April 15, 2025

MIR-25-16

Fire aboard Roll-on/Roll-off Container Vessel *Grande Costa D'Avorio*

Newark, New Jersey
July 5, 2023

Abstract: This report discusses the July 5, 2023, fire aboard the 692-foot-long, Italian-flagged roll-on/roll-off container (Ro/Con) vessel *Grande Costa D'Avorio* while the vessel was docked at Port Newark, New Jersey. A pusher vehicle (a passenger vehicle, owned by the cargo loading company and retrofitted with a steel front bumper), operated by shoreside workers who were loading used vehicles onto the vessel's garage decks, caught fire in an interior garage deck. Vessel crewmembers attempted to put out the fire using portable fire extinguishers but were unsuccessful. The captain ordered the vessel's fixed gas (carbon dioxide [CO_2]) fire extinguishing system to be activated. The crew attempted to seal the garage decks where the CO_2 had been released to allow the CO_2 to smother the fire, but they were unable to close a large rampway door that was controlled from a single panel inside the garage where the fire was located. Land-based firefighters arrived on scene. While attempting to put out the fire, two land-based firefighters likely became disoriented, and, unable to find their way out of one of the smoke-filled garage decks, died. Six additional emergency responders were injured during the firefighting and rescue operations. The damage to the vessel was estimated to be over $23 million. Safety issues identified in this report include hazards associated with using passenger vehicles as pusher vehicles in cargo operations, absence of operating controls on the outside of a garage deck door that was part of a fire boundary zone for a space protected by a fixed gas fire extinguishing system, ineffective land-based firefighting response, and lack of emergency procedures for shoreside personnel. Recommendations are made to the US Coast Guard, the Occupational Safety and Health Administration, the Newark Fire Division, the Port Authority of New York and New Jersey, RINA Services, the American Association of Port Authorities, the International Association of Fire Fighters, the International Association of Fire Chiefs, the National Volunteer Fire Council, Grimaldi Deep Sea, Ports America, and American Maritime Services.

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Acronyms and Abbreviations

Abbreviation	Name
AMS	American Maritime Services
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
CFR	*Code of Federal Regulations*
CO_2	carbon dioxide
FCP	fire control plan
FDNY	Fire Department of the City of New York
IC	incident commander
ICLL	International Convention on Load Lines
IDLH	immediately dangerous to life and health
IMO	International Maritime Organization
NFD	Newark Fire Division
NFPA	National Fire Protection Association
NHTSA	National Highway Traffic Safety Administration
NIOSH	National Institute for Occupational Safety and Health
NTSB	National Transportation Safety Board
OSHA	Occupational Safety and Health Administration
PIT	powered industrial truck
Ro/Con	roll-on/roll-off container
Ro/Ro	roll-on/roll-off
SCBA	self-contained breathing apparatus
SOLAS	*International Convention for the Safety of Life at Sea*
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
UASI	Urban Area Security Initiative

Executive Summary

What Happened

On July 5, 2023, about 2100 local time, the 692-foot-long roll-on/roll-off container (Ro/Con) vessel *Grande Costa D'Avorio* was docked at Port Newark, New Jersey, when a pusher vehicle (a passenger vehicle, owned by the cargo loading company and retrofitted with a steel front bumper), operated by shoreside workers who were loading used vehicles onto the vessel's garage decks, caught fire in an interior garage deck.

Vessel crewmembers attempted to put out the fire using portable fire extinguishers but were unsuccessful. The captain ordered the vessel's fixed gas (carbon dioxide [CO_2]) fire extinguishing system to be activated. The crew attempted to seal the garage decks where the CO_2 had been released to allow the CO_2 to smother the fire, but they were unable to close a large rampway door that was controlled from a single panel inside the garage where the fire was located. Land-based firefighters arrived on scene. While attempting to put out the fire, two of the land-based firefighters likely became disoriented, and, unable to find their way out of one of the smoke-filled garage decks, died. Six additional emergency responders were injured during the firefighting and rescue operations. The damage to the vessel was estimated to be over $23 million.

What We Found

We found the vessel fire resulted from the overheated transmission fluid of a pusher vehicle, which boiled over and ignited on a hot engine surface. Such a vehicle is not suitable for use as a powered industrial truck because it did not meet Occupational Safety and Health Administration powered industrial truck standards. We found that, although the vessel captain's decision to release CO_2 into the fire protection zone that included the deck with the fire was appropriate, the deck 12 hydraulic garage door lacked operating controls outside the fire protection zone, which prevented the crew from safely closing the door and thus led to the ineffectiveness of the CO_2 to extinguish the fire.

By directing firefighters to enter the area where the CO_2 extinguishing system had been activated, contrary to general marine firefighting convention, firefighters were exposed to additional and unnecessary risk. The Newark Fire Division was not adequately prepared to respond to a vessel fire, and they lacked marine vessel firefighting training; therefore, their actions were ineffective and contributed to the fire's spread and the vessel damage, and led to the firefighter casualties. When ports

work with local municipalities in advance to coordinate vessel firefighting response preparedness and training, safety is improved, and better outcomes are achieved. Lastly, the lack of an emergency procedure that provided a way to account for all employees after an emergency evacuation, such as a muster area, or training in the event of an emergency on board a vessel increased the risk to life or injury to the shoreside workers.

We determined that the probable cause of the fire aboard the Ro/Con vessel *Grande Costa D'Avorio* was Ports America's use of a passenger vehicle as a pusher vehicle in an industrial application for which it was not intended, which led to the vehicle's transmission fluid overheating, boiling over, and igniting on a hot engine surface. Contributing to the fire's duration and severity was the absence of operating controls on the outside of one of the vessel's fire boundary garage doors, which prevented the crew from safely closing the door and directly led to the ineffectiveness of the fixed gas fire extinguishing system. Also contributing to the severity of the fire was the Newark Fire Division's lack of marine vessel firefighting training, which resulted in an ineffective response and led to the firefighter casualties.

What We Recommended

As a result of this investigation, we made recommendations to the Occupational Safety and Health Administration to inform their field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance in proper enforcement of the powered industrial truck requirements at marine terminals and during longshoring operations to assure safe and healthy working conditions. We also made recommendations to the Newark Fire Division and the Port Authority of New York and New Jersey, the American Association of Port Authorities, the International Association of Firefighters, the International Association of Fire Chiefs, and the National Volunteer Fire Council to improve land-based firefighting departments' marine vessel firefighting training and familiarity. To ensure that shoreside personnel are aware of what to do in the event of a fire on board a vessel, we recommended that Ports America and American Maritime Services develop policies, per Title 29 *Code of Federal Regulations* 1917.30 and 29 *Code of Federal Regulations* 1918.100, for such emergencies, including accounting for all employees.

In addition, we made a recommendation to Grimaldi Deep Sea, the ship owner, to inventory all their vessels to identify all openings that are part of a fire boundary and modify their vessels so that the openings are capable of being closed from outside the protected space. We also recommended that RINA Services, the vessel classification society, revise their procedures for review and approval of vessel plans to ensure compliance with all applicable international regulations. Lastly, we

recommended that the US Coast Guard submit a proposal to the International Maritime Organization to clarify the *International Convention for the Safety of Life at Sea* regulation requiring that all openings capable of admitting air into or allowing gas to escape from a protected space can be closed from outside the protected space applies, regardless of their expected operational condition when in port or at sea.

1 Factual Information

1.1 Casualty Narrative

1.1.1 Synopsis

On July 5, 2023, about 2100 local time, the 692-foot roll-on/roll-off container (Ro/Con) vessel *Grande Costa D'Avorio* was docked at Port Newark, New Jersey, when a pusher vehicle (a passenger vehicle, owned by the cargo loading company and retrofitted with a steel front bumper), operated by shoreside workers who were loading used vehicles onto the vessel's garage decks, caught fire in an interior garage deck.[1] Vessel crewmembers attempted to put out the fire using portable fire extinguishers but were unsuccessful. The captain ordered the vessel's fixed gas (carbon dioxide [CO_2]) fire extinguishing system to be activated. The crew attempted to seal the garage decks where the CO_2 gas had been released to allow the CO_2 to smother the fire, but they were unable to close a large rampway door that was only controlled from a single panel located inside the garage where the fire was located. Land-based firefighters arrived on scene. While attempting to put out the fire, two land-based firefighters were unable to find their way out of one of the smoke-filled garage decks and died. Six additional emergency responders were injured during the firefighting and rescue operations. The damage to the vessel was estimated to be over $23 million.[2]

1.1.2 Precasualty Events

On the morning of July 5, 2023, the *Grande Costa D'Avorio*, with a crew of 28, docked alongside berth 18 in Port Newark, New Jersey (see Figure 1). The *Grande Costa D'Avorio* was on a regular run, loading containerized cargo and used vehicles at ports along the US east coast and delivering them to ports in West Africa. The vessel was scheduled to load about 920 used vehicles at Port Newark, a process

[1] (a) All times in this report are eastern daylight time. (b) A *Ro/Con* shipping vessel is a hybrid of a roll-on/roll-off (Ro/Ro) and a container vessel. In addition to cargo decks accessible to cranes for loading containers, Ro/Con vessels have enclosed garage decks connected by a series of ramps, which allow cargo—especially wheeled cargo—to be driven, pushed, or forklifted directly onto the vessel.

[2] Visit ntsb.gov to find additional information in the public docket for this NTSB accident investigation (case number DCA23FM039). Use the CAROL Query to search safety recommendations and investigations.

that would normally take about 15 hours, before shifting to the Red Hook terminal in Brooklyn, New York, to load and unload containers.

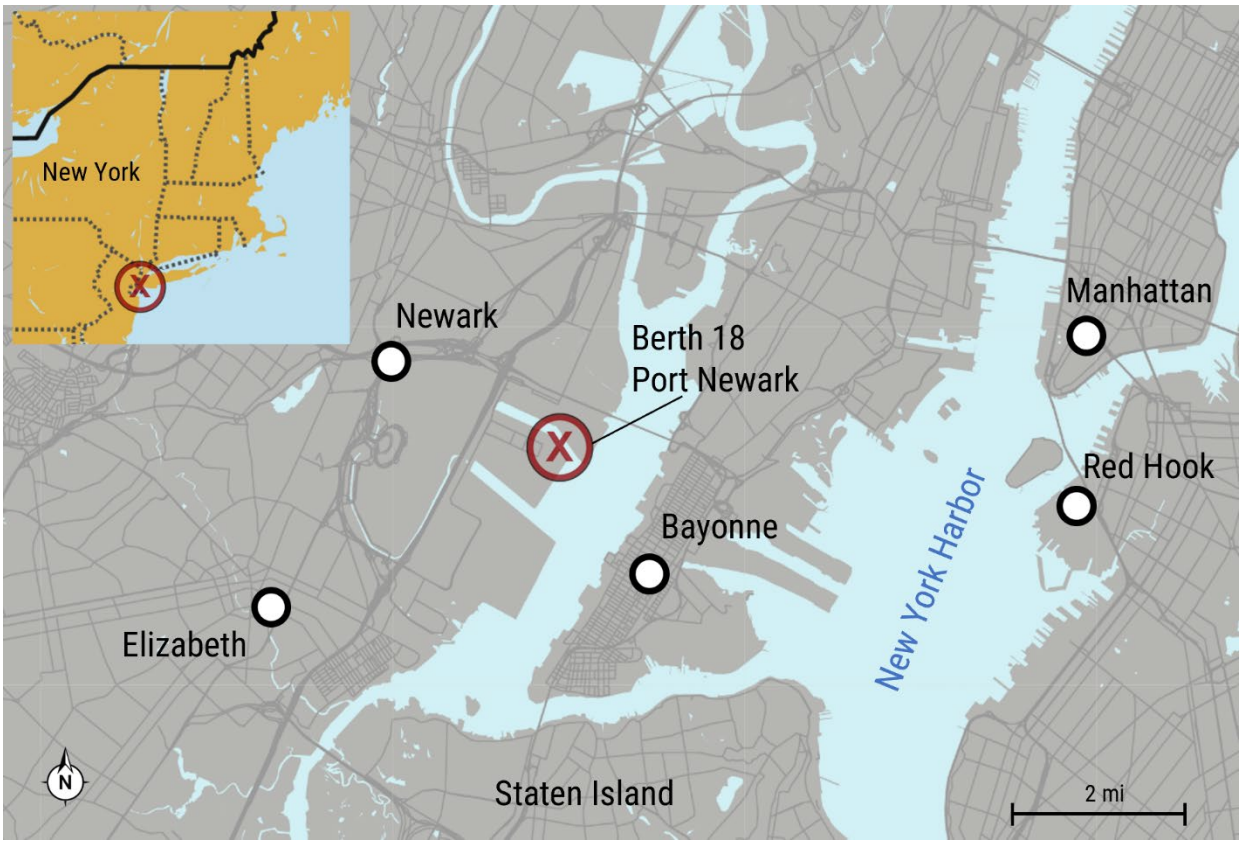

Figure 1. Port Newark and surrounding area; the circled *X* is where the *Grande Costa D'Avorio* was docked when the fire occurred. (Background source: Google Maps)

About 0700, with the vessel secured starboard side to the dock, the used vehicle loading operation began. Under the oversight of the vessel crew and superintendents employed by Ports America (the operator of Port Newark Terminal), shoreside workers loaded the vehicles onto the vessel and situated them according to the load plan, which was developed by the vessel owner and operator to maximize efficiency of loading and use of space on the vessel.[3] Most of the 920 vehicles scheduled to be loaded were minivans, trucks, and other passenger vehicles. All of the vehicles were gasoline or diesel powered.

Ports America classed cargo vehicles into three categories: a "runner" was a vehicle that could be driven onto the vessel under its own power, a "nonrunner"

[3] A *load plan* identifies where and on which deck on the vessel each vehicle should be parked. The plan also identifies how vehicles are to be loaded to ensure proper vessel stability and provides procedures for maximizing efficiency during the loading and unloading process.

would have to be assisted onto the vessel by a pusher vehicle or other piece of equipment, and a "forkliftable" vehicle needed to be lifted and brought aboard via a forklift.

Shoreside workers consisted of longshoremen (direct hires working for Ports America), who drove all the runners and operated the forklifts, and lashers (employed by American Maritime Services [AMS]), who steered the nonrunners and operated the pusher vehicles. The lashers were also responsible for lashing down the cargo vehicles for sea transit by strapping the vehicles (usually the tires) to anchor points on the decks and disconnecting their batteries once the vehicles were on board the ship. Once completely loaded, full decks had an average of 4–6 inches of space between each vehicle's most outward points (often the side mirrors or bumpers). At any given time, between 40 and 50 Ports America superintendents and longshoremen and AMS lashers participated in the loading operation.

Ports America owned five passenger vehicles (one Jeep Wrangler, two Ford Ranger pickups, and two Chevrolet Colorado pickups) that had been retrofitted with customized large front bumpers, lights, and strobes, and were used as pusher vehicles to load nonrunner vehicles onto the vessel (see Figure 2). The pusher vehicles were not registered with the New Jersey Department of Motor Vehicles and, according to Ports America, were not road legal, nor were they required to be, because they were not used on public roadways.

Figure 2. Ports America-owned pusher vehicles. Photo on left taken following the fire; photo on right taken on unknown date before the day of the fire. (Source [*right*]: gCaptain)

Loading operations continued throughout the day and into the evening. By day's end, the loading was nearing completion, and the vessel was laden with more than 1,200 vehicles and 50 containers.

1.1.3 Casualty Events

At 2058, the Jeep pusher vehicle, operated by an AMS lasher, pushed a nonrunning Toyota Venza (weighing about 3,900 pounds and steered by another AMS lasher) up the stern ramp and onto the vessel. According to the lasher operating the Jeep, as the two vehicles climbed the ramp from deck 6 to deck 10, he could hear a "clunking noise" coming from what he assumed was the Jeep.[4] Figure 3 shows the route the vehicles took. As the two vehicles reached deck 10 (about 2100), other shoreside workers nearby saw that the Jeep was on fire and alerted the lasher driving the Jeep; he then saw flames coming from under the hood and beginning to enter the open passenger window. With the Jeep still running, the lasher exited the vehicle and saw what he described as "flaming fire balls dripping" from the undercarriage of the vehicle. He grabbed a nearby portable 6-kilogram dry chemical powder fire extinguisher and attempted to put out the fire. Shortly thereafter (at 2100:31), the vessel's fire alarm automatically activated and sounded on the fire control panel on the bridge. The shoreside workers began evacuating the vessel once the fire was discovered.

[4] The US Coast Guard was the lead federal agency in this investigation. Five days after the casualty, the Coast Guard convened a District One Formal Investigation. From January 10 to 18, 2024, the Coast Guard, in conjunction with the NTSB, conducted a formal public hearing to consider evidence related to the casualty. During the hearing, Coast Guard and NTSB investigators questioned over 20 individuals, including vessel crewmembers, shoreside labor and management personnel, firefighters, industry experts, and others directly involved in the casualty. The casualty events are derived from this testimony.

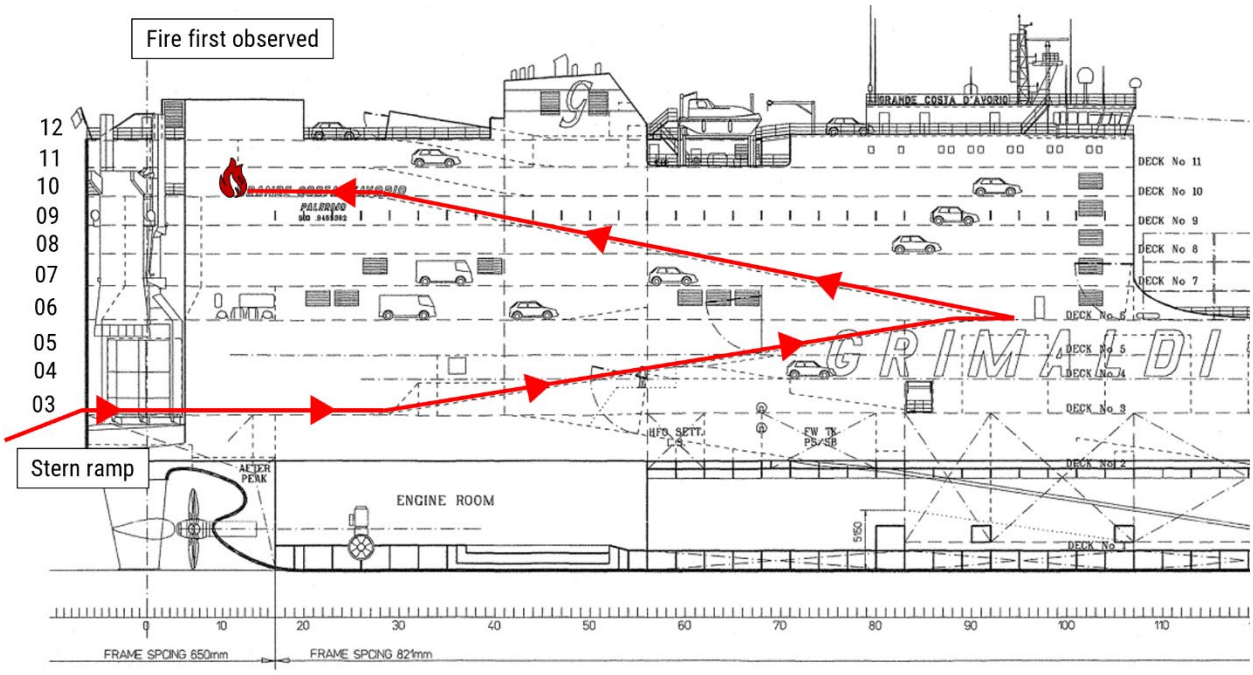

Figure 3. Partial profile of the *Grande Costa D'Avorio*, showing the garage decks, the Jeep's approximate route to deck 10, and location of the fire. (Background source: Grimaldi Deep Sea SPA, the owner of the *Grande Costa D'Avorio*)

The vessel's chief mate and another crewmember (ordinary seaman), who were nearby, immediately started using nearby portable fire extinguishers to battle the fire.[5] Five extinguishers were discharged to fight the fire, but the lasher and the vessel crewmembers were unable to extinguish it. The chief mate used his handheld ultrahigh frequency radio to notify the other vessel crew on duty about the fire. He also instructed the third mate (the mate on watch, who was on duty near the deck 3 stern ramp) to alert the captain (who was off duty in his stateroom at the time).

Shortly after the third mate notified the captain via shipboard telephone, the captain reported to the bridge. He first activated the emergency ventilation stop, which secured (shut off) exhaust (extractor) fans and closed dampers (louvers) to fire protection zone C, which included the deck where the fire was located. He also silenced the fire alarm sounding on the fire control panel, started one of the vessel's fire pumps, and called the chief engineer and told him to report to the engine room and stand by. (For more information on vessel crew training and shipboard firefighting tactics, see Appendix D: Basics of Shipboard Firefighting.)

[5] An *ordinary seaman* is an entry-level deckhand and usually has 1 year of experience or less.

Once the ventilation was secured, deck 10, the location of the pusher Jeep, quickly began to fill with "very heavy black smoke," and the chief mate said that flaming debris was falling to deck 9 through the tie-down holes on deck 10. The chief mate radioed the bosun and instructed him to put on a firefighting outfit (turnout gear), don a self-contained breathing apparatus (SCBA), and then report to deck 10.[6] (In accordance with regulations, the vessel was equipped with two sets of firefighting gear and SCBAs.) As they waited for the bosun to arrive, the chief mate and the ordinary seaman ran out two of the vessel's fire hoses on deck 9 and deck 10, respectively, from fire stations located nearby. Once the fire hoses were pressurized, the chief mate and ordinary seaman began applying water toward the fire. A few minutes later, the bosun arrived on deck 10 in firefighting gear and took over a hose that was directed toward the Jeep.

The captain ordered additional crew to inspect decks 11 and 12 for signs of fire. The first assistant engineer reported back that there was smoke coming out from the open deck 12 ramp door, and the second officer reported that there was also smoke visible on deck 11. The chief mate radioed the captain that the heavy black smoke continued to worsen on deck 10, he could no longer see into the deck 10 garage space from his position on the ramp, and he could hear what he believed to be vehicle tires and windows exploding from the fire and heat.

At 2114, 14 minutes after the shoreside workers noticed the fire, the captain ordered the chief mate and other crew on scene to stop engaging the fire, evacuate the space, and prepare to discharge CO_2 from the vessel's fixed gas fire extinguishing system. The captain had already secured the ventilation fans and dampers to fire protection zone C, which included enclosed garage decks 6–11; he also ordered his crew to secure the four hydraulically operated rampway and vehicle doors on the garage decks. Around this time, one Ports America superintendent drove his company vehicle up to deck 9 to assess the situation; he did not see any shoreside laborers around the fire or within the garage space.

The chief mate, bosun, and others fighting the fire retreated down the internal vehicle ramps from decks 9 and 10 to deck 3. Along the way, the chief mate closed the hydraulic garage doors on deck 6 (Dk-6) and on the ramp leading from deck 6 to 3 (Dk 3-6) to seal fire protection zone C (see section 1.3.3.2 *Grande Costa D'Avorio* Fixed Gas Fire Extinguishing System). Once on deck 3, he also closed the hydraulic

[6] The *bosun*, or boatswain, is the highest ranking nonofficer in the deck department.

garage door there (Dk 2-3; this door was not a barrier to zone C, but he closed it out of an abundance of caution).

The chief mate told investigators that he had visually inspected the spaces as he exited fire protection zone C down to deck 3, and that, when he reached deck 3 near the stern loading ramp, he saw the shoreside workers exit the vessel. He told investigators that he was confident that all had evacuated the vessel. The Ports America superintendents relied on verbal communications and text messages between the foremen of the shoreside labor to account for all shoreside personnel and eventually were able to determine that all shoreside labor was accounted for.

The captain then ordered the vessel's fitter (a member of the engine department and assigned to one of the vessel's fire teams) and the first engineer to close the Dk-12 hydraulic garage door, located at the top of the vehicle ramp leading from deck 11 to deck 12 (see Figure 4). The door was operated via a single local operation panel, located near the door, toward the top of the ramp, about 6 feet inside the space, which meant that once a person closed the door, they would be inside fire protection zone C and would have to find an alternate route to exit after the door was closed. The closest egress was down the ramp to deck 11, around a turn, and about 120–130 feet aft to the port ladderwell.

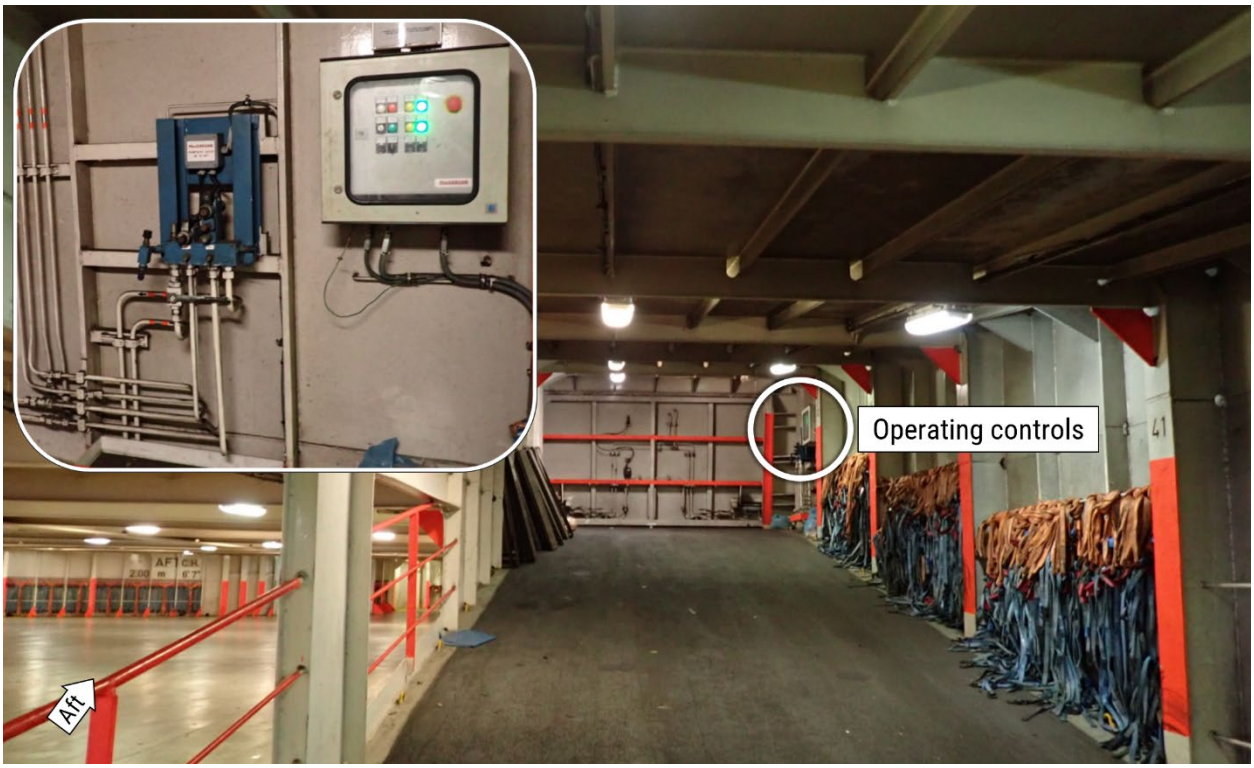

Figure 4. Deck 12 hydraulic garage door looking aft up the vehicle ramp, from the interior of the garage space. Inset shows the door's control panel to the right of the valves used for manual operation. Photos taken on the Grimaldi vessel *Grande Senegal*, a sister vessel to the *Grande Costa D'Avorio*. (Background source: Coast Guard)

The vessel's fitter had dressed out in firefighting gear and an SCBA, but heavy black smoke was coming out of the Dk-12 hydraulic garage door, and he did not feel safe attempting to shut the door and then having to navigate alone out of deck 11. The captain agreed and instead instructed the fire team to use a fire hose and spray water from above the Dk-12 hydraulic garage door in an attempt to create, in his assessment, an air boundary via a water curtain.

About this time (around 2117), vessel crew also observed and reported fire on deck 12. The captain called the chief engineer, who was responsible for releasing the CO_2, and told him to report to the CO_2 room, where the system's main controls were located. At 2119, in preparation for the CO_2 release, the captain requested and received a full muster of vessel crew over the radio. He then sounded the vessel's general alarm, which rang throughout the vessel.

At 2122, about 22 minutes after the fire was first observed, the captain ordered the chief engineer to release the CO_2, and the chief engineer activated the controls to

release CO_2 into fire protection zone C.[7] Shortly following the release of CO_2, members of the vessel crew on deck 12 said that the smoke emanating from the open Dk-12 hydraulic garage door changed from black to gray and decreased in volume. Over the next several minutes, vessel crew on deck 12 maintained the water curtain application above the Dk-12 hydraulic garage door and also used vessel fire hoses to begin boundary cooling the deck and fighting the fire that had been observed on deck 12.[8] The vessel's chief mate and other crew that had mustered at the stern ramp following the partial securing of fire protection zone C reported to decks 11 and 12 to aid with boundary cooling.

1.1.4 Land-based Firefighter Arrival and Staging

At 2124, the Port Authority Police Department, which had been called and alerted of the fire on board the vessel by a shoreside security guard, notified the Newark Fire Division (NFD) Dispatch Center of a fire on board the *Grande Costa D'Avorio*.[9] In response, the NFD initially dispatched eight companies and three chief officers. A typical company for the NFD, whether a ladder company or

[7] The vessel's fixed gas fire extinguishing system was a low-pressure system that released a precalculated amount of CO_2 into the designated space. In the case of fire protection zone C, the system was designed to take about 10 minutes to fully flood the space. The vessel had enough CO_2 available to flood the largest fire protection zone (zone B) once. If CO_2 was released into a smaller fire protection zone (such as zone C), the remainder could be used in subsequent releases.

[8] *Boundary cooling* is the use of water (in this case via the vessel's firehoses) to keep bulkheads and decks cool to prevent the spread of fire through conduction and to prevent structural collapse, all while taking care to not flood the ship with firefighting water, which would risk sinking or capsizing the vessel.

[9] Information in this section draws from formal interviews conducted throughout the investigation, and from testimony and included exhibits from the Coast Guard public hearing, including the log of transmissions received and recorded by the Dispatch Center. The Dispatch Center, which has more powerful radio receivers and transmitters, acts as an overseer and recorder of the operation.

an engine company, consisted of a captain and three firefighters.[10] (For a detailed accounting of the response events, see Appendix C: Response Timeline.)

At 2127, the vessel captain called the Coast Guard on VHF channel 16 to report the fire and the location of the vessel. At 2132, NFD Engine 27 (E-27), which was located was about 3 miles from the port, arrived on scene.[11]

The E-27 firefighters met an able seafarer from the vessel and the vessel's port captain at the stern ramp.[12] At the firefighters' request, the port captain escorted two firefighters up the starboard ladderwell to deck 11, where the third mate briefed them on the situation (see Figure 5 for a diagram of the ship).[13] The E-27 firefighters asked the third mate how to access garage deck 11 (included in fire protection zone C) to inspect the space; the third mate later testified in a formal interview following

[10] With respect to the land-based firefighting response, the NTSB's investigation focused on the shipboard aspects of the land-based firefighting operations and how the NFD interacted with the vessel crew and in the marine environment. The National Institute for Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program is conducting a concurrent investigation of firefighter line-of-duty deaths to formulate recommendations for preventing future deaths and injuries (F2023-10, NJ). Their investigation is focused more closely on the NFD and the land-based firefighting response. Areas that NIOSH is concentrated on include adequate NFD staffing levels, equipment and apparatus used, communications, accountability, the Incident Command, effectiveness of mutual aid, and the coordination of land-based firefighters and vessel crew. In addition, due to the fatalities of the two firefighters, and the fact that they were public employees, the state of New Jersey's Office of Public Employees Occupational Safety and Health also conducted an independent investigation into the incident, which also focused on NFD's land-based firefighter response, internal policies, firefighting tactics, and Incident Command structure. Their investigation has concluded, and they have issued an Order to Comply to the city of Newark, alleging violations and proposing monetary penalties.

[11] Fire service convention refers to companies by type and number—e.g., Engine-27 (E-27). Individual firefighters are designated by their company with additional identifying titles or roles as needed for clarity.

[12] An *able seafarer* is a more experienced deckhand who is qualified usually by 3 years' sea service on deck and is capable of performing all duties required to maintain, manage, and operate the vessel. These include (among other things) steering by compass, keeping lookout, operating deck machinery, and rigging cargo gear. A *port captain* is employed by the shipping company but is not a member of the vessel crew; they act as a liaison between the vessel and the port, ensuring continuity of operations.

[13] During the incident, crew and firefighter access to decks 11 and 12 was via two ladderwells. The starboard ladderwell led from deck 3 to the external section of deck 11 with intermediate access to decks 3–6 only (decks 7–10 were inaccessible from that ladderwell). An open exterior ladder led from the deck 11 ladderwell access to deck 12. The port aft ladderwell led from deck 3 to (the external) deck 12. This ladderwell had access to decks 6–11.

the casualty that he had to tell the firefighters multiple times that CO_2 had been released in the space and that they would need to wear their SCBAs.

Additional firefighting companies arrived, including an NFD battalion chief (B-5), who climbed the starboard ladderwell to deck 12, where he assumed on-scene operational command and met the vessel's captain. The captain informed B-5 that the fire had originated on deck 10, the vessel crew were fully accounted for, and that CO_2 had been released into the vehicle garage space (fire protection zone C).

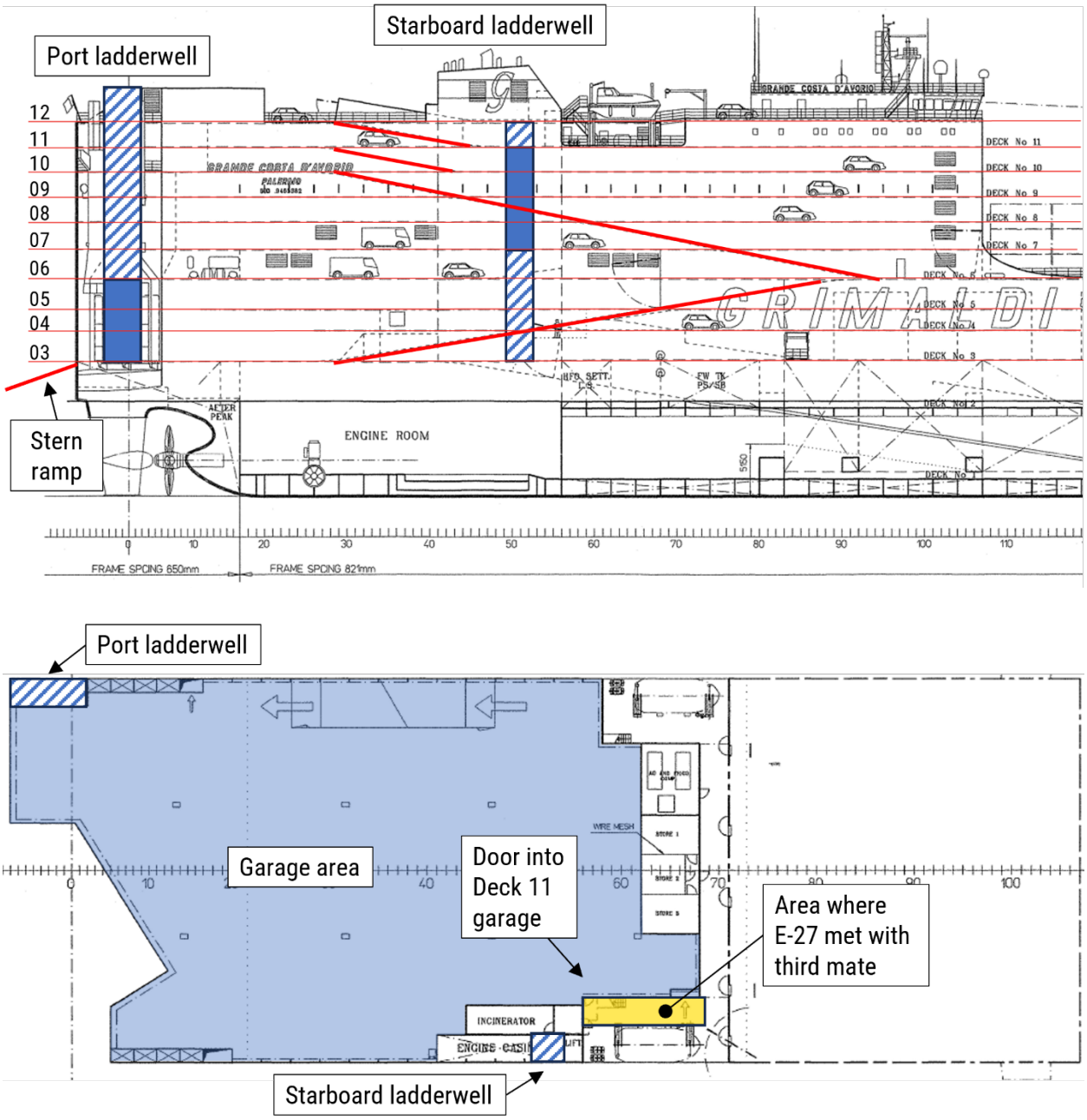

Figure 5. *Top*: Partial profile of the *Grande Costa D'Avorio*. Port and starboard ladderwells used by crew and firefighters are emphasized. The striped fill portions indicate that the ladderwells were accessible from the adjacent garage deck, and the solid blue shaded regions indicate that there was no access to those garage decks. The red lines are the ramps. *Bottom*: Overhead view of deck 11 layout. The blue shaded region indicates the interior portion of deck 11 that is part of fire protection zone C. (Background source: Grimaldi)

About 2141, the NFD's deputy chief arrived on scene and, in coordination with B-5, assumed the role of incident commander (IC) for the land-based fire department. At some point shortly after the IC arrived, a member of the vessel's crew gave him a

copy of the vessel's fire control plan (FCP), at the vessel captain's request (none of the previous responding firefighters had requested or been provided the plan).[14] The IC later told investigators that he had never before seen an FCP, he "couldn't understand it," and that the crewmember who gave it to him was not helpful in his attempts to interpret the document.

1.1.5 Initial Land-Based Firefighter Efforts

From about 2135 to 2224 (the time of the first firefighter Mayday call), firefighting companies entered into the garage spaces on decks 10 and 11 to investigate and fight the fires: The E-27 firefighters eventually donned their SCBAs and first entered the deck 11 garage space, reporting heavy smoke but no visible flames.[15] They planned to subsequently check deck 10, and the IC sent up a second battalion chief (B-4) and a ladder company (L-4) to aid in the inspection and firefighting. Meanwhile, the vessel's crew extinguished a small fire that had started on the open deck 12.

While climbing the starboard ladderwell to deck 12, B-4 opened the door to deck 6 to survey the space. He was not wearing an SCBA, and he later told investigators that his breath was taken away immediately, which he presumed was caused by the CO_2. He said no one had informed him that CO_2 had been released. (Following the casualty, B-5 and the IC indicated that they were aware that CO_2 had been released into the space, but B-4 and some of the other firefighters who were entering the space were not aware of it having been discharged. Additionally, the firefighters who had been informed about the CO_2 told investigators that they understood that the gas created a hazardous atmosphere. However, they reported that they were not aware that, for the gas fire extinguishing system to function as designed and extinguish the fire, the space needed to be sealed off and remain sealed for many hours following the CO_2 release.)

At 2154, E-27 reported to B-5, who was setting up a command post on deck 12, that they had inspected deck 10 and found heavy smoke but no fire.

[14] The FCP is required by *SOLAS* Chapter II-2, Regulation 15.2.4; it is a document unique to each vessel that provides both vessel crew and responding emergency personnel a detailed graphical layout of the vessel, including escape routes, areas of refuge, embarkation stations, the location of fire protection and emergency equipment, and structural fire protection boundaries. Copies aboard the *Grande Costa D'Avorio* were posted throughout the vessel in common areas. Additionally, copies were stored in labeled red tubes, located at egress points to the vessel, including the port and starboard sideports on deck 6 and on deck 3, directly to starboard of the stern ramp.

[15] The National Fire Protection Association (NFPA) defines "Mayday" as "code that indicates a firefighter is lost, missing or requires immediate assistance."

Additional firefighters, including L-4 and B-4, arrived on deck 12. The firefighters planned to re-enter deck 10 to further investigate, and B-4 positioned himself in the port aft ladderwell on deck 10 (he still did not have an SCBA). At 2204, E-27, who was still investigating deck 10, reported visible flames to B-4. Additional firefighter companies continued to arrive and stage on deck 12 and in the port ladderwell, awaiting direction from B-4 (see Table 1 for a summary of the actions and locations of key firefighting personnel described in this report).

Table 1. Actions and locations of key NFD response personnel referred to in this report.

Company/personnel	Location
Engine-27 (E-27) • E-27 captain • E-27 FF-1 • E-27 FF-2	Arrived at deck 11 Deployed into deck 11 and deck 10 to investigate and engage the fire
Ladder-4 (L-4) • L-4 captain • L-4 FF-1 • L-4 FF-2 • L-4 FF-B (deceased)	Arrived at deck 12 Deployed into deck 10 to investigate and engage the fire
Engine-16 (E-16) • E-16 captain • E-16 FF-A (deceased)	Deployed into deck 10 to investigate and engage the fire
Deputy chief (IC)	Commanded activities from IC post on deck 3 and the stern ramp
Battalion chief 5 (B-5)	Coordinated deck 12 staging area
Battalion chief 4 (B-4)	Tracked and directed firefighters into deck 10 from the aft port ladderwell

Meanwhile, the vessel's bosun, who was still wearing firefighting gear and an SCBA, and the chief mate, who did not have an SCBA, attempted to close the Dk-12 hydraulic garage door. Although the chief mate was able reach the controls, a red fault light appeared and prevented the door from being operated from the panel.[16] They then continued to assist with the other firefighting efforts.

[16] The red fault light was an indication of at least one of several potential conditions, including an alarm from one of the system pump's motor starters, the activation of an emergency stop push button for one of the system pumps or the local panel, a fault from the operating system's programmable logic controller, or a hard wire circuitry interruption. The source of the fault could not be definitively determined following the casualty due to the extent of damage to the vessel.

By 2213, the NFD confirmed that the fire (the visible flames reported by E-27) was concentrated around the Jeep pusher vehicle on deck 10, and they began to concentrate their efforts in this area. B-4, who was still in the aft port ladderwell on deck 10, assumed command of personnel in and out of deck 10. He directed L-4 to relocate from deck 12 to deck 10 to combat the fire—the L-4 captain and L-4 FF-B (an eventual casualty), equipped with SCBAs, entered the space. Visibility was between 10 and 15 feet at the ladderwell door but decreased as they got deeper into the space. They followed the hose line that was left on the deck from the previous group and located the Jeep pusher vehicle. L-4 FF-B engaged the Jeep fire while the L-4 captain monitored temperatures using a handheld thermal imaging camera. However, when he attempted to report the conditions to B-4, his radio transmissions were not being received clearly, so he followed the hose back out of the space (leaving L-4 FF-B alone on the nozzle of the fire hose).[17] The L-4 captain reached the deck 10 ladderwell and reported to B-5; at that time, he noticed that the outer soles of both of his boots had separated from the upper portion of the boot; he was thus unable to reenter the space.

Soon after, two firefighters from E-16 (the E-16 captain and E-16 FF-A [another eventual casualty]) also entered deck 10 to fight the fire. They followed the hose line until they reached L-4 FF-B, who was fighting the fire alone. Shortly behind the E-16 firefighters, a new pair of firefighters from L-4 entered deck 10 (L-4 FF-1 and L-4 FF-2). They encountered the E-16 captain with E-16 FF-A and L-4 FF-B (the two were later lost) but did not communicate with them. They proceeded to overhaul the Toyota Venza (pushed vehicle).[18]

At 2218, B-4, who was still at the deck 10 door in the port ladderwell, reported to the IC that the "fire appears to be knocked down" and they were "mopping up." L-4 FF-1 and L-4 FF-2 exited the space; the E-16 captain reported from within deck 10 that there was "no additional fire at this time."

However, soon after, B-4 began receiving information that fire was detected on deck 11, one deck above, so at 2222, he ordered the three remaining firefighters in deck 10 (the E-16 captain, E-16 FF-A, and L-4 FF-B) to "bring the line out" the way they had entered and exit deck 10. The firefighters confirmed over radio that they received the order and began to follow the hose out of the space.

[17] The firefighters reported that, throughout the casualty, radio communications were unreliable. For more information, see section 1.7.2.1, Firefighters' Radio Equipment.

[18] The NFPA defines "overhaul" as the final steps taken to extinguish a fire and ensure it is completely out.

Suddenly, a large volume of smoke and heat flooded the port ladderwell, forcing B-4 and the other firefighters there to evacuate the space. Some climbed the ladderwell to deck 12, while two others (L-4 FF-1 and L-4 FF-2) went several decks lower to take refuge. Those who evacuated up to the open deck 12 reported the worsening conditions to B-5.

The E-16 captain on deck 10 later testified that visibility was reduced to "about an arm's length." He heard L-4 FF-B's mask began to vibrate, indicating that he was getting low on air, so the E-16 captain instructed him to get in front of him and E-16 FF-A so that he could be the first out of the space.[19]

As the trio followed the hose line out of the space, the E-16 captain lost contact with L-4 FF-B and E-16 FF-A. His air supply was low, and he told investigators that he broadcasted a Mayday call over his radio and indicated that he was disoriented, separated from his crew, and running low on air (NFD dispatch could not confirm if they received the call). He eventually followed the bulkhead to the port ladderwell door.

At 2223, NFD dispatch received a radio transmission from the firefighters still within the deck 10 garage space, stating that "we cannot find our way out, we are lost," followed 1 minute later by "we are lost!" (it could not be definitively determined if these calls came from either E-16 FF-A or the E-16 captain).

Over the next 11 minutes, land-based firefighters attempted to account for these firefighters, as well as all other firefighters on board. However, the accountability was complicated by the challenges with radio communications and the dispersing of personnel following the smoke event that occurred in the port ladderwell staging area several minutes earlier.

1.1.6 Firefighting Response Following Firefighter Maydays

At 2234 (just over an hour after the first firefighting company arrived on scene), the NFD was able to confirm that both L-4 FF-B and E-16 FF-A were unaccounted for on deck 10, but that all other land-based firefighters were accounted for. Since the firefighters had arrived on scene, the fire had spread from deck 10 to deck 11. Firefighter search crews who had been standing by at the command post assembled on deck 12. B-5, who was still commanding on-scene operations from deck 12, reported to the chief mate and vessel captain that the land-based fire department

[19] A 30-minute air cylinder was the standard issue to NFD firefighters. SCBA air cylinder minute-ratings are based on NIOSH testing. Actual available airtime may be reduced based on the wearers' exertion level and respiratory rate, which is frequently higher than average for firefighters.

was missing two firefighters, and they were transferring efforts from firefighting to search and rescue.

At 2240, members from the NFD rapid intervention team, who had entered deck 10 and were searching for the two missing firefighters, found one of the missing firefighters (E-16 FF-A) pinned between two vehicles, about 40 feet forward of the pusher Jeep and about 20 feet inboard of the starboard bulkhead of the vessel. His Personal Alert Safety System device was sounding, but he was unresponsive, his SCBA mask was pushed up on his face to his nose level, and his helmet was off.[20] The rescue crew established a fresh air supply for him and began attempting to free him from between the two vehicles.

Meanwhile, the vessel's crew was extinguishing fires that broke out on deck 12 and became aware of the active fire on deck 11. The vessel captain suggested discharging additional CO_2 into zone C to combat the fire, but, due to the ongoing search and rescue efforts, he and the IC agreed not to. Standing water began to accumulate on deck 12 from the crew's boundary cooling and other firefighting efforts. The water, which was heated from the fire below, was so hot that many of the firefighters stationed there had to climb onto vehicles to escape the scalding water.

The NFD continuously circulated crews in and out of deck 10 as they attempted to free E-16 FF-A from between the two vehicles and continued to search for L-4 FF-B. Acknowledging that his department was being strained by such an operation, the NFD chief, who had arrived on scene after learning of the two missing firefighters and was acting in an advisory role to the IC, called dispatch at 2313 to request mutual aid from neighboring New Jersey communities, including Jersey City and specialized companies from the Newark Metro Urban Area Security Initiative (UASI).[21]

At 2345, B-4 and B-5 requested the vessel crew to start the garage space extractor fans and remove the smoke from deck 10, to better aid in their search and rescue efforts. The captain instructed the chief engineer to reset the dampers (allowing them to open) and start the extractor fan for deck 10. The extractor fan was

[20] The Personal Alert Safety System device sounds a loud alert to notify others in the area that the firefighter is in distress. The device can be manually activated or will activate automatically if the firefighter is motionless for a set time, typically more than 30 seconds.

[21] The Newark Metro UASI group included Jersey City and the counties of Bergen, Hudson, Essex, Middlesex, Morris, Passaic, and Union. The UASI included a search and rescue strike team that consisted of 11 agencies, including Bayonne FD, Elizabeth FD, Hackensack FD, Hoboken FD, Jersey City FD, NFD, Paterson FD, Morristown FD, the Port Authority of New York and New Jersey, Middlesex County, and North Hudson Regional FD.

again shut off about 35 minutes later because it was exhausting heavy smoke directly onto deck 12 and negatively affecting the firefighters, vessel crew, and other first responders stationed there.

About midnight, nearly 1 hour and 20 minutes after locating the unconscious E-16 FF-A, crews were able to free him from between the two vehicles by using a battery-operated spreader tool (jaws of life) to physically separate the two vehicles. He was taken to deck 12, where emergency medical service crews attempted lifesaving procedures in the bed of a pickup truck. Forty-five minutes later, at 0045 on July 6, firefighters and the vessel crew moved E-16 FF-A to the pier. An ambulance took him to a local hospital, where he was later pronounced dead.

While efforts to remove E-16 FF-A from the vessel were ongoing, difficulties with radio communications persisted, exacerbated by several additional Mayday calls from firefighters that found themselves in compromised situations. The NFD fire chief decided to request assistance from the Fire Department of the City of New York (FDNY).

From 0122 to 0208, land-based firefighters from the UASI and FDNY conducted multiple searches for L-4 FF-B on deck 10. The vessel's crew again attempted to close the Dk-12 hydraulic garage door, this time by mechanically disconnecting the hydraulic rams that held the door open, but were unsuccessful. The vessel crew also continued to boundary cool deck 12, as the fire on deck 11 was not being actively fought during the search and rescue and continued to grow in intensity.

At 0208, almost 4 hours after the initial firefighter Mayday was called, firefighters from the FDNY located L-4 FF-B about 175 feet forward of the location of the Jeep and the initial fire, and about 20 feet inboard from the starboard bulkhead of the vessel (see Figure 6). He was also unresponsive. Over the next hour, firefighter crews worked to remove L-4 FF-B from his location on deck 10, across the nearly fully loaded deck of vehicles, up the port ladderwell, across deck 12, and down to the pier, where he was transported by ambulance to the hospital. At the hospital, he was later pronounced dead.

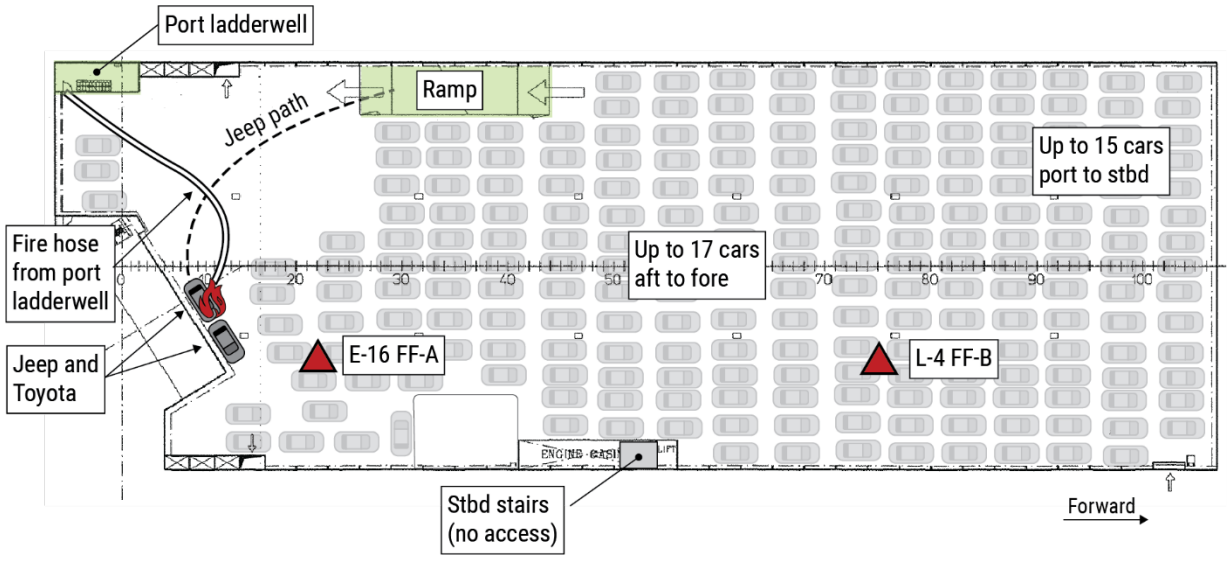

Figure 6. Deck 10 layout, showing an approximation of the deck's loaded condition (based on the estimated 200 cars loaded on that deck at the time). The locations where the two missing firefighters were found are indicated by triangles. (Background source: Grimaldi)

About 0325, a marine battalion chief for the FDNY met the captain of the vessel on the bridge. They discussed releasing additional CO_2 into zone C, but they ultimately agreed that the Dk-12 hydraulic garage door would have to be shut first. Vessel crew, aided by land-based firefighters, attempted again to close the door—this time using hydraulic jacks and wooden timbers to hold the door open while they attempted to manually retract the locking pins using pry bars and also removing the hydraulic rams. All attempts failed. They also attempted to use tarps to cover the large opening, but this too failed.

About 0400, the vessel's captain and the FDNY marine battalion chief reviewed the vessel's FCP and Non-Tank Vessel Response Plan.[22] Together they called the marine salvor (salvage company) listed in the Non-Tank Vessel Response Plan, informing them of the situation and requesting assistance. Shortly after this, the IC and fire chief ordered all fire department personnel to exit the vessel—the fire chief told investigators that this decision was due to the loss of two of his firefighters, his

[22] A vessel that is not a tanker but carries oil as fuel is required by Title 33 *Code of Federal Regulations* 155.5050 to have a *non-tank vessel response plan*, which is used to prepare the vessel's crew and management to respond to an oil spill (primarily) or any other casualty or emergency. The plan typically includes a checklist with all notifications, including contact numbers, in order of priority to be made by shipboard or shore-based personnel and the information required for those notifications.

department's depleted resources, and his desire not to put any more of his department in harm's way.

After the land-based firefighters left the vessel, the fire continued to intensify, spreading within the garage space. A FDNY fire boat arrived, and the captain of the *Grande Costa D'Avorio* instructed them to direct their stream of firefighting water on deck 12 and at the open Dk-12 hydraulic garage door (see Figure 7). Even with these efforts, the vessel crew indicated that the fire on deck 11 intensified and that visible flames increased on deck 12. About this time, according to the chief mate, a 4–5° starboard list (toward the dock) developed due to the firefighting water that had accumulated on board the vessel. At 0640, the captain of the *Grande Costa D'Avorio,* fearing for the safety of his crew, ordered all vessel crew to evacuate the vessel.

Figure 7. A fire boat directing water onto the *Grande Costa D'Avorio*. (Source: Bureau of Alcohol, Tobacco, Firearms and Explosives)

Throughout the morning of July 6 and over the next several days, senior vessel crew continued to provide vessel technical expertise to aid the marine salvors, land-based fire department personnel, Coast Guard, and other stakeholders (such as various criminal investigative entities) to contain and mitigate the spread of the fire on board the vessel and to maintain vessel stability. On July 10, after 5 days of firefighting efforts, the fire aboard the *Grande Costa D'Avorio* was extinguished.

1.2 Injuries and Fatalities

Table 2. Injuries sustained in the *Grande Costa D'Avorio* fire.[a]

Type of Injury	Crew	Emergency Responder	Total
Fatal	0	2	2
Serious	0	0	0
Minor	0	6	6
None	28	*	*

[a] The NTSB uses the International Civil Aviation Organization injury criteria in all of its casualty reports, regardless of transportation mode. A serious injury is a nonfatal injury that requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; results in a fracture of any bone; causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burn affecting more than 5% of the body surface.

*Due to the nature of the event, the NTSB was unable to determine the exact number of responders on board.

The medical examiner determined that the primary cause of death for the two fatally injured firefighters was smoke inhalation, including carbon monoxide intoxication.

1.3 Vessel

1.3.1 General

The *Grande Costa D'Avorio* was a 692-foot-long Ro/Con vessel with 12 decks. Vehicles were loaded using a stern ramp that led up to deck 3 (see Figure 8). Deck 11 was partially exposed and had a cargo vehicle deck, weather deck, and crew accommodation space.

Figure 8. The *Grande Costa D'Avorio* docked in 2021 with the stern loading ramp open/extended. (Source: Egidio Ferrighi, MarineTraffic.com)

The decks were connected by vehicle ramps. Decks 2–5 were enclosed garage spaces that ran the length of the vessel; decks 6–10 and the enclosed section of deck 11 were garage spaces that ran the length of the superstructure (see Figure 9).[23]

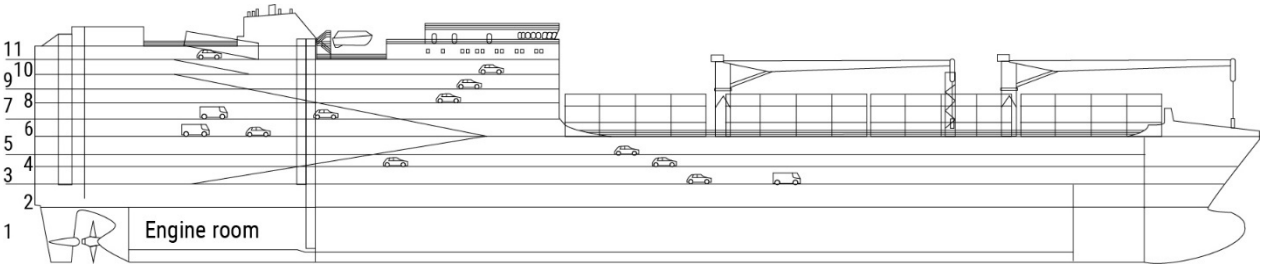

Figure 9. Simplified profile view of the *Grande Costa D'Avorio*.

[23] A *superstructure* is the area on the main deck of a ship that houses crew stateroom accommodations and the galley. The ship's bridge sits atop the superstructure.

Table 3 shows vessel particulars for the *Grande Costa D'Avorio*.

Table 3. Vessel Particulars

Vessel Particulars	
Vessel	***Grande Costa D'Avorio***
Type	Cargo, General (Ro/Con)
Owner/Operator	Grimaldi Deep Sea SPA (Commercial)
Flag	Italy
Port of registry	Palermo, Italy
Year built	2011
Official number	247311200 (MMSI)
IMO number	9465382
Classification society	RINA Services
Length (overall)	692.0 ft (210.9 m)
Breadth (max.)	105.0 ft (32.0 m)
Draft (casualty)	30.8 ft (9.4 m)
Tonnage	47,232 GT ITC
Engine power; manufacturer	1 ×25,532 hp (19,039 kW); MAN B&W direct drive diesel engine

1.3.2 Regulatory Oversight

The International Maritime Organization (IMO) is the global standard-setting authority for the safety, security, and environmental performance of international shipping. Its main role is to create a regulatory framework for the shipping industry that is universally adopted and implemented. IMO measures cover all aspects of international shipping, including ship design, construction, equipment, manning, operation, and disposal. The IMO's *International Convention for the Safety of Life at Sea* (*SOLAS*) is generally regarded as the most important of all international treaties concerning the safety of merchant ships.[24] Other IMO conventions include the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), which establishes "basic requirements on training, certification and watchkeeping for seafarers on an international level," and the International

[24] The main objective of *SOLAS* is to specify minimum standards for the construction, equipment, and operation of ships, compatible with their safety. The first version of the *SOLAS* Convention was adopted in 1914 in response to the *Titanic* disaster. The current version in force is the 1974 Convention, as amended on numerous occasions. (IMO 1974)

Convention on Load Lines (ICLL), which governs the design, construction, and operation of ships relating to a vessel's stability.[25]

The *Grande Costa D'Avorio* was built in 2011 and flagged in Italy. The certification of a ship and its associated safety equipment and machinery are the responsibility of the "flag state," or the country in which the vessel is registered. Like most signatory nations, Italy has incorporated *SOLAS* requirements into its national regulations. *SOLAS* provides that flag states may delegate their authority to ensure vessels' compliance with its regulations to recognized organizations. Italy has delegated certification inspection authority to the Italian classification society, RINA, as a recognized organization. Grimaldi (the vessel's owner) had the *Grande Costa D'Avorio* classed by RINA.[26] In its role as the recognized organization and classification society for the vessel, RINA was responsible for ensuring that the *Grande Costa D'Avorio* complied with *SOLAS*, other applicable regulations, and its class rules.

1.3.3 *Grande Costa D'Avorio* Fire Systems and Equipment

1.3.3.1 Vessel Firefighting Equipment

The vessel was outfitted for firefighting in accordance with *SOLAS* standards. Hydrants, hoses, and nozzles were located throughout the vessel. During the fire on July 5, the vessel crew and land-based firefighters used the vessel's hoses from various shipboard hydrants simultaneously. Land-based firefighters and the vessel crew both described the water supply as adequate, and the vessel's seawater fire pumps (electrically powered from the vessel's generators) drew water from the harbor and remained in operation without issue until the marine salvors, aided by the vessel crew, secured the vessel's electrical generators on the afternoon of July 6 due to safety concerns associated with the ongoing fire and the shipboard electrical system. (Securing the generators shut off power to the vessel and stopped the fire pumps; firefighters then used firefighting water supplied via a shore supply.)

[25] *Load lines* are marks at the midpoint along the length of each side of a vessel's hull that establish the minimum safe freeboard (the vertical distance between the vessel's waterline and the highest watertight deck); load line standards set specific structural design, construction, and maintenance criteria.

[26] RINA Services S.p.A. was originally founded as Registro Italiano Navale in Italy in 1861. As the company grew, it underwent some mergers and, in 1999, Registro Italiano Navale changed its name to RINA S.p.A. In 2009, all operations, licenses, and accreditations dealing with classification, certification, tests, and inspections were transferred to RINA Services S.p.A.

The vessel was also equipped with two international shore connections. The flanged connection was designed to adapt a shoreside pressurized water supply to the vessel's fire main in the event that the vessel's fire pumps became inoperable. Aboard the *Grande Costa D'Avorio*, one of the connections was in a labeled red box at the entrance to the vessel from the stern ramp on deck 3. It was not used during the casualty event.

1.3.3.2 *Grande Costa D'Avorio* Fixed Gas Fire Extinguishing System

The *Grande Costa D'Avorio* had a fixed gas fire extinguishing system that, in the event of a fire, released CO_2 into one or more of the vessel's six fire protection zones.[27] (For more information on shipboard fire extinguishing systems, see Appendix D: Basics of Shipboard Firefighting.) The enclosed garage spaces of decks 6–11 were all part of the same fire protection zone (zone C) and were therefore designed to be able to be sealed off from the other decks and the outside with the aid of three hydraulically operated garage doors (see Figure 10). Although decks 7–11 were perforated with tie-down holes for securing cargo, deck 6 had dee rings welded to the deck, but no holes, to maintain the fire boundary.

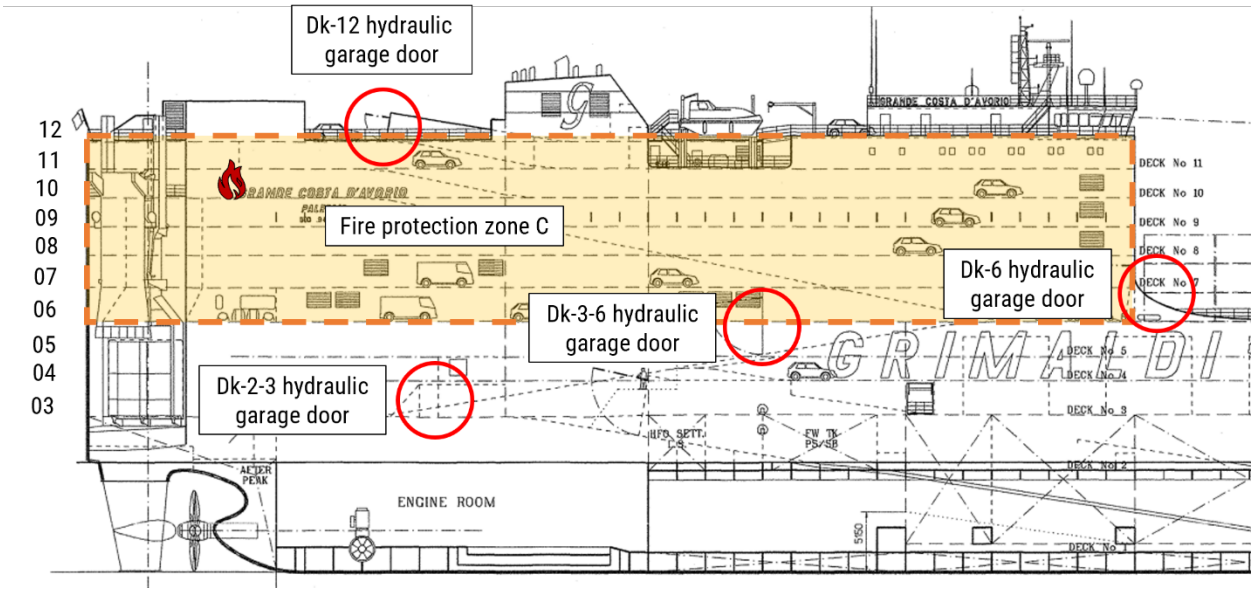

Figure 10. Partial profile of the *Grande Costa D'Avorio*. Fire zone C is indicated by the shaded region. The vessel's four hydraulic garage doors are circled. (The Dk-2-3 door was not part of the fire boundary for zone C.)

[27] When dispersed into a space, the CO_2 gas displaces the oxygen that is present and smothers the fire. To be effective in extinguishing a fire, the space into which the CO_2 is released must be segregated and sealed off from sources of oxygen.

1.3.3.3 Hydraulic Garage Doors

The vessel had four hydraulically operated garage doors designed to seal off the vessel's fire protection zones. All four doors could be sealed shut.[28] The vessel crew indicated that they had learned how to operate these doors via on-the-job training. The control panels for these doors required the operator to be present and holding down a button until the door was completely shut or open, which was a standard safety feature for hydraulic doors on vessels (see Figure 11). These doors were normally kept closed when the vessel was at sea but were typically opened when the vessel was alongside the dock to facilitate Ro/Ro cargo operations and the movement of vehicles throughout the garage decks.

Figure 11. Hydraulic garage door control panel from a sister vessel. (Source: Grimaldi)

The control panel for the Dk-12 hydraulic garage door was at the top of the vehicle ramp leading from deck 11 to deck 12.[29] The door was listed on the vessel's damage control plan as part of the boundary to seal fire protection zone C.[30]

All the hydraulic garage doors on the vessel had independent local control panels but used a common hydraulic system that was supplied by a reservoir and pumps located in the engine room. If the local control panel for one of these doors became nonoperational, manual manipulation of the local hydraulic solenoid valves

[28] The construction of these doors was similar, and, depending on the location of the hydraulically operated garage door on the vessel, they were assigned and functioned as either *watertight*, meaning being capable of preventing the passage of water in any direction under the pressure of water likely to occur in intact (normal operating) and damaged conditions, or *weathertight,* meaning that, in any sea conditions, water will not penetrate the door, or, in some cases discussed later, merely a hatch. During vessel crew interviews, these doors were generically referred to as watertight doors.

[29] Other vessels of the same class, with similar design features, size, and capabilities constructed for Grimaldi were built in a different shipyard and had local operating controls both inside and outside the door.

[30] The damage control plan and damage control booklet, which are required by *SOLAS* II 1/19, are intended to provide clear information on the ship's watertight subdivision and equipment related to maintaining the boundaries and effectiveness of the subdivision so that, in the event of damage to the ship causing flooding, proper precautions can be taken to prevent progressive flooding through openings therein and effective action can be taken quickly to mitigate and, where possible, recover the ship's loss of stability.

could operate the door as long as the system had hydraulic pressure. An emergency portable hand pump could also be used to actuate the doors from their respective panels (the hand pump, located in the engine room, could service all the doors). Neither backup method—both of which required accessing the door control panel from within the garage space—was attempted on July 5.

1.3.3.4 Vessel Door Regulatory Oversight and Classification

International regulations define and regulate vessel doors in different ways based on their location and function: both ICLL and *SOLAS* have definitions and requirements relating to vessel doors. ICLL identifies doors as "watertight" if they contribute to damage stability and flooding control. Watertight doors, unless permanently closed at sea, are required to be capable of being closed from either side. *SOLAS* Chapter II-2 identifies doors and other openings in fire boundaries, and requires that "any opening which could permit air to enter or gas to escape a space protected by CO_2 must be capable of being closed from outside the protected space." (See Table 4 for comparisons of the door requirements.)

After the *Grande Costa D'Avorio* casualty, RINA, the classification society of the vessel, was contacted by investigators and asked to explain the rules pertaining to the opening and the means of closure for the Dk-12 hydraulic garage door. They determined that, per load line regulations, and due to the Dk-12 hydraulic garage door's physical position on the vessel (well above the freeboard deck), the door was considered a "hatch" and did not need to meet watertight or weathertight door requirements, and thus was not required to be able to be operated from both sides of the bulkhead. Additionally, RINA was asked how the Dk-12 hydraulic garage door, with operating controls only on the inside, would meet applicable *SOLAS* Chapter II-2 requirements. They responded that, as per the vessel's standard operating practice, "the ramp door [Dk-12 garage door] is kept closed during navigation and it is not required to be closed from outside of the spaces," and would therefore adhere to the regulatory requirements because it would remain closed while underway.[31]

[31] See the docket for RINA's interpretation and additional correspondence with the NTSB.

Table 4. Vessel door regulations, requirements, and interpretations.

	ICLL	*SOLAS* II-2
	Stability	Construction/Fire boundaries
Regulation	Regulation 12.1 (Doors)	Regulation 10.4.2 (Closing appliances for fixed gas fire extinguishing systems)
Requirement	All access openings in bulkheads at ends of enclosed superstructures shall be fitted with doors of steel or other equivalent material, permanently and strongly attached to the bulkhead, and framed, stiffened and fitted so that the whole structure is of equivalent strength to the un-pierced bulkhead and weathertight when closed […] the doors shall be so arranged that they can be operated from both sides of the bulkhead.	Where a fixed gas fire-extinguishing system is used, openings which may admit air to, or allow gas to escape from, a protected space shall be capable of being closed from outside the protected space.
RINA interpretation of the Dk-12 hydraulic garage door	Because the Dk-12 hydraulic garage door was well above the freeboard deck of the vessel, RINA considered the Dk-12 hydraulic garage door to be a hatch and therefore not subject to requirements reserved for watertight and weathertight doors. [ab]	Because it was the vessel's standard practice to have the Dk-12 hydraulic garage door closed while underway, it would meet the fire boundary requirements.

[a] The *freeboard deck* is normally the uppermost complete deck exposed to weather and sea. It has a permanent means of closing all openings weathertight, and below it all openings in the sides of the ship are fitted with permanent means of watertight closing.

[b] *Watertight* is defined as capable of preventing the passage of water in any direction under the pressure of water likely to occur in intact (normal operating) and damaged conditions; *weathertight* means that, in any sea conditions, water will not penetrate the door.

1.4 Damages

After the fire, the vessel was towed to Turkey for repairs. The damage cost to the vessel was estimated to be over $23 million.

1.4.1 Vessel Damage

Although the exterior of the vessel was relatively intact after the fire, a large section on the port stern at deck 10 and the port aft corner at deck 11 exhibited significant thermal damage: all the paint was missing, and the bulkhead in those areas was heavily oxidized and warped (see Figure 12). The adjacent areas exhibited heavy sooting.

Figure 12. Damage to the vessel's stern.

On both sides of the vessel, between deck 6 and deck 11, paint was missing in areas, and adjacent areas were discolored and blistered. Damage was also present on the forward starboard corner of deck 11. Similar thermal damage was found in the forward section of deck 11, next to the Dk-12 hydraulic garage door, which had remained open. The door control panel, located inside the vessel, was destroyed (see Figure 13).

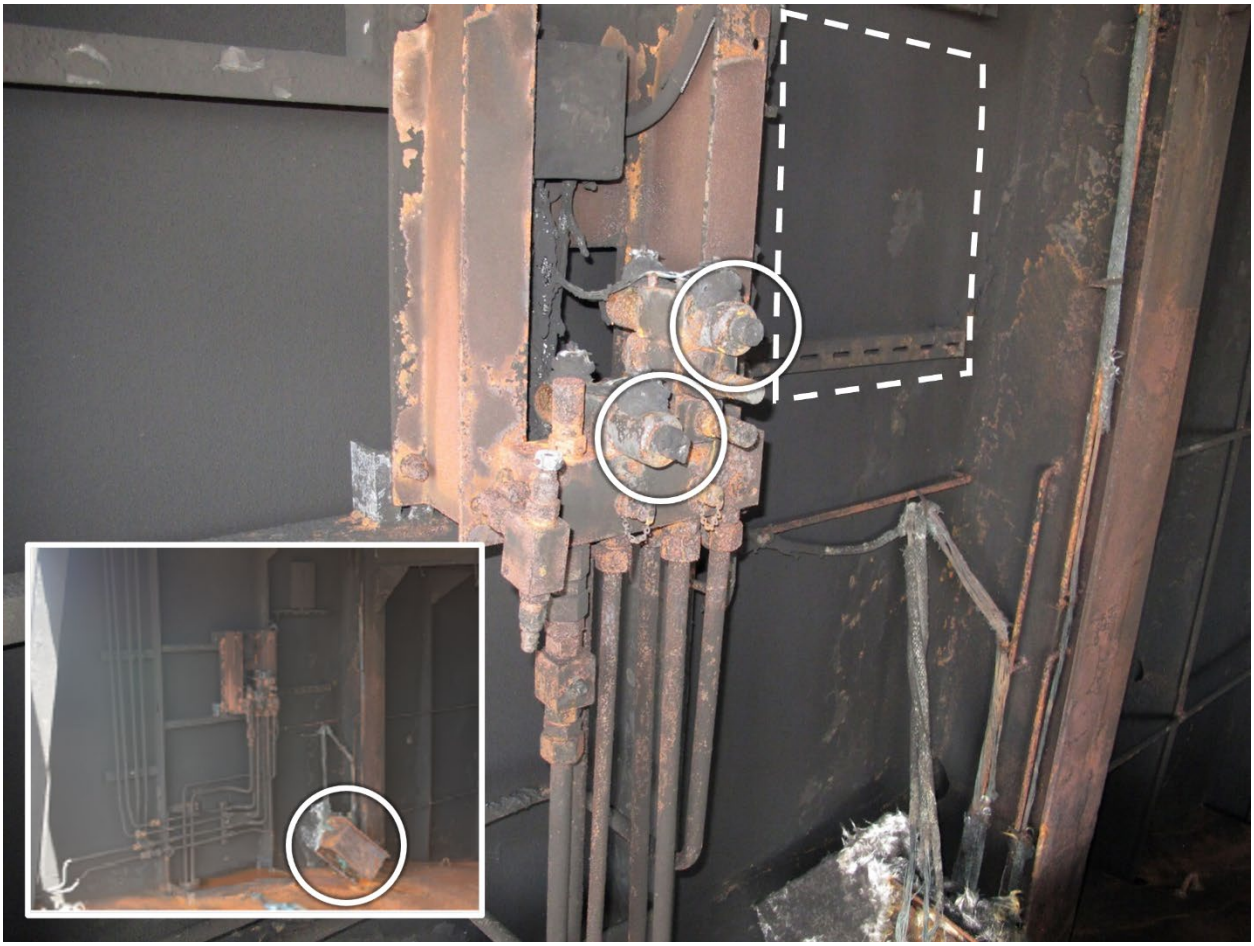

Figure 13. The Dk-12 garage door hydraulic valve block after the fire, with manual operating control valves circled. The location of the door's control panel, which burned and fell off the bulkhead, is outlined in the dotted line. *Inset*: a wide view of the area, showing the control panel on the floor (circled). (Inset source: Bureau of Alcohol, Tobacco, Firearms and Explosives)

Additionally, the open portion of deck 12 exhibited significant warpage, and several groups of vehicles stowed on the deck were damaged or destroyed by fire (see Figure 14).

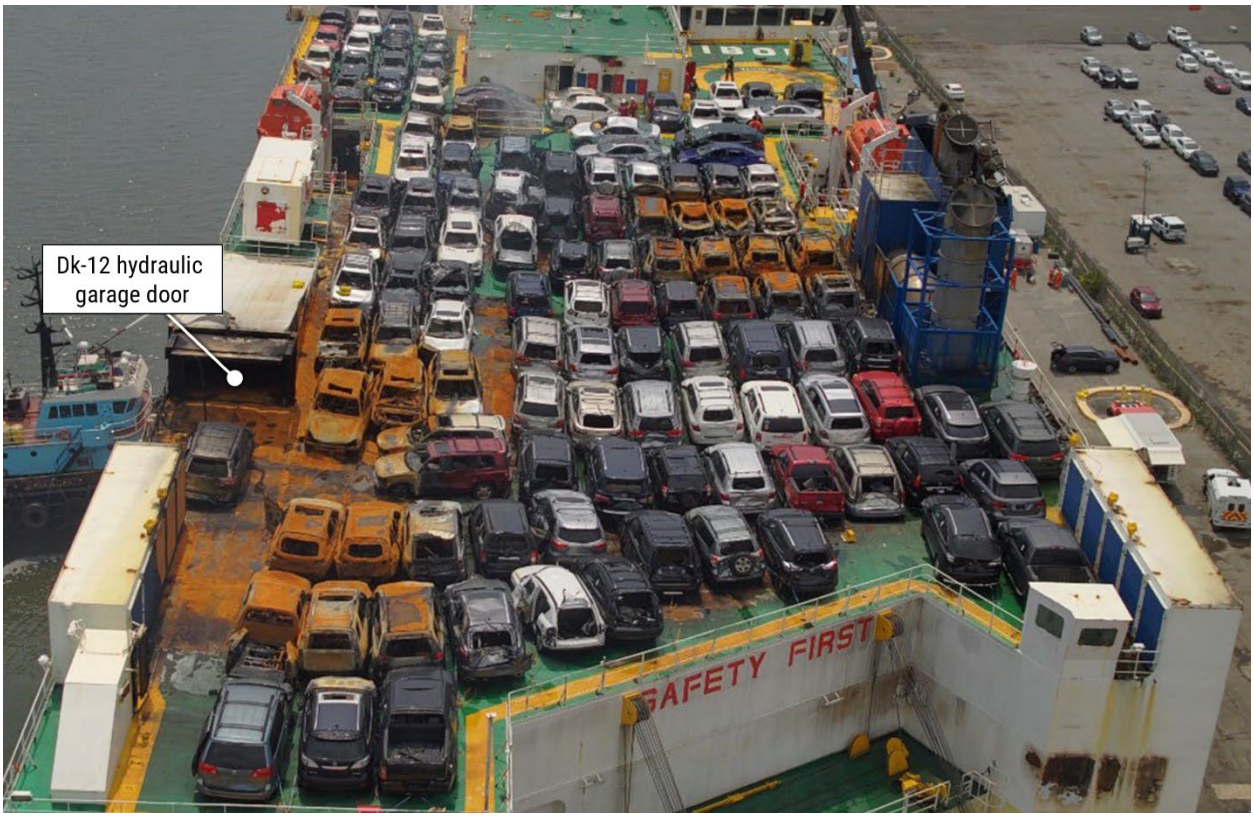

Figure 14. Overall damage to deck 12 (looking forward). (Background source: Bureau of Alcohol, Tobacco, Firearms and Explosives)

Decks 1 through 6 were undamaged. However, decks 7 through 9 exhibited varying degrees of fire damage to the ship's structure—including deck warpage, blistering paint, discoloration, and heavy sooting—and to loaded cargo. Figure 15 shows an example of the damage on deck 8.

Figure 15. Damage to deck 8 aft.

On deck 10, about 200 vehicles were stowed forward of the cargo ramp, and about 12 vehicles were stowed starboard and aft of the midship cargo ramp. All of the stowed vehicles, including the straps and hardware securing the vehicles to the deck, were destroyed by the fire. The overhead beam adjacent to the Jeep and the car it was loading was significantly warped, as was the aft bulkhead adjacent to the two vehicles.

Deck 11 was loaded with cars, which were all destroyed by the fire. The accommodation spaces and storage areas on deck 11 were also destroyed by fire. The bridge (deck 12) sustained significant damage. The port side was collapsed, and the compartment was significantly damaged by fire.

1.4.2 Vehicle Fire Damage

Two vehicles—a Jeep Wrangler and a Toyota Venza—were involved in the initiating events of the fire: The Jeep was being used to push the Venza to its stow position on deck 10 (see Figure 16). During this operation, a fire started on the Jeep and then spread to the Toyota.

Figure 16. The Toyota Venza (*left*) and Jeep Wrangler pusher (*right*) on deck 10.

Investigators from multiple agencies and jurisdictions first examined the Jeep pusher vehicle on board the vessel in the location where the driver left it after he saw the fire (see Figure 17).[32] The Jeep sustained heavy fire damage. Almost all the vehicle's exterior paint was missing, and the remaining vehicle body was heavily oxidized and buckled in places. The oxidation pattern was heavier on the front of the vehicle (front, hood, and front quarter panel) and decreased in severity toward the rear of the vehicle. All nonmetallic components (light lens, fenders, door handles, grill, and weatherstripping) were missing and presumed destroyed by the fire. Both front tires and the passenger side back tire were completely consumed in the fire, and the driver side back tire was partially consumed. Most of the composite hard-top roof and all the windows were missing. The interior was destroyed, with only metallic components remaining. The push bar was still attached but also heavily oxidized.

[32] Investigators from the Bureau of Alcohol, Tobacco, Firearms and Explosives, Coast Guard, NTSB, Port Authority police, and County Sheriff were present.

Figure 17. (*Top to bottom*) Damage to Jeep (driver side), and front end with attached (retrofitted) steel front bumper/push bar.

The engine compartment also sustained significant thermal damage: The underside of the hood was heavily oxidized, and all nonmetallic components in the engine compartment were missing and presumed consumed in the fire (see Figure 18).

Figure 18. Fire damage to the Jeep engine compartment.

On October 18, 2023, investigators from the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) and Coast Guard, with other party representatives, examined the Jeep's engine compartment and undercarriage after the Jeep had been removed from the vessel and taken to a storage facility.[33]

The severity of the damage to the underside of the vehicle increased from the rear of the Jeep toward the front. The most significant directional damage started at the transmission bell housing—the piece that connected the transmission to the engine—located on the passenger side of the vehicle. Most of the engine components in that area were missing and presumed consumed by the fire. The gasoline tank itself was not completely visible but appeared intact where it was visible, and the visible sections did not exhibit any signs of catastrophic failure.

[33] The Coast Guard and the ATF have a memorandum of understanding establishing that the ATF may provide investigative expertise for fires and explosions on Coast Guard facilities, involving Coast Guard personnel, or under investigation by the Coast Guard. ATF may provide fire investigators, lab analysis, fire cause or destructive device determination statements, and training. The findings of ATF's examination were detailed in the ATF report, ATF case number 769030-23-0079).

1.5 Port and Waterway Information

1.5.1 Port Newark and the Port Authority of New York and New Jersey

The City of Newark owned Port Newark and leased the property to the Port Authority of New York and New Jersey (Port Authority), which managed the port. Port Newark is part of the Port of New York and New Jersey, which, as a whole, is "the largest port on the East Coast, and the third largest in the nation."[34] The Port Authority had its own police department for Port Newark, but fire response capabilities were handled by local municipalities. The NFD was responsible for the berth where the *Grande Costa D'Avorio* was docked.

1.5.1.1 Port Authority-Provided Training

The Port Authority had previously arranged ad hoc training exercises at the port for local municipalities, including the NFD, centered around port security and the Port's Facility Security Plan. The Port Authority had also previously engaged with local municipalities to conduct exercises on hazmat and fire response on shoreside facilities. However, these exercises were rarely conducted on board vessels alongside the dock and did not include vessel firefighting tactics or coordination with vessel crew.

In the past, the Port Authority had worked with vessel operators to conduct familiarization tours for Port Authority employees and local fire departments. However, the Port Authority did not track attendance on these tours, and a representative for the Port Authority could not remember the last time NFD had participated in a vessel tour and stated that it had been "quite a few years." (See section 1.7.2, Newark Fire Division.)

In summer 2023, just before the fire, the Port Authority partnered with the New Jersey Office of Homeland Security and Preparedness to provide the NFD with a training seminar titled, "Fire Fighting Awareness Seminar for Maritime Transport of Electric Vehicles." All members of the NFD were required to attend one of the 3-hour classroom seminars. The seminar consisted of a classroom discussion and slide presentation on the dangers of lithium-ion battery fires in the intermodal system. The slide presentation highlighted some of the potential dangers on board a vessel, including densely loaded cargo decks and confined spaces. The slide presentation also included a short walkthrough video of a Ro/Ro vessel's cargo area. According to

[34] Containerport Information | Port Authority of New York & New Jersey (panynj.gov)

the Port Authority, the training seminar did not, nor was it intended to, provide training on shipboard firefighting tactics.

1.6 Ports America and American Maritime Services Cargo Operations

Ports America was a company hired by shipping companies to load and unload cargo from their vessels (stevedoring). In the case of used vehicle transport, Ports America also oversaw the receiving and staging of vehicles before loading them onto the vessels. Ports America owned the pusher vehicles, forklifts, and other shoreside equipment used to load cargo onto the vessels and employed superintendents that oversaw the cargo operations. Ports America provided shipping companies with unionized labor from the International Longshoreman's Association and AMS to conduct cargo operations.

Ports America at Port Newark owned five passenger vehicles, which had been retrofitted with large steel front bumpers to facilitate pushing vehicles. Ports America did not have a routine preventive maintenance schedule for their pusher vehicles: All maintenance was completed on an as-needed basis. Minor maintenance, such as repairing a flat tire or topping off fluids, was performed by an AMS noncertified mechanic; other more technical maintenance items like oil changes, transmission fluid flushing, and tire replacement were conducted at a nearby auto body and service shop.

1.6.1 Ports America Jeep Pusher Vehicle

Ports America had purchased the 2008 Chrysler Jeep Wrangler in 2012.[35] The two-door/four-wheel drive, 202-hp Jeep had a rated towing capacity of 2,000 pounds and an automatic transmission. (Chrysler, like most other vehicle manufacturers, did not list a "pushing" capacity rating.) The Jeep's curb weight (the vehicle without any fluids or cargo) was 3,760 pounds. The gross combined weight rating (the maximum total weight the Jeep could carry and tow) was 6,032 pounds.

[35] Chrysler was the manufacturer of the Jeep and the company that issued the recall; Stellantis North America owns the Jeep brand.

In 2009, Chrysler recalled the Jeep model to address transmission fires as a result of overheated transmission fluid boiling over while in use and igniting on hot engine surfaces.[36] Chrysler's Defect Information Report noted that:

> Operating a vehicle under rigorous offroad conditions will cause the vehicle's transmission fluid temperature to elevate. Continuous operation under such rigorous conditions may lead to a transmission failure. In cases where the limits of the vehicle are exceeded beyond reasonable usage over an extended period, the fluid could boil over and may come into contact with a hot engine or exhaust component and cause a fire.

To address the problem, Chrysler reprogrammed the vehicle's instrument panel to add a transmission temperature warning feature (a text warning message on the odometer section of the dashboard instrument cluster accompanied by a continuous audible chime). Chrysler also provided an addendum to the vehicle owner's manual, which stated:

> The 'HOTOIL' cluster message accompanied with a continuous audible chime indicates that there is excessive transmission fluid temperature that might occur with severe usage such as trailer towing. … If this 'HOTOIL' message accompanied with a continuous chime comes on, stop the vehicle, and run the engine at idle or faster, with the transmission in NEUTRAL until the light turns off.
>
> A warning was also included in the addendum, which stated:
>
> WARNING! Continued operation with the Transmission Temperature "HOTOIL" Warning message illuminated could cause the fluid to boil over, come in contact with hot engine or exhaust components causing a fire that may result in personal injury.

[36] Transmission fluid "boil over" occurs when the fluid (oil) reaches temperatures typically above 240°F, causing the oil to lose its lubricating properties, which leads to increased friction and heat within the transmission. Additives in the oil break down, burn, and foam up within the transmission housing. This foaming can cause oil to exit the transmission's vent or fill tube. Along with the expulsion of oil, prolonged operation of the transmission in this state can cause seals within the transmission to harden and fail, slippage of clutch plates and internal components, and, in severe cases, transmission failure.

Chrysler reported to the National Highway Traffic Safety Administration (NHTSA) that this particular Jeep's recall was completed in August 2010 (before Ports America purchased the vehicle).

The Ports America and AMS employees who testified at the Coast Guard formal public hearing following the casualty stated that they had not read the owner's manual addendum. It could not be determined if the updated owner's manual was supplied with the vehicle when Ports America purchased it in 2012. NHTSA maintains an online database of recalls, including the one for this particular Jeep; the Jeep's manual could also be found online.

About 11 months before the fire, in August 2022, the Jeep was serviced at an accredited service facility. Included in the vehicle service was a 16-point safety inspection, engine oil and filter change, transmission oil and filter change, replacement of two tires, and the installation of a backup alarm and strobe light.

Investigators examined video surveillance footage from the pier to document the number of times the Jeep was used to push nonrunners onto the vessel on the day of the fire. From when loading began until the time of the fire, the Jeep pushed 37 nonrunners—averaging between 2,500 and 6,800 pounds each—onto the vessel.[37] An AMS lasher, who was not operating the vehicle on the day of the casualty but had operated it in the past, testified that, in the 6 months before the fire, he had experienced the Jeep overheating "a couple or more times" and had seen this "HOTOIL" light illuminated several times while pushing vehicles onto different vessels.

The lasher who was operating the Jeep just before the fire reported that he did not observe the "HOTOIL" light or hear the chime. However, he also told investigators that the back lights on the dashboard didn't work, and the dash was dirty, making it difficult to read the dashboard display—he noted that, because of that, he "didn't really pay attention to the lights on the dash." He did report that, on occasion when pushing heavier vehicles, he would have to switch the Jeep into four-wheeled drive, back down the ramp, get a "running start," and press the accelerator pedal to the floor to get the nonrunner up the ramp.

1.6.2 Occupational Safety and Health Administration Regulations

The Occupational Safety and Health Administration (OSHA) provides standards for Marine Terminals (Part 1917) and Safety and Health Regulations for Longshoring

[37] This was not continuous, as the Jeep was not used during scheduled shoreside labor breaks.

(Part 1918). OSHA expects employers to comply with regulations and conducts two types of inspections: unprogrammed (a reactive inspection in response to an accident or complaint) and programmed (inspections based on data trends). However, OSHA does not conduct scheduled inspections or require annual certification.

1.6.2.1 Powered Industrial Trucks

OSHA's standards for Material Handling and Storage (Part 1910), Marine Terminals (Part 1917) and Safety and Health Regulations for Longshoring (Part 1918) all include standards for powered vehicles used for material or equipment handling in general industry, within a marine terminal, and aboard a vessel, respectively.

OSHA defines a powered industrial truck as a "mobile, power-driven vehicle used to carry, push, pull, lift, stack, or tier material." Minimum general requirements for powered industrial trucks include the proper vehicle labeling of the vehicle's capacity rating and labeling that it has been approved for purpose by an accredited testing laboratory. Additionally, the regulations require that any modification to the vehicle also be approved by the vehicle manufacturer or an accredited testing laboratory, the vehicle be maintained by designated personnel, and that the operators of the vehicle be properly trained.

OSHA's safety requirements for powered industrial trucks (PITs) in Part 1910 include "fire protection, design, maintenance, and use of fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines."

According to OSHA's Office of Maritime Enforcement, in response to queries from the National Transportation Safety Board (NTSB), the pusher vehicles were being used as PITs and would therefore be subject to the applicable regulations, and safety and design standards. However, there had been no programmed or unprogrammed inspections specific to pusher vehicles prior to the fire, and OSHA did not investigate this accident, because NJ Public Employees Occupational Safety and Health conducted an investigation, prompted by the deaths of the two publicly employed firefighters. Their investigation concentrated on the fire division's involvement in the casualty and specifically on firefighting regulations and respiratory protection.

1.6.2.2 Emergency Plans

Ports America and AMS were subject to OSHA regulations Title 29 *Code of Federal Regulations* (*CFR*) Part 1918—Safety and Health Regulations for Longshoring. Under OSHA safety regulations (29 *CFR* 1918.100), longshoring employers are

required to develop and implement a written emergency action plan that covers the designated actions employers and employees must take to ensure employee safety from fire and other emergencies. At the time of the fire, neither Ports America nor AMS had a formal training program, policy, or procedure in place on how to respond to shipboard fire and emergencies.

1.7 Key Personnel Information

1.7.1 Vessel Crew

On the day of the casualty, 28 crew were aboard the *Grande Costa D'Avorio*; this was the number required by the vessel's minimum safe manning certificate. All crew were credentialed for the positions they filled on board the vessel. As a requirement for obtaining their STCW credentials, all senior-level members of the vessel crew, including the captain and the chief mate, completed marine firefighting training within the previous 5 years (STCW requires that this training be retaken every 5 years). STCW requirements for this training included, among other areas, shipboard-specific firefighting tactics, command strategies, managing injured personnel, shipboard fire suppression systems, and communications. The training also included in-port firefighting procedures, which covered coordination with shore-based firefighters.

In addition, the vessel crew conducted weekly drills, per company policy and regulations, ranging from lifesaving to firefighting. Per *SOLAS* regulations, at least once a month one of these drills had to be a fire drill. Records of these drills were destroyed in the fire, but the captain of the vessel testified at the public hearing that a fire drill had been completed within the previous month. The crew also stated that fire drills were always completed while the vessel was at sea, away from the dock, and that the drills did not include operation of the hydraulic ramp doors, as these doors were typically closed while underway.

Throughout the casualty, the vessel's crew supported the firefighters and response effort, including escorting land-based firefighters from deck 3 up to decks 11 and 12, and continuing to operate fire hoses on the top deck. The chief mate acted as the on-scene commander for the vessel's crew and as a liaison between the fire department and the vessel's captain. Although several of the responding firefighters, including a battalion chief (B-5) and the deputy chief (IC), cited a perceived language barrier between the majority native Italian-speaking vessel officers and themselves, the battalion chief told investigators that he was still "by and large" able to understand the crew of the vessel.

1.7.2 Newark Fire Division

The NFD was a division of the Newark Department of Public Safety and was led by the fire chief, who reported directly to the public safety director. The NFD had 16 fire stations, as well as administrative and operations offices, throughout the city of Newark. The NFD also had a nonaccredited training facility to train new recruits. The NFD had two fire boats, but neither was deployed to the *Grande Costa D'Avorio*. (One was nonoperational, and on-scene command decided that a fire boat would be ineffective on the large vessel fire.)

The NFD's fire boats were part of the New Jersey Fire Boat Task Force, which was created in coordination with the Coast Guard Sector New York to coordinate resources of area municipalities for marine fires and emergencies. Task force members received grant money to fund equipment and train personnel, including training in fighting shipboard fires, if requested. All member municipalities actively participated in these exercises and meetings, except for the NFD, who said following the casualty that it lacked the funding to pay the necessary overtime pay to firefighters to attend.

The National Fire Protection Association (NFPA) is a nonprofit organization that develops and publishes codes and standards related to fire safety. It publishes several standards for firefighters related specifically to fighting shipboard fires. *NFPA 1405: Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires*, "identifies the elements of a comprehensive marine fire-fighting response program including, but not limited to, vessel familiarization, training considerations, pre-fire planning, and special hazards that enable land-based firefighters to extinguish vessel fires safely and efficiently" (NFPA 2020).

NFPA 1005: Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters, identified minimum job performance requirements for land-based firefighters operating at marine firefighting incidents, with the intent of ensuring that personnel are qualified. Areas of knowledge and skills requirements included: general knowledge of marine vessel construction; marine vessel terminology; structural hazards; the identification and recognition of the vessel's fire control plan; the ability to identify onboard fixed gas fire extinguishing systems, their activation times, and the hazards associated with controlling and extinguishing fires on vessels; and the types and capabilities of vessel communication systems, including methods for overcoming language barriers (NFPA 2019).

The NFD did not have any formal marine shipboard firefighting-specific training or requirements. The most recent marine shipboard firefighting training provided by the NFD, which consisted of both classroom training and practical

exercises, was in 2014. Only two of the responding firefighters had taken part in the 2014 shipboard firefighting training. Most firefighters, including the deputy chief (IC during the fire) had no tactical shipboard firefighting training and had never been on a large vessel before.

1.7.2.1 Firefighters' Radio Equipment

The NFD issued all land-based firefighters responding to the vessel fire a portable VHF radio (it was standard practice to issue a radio to a firefighter at the beginning of their shift and require it be returned when the shift was completed). However, the responding land-based firefighters unanimously reported that communicating via radio during the casualty was extremely difficult and unreliable, and that these difficulties in communication hampered their response and search and rescue operations. Often, to establish communications, they would have to leave the space or deck where they were. The IC repeatedly had to walk down the loading ramp of the vessel to receive and transmit; he indicated that transmissions from firefighters inside the superstructure were "sporadic at best." On several occasions, firefighters reported using cell phones to communicate with the IC on deck 3. The NFD did not have a plan to mitigate these communication issues resulting from the vessel structure.

1.7.3 Other Responding Municipalities and Port Facilities

The FDNY, which responded to the fire aboard the *Grande Costa D'Avorio* as part of the mutual aid response, had a designated Marine Division as part of the department's special operations. The Marine Division employed between 100 and 120 personnel year-round and routinely hired more during the summer months. A designated fire chief for the Marine Division oversaw its activities. The Marine Division had a ship simulator located at the department training facility, which exposed firefighters to a controlled shipboard environment where they could become familiar with the layout of a vessel and the techniques for combating fires on board. The simulator was available to the entire department and to other municipalities for a fee.

The FDNY Marine Division routinely sent its firefighters to a 1-week marine shipboard firefighting school in Fort Lauderdale, Florida, which was tailored toward land-based firefighters. The Division's goal was to have this training every 5 years. The Division's firefighters would also annually attend and participate in a 5.5-day, hands-on marine firefighting course, put on by the Virgina Port Authority. In addition to the simulator and the external marine shipboard firefighting training, the Marine Division personnel participated in routine in-house training, exercises, and drills, and participated in shipboard vessel familiarization tours, on average, twice per year.

1.8 Tests and Research

1.8.1 Postaccident Fire Protection Systems Evaluation

To determine the efficacy of the fire protection systems on board the *Grande Costa d'Avorio*, the Coast Guard Marine Safety Center conducted a technical review of:

- The effectiveness of installed fire-extinguishing systems in fire protection zone C.
- The impact of the open door (Dk-12 hydraulic garage door) at the top of the ramp between deck 11 and the open deck above (deck 12).
- The effectiveness of structural fire protection installed on the boundaries of fire protection zone C.[38]

Using fire modeling data developed by the ATF, vessel and system drawings, and witness testimony, the Marine Safety Center concluded:

- The installed fire-extinguishing system in fire protection zone C was initially effective but was unable to maintain an adequate concentration of CO_2 to suppress the fire. The CO_2 system operated as designed.
- The impact of the Dk-12 hydraulic garage door being open was a significant factor in the inability of the CO_2 system to suppress the fire. Had the Dk-12 hydraulic garage door been closed before the discharge of the CO_2 system, it is likely that the system would have been effective in controlling the fire.
- The structural fire protection installed on the boundaries of fire protection zone C performed as designed.

[38] *Structural fire protection* is a component of an overall vessel fire-protection strategy that uses passive design features in a vessel's structure to slow the expansion of a fire from one compartment to another. Structural fire protection uses fire-resistant materials and insulation installed on the horizontal and vertical surfaces of a compartment, on doors/hatches, and in pipe and cable openings to slow the transfer of heat and smoke, thus providing additional time for evacuation and firefighting to contain and extinguish a fire.

1.9 Postaccident Actions

1.9.1 Coast Guard Marine Safety Alert

On November 20, 2023, the Coast Guard published Marine Safety Alert 09-23, "By Land and Sea—Firefighting Preparation is Key!" (Coast Guard 2023). The alert summarized the *Grande Costa D'Avorio* casualty and "strongly" recommended that fire departments and port stakeholders:

- Engage with each other to establish regular shipboard firefighting education and training in conjunction with vessels' required drills and exercises
- Develop training and policies using guidance from *NFPA 1005: Standards for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters*, and *NFPA 1405: Guide for Land-Based Fire Departments that Respond to Marine Vessel Fires*

In the alert, the Coast Guard also strongly recommended that Coast Guard Captains of the Port, emergency response services, and port stakeholders consider translation capabilities to assist first responders.[39]

1.9.2 Newark Fire Division

The NFD created and published a General Order for the NFD in relation to Shipboard Firefighting on June 5, 2024. The NFD trained all their members on the new policy and put all members through a 4-hour classroom-based class, Shipboard Firefighting Awareness, conducted by a third party.

The NFD also added vessel tours, in cooperation with the Department of Homeland Security and the Port Authority of New York and New Jersey, in which firefighting units conducted walkthroughs of Ro/Ros and other commercial vessels at the Port of Newark. The walkthroughs included presentations on vessel internal and external features, especially in relation to emergency response.

1.9.3 Port Authority of New York and New Jersey

In November 2024, the Port Authority of New York and New Jersey issued requirements for the handling of previously owned vehicles within their owned or

[39] A Coast Guard Captain of the Port is a Coast Guard officer who is responsible for the enforcement of Coast Guard laws and regulations in a specific port area.

operated facilities. These requirements were accompanied by the lifting of a moratorium on the loading of previously owned vehicles that had been put in place by the Port Authority following the fire on board the *Grande Costa D'Avorio*, on July 5, 2023. The target audiences for the new requirements were the ocean carriers, tenants (companies that lease space from the Port Authority), and companies supplying shoreside labor.

One of the 16 requirements, specifically addressing pusher vehicles, stated:

> All "non-runners" must be loaded on to the vehicle by equipment that is (i) specifically fit for the purpose of lifting or towing vehicles (either by original design or approved modification) […] Pusher vehicles are not permitted to be used.

1.9.4 Ports America

Before the fire, Ports America used pusher vehicles at four locations (Davisville, Rhode Island; Newark; Baltimore, Maryland; and Freeport, Texas). After July 5, 2023, Ports America does not use pusher vehicles during cargo operations: Nonrunners are loaded via forklift or tow truck. Ports America has conducted audits and site visits to ensure that pusher vehicles are not used and that all vehicles conform to the OSHA PIT standards.

1.9.5 Grimaldi

Grimaldi owned the *Grande Costa D'Avorio* as well as six other G3-class sister vessels built in a shipyard in Croatia. All seven vessels had the same Dk-12 hydraulic garage door control configurations, with the controls inside the door. Grimaldi has indicated that modifications to install operating controls on the outside of the Dk-12 hydraulic garage door on six G3-class vessels that had been built in Croatia have been completed and the modification of the seventh vessel is ongoing.

2 Analysis

2.1 Introduction

On July 5, 2023, the Ro/Con vessel *Grande Costa D'Avorio* was docked and loading used vehicles at Port Newark, New Jersey, when a Jeep pusher vehicle operated by shoreside workers caught on fire inside the garage decks. The vessel crew were unable to put out the fire using portable fire extinguishers and shipboard fire hoses, so the captain ordered the vessel's fixed gas fire extinguishing system to be activated. The crew attempted to seal the garage decks where the CO_2 gas was released to allow the CO_2 to smother the fire, but because of the fire and dense smoke inside the garage, they were unable to close a large rampway door that was controlled from a single panel inside the garage where the fire was located, so the CO_2 was not effective in extinguishing the fire. Land-based firefighters arrived on scene, and multiple firefighters entered the garage decks to investigate and fight the fire. While attempting to put out the fire, two land-based firefighters were unable to find their way out of one of the smoke-filled garage decks and died. The damage to the vessel was estimated to be over $23 million.

This analysis discusses the following safety issues:

- The hazards associated with using passenger vehicles as pusher vehicles in cargo operations (section 2.3)
- Absence of operating controls on the outside of a garage deck door that was part of a fire boundary zone for a space protected by a fixed gas fire extinguishing system (section 2.4)
- Ineffective land-based firefighting response (sections 2.5 and 2.6)
- Lack of emergency procedures for shoreside personnel (section 2.7)

Having completed a comprehensive review of the circumstances that led to the casualty, the investigation excluded the following as casual factors:

- *Mechanical equipment or electrical systems.* There was no evidence to suggest the vessel's mechanical equipment or electrical systems were malfunctioning prior to the ignition of the fire. Thus, the NTSB concludes that the ship's mechanical equipment and electrical systems were not causal to the fire.
- *Vessel crew response.* When the fire started on deck 10, the chief mate of the vessel was working in the area and quickly responded to the fire. He and another crewmember immediately engaged the fire with handheld

extinguishers. The captain secured ventilation fans and dampers to fire protection zone C (which included deck 10), which limited the oxygen available for the fire to consume and prepared the space for activating the fixed gas fire extinguishing system. The crew attempted to use the vessel's fire hoses to fight the fire; however, the heavy smoke impeded their efforts in reaching the fire. Once the captain recognized that initial on-scene firefighting efforts were not effective, he ordered the crew to evacuate the space, account for all personnel, and secure all doors into the fire protection zone. One opening to the fire protection zone (the hydraulically operated garage door on deck 12), could only be closed from within the space—which would have placed crewmembers at risk. The captain decided to discharge the CO_2 even though all openings were not secured. The NTSB concludes that, given the vessel crew's inability to put the fire out with handheld fire extinguishers and fire hoses, the captain's decision to secure the fire protection zone and activate the vessel's fixed fire extinguishing system, even with the deck 12 hydraulic garage door open, was appropriate.

2.2 Origin and Cause of Fire

The fire originated in the Jeep pusher vehicle. The first indication of a potential problem was when the Jeep driver was pushing a nonrunner vehicle up the vessel's loading ramps and heard a "clunking noise," indicating a mechanical issue with the Jeep. The driver continued to operate the Jeep, and, shortly after the Jeep reached deck 10, several nearby workers noticed it was on fire. The Jeep driver saw flames coming from under the hood and, leaving the Jeep's engine running, exited the vehicle.

No witnesses described seeing, smelling, or hearing anything that would be indicative of a catastrophic failure of the pusher Jeep's engine or failure to its fuel supply system, such as the engine stalling or stopping, or the smell of gasoline. In fact, the Jeep was still running at the time witnesses first observed the fire. Although extensive damage inside the Jeep's engine compartment prevented the NTSB and Coast Guard from examining all the system components, there was no physical evidence of a catastrophic failure of an engine or other non-transmission drive train component.

The transmission bell housing had significant thermal damage; however, due to the extent of the damage, the NTSB was unable to determine if the damage was caused by the fire or by the rigorous operating conditions the vehicle was subjected to during the pushing operation as the vehicles traveled up the ramps. The Jeep was

a passenger vehicle that Ports America had retrofitted with a large steel front bumper for use in an industrial, cargo-loading setting (pushing nonrunning vehicles onto vessels and up multiple ramps). As a passenger vehicle, the Jeep's transmission was not designed to handle this type of heavy vehicle use; as a pusher vehicle, it was used in an industrial manner and routinely subjected to rigorous conditions.

Additionally, the Jeep was subject to a NHTSA recall for the transmission. The recall warned that when operated under "rigorous offroad" conditions "beyond reasonable usage," the transmission fluid temperature would elevate (Chrysler 2009). According to the recall, heated fluid could eventually boil over and contact hot engine and exhaust components, causing the fluid to ignite. The Jeep had been serviced to implement the recommended corrective action—a "HOTOIL" light was programmed into the vehicle's dashboard and an audible alarm was added. (The corrective actions did not address the transmission system design that allowed transmission fluid to boil over in the first place; it only provided a way to alert the operator that the transmission fluid temperature was increasing and outlined specific actions the operator should take to lower the transmission system temperature.)

On the day of the casualty, the Jeep had pushed 37 vehicles—weighing between 2,500 and 6,800 pounds each—up multiple stories of steep ramps and around sharp corners. The Jeep's manufacturer did not provide a "pushing" capacity rating, but the Jeep's gross combined weight rating (the maximum total weight the Jeep could carry and tow) was 6,032 pounds. On the Jeep's last run, the combined curb weight of the Jeep pusher and the Toyota Venza—not including the two operators, the vehicles' fluids and cargo, and the weight of the steel bumper that Ports America had added to the Jeep—was about 7,660 pounds, which well exceeded the Jeep's gross combined weight rating. Although the driver at the time of the fire did not recall either seeing the HOTOIL light or hearing the alarm, he said that, because the dash was dirty and the back lights on the dashboard were nonoperational, he didn't pay attention to lights on the dash. Other shoreside workers who operated the Jeep had reported seeing the light and hearing the alarm during previous loading operations, indicating that the Jeep transmission had previously overheated during loading operations. Based on the witness accounts of the fire, the manufacturer's recall warning that the Jeep model transmission fluid was susceptible to overheating when used in rigorous offroad conditions, the Jeep's post-fire damage, and the Jeep's operating history in rigorous industrial conditions pushing nonrunning vehicles onto vessels, the fire originated when the Jeep's transmission fluid boiled over and ignited on a hot engine surface.

2.3 Pusher Vehicle Use

OSHA's Office of Marine Enforcement confirmed to the NTSB that a mobile, power-driven vehicle used to push nonrunners aboard a vessel at a marine terminal was subject to OSHA's PIT standards. These standards require capacity ratings, maintenance, and operator training, and modifications must be approved by the manufacturer or an accredited testing laboratory (see section 1.6.2, Occupational Safety and Health Administration Regulations). However, the Jeep was a passenger (non-industrial) vehicle with modifications (a pusher bar attached to the front bumper)—as such, it did not meet OSHA's PIT standards, including the requirement for modifications to be approved by the manufacturer or an accredited testing laboratory. Therefore, the NTSB concludes that, as a passenger vehicle, the Jeep was not suitable for use as a PIT because it did not meet OSHA's PIT standards.

OSHA schedules inspections based on accidents, data trends, or complaints, but had not conducted any inspections specific to pusher vehicles and had no apparent awareness of the use of the modified vehicles as PITs. Therefore, the NTSB recommends that OSHA inform their field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist OSHA compliance officers in proper enforcement of the PIT requirements (29 *CFR* 1917.43 and 29 *CFR* 1918.65) at marine terminals and during longshoring operations to assure safe and healthy working conditions.

Following the casualty, the Port Authority of New York and New Jersey issued loading requirements for operations within their jurisdiction, including Port Newark, that nonrunners must be loaded onto vessels by equipment "specifically fit for lifting or towing vehicles." However, the NTSB concludes that other ports may not be aware of OSHA's interpretation that vehicles used as pusher vehicles, pushing nonrunning vehicles onto vessels, must comply with its PIT standards.

The American Association of Port Authorities represents public port authorities throughout North and Central America and is therefore positioned to communicate with port authorities. Therefore, the NTSB recommends that the American Association of Port Authorities inform its members about the circumstances of the *Grande Costa D'Avorio* fire, highlighting that pusher vehicles used to load nonrunning vehicles aboard vessels are included in OSHA's definition of PITs and must comply with those standards.

2.4 Fire Boundaries for Fixed Gas Fire Extinguishing Systems

Before ordering the release of the vessel's fixed gas fire extinguishing system, the captain ordered the crew to seal the space. However, the crew could not close

the Dk-12 hydraulic garage door because the door controls were located *inside* the door. For a crewmember to close the door, they would have had to hold a button down (or operate the manual valves or hand pump) inside the fire protection zone until the door was completely closed, and then travel down the ramp and about 120 feet through a smoky garage deck partially loaded with cargo vehicles to exit into the port ladderwell—a dangerous egress even for a crewmember equipped with an SCBA. The captain concurred with the crew's assessment that the door could not be closed safely and ordered the chief engineer to discharge the CO_2 fixed fire extinguishing system in hopes of containing the fire. However, fixed fire extinguishing systems, such as CO_2, can only be fully effective if the space is completely sealed and isolated from admitting outside air or venting CO_2.

Following the fire, ATF modeling and Coast Guard Marine Safety Center analysis showed that the CO_2 extinguishing system was initially effective; however, it was ultimately ineffective in extinguishing the fire in zone C because the Dk-12 hydraulic garage door was open—allowing outside air (oxygen) to enter the space and feed the fire, and the fire extinguishing gas (CO_2) to escape the space. The analysis also concluded that, had the door been closed before discharge of the CO_2 system, thereby starving the space of oxygen, the fire likely would have been effectively controlled. Therefore, the NTSB concludes that the absence of operating controls outside the protected space at the Dk-12 hydraulic garage door prevented the crew from safely closing the door, which resulted in the inability of the CO_2 extinguishing system to extinguish the fire.

A similar situation occurred in 2018 when a used car caught fire on the Ro/Ro vessel *Auto Banner* in Incheon, South Korea. Although the crewmembers and firefighters attempted to use the CO_2 suppression system within a fire zone, the gastight doors and an inner ramp at the zone division remained open. Like on the *Grande Costa D'Avorio*, the crew on the *Auto Banner* were unable to reach the gastight doors' control lever, which was at the site of the fire and inaccessible due to smoke and flames. The Korea Maritime Safety Tribunal report recommended that:

> crew should be able to remotely control the gastight door for each fire retarding division … To ensure that this is possible, installing the remote control devices for the gastight doors on the bridge or in the engine room should be considered (Korea Maritime Safety Tribunal 2020).

After the *Grande Costa D'Avorio* casualty, RINA, the classification society of the vessel, again reviewed the rules pertaining to the opening and the means of closure for the Dk-12 hydraulic garage door. They determined that, per load line regulations, the Dk-12 hydraulic garage door's position on the vessel (well above the freeboard deck), made the door a "hatch" and, therefore, did not need to meet watertight or

weathertight door requirements, and thus, in accordance with the load line regulations, was not required to be able to be operated from both sides of the bulkhead.

However, according to *SOLAS* fire boundary construction requirements, the Dk-12 hydraulic garage door was also an opening that could "admit air to, or allow gas to escape from, a protected space [fire protection zone C] where a fixed gas fire extinguishing system was used," which required it to be closable from outside the protected space. In their determination of whether the Dk-12 hydraulic garage door needed to meet these requirements, RINA noted to investigators following the fire that the assumption was that the door would be closed while underway, per the vessel's standard operating practice, and would not be an "opening" at all—that is, by assuming that the "hatch" [Dk-12 hydraulic garage door] would be closed, they concluded that it would not need to be closable from outside the space in order for it to meet *SOLAS* fire boundary opening construction requirements. However, characterizing the hydraulic garage door as a "hatch" that would be closed did not account for the fact that the door would typically be opened when the vessel was in port conducting cargo operations.

SOLAS' construction requirements for fire boundaries do not delineate between different vessel operations, such as when the vessel is underway or in port. Regardless of whether the vessel was underway or in port, the Dk-12 hydraulic garage door was a fire boundary for fire protection zone C. The ability to safely isolate a space protected by CO_2 is vital and should not depend on whether the vessel is in port or underway. Although the Dk-12 hydraulic garage door was typically closed while underway, this casualty shows that the risk of fire exists both underway and in port, necessitating that a fire boundary be functional at all times. If a fire boundary opening often remains open in port during cargo operations, such as the Dk-12 hydraulic garage door, it should be considered as such (open) for fire boundary regulations. Thus, while the door was open, it functioned as an opening to a protected space per *SOLAS* fire boundary construction requirements. As such, it should have had operating controls outside the door opening. Therefore, because the Dk-12 garage door did not have operating controls outside of the protected space, the vessel did not meet *SOLAS* fire boundary construction requirements, which are critical for containing vessel fires.

However, the classification society for the vessel, RINA, approved the door configuration without controls outside of the protected space. Therefore, the NTSB recommends RINA revise their procedures for review and approval of vessel plans to ensure compliance with *SOLAS* by requiring that all openings capable of admitting air into or allowing gas to escape from a protected space can be closed from outside

the protected space, regardless of their expected operational condition in port or at sea.

Because RINA is only one of many classification societies responsible for ensuring that vessels comply with *SOLAS* and other applicable regulations, the NTSB believes that IMO is the best way to reach all class societies, thus additionally recommends that the Coast Guard submit a proposal to IMO to clarify and emphasize that the existing *SOLAS* regulation requiring that all openings capable of admitting air into or of allowing gas to escape from a protected space can be closed from outside the protected space applies regardless of their expected operational condition when in port or at sea.

Grimaldi, the vessel owner, is adding operating controls to the exterior sides of the Dk-12 hydraulic garage door on the six other G-3 class vessels in their fleet that were built in the same shipyard as the *Grande Costa D'Avorio* (and are therefore known to have the same absence of operating controls on the outside of the Dk-12 hydraulic garage door). However, based on RINA's interpretation of the *Grande Costa D'Avorio* door as a fire boundary, there may be other Grimaldi vessels that do not have controls on the outside of the protected space.

The NTSB recommends that Grimaldi inventory all their vessels to identify all openings that are part of a fire boundary and modify the vessels, as necessary, so that the openings are capable of being closed from outside the protected space.

2.5 Land-Based Firefighting Response

By the time land-based firefighters arrived at the vessel, the captain had determined that the best method to extinguish the fire was to activate the CO_2 fire extinguishing system even though he couldn't completely seal the area (due to the Dk-12 hydraulic garage door). With the CO_2 fire extinguishing system activated, all of deck 10 and the rest of fire protection zone C was considered an "immediately dangerous to life and health [IDLH] area."[40] Soon after the first responding company arrived, the vessel's captain told an NFD battalion chief (B-5) that all members of the crew were accounted for and that no one was within the fire protection zone C, where the fire had originated. Thus, the fire presented no immediate danger to life. Vessel crewmembers also told the first arriving firefighting company that the CO_2 system had been activated and that they would need their SCBAs to enter the space.

[40] According to NIOSH, an *IDLH* area is one where exposure to airborne contaminants within the area would "likely cause death or immediate or delayed permanent adverse health effects."

Following the activation of the system, shipboard firefighting convention would have been to keep the space sealed to allow the CO_2 gas to thoroughly smother the fire, while boundary cooling the bulkheads and decks that bordered the space with firefighting water, as well as continually monitoring temperatures to help determine the status of the fire inside.

At this point, the NFD responding units should have followed these conventions. However, the IC and chiefs—who were responsible for the land-based fire response, the firefighters, and their safety—continued to direct firefighting efforts into the fire protection zone in which CO_2 had been released. These efforts included restarting fire protection zone C's ventilation fans and directing firefighters in and out of the garage (which entailed opening doors from the ladderwell into the protected space) and to run hoses into the garage decks (which necessitated leaving those doors open)—all of which allowed more CO_2 out and more oxygen into the fire protection zone. The NTSB concludes that the IC and other on-scene NFD chiefs reduced the effectiveness of the CO_2 extinguishing system, ultimately increasing the severity of the fire, by directing the firefighters to actively engage the fire in the fire protection zone where the extinguishing system had been activated, which allowed more CO_2 out and more oxygen in, contrary to general marine firefighting convention.

During the early phases of the casualty (following the activation of the CO_2 system and the initial arrival of the fire department), the fire was mostly localized to the aft section of deck 10—meaning that other decks in the fire protection zone did not contain signs of smoke or fire but were still flooded with CO_2 gas and presented an IDLH risk for the firefighters. However, the NFD deputy chief (acting as IC) and other NFD chiefs on scene—B-4 and B-5—continued to deploy companies into the fire protection zone garage spaces to inspect the decks and engage the fire. Following the casualty, B-5 and the IC indicated that they were aware that CO_2 had been released into the space and the danger it presented, but B-4 and some of the other firefighters who were entering the space were not aware that CO_2 had been released and thus, especially in the garage spaces without visible signs of smoke or fire, were not necessarily aware they were entering into an ILDH. The NTSB concludes that, by directing firefighters into the fire protection zone and failing to notify all of those firefighters that the CO_2 extinguishing system had been activated, the IC and other on-scene NFD chiefs exposed the firefighters to additional and unnecessary risk.

Two firefighters lost their lives attempting to fight the fire, and it took recovery teams several hours to locate and recover the firefighters once they discovered they were missing. In the garage spaces, the firefighters had to navigate extremely challenging conditions: The decks were almost fully loaded with cars parked 4–6 inches apart, and, as the fire evolved, the heavy smoke reduced visibility

significantly. The firefighters relied on following hoses, which were actively being repositioned and used, to find their way in and out of the space. Additionally, the companies occasionally had to move away from each other or into other spaces to get a clear radio signal to report conditions. The NTSB concludes that the smoky, unfamiliar, and IDLH conditions likely caused two firefighters to become disoriented and unable to find their way out of the garage, which led to their deaths.

2.6 Land-Based Firefighter Training for Shipboard Firefighting

Although fixed gas fire extinguishing systems have been installed aboard cargo and passenger ships for decades and are ubiquitous for ocean-going vessels, similar types of firefighting systems are not typically found ashore in commercial or residential buildings. Therefore, although the senior vessel personnel were familiar with the vessel's fixed gas firefighting system, unless the responding firefighters had been specifically trained in shipboard firefighting, most would be unfamiliar with these systems. Most of the NFD firefighters who responded to the fire, as well as the chief and deputy chief of the department, had never taken marine vessel firefighting training.

As the casualty evolved, another gap in the NFD firefighting training emerged beyond the lack of familiarity with the fixed gas fire extinguishing system: a lack of awareness regarding the use of a FCP. A vessel's FCP is specifically designed to assist vessel crew and responders with fighting a shipboard fire. It contains clear information on the vessel's structural fire boundaries, fixed gas fire extinguishing zones, and locations of available firefighting equipment. Although he was given a copy of the vessel's FCP, the IC later told investigators that he couldn't understand it and that this was his first time seeing a document of that type. Because the IC did not understand the FCP, he lacked an effective tool to safely and efficiently direct firefighting efforts.

Therefore, the NTSB concludes that the NFD's lack of marine vessel firefighting training left land-based firefighters unprepared to respond to a vessel fire, resulting in an ineffective response that contributed to the fire's spread and the vessel damage, and led to the firefighter casualties.

Following the fire, the NFD issued a general order on shipboard firefighting and provided basic classroom training on shipboard firefighting to their firefighters. However, the 4-hour classroom training only provided participants with a basic awareness of marine firefighting, whereas a typical comprehensive marine firefighting course includes 30–40 hours of both classroom and field instruction. Recognizing the exceptional challenges that a land-based firefighter can face when encountering a marine vessel fire, the NFPA developed two guides containing standards devoted to

land-based firefighters and the professional training and qualifications they should possess and how they should respond to marine vessel fires.[41] These standards are integrated into many marine firefighting training courses available to land-based firefighters. Therefore, the NTSB recommends the NFD require all chiefs and first responding companies and units that respond to vessel fires to complete specialized marine firefighting training that includes both classroom and practical firefighting training and is based on the NFPA's marine firefighting standards.

The NTSB has investigated other in-port vessel fires that resulted in land-based firefighter injuries from a lack of land-based firefighter training in vessel firefighting. Following the 2020 Ro/Ro *Hoegh Xiamen* fire, we found that, when responding land-based firefighters opened a vent for a garage deck, an overpressurization event occurred, resulting in some firefighters sustaining serious injuries (NTSB 2021). In response to the *Hoegh Xiamen* fire, the Jacksonville Fire and Rescue Department (the responding fire department) revised its Shipboard Fire Attack Decision Model to reduce the risk to firefighters responding to vessel fires, to prevent similar injuries from occurring in the future, and to improve communications with the Coast Guard and crew of the involved vessel. The Jacksonville Fire and Rescue Department also sent personnel to an advanced shipboard firefighting training program to identify any other areas they could improve in their operations.

Following the 2022 fire aboard the passenger vessel *Spirit of Norfolk*, we found similar issues, noting that, although vessels are constructed to contain a fire,

> the City of Norfolk reported that their firefighters were unaware of the risks inherent in opening the door to the engine room where the fire was contained (the accumulated firefighting water and breaking the fire boundary). Had the land-based firefighting teams been educated on marine vessel firefighting tactics, they might have avoided these risks (NTSB 2023).

The Korea Maritime Safety Tribunal report on the *Auto Banner* fire noted similar training gaps existed with land-based firefighters at a Korean port, stating that "vessels require different firefighting strategies than those of buildings," and that "technical education on vessels is not included in the current education programs for fire officers, and firefighters stationed near ports lack opportunities to learn about the firefighting systems installed onboard vessels as well as the basic structure of vessels" (Korea Maritime Safety Tribunal 2020). The report recommended that "it is deemed

[41] *NFPA 1005*: *Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters* and *NFPA 1405*: *Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires*.

necessary to consider open professional education programs for fire officers or train or hire experts on responding to fires onboard vessels in order to enhance their expertise."

The NTSB concludes that awareness of the *Grande Costa D'Avorio* fire and its associated firefighting challenges would help other land-based fire departments identify necessary changes to improve the effectiveness of their shoreside vessel fire response.

The International Association of Fire Fighters is a labor union representing firefighters, emergency medical workers, and rescue workers in the US and Canada. The International Association of Fire Chiefs represents the interests of emergency responders with a focus on leaders. The National Volunteer Fire Council represents the interests of the volunteer fire services, emergency medical services, and rescue services. These organizations provide resources, programs, education, and advocacy for emergency responders and are well positioned to inform members about this casualty and share information about shoreside vessel fire response efforts.

Therefore, the NTSB recommends that the International Association of Fire Fighters, the International Association of Fire Chiefs, and the National Volunteer Fire Council advise their members of the circumstances of the *Grande Costa D'Avorio* fire and encourage those members that may respond to marine vessel fires to identify any gaps in their training for marine vessel fires and familiarize themselves with available resources, such as the NFPA firefighting standards.

Port Authorities, like the Port Authority of New York and New Jersey, that operate large marine terminals and rely on local municipalities to respond to fires and emergencies within their facilities should ensure that those responding municipalities are familiar with the potential vessel fire dangers in the port. Although the Port Authority provided a classroom seminar to the NFD on electric battery fires, the course lacked specifics of marine vessel fire dangers and firefighting tactics and did not include a vessel familiarization component. The Port Authority had previously worked with vessel operators to conduct familiarization tours for Port Authority employees and local fire departments, but these tours had not occurred for years.

Other tools that ports have used to inform and educate local land-based fire departments of what to expect when responding to their port include memorandums of understanding with local municipalities, to help open formal channels to clearly communicate the potential dangers and challenges local fire departments may encounter when responding to shipboard fires inside the port, and sponsoring formal marine firefighting training and vessel familiarization tours for responding fire departments. The NTSB concludes that, considering the NFD's lack of marine vessel

firefighter training, the Port Authority of New York and New Jersey could improve safety and achieve better outcomes when fires occur by working in advance with local municipalities to coordinate vessel firefighting response preparedness and training.

Therefore, the NTSB recommends that the Port Authority of New York and New Jersey establish procedures to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at their facilities and on board vessels.

Further, the NTSB recommends that the American Association of Port Authorities inform their members of the circumstances of the *Grande Costa D'Avorio* fire and encourage them to establish procedures with local fire departments to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at port facilities and on board vessels.

2.7 Shoreside Personnel Emergency Procedures

Accounting for all personnel during fire and emergency events is critical to ensure an effective, safe evacuation and provide fire responders needed information related to who is on board. This is especially crucial aboard vessels such as the *Grande Costa D'Avorio*, where often there are upwards of 50 shoreside personnel on board the vessel engaged in cargo operations. While the personnel were likely familiar with the decks on which they were loading cargo, they likely weren't familiar with the overall vessel layout, emergency escape routes, and the firefighting and extinguishing systems, such as CO_2. If shoreside personnel remain on board and are unaccounted for, the risk that they may become trapped or isolated and encounter fire or other hazards such as the release of a fire extinguishing system (such as CO_2) increases, and their chance of rescue decreases. Under OSHA safety regulations (29 *CFR* 1918.100), longshoring employers are required to develop and implement a written emergency action plan that covers the designated actions employers and employees must take to ensure employee safety from fire and other emergencies.

When the shoreside laborers evacuated the vessel shortly after the fire began, both Ports America and AMS used informal methods—supervisors' text messages and verbal communications—to account for their employees and determine that all personnel were off the vessel and safe. Although both the vessel's chief mate and a Ports America superintendent visually checked fire protection zone C and did not see any shoreside personnel, the chief mate told investigators that he could not verify how many shoreside workers were on board at any given time. Additionally, neither Ports America nor AMS had a designated muster area on the pier, a training program, a procedure, or a policy (as required by 29 *CFR* 1918.100) in place that outlined the

actions employees must take during emergencies to ensure their safety. The NTSB concludes that the lack of an emergency procedure providing a way to account for all employees after an emergency evacuation, such as a muster area, and the lack of training for Ports America or AMS employees in the event of a fire or emergency on board a vessel, increased the risk to life or injury to the shoreside workers.

Therefore, the NTSB recommends that Ports America and AMS develop policies for fire and emergencies on board vessels, per Title 29 *CFR* 1917.30 and 29 *CFR* 1918.100, to include accounting for shoreside employees, and train employees on what to do in the event of a fire or emergency on board a vessel.

OSHA schedules inspections based on accidents, data trends, or complaints, but had not conducted any inspections specific to shoreside employee emergency policies and had no apparent awareness of the potential for gaps in longshoring company policies. Therefore, the NTSB recommends that OSHA inform their field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist OSHA compliance officers in proper enforcement of the emergency procedures requirements (Title 29 *CFR* 1917.30 and 29 *CFR* 1918.100) at marine terminals and during longshoring operations to assure safe and healthy working conditions.

3 Conclusions

3.1 Findings

1. The ship's mechanical equipment and electrical systems were not causal to the fire.

2. Given the vessel crew's inability to put the fire out with handheld fire extinguishers and fire hoses, the captain's decision to secure the fire protection zone and activate the vessel's fixed fire extinguishing system, even with the deck 12 hydraulic garage door open, was appropriate.

3. Based on the witness accounts of the fire, the manufacturer's recall warning that the Jeep model transmission fluid was susceptible to overheating when used in rigorous offroad conditions, the Jeep's post-fire damage, and the Jeep's operating history in rigorous industrial conditions pushing nonrunning vehicles onto vessels, the fire originated when the Jeep's transmission fluid boiled over and ignited on a hot engine surface.

4. As a passenger vehicle, the Jeep was not suitable for use as a powered industrial truck because it did not meet the Occupational Safety and Health Administration's powered industrial truck standards.

5. Other ports may not be aware of the Occupational Safety and Health Administration's interpretation that vehicles used as pusher vehicles, pushing nonrunning vehicles onto vessels, must comply with its powered industrial truck standards.

6. The absence of operating controls outside the protected space at the deck 12 hydraulic garage door prevented the crew from safely closing the door, which resulted in the inability of the carbon dioxide extinguishing system to extinguish the fire.

7. Because the deck 12 garage door did not have operating controls outside of the protected space, the vessel did not meet *International Convention for the Safety of Life at Sea* fire boundary construction requirements, which are critical for containing vessel fires.

8. The incident commander and other on-scene Newark Fire Division chiefs reduced the effectiveness of the carbon dioxide extinguishing system, ultimately increasing the severity of the fire, by directing the firefighters to actively engage the fire in the fire protection zone where the extinguishing

system had been activated, which allowed more carbon dioxide out and more oxygen in, contrary to general marine firefighting convention.

9. By directing firefighters into the fire protection zone and failing to notify all of those firefighters that the carbon dioxide extinguishing system had been activated, the incident commander and other on-scene Newark Fire Division chiefs exposed the firefighters to additional and unnecessary risk.

10. The smoky, unfamiliar, and immediately dangerous to life or health conditions likely caused two firefighters to become disoriented and unable to find their way out of the garage, which led to their deaths.

11. The Newark Fire Division's lack of marine vessel firefighting training left land-based firefighters unprepared to respond to a vessel fire, resulting in an ineffective response that contributed to the fire's spread and the vessel damage, and led to the firefighter casualties.

12. Awareness of the *Grande Costa D'Avorio* fire and its associated firefighting challenges would help other land-based fire departments identify necessary changes to improve the effectiveness of their shoreside vessel fire response.

13. Considering the Newark Fire Division's lack of marine vessel firefighter training, the Port Authority of New York and New Jersey could improve safety and achieve better outcomes when fires occur by working in advance with local municipalities to coordinate vessel firefighting response preparedness and training.

14. The lack of an emergency procedure providing a way to account for all employees after an emergency evacuation, such as a muster area, and the lack of training for Ports America or American Maritime Services employees in the event of a fire or emergency on board a vessel, increased the risk to life or injury to the shoreside workers.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the fire aboard the roll-on/roll-off container vessel *Grande Costa D'Avorio* was Ports America's use of a passenger vehicle as a pusher vehicle in an industrial application for which it was not intended, which led to the vehicle's transmission fluid overheating, boiling over, and igniting on a hot engine surface. Contributing to the fire's duration and severity was the absence of operating controls on the outside of

one of the vessel's fire boundary garage doors, which prevented the crew from safely closing the door and directly led to the ineffectiveness of the fixed gas fire extinguishing system. Also contributing to the severity of the fire was the Newark Fire Division's lack of marine vessel firefighting training, which resulted in an ineffective response and led to the firefighter casualties.

4 Recommendations

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations.

To the US Coast Guard:

1. Submit a proposal to the International Maritime Organization to clarify and emphasize that the existing *International Convention for the Safety of Life at Sea* regulation requiring that all openings capable of admitting air into or of allowing gas to escape from a protected space can be closed from outside the protected space applies regardless of their expected operational condition when in port or at sea. (M-25-01)

To the Occupational Safety and Health Administration:

2. Inform your field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist Occupational Safety and Health Administration compliance officers in proper enforcement of the powered industrial truck requirements (Title 29 *Code of Federal Regulations* 1917.43 and 29 *Code of Federal Regulations* 1918.65) at marine terminals and during longshoring operations to assure safe and healthy working conditions. (M-25-02)

3. Inform your field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist Occupational Safety and Health Administration compliance officers in proper enforcement of the emergency procedures requirements (Title 29 *Code of Federal Regulations* 1917.30 and 29 *Code of Federal Regulations* 1918.100) at marine terminals and during longshoring operations to assure safe and healthy working conditions. (M-25-03)

To the Newark Fire Division:

4. Require all chiefs and first responding companies and units that respond to vessel fires to complete specialized marine firefighting training that includes both classroom and practical firefighting training and is based on the National Fire Protection Association's marine firefighting standards. (M-25-04)

To the Port Authority of New York and New Jersey:

5. Establish procedures to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at your facilities and on board vessels. (M-25-05)

To RINA Services:

6. Revise your procedures for review and approval of vessel plans to ensure compliance with *International Convention for the Safety of Life at Sea* by requiring that all openings capable of admitting air into or allowing gas to escape from a protected space can be closed from outside the protected space, regardless of their expected operational condition in port or at sea. (M-25-06)

To the American Association of Port Authorities:

7. Inform your members about the circumstances of the *Grande Costa D'Avorio* fire, highlighting that pusher vehicles used to load nonrunning vehicles aboard vessels are included in the Occupational Safety and Health Administration's definition of powered industrial trucks and must comply with those standards. (M-25-07)

8. Inform your members of the circumstances of the *Grande Costa D'Avorio* fire and encourage them to establish procedures with local fire departments to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at port facilities and on board vessels. (M-25-08)

To the International Association of Fire Fighters, the International Association of Fire Chiefs, and the National Volunteer Fire Council:

9. Advise your members of the circumstances of the *Grande Costa D'Avorio* fire and encourage those members that may respond to marine vessel fires to identify any gaps in their training for marine vessel fires and familiarize themselves with available resources, such as the National Fire Protection Association firefighting standards. (M-25-09)

To Grimaldi Deep Sea:

10. Inventory all your vessels to identify all openings that are part of a fire boundary and modify the vessels, as necessary, so that the openings are capable of being closed from outside the protected space. (M-25-10)

To Ports America and American Maritime Services:

11. Develop policies for fire and emergencies on board vessels, per Title 29 *Code of Federal Regulations* 1917.30 and 29 *Code of Federal Regulations* 1918.100, to include accounting for shoreside employees, and train employees on what to do in the event of a fire or emergency on board a vessel. (M-25-11)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER L. HOMENDY
Chairman

MICHAEL GRAHAM
Member

ALVIN BROWN
Vice Chairman

THOMAS CHAPMAN
Member

J. TODD INMAN
Member

Report Date: April 15, 2025

Board Member Statements

Chairman Jennifer L. Homendy filed the following concurring statement on April 22, 2025. Vice Chairman Alvin Brown, Member Michael Graham, and Member J. Todd Inman joined in this statement.

I am profoundly concerned with ongoing failures to appropriately train our nation's firefighters despite the NTSB sounding the alarm time and again following tragedies in all modes of transportation, including the fire aboard the roll-on/roll-off container vessel *Grande Costa D'Avorio*, which occurred on July 5, 2023, while docked in the Port of Newark, New Jersey. Devastatingly, two firefighters died in the fire and six other emergency responders were injured, all of which were preventable.

Prior NTSB Investigations

This is not the first time we've seen vessel fires that resulted in land-based firefighter fatal and non-fatal injuries; nor is it the first time we've identified a lack of land-based firefighter training in vessel firefighting. As a result of the NTSB's investigation into the 2020 Roll-on/Roll-off *Hoegh Xiamen* fire in Jacksonville, Florida, we found that when responding land-based firefighters opened a vent for a garage deck, an overpressurization event occurred, resulting in firefighters sustaining serious injuries.

While we didn't issue any recommendations to the Jacksonville Fire and Rescue Department (JFRD) (the responding fire department), JFRD took action after the fire to address gaps in training provided to its firefighters. JFRD revised its Shipboard Fire Attack Decision Model to reduce the risk to firefighters responding to vessel fires, to prevent similar injuries from occurring in the future, and to improve communications with the U.S. Coast Guard and crew of the involved vessel. JFRD also sent personnel to an advanced shipboard firefighting training program to identify any other areas they could improve in their operations.

In 2022, we investigated a fire aboard the passenger vessel *Spirit of Norfolk* in Norfolk, Virginia, and similarly found that the City of Norfolk's firefighters were unaware of the inherent risks in their actions and had these land-based firefighting teams been educated on marine vessel firefighting tactics, they may have avoided these risks.

We have issued recommendations on firefighter standards and training as a result of our investigations in other modes of transportation, including the 2012 Conrail freight train derailment with vinyl chloride release in Paulsboro, New Jersey; the 2018 collision between a sport utility vehicle operating with partial driving

automation and a crash attenuator in Mountainview, California; the 2018 Atmos Energy natural gas fuel explosion in Dallas, Texas; and the 2013 Asiana Airlines descent below visual glidepath and impact with seawall in San Francisco, California. Most recently was the final investigation report of the 2023 freight train derailment in East Palestine, Ohio, in which we recommended that the International Association of Fire Chiefs, the International Association of Fire Fighters, and the National Volunteer Fire Council identify personnel not trained to National Fire Protection Association (NFPA) 1010 standard on professional qualifications for firefighters and adopt training that meets this standard.

Marine Vessel Firefighting Standards and Training

The NFPA has developed and published professional, comprehensive standards focused on marine firefighting, including NFPA 1005 Standard for Professional Qualifications for Marine Firefighting for Land-Based Firefighters, NFPA 1405 Guide for Land-Based Firefighters That Respond to Marine Vessel Fires, and NFPA 1500 Standard on Fire Department Occupational Safety, Health, and Wellness Program. NFPA 1405 provides the elements that any comprehensive marine firefighting response program should have and the intent of NFPA 1005 is to ensure that land-based firefighters responding to marine vessel fires have the appropriate training and qualifications. However, NFPA cannot mandate these standards. It is up to States and others to adopt those standards and provide sufficient funding for fire departments and companies to train to those standards.

The Fire Department of New York (FDNY) is a good example of how a fire department can establish an effective program for response to marine vessel fires and train its firefighters, given adequate resources. The FDNY Marine Division has a ship simulator located at the department training facility, which exposes firefighters to a controlled shipboard environment and helps them become familiar with the layout of a vessel and firefighting techniques. They also routinely send their firefighters to a 1-week marine shipboard firefighting school, in Fort Lauderdale, Florida and annually attend and participate in a 5.5-day, hands-on marine firefighting course, put on by the Virgina Port Authority. In addition, they participate in routine in-house training, exercises, and drills, and participated in shipboard vessel familiarization tours.

Lack of Newark Fire Department Marine Vessel Training

The Newark Fire Department (NFD) did not have any formal shipboard firefighting-specific training or requirements prior to the 2023 fire aboard the *Grande Costa D'Avorio*. After the fire, NFD firefighters were provided with a 4-hour Shipboard Firefighting Awareness class and participated in vessel tours. This is far

from the training firefighters need and deserve to appropriately respond to vessel fires.

With the size and frequency of ships continuing to increase at ports throughout the United States, it is critical that our nation's firefighters have adequate training. There's a saying in the fire community: "Train as if your life depends on it, because it does." Had NFD firefighters received the training they needed to appropriately address this vessel fire, they would've never gone in and, today, two firefighters would still be with their loved ones.

The Newark Fire Department, the Port of New York and New Jersey, the International Association of Fire Fighters, International Association of Fire Chiefs, and the National Volunteer Fire Council need to act on our safety recommendations without delay to prevent future tragedies and ensure the safety of firefighters, shore workers, and vessel crews alike.

Member J. Todd Inman filed the following concurring statement on April 21, 2025. Chairman Jennifer L. Homendy, Vice Chairman Alvin Brown, and Member Michael Graham joined in this statement.

Commentary on Firefighting Preparedness

Upon further reflection following the Board meeting—and drawing from my experience as a former instructor with the National Fire Academy—I must emphasize that comprehensive training remains the most critical foundation for ensuring safety. I was deeply concerned to learn that the City of Newark and its Fire Department appeared to consider a four-hour classroom familiarization session an adequate outcome in response to the tragic incident that resulted in the loss of two firefighters. A clear result of lack of proper training.

While the final report does not formally cite this as a sufficient measure, testimony presented during the U.S. Coast Guard hearing highlighted a contrasting example: the collaborative efforts at the Port of Virginia. This example illustrates how effective communication, interagency coordination, and thorough training protocols can significantly enhance operational safety. Though it may not be a universal standard, the Port of Virginia was specifically recognized during the Board meeting as a model of best practices.

It is imperative that other port authorities, municipalities, and fire departments take proactive steps to critically evaluate and strengthen their training programs. We must not wait for tragedy at individual ports to compel change. Instead, let us learn from the hard lessons of this incident and ensure that robust training and interagency coordination are prioritized, so that such a devastating loss does not occur again.

Appendixes

Appendix A: Investigation

The US Coast Guard was the lead federal agency for the investigation. The Coast Guard declared the accident a major marine casualty, and, on July 7, 2023, the National Transportation Safety Board (NTSB) launched an investigator and a fire specialist to the scene. While on scene, NTSB investigators, working with the Coast Guard and other local agencies, collected documentation and interviewed members of the vessel's crew, fire department personnel, shoreside labor personnel, and company representatives. The Bureau of Alcohol, Tobacco, Firearms and Explosives assisted with the on-scene examination of the vessel. The National Institute for Occupational Safety and Health Fire Fighter Fatality Investigation and Prevention Program conducted a parallel investigation and provided subject matter expertise in the areas of shoreside firefighting and response.

Five days after the casualty, the Coast Guard convened a District One Formal Investigation. On January 10–18, 2024, the Coast Guard, in conjunction with the NTSB, conducted a formal public hearing to consider evidence related to the casualty.

The Coast Guard, Grimaldi Deep Sea SPA, the Newark Fire Division (City of Newark, New Jersey), Ports America, American Maritime Services of NY, and the International Association of Fire Fighters are parties to the investigation.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the US Coast Guard:

M-25-01
Submit a proposal to the International Maritime Organization to clarify and emphasize that the existing *International Convention for the Safety of Life at Sea* regulation requiring that all openings capable of admitting air into or allowing gas to escape from a protected space can be closed from outside the protected space applies regardless of their expected operational condition when in port or at sea.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4, Fire Boundaries for Fixed Gas Fire Extinguishing Systems. Information supporting (b)(1) can be found on page 59-62; (b)(2) can be found on page 60; and (b)(3) is not applicable.

To the Occupational Safety and Health Administration:

M-25-02
Inform your field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist Occupational

Safety and Health Administration compliance officers in proper enforcement of the powered industrial truck requirements (Title 29 *Code of Federal Regulations* 1917.43 and 29 *Code of Federal Regulations* 1918.65) at marine terminals and during longshoring operations to assure safe and healthy working conditions.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Pusher Vehicle Use. Information supporting (b)(1) can be found on page 59; (b)(2) can be found on page 59; and (b)(3) is not applicable.

M-25-03

Inform your field personnel of the circumstances of the *Grande Costa D'Avorio* fire and provide guidance to assist Occupational Safety and Health Administration compliance officers in proper enforcement of the emergency procedures requirements (Title 29 *Code of Federal Regulations* 1917.30 and 29 *Code of Federal Regulations* 1918.100) at marine terminals and during longshoring operations to assure safe and healthy working conditions.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.7, Shoreside Personnel Emergency Procedures. Information supporting (b)(1) can be found on page 67; (b)(2) is not applicable; and (b)(3) is not applicable.

To the Newark Fire Division:

M-25-04

Require all chiefs and first responding companies and units that respond to vessel fires to complete specialized marine firefighting training that includes both classroom and practical firefighting training and is based on the National Fire Protection Association's marine firefighting standards.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.6, Land-Based Firefighter Training for Shipboard Firefighting. Information supporting (b)(1) can be found on page 64-67; (b)(2) can be found on page 65-66; and (b)(3) is not applicable.

To the Port Authority of New York and New Jersey:

M-25-05
Establish procedures to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at your facilities and on board vessels.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.6, Land-Based Firefighter Training for Shipboard Firefighting. Information supporting (b)(1) can be found on page 64-67; (b)(2) can be found on page 65-66; and (b)(3) is not applicable.

To RINA Services:

M-25-06
Revise your procedures for review and approval of vessel plans to ensure compliance with *International Convention for the Safety of Life at Sea* by requiring that all openings capable of admitting air into or allowing gas to escape from a protected space can be closed from outside the protected space, regardless of their expected operational condition in port or at sea.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.4, Fire Boundaries for Fixed Gas Fire Extinguishing Systems. Information supporting (b)(1) can be found on page 59-62; (b)(2) can be found on page 60; and (b)(3) is not applicable.

To the American Association of Port Authorities:

M-25-07
Inform your members about the circumstances of the *Grande Costa D'Avorio* fire, highlighting that pusher vehicles used to load nonrunning vehicles aboard vessels are included in the Occupational Safety and Health Administration's definition of powered industrial trucks and must comply with those standards.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Pusher Vehicle Use. Information supporting (b)(1) can be found on page 59; (b)(2) can be found on page 59; and (b)(3) is not applicable.

M-25-08
Inform your members of the circumstances of the *Grande Costa D'Avorio* fire and encourage them to establish procedures with local fire departments to facilitate training, drills, and vessel familiarization tours for responding firefighters to enable them to better prepare and respond to fires and other emergencies at port facilities and on board vessels.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.5, Land-Based Firefighting Response. Information supporting (b)(1) can be found on page 62-64; (b)(2) is not applicable; and (b)(3) is not applicable.

To the International Association of Fire Fighters, the International Association of Fire Chiefs, and the National Volunteer Fire Council:

M-25-09
Advise your members of the circumstances of the *Grande Costa D'Avorio* fire and encourage those members that may respond to marine vessel fires to identify any gaps in their training for marine vessel fires and familiarize themselves with available resources, such as the National Fire Protection Association firefighting standards.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.6, Land-Based Firefighter Training for Shipboard Firefighting. Information supporting (b)(1) can be found on page 64-67; (b)(2) can be found on page 65-66; and (b)(3) is not applicable.

To Grimaldi Deep Sea:

M-25-10
Inventory all your vessels to identify all openings that are part of a fire boundary and modify the vessels, as necessary, so that the openings are capable of being closed from outside the protected space.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4, Fire Boundaries for Fixed Gas Fire Extinguishing Systems. Information supporting (b)(1) can be found on page 59-62; (b)(2) can be found on page 60; and (b)(3) is not applicable.

To Ports America and American Maritime Services:

M-25-11
Develop policies for fire and emergencies on board vessels, per Title 29 *Code of Federal Regulations* 1917.30 and 29 *Code of Federal Regulations* 1918.100, to include accounting for shoreside employees, and train employees on what to do in the event of a fire or emergency on board a vessel.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.7, Shoreside Personnel Emergency Procedures. Information supporting (b)(1) can be found on page 67-68; (b)(2) is not applicable; and (b)(3) is not applicable.

Appendix C: Response Timeline

This timeline has been developed based on the Newark Fire Department (NFD) Radio Timeline, which has been edited for length and clarity. Additional information from the investigation has been added, including interviews and testimony. Entries are generally chronological; where possible, confirmed times are provided.

Table C-1. Timeline of events.

Time	Event
	July 5
0700	Vessel docked at Port Newark, berth 18
	Vehicle loading continued throughout the day and into the evening
2058	Jeep pusher vehicle pushed nonrunning vehicle up stern ramp and into the vessel
2100	Fire first observed in Jeep pusher vehicle on deck 10
	Vessel's chief mate and ordinary seaman, with Jeep driver, engaged fire with handheld fire extinguishers
	Vessel's fire alarm automatically activated; sounded on fire control panel on the bridge
	Chief mate broadcasted via ultrahigh frequency radio that there is a fire on deck 10; instructed the third mate to call and notify the captain, off duty in his stateroom; and instructed the bosun to dress out in firefighter gear and report to the scene of the fire
	Captain reported to bridge and secured ventilation to deck 10
2106	Captain started fire pump and ordered chief engineer to report to the engine control room
	Chief mate and ordinary seaman ran out fire hoses on decks 9 and 10 Bosun arrived at scene of fire dressed out in firefighting gear, engaged fire with fire hose
2108	Captain ordered additional crew to inspect decks 11 and 12 for signs of fire
	First engineer reported smoke coming from open Dk-12 hydraulic garage door Second officer reported smoke visible on deck 11 Chief mate reported heavy black smoke continued to worsen on deck 10, and he could no longer see into the deck 10 garage space from his position on the ramp Ports America superintendent drove work vehicle up to deck 9 to assess the situation; confirmed shoreside labor was off the vessel
2114	Captain ordered the chief mate and other crew on scene to stop engaging the fire, evacuate from the space, and prepare to discharge carbon dioxide (CO_2)
	Captain ordered chief mate and first engineer via the radio to close all hydraulically operated garage doors
	First engineer reported to the captain that it was too dangerous to close Dk-12 hydraulic garage door because the operator would be trapped in the fire protection zone
2117	Vessel crew observed and reported fire on deck 12

	Captain ordered chief engineer to report to CO_2 room and stand by to release the CO_2 into fire protection zone C
2119	Captain received full muster of crew and sounded alarm in preparation for CO_2 release
2122	Captain ordered CO_2 released; chief engineer activated system (once initiated, full release would take 10 minutes)
	Crew on deck 12 boundary cooling and fighting small deck 12 fire
	Crew reported smoke emanating from open Dk-12 hydraulic garage door changed from black to gray and decreased in volume
2124	Port Authority Police Department notified NFD Dispatch Center of a fire
2127	Vessel captain called the US Coast Guard on VHF channel 16 to report a fire on board
2132	E-27 on scene, escorted to deck 11, and briefed by third mate that CO_2 had been released and self-contained breathing apparatus (SCBAs) were needed to enter the garage space
	Most vessel crew on decks 11 and 12 boundary cooling Chief mate went down to deck 3 to meet additional oncoming firefighting companies B-5 on scene, briefed by captain on deck 12
2134	NFD deputy chief on scene, assumed IC, and set up command post on deck 3 stern ramp Crewmember gave NFD deputy chief fire control plan on captain's orders
2135	E-4 and B-4 on scene
2136	B-5 reported fire on the top deck, "they have it sealed off"
2137	L-8 on scene L-11 responding
2138	E-27 reported "you can't get through the door right now, because they wetted down the line with CO"
2140	E-19 on scene
	E-27 donned SCBAs and entered deck 11 garage
2142	E-27 reported fire knocked down
2143	D-1 reported the bulk of the fire has been knocked out
2144	E-27 reported fire knocked down, "we just have smoke"
2146	E-27 reported no fire on deck 11, stated they were going to check deck 10
2149	B-5 with vessel captain on deck 12, reported fire on deck 12 knocked down, crew had sealed off compartments and deployed the CO_2 Reported plan to send E-27 down to check out decks 11 and 10 D-1 reported L-4 also on the way to check deck 10
2150	E-27 reported no fire on deck 11 B-5 requested they check conditions on deck 10
2152	B-5 reported two confirmed fires plus unofficial fire on deck 10
2154	B-5 set up operational command post on deck 12 E-27 reported heavy smoke on deck 10
	Additional firefighters, including L-4 and B-4, arrived on deck 12 B-4 positioned himself in port aft ladderwell on deck 10
	Chief mate and bosun attempted to shut Dk-12 hydraulic garage door but unable to

	Firefighters continued to arrive and stage on deck 12 and in port ladderwell
2159	B-5 reported "We are going to check this sealed off compartment area on level 10"
2204	E-27 reported visible flames on deck 10
	Firefighters coordinated with crew for fire hoses
2205	B-4 reported fire on deck 10
2209	B-5 reported staging location on the top deck
2211	B-5 reported deck 11 clear, fire on deck 10
2213	B-4 directed L-4 into deck 10 to combat the fire
	L-4 captain L-4 FF-B entered deck 10, followed hose to Jeep, and engaged fire L-4 captain left deck 10 garage to report conditions L-4 captain reached ladderwell to report to B-5, unable to reenter the garage
	E-16 firefighters entered deck 10, found L4 fighting fire alone Another L-4 team entered deck 10 and encountered E-16 captain, E-16 FF and L-4 FF The L-4 team began overhauling the Toyota
2216	D-1 updated HQ that there were "multiple cars on fire on large ship (inaudible), I have multiple decks with cars on it. Deck 10 and deck 12, that is the top deck, had about 6–7 cars on fire, still trying to make access to the fire on the 10th floor, all companies working"
2218	B-4 (still in ladderwell at deck 10) reported fire on deck 10 "appears to be knocked down, we are mopping up" L-4 FF-1 and L-4 FF-2 exited the space E-16 captain reported from deck 10 that there was "no additional fire at this time."
	B-4 began receiving information on fire on deck 11
2220	B-4 to E-16 "Bring that line back out to the door"
2222	B-4 ordered remaining firefighters on deck 10 (E-16 captain, E-16 FFA, and L-4 FF-B) to bring line out
2222	HQ to E-16 "E-16, did you receive B-4's message, he stated you should bring the line back out"
	Smoke event in port ladderwell B-4 and others evacuated to deck 12 and to lower decks Evacuating firefighters reported conditions to B-5
	E-16 captain reported reduced visibility in deck 10 garage Firefighters evacuating deck 10 L-4 FF on deck 10 low on air, so E-16 captain instructed him to get in front to be first out of space E-16 captain lost contact with others
2223	Inaudible transmission / "WE CAN NOT FIND OUR WAY OUT WE ARE LOST!"
2224	HQ reports receiving Mayday call from E-16 HQ to B-4 / HQ to D-1 "Did you just hear E-16's last transmission?" / D-1 "Negative" / HQ "Be advised, it sounds like he said that he cannot find his way back out"
2224	*Inaudible transmission / "WE ARE LOST!"
2224	Multiple transmissions from multiple sources HQ & Personnel "You need to back out" / "Unit calling, identify yourself, what is your location, what do you need?" / "All companies come out"
2224	DISPATCH ordered all units to evacuate
2234	NFD confirmed that L-4 FF-B and E-16 FF-A were unaccounted for on deck 10

	L-5 rapid intervention team on deck 12 navigated down the aft port ladderwell and entered deck 10 to search for the missing firefighters
2240	L-5 located E-16 FF-A
	Multiple rescue teams attempted to extricate E-16 FF-A
2313	NFD Chief requested mutual aid from neighboring New Jersey communities
2345	B-4 and B-5 requested the vessel crew to start the garage space extractor fans and remove the smoke from deck 10, to better aid in their search and rescue efforts
2359	E-16 FF-A freed from between two vehicles and brought to deck 12
July 6	
0045	Firefighters and the vessel crew moved E-16 FF-A to the pier using vessel crane
	NFD fire chief decided to request assistance from the Fire Department of the City of New York (FDNY)
0122	Urban Area Security Initiative and FDNY initiated searches for L-4 FF-B on deck 10
	Land-based firefighters attempted to help vessel crew shut Dk-12 hydraulic garage door
0208	FDNY firefighters located L-4 FF-B unresponsive and begin extracting him from deck 10
0300	L-4 FF-B lowered to the pier using the vessel's crane
0325	FDNY marine battalion chief met the captain of the vessel on the bridge and discussed fire status and the vessel's options for combating the fire
0400	FDNY battalion chief and vessel captain consulted vessel response plan, and contacted salvors that specialized in marine firefighting
	NFD and other land-based firefighters and emergency medical servicespersonnel depart vessel
	FDNY fire boat arrived, and the captain of the vessel instructed them to direct their stream of firefighting water on deck 12 and at the open Dk-12 hydraulic garage door
0640	The captain of the vessel ordered all vessel crew to evacuate the vessel
0651	Salvage company marine firefighting assets began to arrive and salvor assumed the primary fire response
0930	Unified Command established to oversee the continuing response efforts, which continued until the fire was officially declared extinguished on July 10

Appendix D: Basics of Shipboard Firefighting

Crew Training

The International Maritime Organization's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) establishes requirements on training, including shipboard-specific firefighting tactics. Mariners credentialled to operate large vessels must be trained and participate in regular drills to use their vessels' installed firefighting systems, such as the fixed gas fire extinguishing system, as well as their vessels' firefighting equipment, such as firefighting outfits, self-contained breathing apparatus (SCBAs), and fire hoses.

Vessel crewmembers also have special training on how to fight fires aboard their vessels. Senior officers aboard ships, such as the captain and chief engineer, will reference the vessel's fire control plan to guide them in understanding the vessel's structural fire protection boundaries, fire zones for fixed firefighting systems, and locations of available firefighting equipment when planning firefighting efforts.

Once a fire is detected on board a vessel, the crew's first reaction is to notify all on board and verify the fire location and its severity. Next, the crew will use the vessel's onboard equipment and their training to fight the fire. If the vessel is in port, the captain will notify the local Coast Guard on very high frequency (VHF) channel 16 (the international distress, safety, and calling frequency) only after they determine that the fire is reportable or exceeding the vessel crew's firefighting abilities.

Vessel Construction and Layout

Vessels are constructed with structural fire protection, a component of an overall vessel fire-protection strategy that uses passive design features in a vessel's structure to slow the expansion of a fire from one compartment to another. Structural fire protection uses fire-resistant materials and insulation installed on the horizontal and vertical surfaces of a compartment, on doors/hatches, and in pipe and cable openings to slow the transfer of heat and smoke, thus providing additional time for evacuation and firefighting to contain and extinguish a fire.

The fire-resistant bulkheads and decks also divide the ship into fire protection zones that can be sealed by doors or dampers at the zone boundaries. Because sealing the zones not only slows the transfer of heat and smoke but also starves the fire of oxygen, the first step during a ship fire is usually to shut down ventilation systems by securing ventilation fans and closing all dampers.

Shipboard Fire Extinguishing Systems

Vessels usually have fire hydrants, hoses, and nozzles for crew to use in firefighting efforts; the hydrants are usually supplied by seawater fire pumps. Vessels may also have shore connections that connect to a shoreside water supply if the fire pumps become inoperable. However, the water applied to a vessel fire can accumulate within the vessel, and too much water can affect the vessel's stability—responders should use water and hoses with careful consideration and in consultation with the vessel captain.

Many ships have built-in fixed systems to extinguish shipboard fires. Carbon dioxide (CO_2) systems, a common type of fixed gas fire extinguishing system (also referred to as a suppression system), are designed to protect enclosed spaces such as engine rooms or cargo decks. For vessels with spaces protected by fixed gas firefighting systems, if the captain and crew determine that the fire has grown too large or dangerous to fight with handheld extinguishers or water hoses, shipboard firefighting convention is to isolate the space (securing ventilation, all doors and openings shut) and release the fire suppression agent. Vessel crews generally are trained to use these systems.

When dispersed into a space, the CO_2 gas displaces the oxygen that is present and smothers the fire. To be effective in extinguishing a fire, the space into which the CO_2 is released must be segregated and sealed off from sources of oxygen; once the zone has been sealed and the system activated, personnel should not enter the space prematurely. Not only would unnecessary airflow to the sealed area waste the CO_2 gas that has been released, but the concentration of CO_2 needed to extinguish a fire in such a sealed space is extremely hazardous to humans.

Once the system is activated, marine firefighting convention is then to water-cool and monitor the temperatures of the gas-flooded compartments' boundaries. Temperatures that decrease over time indicate the fire may have subsided or possibly extinguished. Personnel should never attempt to enter a space where CO_2 has been discharged without SCBAs, and personnel should confirm the fire is out before opening the sealed area to outside oxygen sources. Vessel fires can take many days to extinguish with CO_2.

Vessel Effects on Radio Communications

Unlike standard shoreside structures, such as houses and buildings, which are generally constructed of mostly dielectric material (such as wood, plaster, brick, and cement) that allows radio waves to more easily pass through, large vessels are mostly

constructed of steel, which often reflects radio waves. Radio communications challenges aboard large steel vessels are well documented.

NFPA 1405: Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires, states that "the structure of most large vessels creates communications difficulties for responders. Large amounts of steel often make portable radios unusable. The long duration of these incidents often depletes reserves of batteries. Alternate means of communications (i.e., runners, sound-powered phones, wired systems, and even the ship's systems) should be considered in pre-fire planning." The standard continues, "the very nature of a ship's construction, which is mostly steel, creates an immediate negative impact on good, clear communications." It lists methods to combat this impediment to include pre-planning and testing of radios during vessel visits prior to a response (NFPA 2020).

References

Chrysler. 2009. "Defect Information Report," Recall 09V-436. NHTSA (National Highway Traffic Safety Administration), https://static.nhtsa.gov/odi/rcl/2009/RCDNN-09V436-4259.pdf.

IMO (International Maritime Organization). 1974. *International Convention for the Safety of Life at Sea* (*SOLAS*).

Korea Maritime Safety Tribunal. 2020. *Marine Safety Investigation Report on the AUTO BANNER Fire Accident at Incheon Port While Berthed*.

NFPA (National Fire Protection Association). 2019. *NFPA 1005: Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters*.

———. 2020. *NFPA 1405: Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires*.

NTSB (National Transportation Safety Board). 2021. *Fire aboard Roll-on/Roll-off Vehicle Carrier* Höegh Xiamen*, Pier 20, Blount Island, Jacksonville, Florida, June 4, 2020*. NTSB/MAR 21/04.

———. 2023. *Engine Room Fire Aboard Passenger Vessel* Spirit of Norfolk*, Elizabeth River, Norfolk, Virginia, June 7, 2022*. MIR-23-22.

US Coast Guard. Marine Safety Alert 09-23, "By Land and Sea—Firefighting Preparation is Key!," November 20, 2023, https://media.defense.gov/2024/Jan/16/2003377041/-1/-1/1/USCGSA_0923.PDF.

Casualty Summary

Casualty type	Fire/Explosion
Location	Port Newark, berth 18, Newark, New Jersey 40°41.57' N, 74°08.36' W
Date	July 5, 2023
Time	2103 Eastern Daylight Time (coordinated universal time –4 hours)
Injuries	2 fatal, 6 minor (land-based responders)
Property damage	$23,763,000
Environmental damage	None
Persons on board	28

NTSB investigators worked closely with our counterparts from **Coast Guard District 1 Formal Marine Board of Investigation** throughout this investigation.