midship on the port side. This cord was plugged into a Ground Fault Circuit Interrupter (GFCI) duplex receptacle identified with the "B19". The status of this GFCI outlet was not determined due to concerns of spoliation. At the time of investigation, all circuit breakers (including B19) were in the "on" position.

Either of these two sources could generate an electrical arc. The arc may be an intentional or inadvertent welding arc or a parting arc from damage to the extension cord. The temperature of an arc is sufficient to pyrolyze most solid materials; however, a parting arc is usually so brief and of such low energy that only combustible gases, vapors and dust can be readily ignited. A welding arc is, by design, meant to be sustained without protective devices disrupting the flow of current. A welding arc is capable of being sustained to ignite nearly any combustible material.

SMS' welder working in Cargo Hold No. 2 stated he had previous issues with the flux-core welder the morning of the fire and had experienced further issues with the flux-core welder after returning from lunch. The flux-core welder is capable of pyrolysis and ignition of the epoxy coating; however, the residual coke dust on the surface of the epoxy coating resulted in a fuel that was capable of ignition from a welding arc or a parting arc. A parting arc could have been created by failure of the extension cord that was traced back to the area of origin. While the evidence supports the conclusion that the ignition source was an electrical arc, the extension cord cannot be conclusively eliminated as a possible ignition source.

5.3. *Availability of Firefighting Equipment and Resources onboard Cuyahoga* – As indicated in paragraphs 4.1.12., 4.1.27., and 4.2.13., containment of the fire was hampered by the accessibility of firefighting equipment. Occupational Safety and Health Standards for Shipyard Employment require a 1½ inch or larger fire hose with fog nozzle, which has been uncoiled and placed under pressure, to be immediately available for instant use in the vicinity of hot work on the Amerthane 490 epoxy coated bulkhead in *Cuyahoga's* Cargo Hold No. 2. In fire emergencies where firefighting equipment may be relied upon, but not immediately available, the departure from the fire to obtain firefighting equipment and then return to the fire before commencing extinguishing operations requires critical time. The lack of federally mandated firefighting equipment in Cargo Hold No. 2 contributed to the inability to contain the rapidly expanding fire.

5.4. *Improper Application Technique of Portable Water Type Fire Extinguisher* - As indicated in paragraphs 4.1.46., 4.2.16., and 4.2.17., the fire watch in *Cuyahoga's* Cargo Hold No. 2 attempted to extinguish the onset of the fire by spraying water at the center of the fire and then moving the water stream toward the top of the fire. To operate a fire extinguisher effectively, the fire extinguisher should be aimed low at the base of the fire while sweeping the nozzle from side to side. Failing to follow the proper Pull, Aim, Squeeze, Sweep (PASS) technique can reduce the effectiveness of the extinguisher and hinder quick fire suppression. Additionally, fire extinguishers work by disrupting the fire triangle (fuel, oxygen, and heat) at the source. Aiming a fire extinguisher at the flames is less effective than targeting the base of the fire where the fuel is located.

6. Conclusions

6.1 Determination of Cause:

6.1.1 The fire was classified as accidental. The competent ignition source is believed to have been an electrical arc from the flu-core welding unit or the extension cord. The first item ignited is believed to be the epoxy coating on the bulkhead with the residue of nut coke dust from the previous cargo. The condition that brought these two together is believed to be the failure of the extension cord, the inadvertent action of the welder, or failure of the flux-core welding machine. The oxidant is believed to be oxygen in the surrounding air.

6.1.2 The initiating event for this casualty occurred when a fire ignited on the forward bulkhead in *Cuyahoga's* Cargo Hold No. 2. The fire originated on the forward bulkhead approximately 3' above the gates and port side of the forward ladder. Actions and conditions that most likely caused the fire were: (1) an electrical arc from the welder or extension cord; and (2) nut coke residue from the previous cargo combined with the Amerthane 490 epoxy coating on the bulkhead.

6.1.3 The fire on the forward bulkhead in *Cuyahoga's* Cargo Hold No. 2 resulted in a subsequent event, which was substantial damage to Cargo Hold No. 1, Cargo Hold No. 2, the spar deck (upper continuous deck), hatch coamings and hatch covers, the cargo boom and the boom's conveyor belt structure, and the port side and starboard side conveyor tunnels and their associated equipment. Causal factors that contributed to the event were: (1) a lack of firefighting equipment immediately available in the vicinity of hot work being conducted in *Cuyahoga's* Cargo Hold No. 2; and (2) the ineffective firefighting technique used by the fire watch when initially combatting the fire, which likely allowed the fire to spread.

6.2 Evidence of Act(s) or Violation(s) of Law by any U.S. Coast Guard Credentialed Mariner subject to action under 46 USC Chapter 77: There were no violations of law, acts of misconduct, negligence, or unskillfulness by a U.S. Coast Guard credentialed mariner involved in this incident.

6.3 Evidence of Act(s) or Violation(s) of Law by U.S. Coast Guard personnel, or any other person: There were no acts of misconduct, negligence, unskillfulness, or violations of law by members of the U.S. Coast Guard or any other person.

6.4 Evidence of Act(s) Subject to Civil Penalty: There were no acts subject to civil penalty identified as a result of this investigation.

6.5 Evidence of Criminal Act(s): There were no violations of criminal law identified as a result of this investigation.

6.6 Need for New or Amended U.S. Law or Regulation: A need for new or amended regulations was identified during this investigation. A recommendation to amend current regulations is proposed as a Safety Recommendation below.

7. Actions Taken Since the Incident

7.1. No criminal or civil action has been taken by the U.S. Coast Guard.

7.2. OSHA's concurrent investigation cited South Marine Systems, LLC with 15 serious violations and one other-than-serious violation and proposed \$164,540.00 in penalties. Specifically, OSHA found South Marine Systems, LLC failed to:

1. Designate one or more shipyard competent persons, 29 CFR 1915.7(b)(1) – Serious Violation.
2. Ensure the person performing tests and inspections recorded the location, time, date and the operations performed, as well as the test results and any instructions, when tests and inspections were performed by a competent person, Marine Chemist, or Certified Industrial Hygienist, 29 CFR 1915.7(d)(1) – Serious Violation.
3. Ensure sealed and non-ventilated spaces were visually inspected and tested by a competent person to determine the atmosphere's oxygen content prior to initial entry into the space by an employee, 29 CFR 1915.12(a)(1) – Serious Violation.

4. Ensure each employee entering a confined or enclosed space or other areas with dangerous atmospheres was trained to perform all required duties safely, 29 CFR 1915.12(d)(1) – Serious Violation.
5. Establish a shipyard rescue team or arrange for an outside rescue team to respond promptly to a request for rescue service, 29 CFR 1915.12(e) – Serious Violation.
6. Hot work was permitted in dangerous atmospheres before being tested by a competent person and determined to contain no concentrations of flammable vapors equal to or greater than 10 percent of the lower explosive limit, 29 CFR 1915.14(b)(1). Hot work was permitted in or on dry cargo holds or adjacent spaces before being tested by a competent person and determined to contain no concentrations of flammable vapors equal to or greater than 10 percent of the lower explosive limit, 29 CFR 1915.14(b)(1)(i) – Serious Violations.
7. Stop work when the conditions within a tested confined or enclosed space or other dangerous atmosphere changed, 29 CFR 1915.15(b) – Serious Violation.
8. Conduct a test by a competent person to determine the flammability of a surface covered by an unknown preservative coating before welding, cutting, or heating was commenced on the surface, 29 CFR 1915.53(b) – Serious Violation.
9. Provide a 1-½ inch or larger fire hose with fog nozzle, uncoiled, placed under pressure and protected from freezing conditions in the immediate vicinity and ready for use where highly flammable hardening preservatives were being removed, 29 CFR 1915.53(c) – Serious Violation.
10. Have at least one portable or permanent ladder in the vicinity of each floating vessel on which work was being performed, 29 CFR 1915.158(b)(5) – Serious Violation.
11. Have a developed written fire safety plan and be implemented by South Marine Systems, LLC that covered all the actions necessary to ensure the employees safety in the event of a fire, 29 CFR 1915.502(a). The employer did not describe the internal and the external fire response organization that the employer will use in the written policy, 29 CFR 1915.505(a)(2)(i) – Serious Violations.
12. Ensure employees assigned to fire watch duties were able to communicate with the workers exposed to hot work, 29 CFR 1915.504(c)(2)(ii) – Serious Violation.
13. Ensure fire response employees received medical examinations to assure that they were physically and medically fit for duties they were expected to perform, 29 CFR 1915.505(c)(1) – Serious Violation.
14. Provide Self-Contained Breathing Apparatuses (SCBA) to all fire response employees involved in an emergency situation in an atmosphere that was Immediately Dangerous to Life and Health (IDLH), potentially IDLH, or unknown, 29 CFR 1915.505(e)(3)(i) – Serious Violation.
15. Ensure each fire watch employee was trained in basic fire behavior, different classes of fire, extinguishing agents, the stages of fire, and methods of extinguishing fires, 29 CFR 1915.508(e)(2)(i) – Serious Violation.

16. Provide an authorized government representative with records within the four business hours, 29 CFR 1904.40(a), Other-than-Serious Violation.

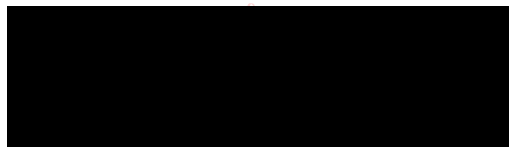
8. **Recommendations**

8.1. Recommend Commandant evaluate the dangers internal rubber conveyor belts pose to merchant mariners serving onboard self-discharging bulk carriers. More specifically, self-discharging bulk carriers are equipped with rubber conveyor belts, which pose a significant fire risk due to their rapid spread potential; however, standards for rubber conveyor belt fire safety are insufficient. While the fire onboard *Cuyahoga* did not originate with the conveyor belt, both conveyor belts on the *Cuyahoga* ignited, burned, and one belt re-flashed exacerbating the fire and firefighting effort. The conveyor belt's length and movement could increase the dangers, allowing fires to quickly travel great distances within a ship. In addition to the fire onboard *Cuyahoga*, several significant maritime casualties have highlighted the fire risk rubber conveyor belts pose, to include the *Roger Blough* (IIA 7139261) in 2021 and *St. Clair* (IIA 6630678) in 2019. These incidents involved large-scale fires onboard the vessels and substantial damage due to the spread of fire through cargo unloading belt systems where their arrangements do not allow for effective structural fire protection installations along the beltways. The U.S. Department of Labor Mine Safety and Health Administration (MSHA) has long been aware of the increased risk and lethality of belts that are not fire-resistant. MSHA developed standards to address these concerns, requiring the use of fire-resistant belts proven through approved tests. The recurrence of conveyor belt fire casualties, and the significant financial losses in those cases indicate a need for further evaluation of regulatory standards and consideration of requirements similar to MSHA conveyor belt fire resistance requirements.

8.2. Administrative Recommendations:

8.2.1. Recommend Sector Eastern Great Lakes formally recognize the Ashtabula Fire Department for their rapid response to the fire onboard *Cuyahoga*. The Ashtabula Fire Department's swift actions limited the spread of fire and quickly extinguished the fire with no reported injuries. Without their efforts, the Marine Transportation System could have suffered a tremendous loss to shore side infrastructure and nearby ships.

8.2.2. It is recommended that this investigation be closed.



U.S. Coast Guard
Investigating Officer