UNITED STATES COAST GUARD

REPORT OF THE INVESTIGATION

INTO THE

FIRE AND SUBSEQUENT LAND-BASED FIREFIGHTER FATALITIES ONBOARD GRANDE COSTA D'AVORIO (9465382) WHILE CONDUCTING CARGO OPERATIONS AT BERTH 18, PORT NEWARK, NEW JERSEY ON JULY 5, 2023

MISLE ACTIVITY NUMBER: 7735267

U.S. Department of Homeland Security

United States Coast Guard

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FIRE AND SUBSEQUENT LOSS OF TWO LAND-BASED FIREFIGHTER LIVES ABOARD THE ITALIAN FLAGGED ROLL-ON ROLL-OFF/CONTAINER VESSEL GRANDE COSTA D'AVORIO (IMO# 9465382) WHILE CONDUCTING CARGO OPERATIONS AT BERTH 18, PORT NEWARK, NEW JERSEY ON JULY 5, 2023

ACTION BY THE COMMANDANT

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

ACTION ON RECOMMENDATIONS

Recommendation 1: Recommend the Commandant work with the International Maritime Organization (IMO) to update the International Convention for the Safety of Life at Sea (SOLAS), Chapter III, Regulation 19.3.4.1. to further define that "various emergencies that may occur" includes fires both at sea and in port. As currently worded, the regulation affords interpretative discretion to the vessel's operator and Master as to the types of "various emergencies that may occur." As a result, most, if not all, shipboard fire drills are conducted only during an "at sea" scenario. This is because, while at sea, the vessel's crew is self-reliant for fire suppression, and it avoids the delay of cargo operations. However, fire drills underway are incapable of fully simulating the conditions that may be presented during in-port cargo operations, which, as this incident demonstrates, are an inherent fire risk. It was the vessel crew's initial actions that would likely prevent the fire from becoming uncontrollable. This update will ensure that vessel crews are conducting training to adequately prepare them to perform initial firefighting during in-port cargo operations.

> **Action**: I concur with the intent of this recommendation. Section 5.10 of the investigation highlights that the subject vessel's crew conducted fire drills that "met, if not exceeded" the requirements of SOLAS. Section 5.11 states "As a result of their routine fire drills and professional training, the vessel's crew were well trained in the aspects of fire attack, which are no different in-port than at sea." There is little evidence to suggest that the crew of the vessel was not adequately prepared to combat the fire, either in-port or underway. Rather, the crew's actions in attempting to close Watertight Door (WTD)-12 before carbon dioxide (CO_2) discharge aligned with established firefighting procedures, whether in-port or underway. The failure to close the door stemmed from the vessel's non-compliant construction, specifically the lack of a means to close WTD-12 from outside the protected space, as required by SOLAS

II-2/10.4.2. While enhancing fire drill effectiveness is a valid goal, enforcing existing regulations related to vessel construction and fire safety systems offers a more direct approach, addressing the primary cause of the fire spread that progressed in this incident. As proposed in response to National Transportation Safety Board (NTSB) recommendation M-25-01 related to this casualty, the United States Coast Guard (USCG) Office of Design and Engineering Standards (CG-ENG) will coordinate with the International Association of Classification Societies (IACS) and, if necessary, submit an IMO Unified Interpretation on SOLAS II-2/10.4.2 to clarify the requirement for external closure mechanisms for spaces protected by a gas fire suppression system.

Recommendation 2: Recommend the Commandant amend Title 33 Code of Federal Regulations (CFR), Chapter I to include a requirement that all large cargo vessels, regardless of their flag state, cargo type, or frequency in U.S. ports, periodically conduct a shipboard fire drill dockside prior to commencing cargo operations. The drill scenario should be required to focus on the probable emergency type(s) associated with cargo operations, and include checking the operation of WTDs, weathertight doors, fire doors, fire dampers, and main inlets and outlets of ventilation systems in the drill area. It is recommended that the drill also simulate notification of land-based fire authorities, the USCG, activation of the Vessel Response Plan, the Port Authority, and interaction with land-based fire response personnel upon arrival. For the reasons discussed above, and as this incident particularly demonstrates, underway drills are inadequate at preparing vessel's crew to respond to an in-port fire. This requirement will ensure that vessel crews are prepared to respond swiftly to in-port emergencies to protect the vessel, human life, cargo, port, and the marine transportation system overall.

Action: I do not concur with this recommendation. Section 5.10 of the investigation highlights that the subject vessel's crew conducted fire drills that "met, if not exceeded" the requirements of SOLAS. Section 5.11 states "As a result of their routine fire drills and professional training, the vessel's crew were well trained in the aspects of fire attack, which are no different in-port than at sea." There is little evidence to suggest that the crew of the vessel was not adequately prepared to combat the fire and needed to conduct additional drills. However, there is evidence that suggests shoreside firefighters responding to the incident lacked the training and experience to combat a shipboard fire. The failure to secure WTD-12 and shut off ventilation to cargo spaces impacted by the fire was a result of vessel design flaws that impeded accessibility to the WTD's controls. Publishing new regulations requiring additional dockside drills prior to commencing cargo operations would impede commerce and do little to improve the capability of local emergency responders to combat shipboard fires. However, the USCG Office of Commercial Vessel Compliance (CG-CVC) will consider updating Work Instruction – 004 (CG-CVC-WI-004(series)) with language that encourages vessels to update their respective Safety Management Systems with shoreside specific firefighting policies and procedures.

Recommendation 3: Recommend the Commandant work with the National Fire Protection Association (NFPA) to update NFPA standard 1405, *Guide for Land-Based Fire Departments*

That Respond to Marine Vessel Fires, to expand and specify the roles, responsibilities, and required coordination by the vessel's crew with land-based firefighters and vessel shoreside representatives, during a response to a shipboard fire in port. Specifically, it is recommended that the Master or other senior vessel officer and/or Port Captain/Engineer be directly incorporated into the land-based firefighting Incident Command Post (ICP) to assist in interpreting the vessel's fire control plan and provide advice on shipboard tactical firefighting efforts. This incorporation will ensure that land-based fire departments understand the various positions and roles on a vessel, have a direct representative to effect orders relating to the ship and its installed systems, and benefit in the expertise they can offer to the vessel's particulars and response.

> **Action**: I do not concur with the recommendation. The numerous challenges that Newark Fire Department (NFD) encountered and the recommendation to include a vessel representative in the ICP, are concepts that are already addressed in NFPA standard 1405. Specifically, Section 5.4 details responsibility and the authority of the Master and various crew members and Section 13.5.2 recommends that the Master or a vessel representative should be included in the incident management system. Additional sections discuss the fire control plan, communications challenges, and hazards specific to vessel firefighting. The USCG believes that it was not the lack of detailed information within NFPA 1405, but the absence of any shipboard firefighting training by NFD that contributed to the severity of the incident. I note that NTSB's Marine Investigation Report (MIR)-25-16 into this incident includes recommendations that land-based firefighting organizations follow the existing NFPA marine firefighting standards to complete classroom and practical specialized marine firefighting training. The USCG concurs with that approach and no additional actions will be pursued at this time to update NFPA 1405.

Recommendation 4: Recommend the Commandant work with the NFPA to update NFPA standard 1970, *Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)*, to include provisions for firefighter protective equipment used by departments who may encounter vessel fires. It is recommended that standards and testing be developed to ensure the protective clothing, gloves, boots, and helmets used by land-based fire departments responding to shipboard fires can withstand the unique conditions of that environment, as this incident presented with reported boot failures. This testing will ensure that land-based fire departments are equipped to respond to shipboard fires that may pose more strenuous and extreme conditions than the typical structure fire to which they are accustomed.

> **Action**: I concur with the intent of the recommendation. After the vessel's crew took initial actions, evacuated the space, and discharged the fixed CO_2 system, NFD's further entry into the space placed firefighters and their equipment in a hazardous environment that should have been avoided. While equipment failure did occur, the primary causal factor for the loss of the two firefighters in this case was the lack of shipboard firefighting training by NFD personnel, not major differences in equipment standards. A USCG review of international firefighting boot standards indicates minor differences in testing standards. The USCG will provide those findings to the

NFPA for their consideration as a minor revision to NFPA 1970. However, the USCG does not believe a full re-write of NFPA 1970 is necessary at this time.

Recommendation 5: Recommend the Commandant issue a directive for all USCG Captains of the Port (COTPs) to update their port's Marine Firefighting Contingency plan(s) to include the following:

- For any vessel fire, the USCG will immediately provide an in-person Agency Representative (AREP) to the land-based firefighting ICP during the firefighting response. The AREP should be well versed in shipboard layout, fire control plans, fire suppression equipment, and vessel crew relations.

- Upon establishment of a land-based firefighting ICP, a senior vessel crewmember or Port Captain should be embedded to help the Incident Commander interpret fire control plans for the vessel and provide advice during tactical planning.

- Establish a shipboard firefighting drill and exercise program at least annually that brings all land-based fire departments within the port's area of responsibility, the USCG (specifically the designated AREP), and other response agencies port-wide for scenarios focused on testing the marine firefighting contingency plans and improving response.

Action: I concur with the intent of this recommendation. Furthermore, I agree that Marine Firefighting Plans (MFFPs) should outline the processes and procedures for integration of vessel crew leadership with subject matter expertise on the vessels' systems and operations into the Incident Management Team. The USCG works with the NFPA to develop national guidance for marine firefighting operations, including NFPA standard 1405. Chapter 14 of NFPA 1405 outlines the USCG's role in Marine Firefighting planning, preparedness, and response to include the designation of a Marine Firefighting Coordinator.

The USCG agrees with the intent of requiring an in-person AREP to the land-based firefighting ICP during the firefighting response. However, before establishing specific requirements, USCG COTPs should work with partner agencies to review existing port level plans and guidance to identify any gaps or shortfalls and determine the best way to incorporate NFPA 1405 guidance in the Area Contingency Plan. Any potential policy solutions should be tailored to the specific threats and capabilities within each area.

The USCG also agrees with the recommendation to establish a shipboard firefighting training and exercise program. The national Salvage and Marine Firefighting (SMFF) Task Force has a workgroup currently developing standard training products and exercise program guidance. The estimated completion for these products is early calendar year 2026.

Administrative Recommendation 1: Recommend USCG Northeast District (fomerly District 1) Commander refer elements of this case to the Occupational Safety and Health Administration (OSHA), who implemented their authority over marine terminal operations and equipment in 29

CFR § 1917 and longshoremen safety and health in 29 CFR § 1918, to conduct a compliance inspection on Ports America operations at Port Newark berth 16-18. Particular attention should be given to pusher vehicle use and modification, maintenance procedures, and out-of-service or "lockout/tag-out" protocols. Additionally, recommend further attention be focused on shipboard emergency action planning, procedures, and training for both Ports America and AMS shipping employees working at this terminal.

> **Action**: I concur with this recommendation and the USCG Northeast District Commander's endorsement. An OSHA compliance inspection of Ports America at Port Newark berths 16-18 in accordance with 29 CFR § 1917 and 29 CFR § 1918, may help prevent future incidents. Specifically, the inspection should focus on pusher vehicle use and modification, maintenance procedures, and out-of-service or "lockout/tag-out" protocols. The Port of Newark is under Sector New York's jurisdiction and the Sector Commander can work with their local port partners to coordinate the recommended compliance inspections.

Administrative Recommendation 2: Recommend the Commandant establish a Memorandum of Understanding (MOU) with the National Institute for Occupational Safety and Health Fire Fighter Fatality Investigation and Prevention Program (NIOSH FFFIPP) to formalize their support of USCG marine casualty investigations involving land-based firefighter fatalities and "near-misses" (maydays). Similar to the benefit the USCG gains from our MOU with the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) in their expertise on fire cause, origin, and spread analysis, NISOH FFFIPP presents expertise to land-based firefighting. The phraseology, culture, doctrine, equipment, and tactics of land-based firefighting varies significantly from shipboard firefighting. This investigation is testament to the professional insight and subject matter expertise of the NIOSH FFFIPP, where the investigator formulated diagrams for public release of the firefighting response and testified at the formal public hearing. NIOSH FFFIPP's engagement in this incident was triggered by a line of duty death (LODD), but still required an invitation from the NFD or firefighter union to investigate. A formalized partnership between the two agencies will ensure future marine casualty investigations, whether involving a LODD, "near miss," or invitation from the local Fire Department or union, can benefit from NIOSH FFFIPP's expertise and enable informed recommendations to prevent fatalities and injuries sustained by land-based firefighters in the shipboard environment.

> **Action**: I concur with this recommendation. The USCG Office of Investigations and Casualty Analysis (CG-INV) is working with the NIOSH FFFIPP to formalize an agreement outlining the cooperation between the agencies. Once finalized, the formal agreement will describe the coordination protocols during investigations into fatalities and serious injuries during land-based fire-fighting responses on vessels, including the process for requesting agency assistance and subject matter expertise.

Administrative Recommendation 3: Recommend the Commandant join the Tokyo and Paris MOU on Port State Control (PSC) in their joint Concentrated Inspection Campaign (CIC) on Fire Safety that occurred from September 1 to November 30, 2023. The CIC examined specific areas related to fire safety in conjunction with regular PSC inspections using a pre-defined questionnaire. This questionnaire should be adopted and expanded upon to include a check of all types of closures that create the barrier for CO_2 fire protection zones on all vessels, both foreign

and domestic, to which SOLAS applies. A campaign of this nature would help identify any vessels that have similar risk factors to those impacting this incident that prohibited the crew from sealing off CO_2 protected spaces and rendered the fixed fire extinguishing system ineffective. The results of the campaign should be shared with relevant flag states to best rectify deficiencies for their vessels.

> **Action**: I partially concur with this recommendation. CG-CVC intends to leverage lessons learned from this incident to focus enhanced exams over the next twelve months. For context, the Tokyo and Paris MOU CICs involve multiple years of planning as well as extensive consolidated training efforts for PSC examiners taking part in the CIC. The USCG has purposefully chosen not to use that model, but rather to utilize a more versatile and responsive approach called the Enhanced Exam Program (EEP). This EEP involves quarterly exam topics and requires USCG PSC officers to spend part of each exam during that quarter examining more in-depth than normal on a particular topic. This model has been highly successful and has been adopted by the Paris MOU with the intent of potentially replacing the CIC process. CG-CVC will use this report of investigation to inform EEP topics for the coming year and to ensure that appropriate topics are covered in greater depth within the scope of existing regulations and international standards.

Administrative Recommendation 4: Recommend the Commandant develop or update policy, Command Center Quick Response Cards (QRC), job aids, and tactics, techniques, and procedures related to commercial vessel fires to prompt Command Center watch standers, Pollution Responders, and Federal On-Scene Coordinator Representatives (FOSCR) to discuss activation of the Vessel Response Plan (VRP) and Salvage and Marine Firefighting (SMFF) resources. While USCG responders are adept at asking about plan activation during a pollution incident, this case shows that the same proficiency may not exist for doing so with vessel fires. Just as Oil Spill Removal Organizations are critical to mitigating environmental impacts, the predesignated SMFF provider is essential to ensuring that vessels receive fire mitigation assistance. While still the sole responsibility of the person in charge of the vessel, prompting by the USCG as a regulatory agency would likely reeinforce timely activation of these critical resources.

> **Action**: I concur with this recommendation. The USCG Office of Marine Environmental Response (CG-MER) has been actively working to develop additional policy and guidance to support Command Center watch standers, Environmental Response Investigators, and FOSCRs in activating VRP and SMFF resources. CG-MER established the national SMFF Task Force comprised of over 100 members from industry, first responders, and USCG personnel. The task force has completed a draft QRC for Command Center watch standers which is currently under review by the USCG Office of Shore Forces (CG-741). Additionally, CG-MER has developed the first-ever standard SMFF plan architecture and is in the process of drafting a SMFF Handbook to guide plan development and committee management. Lastly, CG-MER is working with the Office of Port and Facility Compliance (CG-FAC) to establish joint guidance on the establishment of a joint SMFF subcommittee comprised of members of the Area Maritime Security Committee and the Area

Committee. These combined actions provide comprehensive and holistic policy for all elements of USCG field units engaged in SMFF planning, preparedness, and response operations.

Administrative Recommendation 5: Recommend USCG Northeast District (fomerly District 1) Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation by Grimaldi of Title 46 CFR § 4.06-3(b)(1) as described in section 6.4.1 of the Report of Investigation.

Action: I concur with this recommendation and the USCG Northeast District Commander's endorsement. The recommended violation will be referred to Sector New York for further action.

Administrative Recommendation 6: Recommend USCG Northeast District (fomerly District 1) Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation of Title 33 CFR §155.5012 described in section 6.4.2 of the Report of Investigation.

Action: I concur with this recommendation and the USCG Northeast District Commander's endorsement. The recommended violation will be referred to Sector New York for further action.

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16732
25 Mar 2025

FIRE AND SUBSEQUENT LAND-BASED FIREFIGHTER FATALITIES ONBOARD GRANDE COSTA D'AVORIO (9465382) WHILE CONDUCTING CARGO OPERATIONS AT BERTH 18, PORT NEWARK, NEW JERSEY ON JULY 5, 2023

ENDORSEMENT BY THE COMMANDER, FIRST COAST GUARD DISTRICT

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

ENDORSEMENT/ACTION ON SAFETY RECOMMENDATIONS

Safety Recommendation 1. Update Safety of Life at Sea (SOLAS) fire drill requirements to include training for fires in port. Recommend the Commandant work with the International Maritime Organization (IMO) to update SOLAS Chapter III, Regulation 19.3.4.1. to further define that "various emergencies that may occur" includes fires both at sea and in port. As currently worded, the regulation affords interpretative discretion to the vessel's operator and Master as to the types of "various emergencies that may occur." As a result, most, if not all, shipboard fire drills are conducted only during an "at sea" scenario. This is because, while at sea, the vessel's crew is self-reliant for fire suppression, and it avoids the delay of cargo operations. However, fire drills underway are incapable of fully simulating the conditions that may be presented during in port cargo operations, which, as this incident demonstrates, are an inherent fire risk. It is the vessel crew's initial actions that would likely prevent a fire from becoming uncontrollable. This update will ensure that vessel crews are conducting training to adequately prepare them to perform initial firefighting during in port cargo operations.

Endorsement: Concur – My office agrees with the recommendation for Commandant to work with the IMO to update SOLAS Chapter III, Regulation 19.3.4.1. to further define that "various emergencies that may occur" includes fires both at sea and in port. The Master of the GRANDE COSTA D'AVORIO stated that fire drills were conducted every 15 days as prescribed by the company, but that the subject of the drill was left to the discretion of the Master, which he always elected to perform at sea. While many components in responding to a shipboard fire are the same no matter the vessel's location, when at sea, the Watertight Doors (WTD) in the cargo deck fire protection zone boundary are always closed by regulation. As noted in the investigation, while in-port it was standard practice to have the WTDs open until preparations were made to sail for sea. Since none of the vessel's fire drills were performed while in port, the crew never trained in the action of closing the WTDs during an emergency, either in normal or emergency actuating mode. Had fire drills been conducted while the vessel was in port, the crew would have become familiar with closing the WTDs during an emergency, thus potentially reducing the spread of fire from the cargo decks.

Safety Recommendation 2. Add U.S. Regulatory Requirement to Conduct In-port Fire Drill Prior to Commencing Cargo Operations. Recommend the Commandant amend 33 CFR Chapter I to include a requirement that all large cargo vessels, regardless of its flag state, cargo type, or frequency in U.S. ports, periodically conduct a shipboard fire drill dockside prior to commencing cargo operations. The drill scenario should be required to focus on the probable emergency type(s) associated with cargo operations and include checking the operation of WTDs, weathertight doors, fire doors, fire dampers, and main inlets and outlets of ventilation systems in the drill area. It is recommended that the drill also simulate notification of land-based fire authorities, the Coast Guard, and the Port Authority, activation of the Vessel Response Plan, and interaction with land-based fire response personnel upon arrival. For the reasons discussed above, and as this incident particularly demonstrated, underway drills are inadequate at preparing vessel's crew to respond to an in port fire. This requirement will ensure that vessel crews are prepared to respond swiftly to in port emergencies to protect the vessel, human life, cargo, port, and the marine transportation system overall.

> **Endorsement:** Concur – My office agrees that the vessel crew could have been better trained and prepared to respond swiftly to in-port emergencies to protect the vessel, human life, cargo, port infrastructure, and the overall marine transportation system. It is of my office's opinion that the recommended amendment to 33 CFR Chapter I would be better suited to include a robust in-port checklist of fire prevention items, land-based stakeholder notifications, and Vessel Response Plan reviews be conducted prior to cargo operations as opposed to periodic in-port drills. It is the intent that crews of vessels calling upon U.S. ports are familiar with probable emergency type(s) associated with cargo operations, and the operational condition of watertight doors, weathertight doors, fire doors, fire dampers, and main inlets and outlets of ventilation systems. Additionally, it is with the intent that vessel crews are familiar with notifications required within Vessel Response Plans, as well as their ability to critically identify land-based response agencies to assist in the event of a shipboard emergency.

Safety Recommendation 3. Strengthen Role of Vessel Crew in NFPA Standard 1405. Recommend the Commandant work with the National Fire Protection Association (NFPA) to update NFPA Standard 1405, Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires, to expand and specify the roles, responsibilities, and required coordination by the vessel's crew with land-based firefighters and vessel shoreside representatives, during a response to a shipboard fire in port. Specifically, it is recommended that the Master or other senior vessel officer and/or Port Captain/Engineer be directly incorporated into the land-based firefighting Incident Command Post (ICP) to assist in interpreting the vessel's fire control plan and provide advice on shipboard tactical firefighting efforts. This incorporation will ensure that land-based fire departments understand the various positions and roles on a vessel, have a direct representative to effect orders relating to the ship and its installed systems, and benefit in the expertise they can offer to the vessel's particulars and response.

> **Endorsement:** Concur – My office agrees with the recommendation that the Commandant work with the NFPA to update NFPA Standard 1405, Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires, to expand and specify the roles, responsibilities, and required coordination by the vessel's crew with land-based firefighters and vessel shoreside representatives, during a response to an in-port shipboard fire. In this case, had an adequate ICP been established, it is reasonable to believe that more robust tactical and strategic plans would have been developed and carried out. It was noted multiple times throughout the investigation that Newark Fire Department (NFD) personnel were unfamiliar with the Master's authority for directing

onboard operations. Additionally, the NFD was unable to understand and utilize the onboard Fire Control Plan. With an update to NFPA 1405, it is reasonable to believe that shoreside responders would integrate with onboard crewmembers more proficiently in an ICP to effectively combat shipboard fires at the pier.

Safety Recommendation 4. Incorporate Shipboard Firefighter's Outfits Standards in NFPA 1970. Recommend the Commandant work with the NFPA to update NFPA standard 1970, Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS), to include provisions for firefighter protective equipment used by departments who may encounter vessel fires. It is recommended that standards and testing be developed to ensure the protective clothing, gloves, boots, and helmets used by land-based fire departments responding to shipboard fires can withstand the unique conditions of that environment, as this incident presented with reported boot failures. This testing will ensure that land-based fire departments are equipped to respond to shipboard fires that may pose more strenuous and extreme conditions than the typical structure fire they are accustomed to.

Endorsement: Concur – My office agrees with the recommendation that Commandant work with the NFPA to update NFPA standard 1970, Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS), to include provisions for firefighter protective equipment used by departments who may encounter vessel fires. In this case, NFD's onboard response was challenged by their SCBA air shortages and protective clothing failures. An update to NFPA would ensure that land-based fire departments are adequately equipped to respond to shipboard fires and would help prevent vital equipment failures impacting their shipboard firefighting capabilities.

Safety Recommendation 5. Update Marine Firefighting Contingency Plans. Recommend the Commandant issue a directive for all Coast Guard Captains of the Port to update their port's Marine Firefighting Contingency plan(s) to include the following:

1. For any vessel fire, the Coast Guard will immediately provide an in-person AREP to the land-based firefighting ICP during the firefighting response. The AREP should be well versed in shipboard layout, fire control plans, fire suppression equipment, and vessel crew relations.

2. Upon establishment of a land-based firefighting ICP, a senior vessel crewmember or Port Captain should be embedded to help the Incident Commander interpret fire control plans for the vessel and provide advice during tactical planning.

3. Establish a shipboard firefighting drill and exercise program at least annually that brings all land-based fire departments within the port's area of responsibility, Coast Guard (specifically the designated AREP(s)), and other response agencies port-wide for scenarios focused on testing the marine firefighting contingency plans and improving response.

Endorsement: Concur with intent – My office agrees with the safety recommendation that the Marine Fire Fighting Contingency Plan, in this case, could have been more prescriptive. However, we believe it would be more appropriate for the Commandant to issue a directive for all Coast Guard Captains of the Port to first review and update as

necessary their Port's Marine Firefighting Contingency Plans alongside their port partners and self-identify gaps in forming an effective ICP.

ENDORSEMENT/ACTION ON ADMINISTRATIVE RECOMMENDATIONS

Administrative Recommendation 1. Recommend the First Coast Guard District Commander refer elements of this case to the Occupational Safety and Health Administration (OSHA), who implemented their authority over marine terminal operations and equipment in 29 CFR § 1917 and longshoremen safety and health in 29 CFR § 1918, to conduct a compliance inspection on Ports America operations at Port Newark berth 16-18. Particular attention should be given to pusher vehicle use and modification, maintenance procedures, and out-of-service or "lockout/ tag-out" protocols. Additionally, recommend further attention be focused on shipboard emergency action planning, procedures, and training for both Ports America and AMS employees working at this terminal.

Endorsement: Concur – My office agrees with the recommendation for OSHA to conduct a compliance inspection of Ports America at Port Newark berths 16-18 in accordance with 29 CFR § 1917 and 29 CFR § 1918 respectively. We agree that particular attention should be given to pusher vehicle use and modification, maintenance procedures, and out-of-service or "lockout/ tag-out" protocols. Had a more robust pusher vehicle program been implemented, it is reasonable to believe the Jeep would have been taken out of service and may not have caught fire.

Action: The Port of Newark under Sector New York's jurisdiction and the Sector Commander can readily capitalize on established port partnerships to achieve improved safety compliance. My office intends to refer the recommendation to Sector New York for further action.

Administrative Recommendation 2. Recommend the Commandant establish a Memorandum of Understanding (MOU) with National Institute for Occupational Safety and Health Fire Fighter Fatality Investigation and Prevention Program (NIOSH FFFIPP) to formalize their support of Coast Guard marine casualty investigations involving land-based firefighter fatalities and "near-misses" (maydays). Similar to the benefit the Coast Guard gains from our MOU with ATF in their expertise on fire cause, origin, and spread analysis, NISOH FFFIPP presents expertise to land based firefighting. The phraseology, culture, doctrine, equipment, and tactics of land-based firefighting varies significantly from shipboard firefighting. This investigation is testament to the professional insight and subject matter expertise of the NIOSH FFFIPP, where the investigator formulated diagrams for public release of the firefighting response and testified at the formal public hearing. NIOSH FFFIPP's engagement in this incident was triggered by an LODD but still required an invitation from the NFD or firefighter union to investigate. A formalized partnership between the two agencies will ensure future marine casualty investigations, whether involving a LODD, "near miss," or invitation from the local Fire Department or union, can benefit from NIOSH FFFIPP's expertise and enable informed recommendations to prevent fatalities and injuries sustained by land-based firefighters in the shipboard environment.

Endorsement: Concur – My office agrees with the recommendation for Commandant to establish a MOU with NIOSH FFFIPP to formalize their support of Coast Guard marine casualty investigations involving land-based firefighter fatalities and "near-misses" (maydays). For example, the Coast Guard's MOU with the ATF has proven mutually beneficial in determining fire cause, origin, and spread analysis during multiple marine

casualty investigations. This investigation identified a significant gap in land-based versus shipboard firefighting knowledge and tactics. A formalized relationship with NIOSH FFFIPP through a MOU would bridge the gap between land-based and shipboard firefighting methodologies, greatly reducing future chances for serious injury or loss of life.

Administrative Recommendation 3. Recommend the Commandant join the Tokyo and Paris MOU on Port State Control in their joint Concentrated Inspection Campaign (CIC) on Fire Safety that occurred from September 1 to November 30, 2023. The CIC examined specific areas related to fire safety in conjunction with regular Port State Control inspections using a pre-defined questionnaire. This questionnaire should be adopted and expanded upon to include a check of all types of closures that create the barrier for CO2 fire protection zones on all vessels, both foreign and domestic, to which SOLAS applies. A campaign of this nature would help identify any vessels that have similar risk factors to those impacting this incident that prohibited the crew from sealing off CO2 protected spaces and rendered the fixed fire extinguishing system ineffective. The results of the campaign should be shared with relevant flag States to best rectify deficiencies for their vessels.

Endorsement: Concur – My office agrees that Commandant should conduct a CIC and share the results in accordance with the Tokyo and Paris MOU on Port State Control. It is recommended that CVC adopt and expand upon the questionnaire to assess that fire-fighting systems and equipment comply with the relevant requirements, that the master and crew members are familiar with operations relating to fire safety, and that equipment is properly maintained and functioning. In this case, had the crew been appropriately familiar with the procedures required for deployment of the low pressure CO2 system, it is reasonable to believe they would have identified the deficiencies with the WTD-12 controls. A CIC of this nature would greatly improve shipboard firefighting readiness and reduce the opportunity for critical failures threatening life, property, and the environment in U.S. ports.

Administrative Recommendation 4. Recommend the Commandant develop or update policy, command center Quick Response Cards, job aids, and tactics, techniques, and procedures related to commercial vessel fires to prompt Command Center watch standers, Pollution Responders, and FOSC representatives to discuss activation of the Vessel Response Plan and Salvage and Marine Firefighting (SMFF) resources. While Coast Guard responders are adept at asking about plan activation during a pollution incident, this case shows that the same proficiency may not exist for doing so with vessel fires. Just as Oil Spill Removal Organizations are critical to mitigating environmental impacts, the predesignated SMFF Provider is essential to ensuring that vessels receive fire mitigation assistance. While still the sole responsibility of the person in charge of the vessel, prompting by the Coast Guard as a regulatory agency would likely reinforce timely activation of these critical resources.

Endorsement: Concur – My office agrees that Commandant should develop or update policy, Command Center Quick Response Cards (QRCs), job aids, and Tactics, Techniques, and Procedures (TTPs) related to commercial vessel fires to prompt Command Center watch-standers, Pollution Responders, and FOSC representatives to discuss activation of the Vessel Response Plan (VRP) and SMFF resources immediately following an incident. In this case, had the QRC addressed VRP activation and SMFF notification, it is reasonable to believe that SMFF resources would have been deployed, and they may have bridged the gap between land-based firefighting and shipboard firefighting. This then may have avoided the potential for injury and loss of life.

Administrative Recommendation 5. Recommend the First Coast Guard District Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation of 46 CFR § 4.06-3(b)(1) described in section 6.4.1.

Endorsement: Concur – My office agrees with the recommendation for the Coast Guard to pursue civil penalty enforcement action against Grimaldi for the alleged violation of 46 CFR § 4.06-3(b)(1) described in section 6.4.1.

Action: My office intends to refer the recommendation to Sector New York for further action.

Administrative Recommendation 6. Recommend the First Coast Guard District Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation of 33 CFR § 155.5012 described in section 6.4.2.

Endorsement: Concur – My office agrees in part with the recommendation for the Coast Guard to pursue civil penalty enforcement action against Grimaldi for the alleged violation of 33 CFR § 155.5012 described in section 6.4.2.

Action: My office intends to refer the recommendation to Sector New York for further action.

[redacted]

MICHAEL E. PLATT
Rear Admiral, U.S. Coast Guard
Commander, First Coast Guard District

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
First District

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16732
10 July 2023

MEMORANDUM

[redacted]

From: John W. Mauger, RADM
CGD ONE (d)

To: Christian Barger, CDR
CGD FIVE (dpi)

Subj: FORMAL MARINE CASUALTY INVESTIGATION CONCERNING A FIRE ONBOARD THE ROLL ON-ROLL OFF (RO/RO) CONTAINER VESSEL GRANDE COSTA D'AVORIO (O.N. 9465382) ON 5 JULY 2023

Ref: (a) Title 46 United States Code, Chapter 63
(b) Title 46 Code of Federal Regulations, Part 4
(c) Marine Safety Manual, Volume V; COMDTINST M16000.10A
(d) CG-545 Policy Letter 5-10

1. Pursuant to the authority contained in references (a) and (b), you are to convene a formal investigation for the marine casualty of the Italian Flagged RO/RO Container Vessel GRANDE COSTA D'AVORIO (O.N. 9465382) that occurred on July 5, 2023. In conducting your investigation, you shall follow as closely as possible the policy, guidance, and operational procedures for Coast Guard Marine Investigations Program, as found in reference (c).

2. I have assigned the following persons to assist you with your investigation. For purposes of this investigation, the below persons are all designated as investigating officers as defined under reference (b).

- LCDR [redacted] USCG, Assistant Investigating Officer
- LT [redacted] USCG, Recorder
- LCDR [redacted] USCG, Legal Counsel
- Mr. [redacted] USCG, Subject Matter Expert

3. Upon completion of the investigation, you will issue a Report of Investigation (ROI) to me with the collected evidence, the established facts, conclusions, and recommendation. Conclusions and recommendations concerning commendatory actions or misconduct that would warrant further inquiry shall be referred to me by separate correspondence for consideration and action as appropriate. A weekly summary of significant events shall be transmitted to CGD ONE (dp) while the investigation is in formal session.

4. You will complete and submit your investigation report to me by April 5, 2024. If this deadline cannot be met, you shall submit a written explanation for the delay and notice of the expected completion date. You are highly encouraged to submit any interim recommendations intended to prevent similar causalities, if appropriate, at any point in your investigation.

5. The National Transportation Safety Board (NTSB) is also charged with the responsibility of determining the cause or probable cause of this casualty by the Independent Safety Board Act of 1974 (49 U.S.C. § 1901, et. seq.) and has designated Mr. [redacted] to participate in this investigation. Mr. [redacted] may make recommendations regarding the scope of the inquiry, may identify and examine witnesses, and or submit or request additional evidence.

6. CGD ONE (dpi) will furnish such funding and technical assistance as may be required by the investigation when deemed appropriate and within the requirements for the scope of the work.

#

Copy: COMDT (CG-INV)
COMDT (CG-CVC)
LANTAREA
CGD ONE (dp)(dl)(de)
CGD FIVE (dp)
CG SECTOR New York
Investigations NCOE

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
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16732
15 Mar 2024

MEMORANDUM

[redacted]

From: Christian J. Barger, CDR
Lead Investigating Officer, GRANDE COSTA
D'AVORIO Formal Investigation

To: CGD ONE (d)
Thru: CGD ONE (dp [redacted]

Subj: EXTENSION REQUEST, GRANDE COSTA D'AVORIO DISTRICT FORMAL REPORT OF INVESTIGATION (ROI)

Ref: (a) Your memo 16732 of 10 Jul 2023
(b) CG-INV Policy Letter 02-22 (Change 1) dated 25 Sep 2023

1. I respectfully request a one-month extension to the 05 Apr 2024 ROI submission deadline specified by reference (a). We are still awaiting a final fire origin and cause report from ATF, analysis report of computer modeling on fire spread and CO2 system effectiveness from ATF and CG-MSC, and just received final production requests from the PIIs. The final ATF reports are delayed by our need to conduct virtual follow-up witness testimony sessions following the in-person formal hearing and the PII production requests were made in response to testimony throughout the hearing process. I am confident that extending the deadline to 05 May 2024 will allow us sufficient time to receive and fully incorporate these remaining reports and new evidence into the ROI to support our conclusions and recommendations.

2. Reference (b) recognizes that certain casualty and accident investigations with complex elements may have valid reasons for exceeding the specified time requirements. Valid reasons for exceeding the time limitations applicable to this request include new evidence was introduced, waiting on a report from an entity external to the Coast Guard, and waiting on a report from an entity external to the investigating unit.

3. We are striving to produce a timely ROI, which will include recommendations to improve safety. We have already addressed the most pressing of safety concerns identified during the investigation in the Safety Alert we authored, which was released by CG-INV as Safety Alert 09-23 on 20 Nov 2023.

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Abbreviation	Title
ACL	Atlantic Container Line
ACP	Area Contingency Plan
AMS	American Maritime Services of New York
AREP	Agency Representative
ATF	Bureau of Alcohol, Tobacco, Firearms, and Explosives
BC	Battalion Chief
Capt	Fire Captain
CFR	Code of Federal Regulations
CIC	Concentrated Inspection Campaign
CO_2	Carbon Dioxide
Coast Guard	U.S. Coast Guard
CPR	Cardiopulmonary Resuscitation
DC	Deputy Chief
DPA	Designated Person Ashore
EAB	Emergency Action Button
EGCU	Engine Gas Cleaning Unit
EMS	Emergency Medical Services
FAST	Firefighter Assist Search Team
FC	Fire Chief of Newark Fire Department
FD	Fire Department
FDNY	New York City Fire Department
FDNY BC	New York City Fire Department Marine Battalion Chief
FF	Firefighter (as a title)
FOSC	Federal On-Scene Coordinator
Grimaldi	Grimaldi Deep Sea SPA
ICLL	International Convention on Load Lines
ICP	Incident Command Post
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
ISM	International Safety Management Code
LODD	Line of Duty Death
MOU	Memorandum of Understanding
NFD	Newark Fire Department
NFPA	National Fire Protection Association
NIOSH FFFIPP	National Institute for Occupational Safety and Health, Firefighter Fatality Investigation and Prevention Program
NTSB	National Transportation Safety Board
NTVRP	Non-Tank Vessel Response Plan
NVIC	Navigation and Vessel Inspection Circular
OSHA	Occupational Safety and Health Administration
PAR	Personnel Accountability Report
PASS	Personal Alert Safety System

PII	Party in Interest
PLC	Programmable Logic Controller
Port Authority	Port Authority of New York and New Jersey
QI	Qualified Individual
RIT	Rapid Intervention Team
Ro-Ro	Roll-on Roll-off
SCBA	Self-Contained Breathing Apparatus
Sector NY	U.S. Coast Guard Sector New York
SIS	Substantially Interested State
SMFF	Salvage and Marine Firefighting
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
STCW	Standards of Training Certification and Watchkeeping
the JEEP	2008 Yellow Jeep Wrangler X pusher vehicle
TIC	Thermal Imaging Camera
UASI	Urban Area Security Initiative
USAR	Urban Search and Rescue
USC	United States Code
VDR	Voyage Data Recorder
VHF	Very High Frequency
WTD	Weathertight Cargo Door
WTD-12	Weathertight Cargo Door Ramp 12

LIST OF FIGURES

U.S. Department of Homeland Security
United States Coast Guard

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16732
November 22, 2024

FIRE AND SUBSEQUENT LAND-BASED FIREFIGHTER FATALITIES ONBOARD GRANDE COSTA D'AVORIO (9465382) WHILE CONDUCTING CARGO OPERATIONS AT BERTH 18, PORT NEWARK, NEW JERSEY ON JULY 5, 2023

EXECUTIVE SUMMARY

On July 5, 2023, the Italian-flagged Ro-Ro/Container vessel GRANDE COSTA D'AVORIO (9465382) (hereinafter "the vessel") was docked at Berth 18, Port Newark, New Jersey to load cargo ultimately destined for West Africa. At 0700 Eastern Daylight Time (all times approximate), roll-on/roll-off cargo operations commenced loading mostly used cars, vans, and trucks in varying conditions. These operations continued as planned throughout the day. Non-running vehicles being loaded as cargo were pushed onto the vessel and into place by lashers driving "pusher vehicles." The fleet of pusher vehicles utilized for these operations included one 2008 JEEP Wrangler X (hereinafter "the JEEP") and several small pickup trucks, each modified with large steel front bumpers and weights in the back to enable the vehicle pushing capability.

At 2058, nearing the end of cargo operations onboard the vessel, the JEEP pushed a non-running Toyota Venza cargo vehicle onto the vessel and continued from the top of the stern ramp at deck 3 up to deck 10. Upon reaching deck 10 and getting the Toyota Venza pushed into place, the driver of the JEEP was alerted by the shouts of surrounding vessel crewmembers and lashers that the JEEP was on fire. In response, several unsuccessful attempts were made to extinguish the fire using five nearby portable dry-chemical fire extinguishers. The vessel crewmembers then rigged fire hoses and used one to fight the fire directly while using another to boundary cool below on deck 9. The water was also unsuccessful at extinguishing the fire. The fire quickly spread upwards igniting vehicles on deck 11. Simultaneously, the vessel's fire teams donned their firefighting equipment. In preparation for using the low-pressure Carbon Dioxide (CO_2) fixed fire suppression system, vessel crewmembers closed the boundary doors of Fire Protection Zone C (cargo decks 6 to 11) except for the hydraulically actuated Weathertight Cargo Door Ramp 12 (WTD-12). This door, located at the top of the vehicle ramp going from cargo deck 11 to 12 (top weather deck), was the upper-most opening into CO_2 Fire Protection Zone C. The hot black smoke exhausting out of the opening and the fact that the sole controls for the door were located inside the space, prevented crewmembers from closing the door. Despite the door remaining open, at 2122, CO_2 was discharged into Fire Protection Zone C. Over ten minutes, the system released CO_2 into the space. The smoke exhausting from WTD-12 changed from thick black to light gray. The vessel's crew performed boundary cooling on decks 11 and 12.

At 2132, the first Newark Fire Department units arrived on scene dockside. Firefighters attempted to communicate with the crewmembers at the vessel access point (stern vehicle ramp),

but a perceived language barrier with the foreign crewmembers prevented garnering much information. An incident command post was established at the top of the vessel's stern ramp and the first engine company was sent up to deck 12 to investigate the situation. On their way up, the firefighters accessed cargo deck 11 and reported that there were no visible flames, but heavy smoke. Eventually, at 2142, they made entry into deck 10 and reported that the fire was knocked down. Multiple engine and ladder company teams rotated in and out of deck 10 to further investigate the situation and overhaul the fire. At 2222, a mayday was called with two firefighters lost in deck 10. The first lost firefighter was found stuck between two vehicles at 2240 and extricated from deck 10 at 2358. Varying degrees of search effort continued for the second firefighter until he was found on July 6 at 0208 and was removed from the vessel at 0305. During this time, the fire burned heavily on deck 11. No additional attempts were made to fight the fire, with all fire department personnel evacuating the ship by 0400. The vessel's crew abandoned the vessel at 0640. Shortly after which, the vessel's designated Salvage and Marine Firefighting Provider, working as part of a Unified Command structure, took over and managed the continuing incident response.

As a result of the incident, two Newark firefighters lost their lives, and six other first responders sustained non-life-threatening injuries. The fire continued to burn for five days causing an estimated $23 million in damage to the vessel. In September 2023, the vessel was towed to a repair facility in Yalova, Turkey.

As a result of its investigation, the U.S. Coast Guard determined that the initiating event for this casualty was a mechanical failure of the JEEP, likely the transmission overheated, which caused it to expel a flammable fluid onto the JEEP's hot engine and/or exhaust system components. Subsequently, a fire ignited in the JEEP's engine compartment quickly burning out of control and spreading to surrounding vehicles on both decks 10 and 11. This was followed by the inability to close WTD-12, significantly contributing to fire growth and reducing the effects of the low-pressure CO_2 fire suppression system. Furthering the ineffectiveness of the CO_2, Newark Firefighters accessed decks 10 and 11 through ladderwell doors reintroducing additional oxygen into the space contributing to fire reflash. Newark Firefighters fought the fire on deck 10 until two firefighters were lost in the space, after which efforts turned to only search and rescue. To aid the search, the deck 10 ventilation was activated, further introducing oxygen and stoking the fire on deck 11. By the time the lost firefighters were found and extricated, they had succumbed to carbon monoxide intoxication resulting in their deaths. The causal factors that contributed to this incident included: (1) prolonged misuse of the JEEP beyond designed operating parameters; (2) lack of a formal routine preventative maintenance program for the pusher vehicles; (3) lack of a formally implemented program to remove pusher vehicles experiencing mechanical issues from service; (4) continued use of the JEEP after signs of overheating; (5) ineffective initial shipboard firefighting efforts; (6) lack of operating controls for WTD-12 outside of the fire protection zone; (7) lack of specific in-port fire response training/planning for vessel crew; (8) lack of shipboard firefighting pre-planning/training for Newark firefighters; (9) inadvisable shipboard firefighting planning/tactics used by the Newark Fire Department; and (10) use of equipment and procedures by the Newark Fire Department not compatible for the shipboard environment.

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16732
November 22, 2024

FIRE AND SUBSEQUENT LAND-BASED FIREFIGHTER FATALITIES ONBOARD GRANDE COSTA D'AVORIO (9465382) WHILE CONDUCTING CARGO OPERATIONS AT BERTH 18, PORT NEWARK, NEW JERSEY ON JULY 5, 2023

INVESTIGATING OFFICER'S REPORT

1. Preliminary Statement

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

1.2. On July 10, 2023, the First Coast Guard District Commander, Rear Admiral John Mauger, convened a formal marine casualty investigation into this incident. The U.S. Coast Guard (hereinafter "Coast Guard") investigation designated team members included CDR Christian Barger (Lead Investigating Officer), LCDR [redacted] (Assistant Investigating Officer), LT [redacted] (Recorder), LCDR [redacted] (Legal Counsel), and Mr. [redacted] (Technical Expert). Mr. [redacted], a fire protection engineer from the Coast Guard's Marine Safety Center, informed the investigation through the analysis of fire spread and shipboard fire suppression system effectiveness.

1.2.1. As part of the fact-finding portion of the investigation, a formal public hearing was held in Union, New Jersey from January 10 to 18, 2024, to meet the mandate of 46 USC § 6302. During the proceeding, 14 fact and four expert witnesses provided sworn testimony, and 20 exhibits were publicly presented. Follow-up virtual testimony was held for four fact witnesses who were unavailable during the in-person hearing. Recordings of the hearing and follow-up virtual testimony as well as entered exhibits are available at https://www.news.uscg.mil/News-by-Region/1st-District-Northeast/PADET-New-York/Grande-Costa-DAvorio-Investigation/.

1.2.2. In determining the facts of the incident, this investigation considered and weighed all collected evidence not just that which was presented publicly as testimony or exhibits at the formal hearing. Evidence not entered into the public record as a part of the hearing can be requested, and considered for release, pursuant to the Freedom of Information Act.

1.3. The following organizations were designated as Parties in Interest (PII) by the Lead Investigating Officer in accordance with 46 USC § 6303 and 46 CFR § 4.03-10:

1.3.1. Grimaldi Deep Sea SPA (hereinafter "Grimaldi"), as the managing owner of the GRANDE COSTA D'AVORIO. Grimaldi was represented by counsel from the law firm of Montgomery McCracken Walker & Rhoads LLP.

1.3.2. Ports America, as the organization contracted to conduct cargo loading of the GRANDE COSTA D'AVORIO on the day of the incident. Ports America was represented by counsel from the law firm of Kaufman Dolowich LLP.

1.3.3. American Maritime Services of New York (AMS), as the organization contracted to provide personnel to conduct loading operations of the GRANDE COSTA D'AVORIO on the day of the incident. AMS was represented by counsel from the law firm of Freehill Hogan & Mahar LLP.

1.3.4. Port Authority of New York and New Jersey (hereinafter "Port Authority"), as the operator of Port Newark. The Port Authority was represented by counsel from the law firm of Squire Patton Boggs (US) LLP.

1.3.5. City of Newark, New Jersey, as the municipality that provided the primary land-based firefighting response to the incident. The City of Newark was represented by counsel from the City of Newark Department of Law.

1.4. In accordance with 46 CFR § 4.40, the Coast Guard was designated as the lead federal investigative agency. The National Transportation Safety Board (NTSB) conducted its own independent concurrent investigation into the incident. To avoid duplicated efforts, and in accordance with the 2021 Memorandum of Understanding (MOU) between the agencies, the NTSB participated jointly with the Coast Guard in all fact-finding portions of the investigation and formal hearing. Each agency then conducted its own independent analysis in drafting separate reports inclusive of conclusions and recommendations.

1.5. Per the International Maritime Organization (IMO) Casualty Investigation Code and the implementing policy under the Coast Guard's Navigation and Vessel Inspection Circular (NVIC) No. 05-17, the vessel's flag State, Italy, was designated as a Substantially Interested State (SIS) and provided the opportunity to participate in the investigation. As an SIS, Italy was also afforded the opportunity to review and comment on this report before its finalization.

1.6. To avoid duplicate efforts during preliminary evidence collection, the following federal, state, and local investigative agencies assisted this investigation based on their independent authorities and jurisdictions:

1.6.1. Federal.

1.6.1.1. *Bureau of Alcohol, Tobacco, Firearms, and Explosives* (ATF) determined the fire origin and cause and modeled fire behavior and fire suppression system

effectiveness in accordance with the 2002 Coast Guard – ATF MOU.

1.6.1.2. *The National Institute for Occupational Safety and Health's Firefighter Fatality Investigation and Prevention Program* (NIOSH FFFIPP) provided expertise in land-based firefighting equipment, tactics, standards, and conduct.

1.6.1.3. The *Armed Forces Medical Examiner System* provided consultation and testified as an expert witness on the autopsy results for the fallen firefighters.

1.6.2. State.

1.6.2.1. *New Jersey Division of Fire Safety*; *New Jersey Department of Health*; and *New Jersey Public Employees Occupational Safety and Health* informed this investigation within their respective areas of expertise.

1.6.2.2. The *New Jersey State Medical Examiner* conducted the autopsies on both fallen firefighters to determine cause and manner of death.

1.6.3. Local.

1.6.3.1. *Essex County Prosecutors Office* and *Port Authority Police Department* assisted with evidence collection within their areas of authority and jurisdiction.

1.7. All times in this report are local to the incident (Eastern Daylight Time, Coordinated Universal Time offset minus four hours), in the 24-hour time format, and are approximate. Unless otherwise indicated, conditional states are as they existed on July 5, 2023.

2. Vessel Involved in the Incident

Figure 1. Photograph of GRANDE COSTA D'AVORIO pre-incident from www.VesselFinder.com.

Official Name:	*GRANDE COSTA D'AVORIO*
Identification Number:	9465382, IMO Number
Flag:	Italy
Vessel Class/Type/Sub-Type:	Ro-Ro Cargo Ship/Ro-Ro Container/General
Build Year:	2011
Gross Tonnage:	47,232 GT
Length:	692 FT
Beam/Width:	105 FT
Draft/Depth:	30.8 FT
Main/Primary Propulsion: (Configuration/System Type, Ahead Horsepower)	Direct Diesel/25,532 HP Ahead
Owner:	Grimaldi Deep Sea S.P.A. Palermo, Italy
Operator:	Grimaldi Deep Sea S.P.A. Palermo, Italy
Classification Society:	RINA S.P.A.

3. Deceased, Missing, and/or Injured Persons [1]

Relationship to Vessel	Sex	Age	Status
External Victim (hereinafter "Firefighter A") from Newark Fire Department, Engine-16	Male	45	Deceased
External Victim (hereinafter "Firefighter B") from Newark Fire Department, Ladder-4	Male	49	Deceased

4. Findings of Fact

4.1. The Incident.

4.1.1. On July 5, 2023, at 0520, the GRANDE COSTA D'AVORIO (hereinafter "the vessel") docked at Port Newark, New Jersey, Berth 18.

4.1.2. At 0700, the vessel began Roll-On Roll-off (Ro-Ro) cargo loading operations. The vessel was scheduled to embark 919 used vehicles in varied conditions throughout the day. The vehicles were ultimately destined for West Africa. AMS supplied lashers[2] who used "pusher[3]" vehicles owned by Ports America to load non-running cargo vehicles[4].

4.1.3. The weather that evening was 86 degrees Fahrenheit, clear skies, and a maximum wind speed of eight miles per hour. Sunset occurred at 2031.

4.1.4. At 2049, Lasher 1 drove a 2008 Yellow JEEP Wrangler X retrofitted as a pusher vehicle with a large steel front bumper and weights in the rear (hereinafter "the JEEP" and pictured in the following Figure 2), off the vessel after it loaded a non-running cargo vehicle onboard in a manner similar to the depiction in the following Figure 3. At the bottom of the vessel's stern ramp, Lasher 1 turned the JEEP around to assist another pusher vehicle having trouble pushing a non-running cargo vehicle up the ramp. The JEEP made multiple attempts to independently push the non-running cargo vehicle without success. Eventually, both the JEEP and the other pusher vehicle pushed the non-running cargo vehicle in tandem to the top of the stern ramp and into deck 3 at 2051.

[1] Other injuries occurred during this incident that did not meet the threshold for specific reporting as set forth by 46 CFR § 4.01(b)(6) and interpreted by NVIC 01-15. They are documented in section 4.1.111, however.
[2] Lasher: land-based longshore employee tasked with securing cargo, disconnecting rolling cargo batteries, pushing non-running cargo vehicles onto vessels, and jump-starting running cargo vehicles in the storage yard, as needed.
[3] "Pusher" vehicle: an otherwise stock passenger vehicle retrofitted with a reinforced front bumper, and in some cases weights in the back, used to push non-running cargo vehicles on and off a Ro-Ro vessel.
[4] "Non-running" cargo vehicle: A vehicle that was unable to operate under its own power but was able to be rolled on or off a Ro-Ro vessel during cargo operations by other means.

Figure 2. Photograph of the JEEP taken from Port Newark security footage of July 5, 2023.

Figure 3. Photograph of the JEEP pushing a non-running cargo vehicle taken from Port Newark security footage of July 5, 2023.

4.1.5. At 2058, Lasher 1 drove the JEEP pushing a non-running Toyota Venza cargo vehicle onto the vessel via the stern ramp. The Toyota Venza was destined to be loaded and secured on deck 10.

4.1.6. Lasher 1 recounted experiencing the JEEP going slower than normal while pushing the Toyota Venza and then hearing a loud metallic clang coming from outside the cab of the JEEP while in transit on the vehicle ramp from deck 6 to deck 10. Lasher 1 indicated he had to fully depress the gas pedal to gain enough power to move the cargo vehicle.

4.1.7. At 2100, Lasher 1 drove the JEEP onto deck 10 and pushed the Toyota Venza into place along the aft bulkhead. During this time, other surrounding lashers and vessel crewmembers observed a fire developing in the JEEP, including "liquid flames" that dripped from the undercarriage and pooled on the deck. Witnesses observed flames on the right passenger side of the JEEP. Lasher 1 was notified of the fire by multiple shouts coming from the other lashers and vessel's crew. Through the right passenger window, Lasher 1 stated that he observed flames coming from the engine compartment of the JEEP. Lasher 1 exited the JEEP leaving the engine running. The vessel's fire alarm sounded.

4.1.8. Personally observing the fire, the Chief Mate used his radio to alert the other vessel crewmembers on duty. The Chief Mate then, along with other crewmembers and Lasher 1, used the vessel's portable fire extinguishers aimed at the JEEP's engine compartment.

During these initial efforts, a total of five dry-chemical portable fire extinguishers were used but proved unsuccessful at extinguishing the fire.

4.1.9. The Chief Mate used his radio to notify the Third Mate, who was on watch in the Cargo Control Room on deck 3, of the fire. The Chief Mate directed the Third Mate to shut off the cargo space ventilation, notify the Master, and then report to assist him on deck 10. The Third Mate notified the Master of the fire, who was in his cabin at the time, using the vessel's internal phone system.

4.1.10. At 2106, the Master arrived on the vessel's navigation bridge and started the vessel's fire pumps. The Chief Mate made-up[5] two firefighting hose lines. One hose line was used to combat the fire on deck 10 and the other was used to conduct boundary cooling[6] on deck 9. Witnesses stated that they observed a fiery liquid dripping from deck 10 through the lashing holes[7] into deck 9.

4.1.11. The fire conditions worsened as deck 10 and 11 filled with black smoke that exhausted from exterior boundaries of the vessel on deck 12. Water dispensed on the fire from the fire hoses was unsuccessful at suppressing the fire.

4.1.12. At 2112, the Master ordered the vessel's Firefighter Team No. 2 to dress out the fire team Operator in one of the vessel's firefighter outfits and Self-Contained Breathing Apparatus (SCBA) and then go to deck 12 to investigate and secure Weathertight Cargo Door Ramp 12 (WTD-12). There was a single control panel for WTD-12 on the vessel, which was located internal to the fire boundary. Upon arriving to WTD-12, the team leader informed the Master of heavy black smoke and intense heat coming from the door and that the conditions were too dangerous for the fire team Operator to close the door because it would require the crewmember to do so from inside the space, leaving the only available exit through the fire.

4.1.13. At 2115, the Master ordered the Chief Mate and crew in the cargo decks to evacuate and to prepare for release of the low-pressure Carbon Dioxide (CO_2) fixed fire suppression system into the space. The Chief Mate proceeded to deck 3 and along the way closed Weathertight Cargo Doors (WTD) Deck 6 Front at 2117, Ramp 5-6 at 2118, and Ramp 2-3 at 2119.

4.1.14. At 2119, the Master took a muster, or accountability, of the vessel's crew. All crewmembers were accounted for.

4.1.15. In response to reports that WTD-12 was not closed, the Master directed Firefighter Team No. 2 to use a hose from on top of WTD-12 aimed downward to create a water curtain intended to limit gases exhausting from the ramp opening.

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[5] Making-up Lines: Stretching out a firehose, connecting one end to a hydrant and the other to a nozzle for firefighting operations.

[6] Boundary Cooling: Traditional boundary cooling requires copious quantities of water to be applied onto bulkheads or hull plate boundaries of a fire. This was to prevent or reduce heat from escaping the fire affected space thereby protecting exposures and halting the spread of fire. Similar to "radiant cooling" or "exposure protection".

[7] *See* section 4.2.1.3.2. for a discussion of lashing holes.

4.1.16. Vessel crewmembers advised the Master that fire had spread to an area on deck 12. The vessel's electrician completed electric isolation of the impacted cargo decks.

4.1.17. At 2122, with knowledge that WTD-12 remained open, the Master ordered the Chief Engineer to activate the low-pressure CO_2 system into Fire Protection Zone C[8] which covered the cargo spaces on decks 6 to 11. The Chief Engineer, already stationed in the CO_2 Room, immediately activated the system. After manual activation, the automated system discharged CO_2 into Fire Protection Zone C for approximately 10 minutes. Once complete, the Chief Engineer observed the CO_2 storage tank level indicator, from which he determined that 20 metric tons of CO_2 had been discharged. No attempts were made to manually discharge the remaining CO_2.

4.1.18. Crewmembers observed the smoke conditions coming from open WTD-12 visibly change from black to gray in color and reduce in volume.

4.1.19. From 2122 to 2123, the Newark Fire Department (NFD) Dispatch Center received phone notification from the Port Authority Police Department of five to six vehicles on fire onboard the GRANDE COSTA D'AVORIO.

4.1.20. At 2124, NFD dispatched an initial 11 units to respond, including Battalion Chief (BC)-4[9], BC-5, and the Deputy Chief (DC)-1. While enroute, DC-1 and BC-5 both separately requested through NFD Dispatch to have the vessel's cargo manifest available at the vessel access point upon their arrival. BC-5 also requested the vessel's "blueprint document."

4.1.21. At 2127, the Master notified Coast Guard Sector New York (hereinafter "Sector NY") of the fire using the vessel's Very High Frequency (VHF) radio on channel 16.

4.1.22. At 2132, NFD Engine-27, BC-5, and Ladder-4 arrived on-scene. By the order of DC-1, who was still enroute, NFD Dispatch directed Engine-27 to instead report to and respond with the fireboat. DC-1's order was cancelled by BC-5 due to Engine-27's status as first company already on scene. BC-5 assumed incident command, established a staging area at the base of the vessel's stern ramp, and directed Engine-27 to go onboard the vessel and investigate the situation.

4.1.23. At 2132, the Master notified the Grimaldi on-call vessel Superintendent in Italy by phone alerting him about the fire.

4.1.24. At 2134, DC-1 arrived at the terminal and made his way to the vessel. Shortly after at 2135, BC-4 arrived on scene and, as the second responding BC, automatically

[8] *See* section 4.2.1.3.4.1.1. for a detailed discussion on the vessel's fire protection zones.
[9] With the exception of FF A and FF B, the naming convention used for fire department personnel is reflective of their department position/call sign, numbering does not represent a sequential presentation of those individuals within this report.

assumed the duties of Safety Officer[10].

4.1.25. The crew from Engine-27, escorted by a vessel crewmember, proceeded to the top deck by way of the starboard ladderwell to investigate the fire and report back to BC-5. The Third Mate met the crew from Engine-27 upon their arrival on deck 11 starboard side, where he was leading a team performing boundary cooling. The Third Mate briefed the Engine-27 crew on the status of the fire and the CO_2 release.

4.1.26. At 2136, the crew from Engine-27 attempted to access the cargo space on deck 11 without donning their SCBAs. The Third Mate warned them several times of the unsafe atmosphere conditions caused by the CO_2 release and the need for SCBAs. In response, the Engine-27 crew donned their SCBAs and then accessed the cargo space of deck 11. The Engine-27 crew maneuvered across the space to the port side at the vehicle ramp from deck 11 to deck 12, then retreated across deck 11 and out through the door they originally entered. They reported via radio to BC-5 that there were no visible flames, but heavy smoke on deck 11.

4.1.27. At 2141, based on standard protocol, DC-1 assumed Incident Command from BC-5. This relief was not conducted in person but was announced by DC-1 via radio. DC-1 established an Incident Command Post (ICP) at the top of the vessel's stern ramp. DC-1 met with the Chief Mate on the stern ramp of the vessel. Speaking English, the native-Italian-speaking Chief Mate relayed that the fire started as a car fire on deck 10 and that CO_2 was released into the space. DC-1 perceived[11] a language barrier when communicating with the Chief Mate but said he understood the report. DC-1's aide, who spoke Spanish, attempted to further communicate with the Chief Mate but DC-1 stated his aide also had difficulty. DC-1 was given a copy of the vessel's Fire Control Plan by the vessel's crew. Having never seen or received training on this type of document before, DC-1 found it difficult to discern the information and put it to the side.

4.1.28. Simultaneously, a vessel crewmember escorted BC-5 to deck 12 where he assumed command of the onboard firefighting operations and met with the crew of Engine-27. BC-5 was not wearing his SCBA or turnout gear at the time. Engine-27 reported visible flames on deck 10 to BC-5. BC-5 advised them to use the vessel's hose line from deck 12, which had adequate pressure and water output, to combat the fire on deck 10.

4.1.29. BC-5 met with the vessel Master on deck 12. The Master advised BC-5 that the vessel's crew members were accounted for. Based on personal experience with inaccurate accountability reports at structure fires, BC-5 did not fully trust that all crewmembers were accounted for because he could not personally see them present on decks 11 or 12. However, some crewmembers were not physically present at that location because they were performing assigned duties in other locations on the vessel at the direction of the Master and the vessel's Muster List[12].

[10] The Safety Officer monitors incident operations and advises the Incident Commander on all matters relating to operational safety, including the health and safety of incident personnel.
[11] *See* section 5.13.1.2.1. for discussion on the "perceived" language barrier.
[12] *See* section 4.2.1.7.3. for discussion of the vessel's Muster List.

4.1.30. The Master also advised BC-5 that the fire originated on deck 10 and that no firefighting efforts were conducted by the vessel's crew on deck 11.

4.1.31. The vessel's crew continued to conduct boundary cooling on the deck plating of deck 12 and the exterior bulkheads of cargo spaces on deck 11 using the vessel's hose lines.

4.1.32. At 2142, the crew of Engine-27 engaged the fire on deck 10. They reported to BC-5 that they were able to successfully knock down[13] the fire.

4.1.33. Shortly after, BC-4 arrived at the command post, checked in with DC-1, and then proceeded to deck 12 by way of the starboard ladderwell, the location of which is indicated by the green rectangle on the diagram of deck 12 firefighting operations in the following Figure 4.

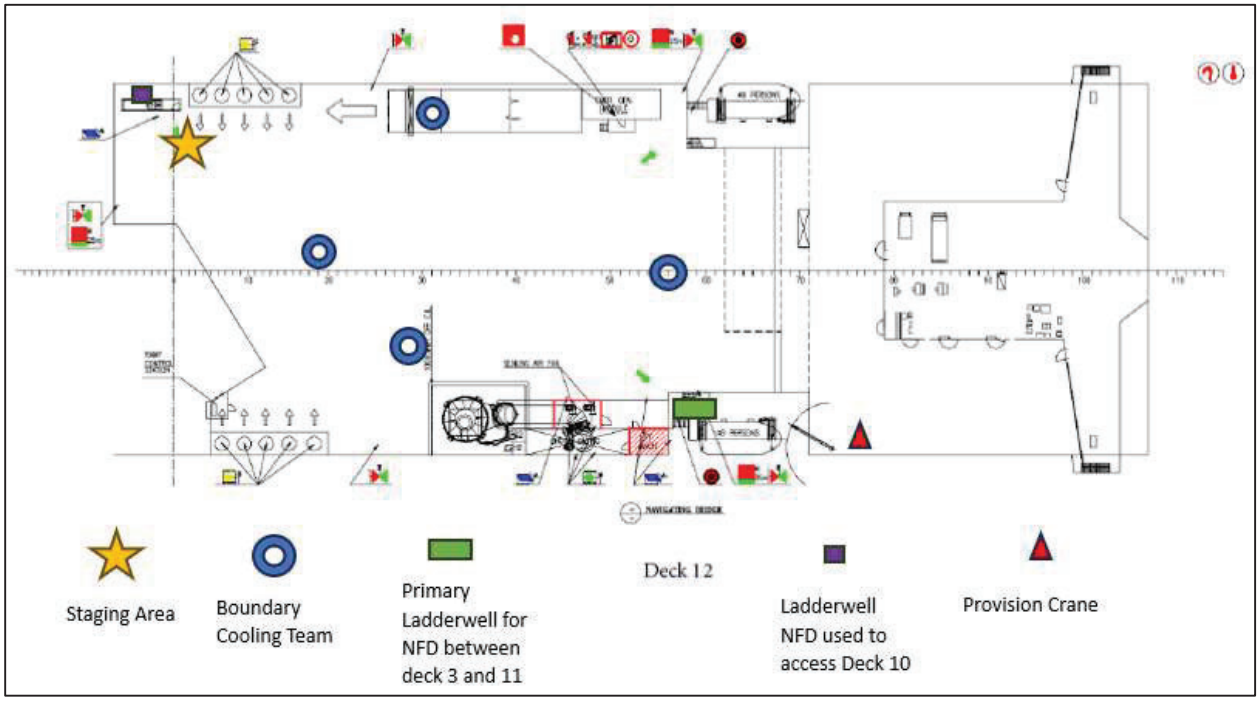

Figure 4. Diagram of deck 12 firefighting operations. Developed by Coast Guard Investigators.

4.1.34. During the transit to deck 12, BC-4 opened a door on deck 6 to survey the space. He stated his "breath was taken away" immediately and he presumed the cause to be the CO_2 in the space. He did not have his SCBA on at this time but was wearing turnout gear and helmet[14].

[13] Knock(ed) Down: the main body of the fire has been suppressed. This occurs when the flames or heat on the more vigorously burning parts of the fire edge have been reduced.
[14] *See* Section 4.2.4.3. for discussion on firefighter equipment.

4.1.35. At 2147, NFD Dispatch informed DC-1 that they notified the mutual aid[15] asset New Jersey Fireboat Taskforce[16], and they were responding to the scene. DC-1 called off this asset since the fire was reportedly knocked down.

4.1.36. BC-5 reported to DC-1 that the vessel's crew was concerned about firefighters entering the cargo decks on the vessel due to the previously released CO_2 in those spaces. BC-5 also reported that the fire was knocked down, yet smoke conditions remained present. BC-5 made a request to DC-1 by radio for additional manpower and air bottles. BC-5 proceeded to make a staging area on the aft port section of deck 12 as indicated by the star in Figure 4.

4.1.37. DC-1 directed Ladder-4 crew to proceed to deck 12 to render assistance to the firefighting efforts.

4.1.38. BC-5 and BC-4 conducted a face-to-face briefing on deck 12. BC-4 stationed himself in the port aft ladderwell to lead operations locally on decks 10 and 11. BC-5 remained at the deck 12 staging area.

4.1.39. The NFD reported issues broadcasting and receiving communications via radio throughout the duration of the response, particularly impacting members operating inside the vessel. In response to these issues, BC-5 primarily communicated with BC-4 verbally. To communicate with DC-1, BC-5 intermittently used his cell phone.

4.1.40. At 2208, the Chief Mate and the vessel's Bosun, who was dressed in a vessel-supplied firefighter outfit and SCBA, reported to WTD-12 to close the door using the control panel inside the space. While attempting to engage the hydraulic control system for WTD-12, which utilized a Programmable Logic Controller[17] (PLC) to automate the opening and closing of the door, a red "fault" light appeared on the panel indicating the controls were inoperable. The fault condition was recorded on the vessel's Voyage Data Recorder (VDR) as a "RORO Bridge Monitoring Unit PLC Fault." Unsuccessful in their attempt to close WTD-12, the Chief Mate and Bosun assisted as needed with the ongoing fire response.

4.1.41. At 2213, BC-4 directed Fire Captain (Capt) L-4 and Firefighter (FF) B to enter the space, follow the hose line that Engine-27 left in place, and then to give a status report on the conditions.

4.1.42. Capt L-4 and FF B entered deck 10 wearing their full firefighter ensembles and SCBAs. Capt L-4 was carrying his radio, FF B was not. They followed the hose line to the nozzle. Capt L-4 recounted conditions as smoky with visibility between ten and 15 feet upon entry to the space. Conditions noticeably degraded as Capt L-4 and FF B progressed further into the space. Upon reaching the nozzle, Capt L-4 reported that there

[15] Mutual Aid: The organized, supervised, coordinated, cooperative and reciprocal assistance in which fire resources from numerous jurisdictions are collectively used in response to a fire or other emergency.
[16] *See* section 4.2.5.2. for discussion on the New Jersey Fireboat Task Force.
[17] PLC: a controller which used programmable memory to store instructions and implement functions such as logic, sequencing, timing, counting, and arithmetic to control machines and processes. (Science Direct)

were a few pockets of visible flames emanating from the rear section of the JEEP. This entry path into the space is represented in the following Figure 5 by the yellow line marked “fire hose.”

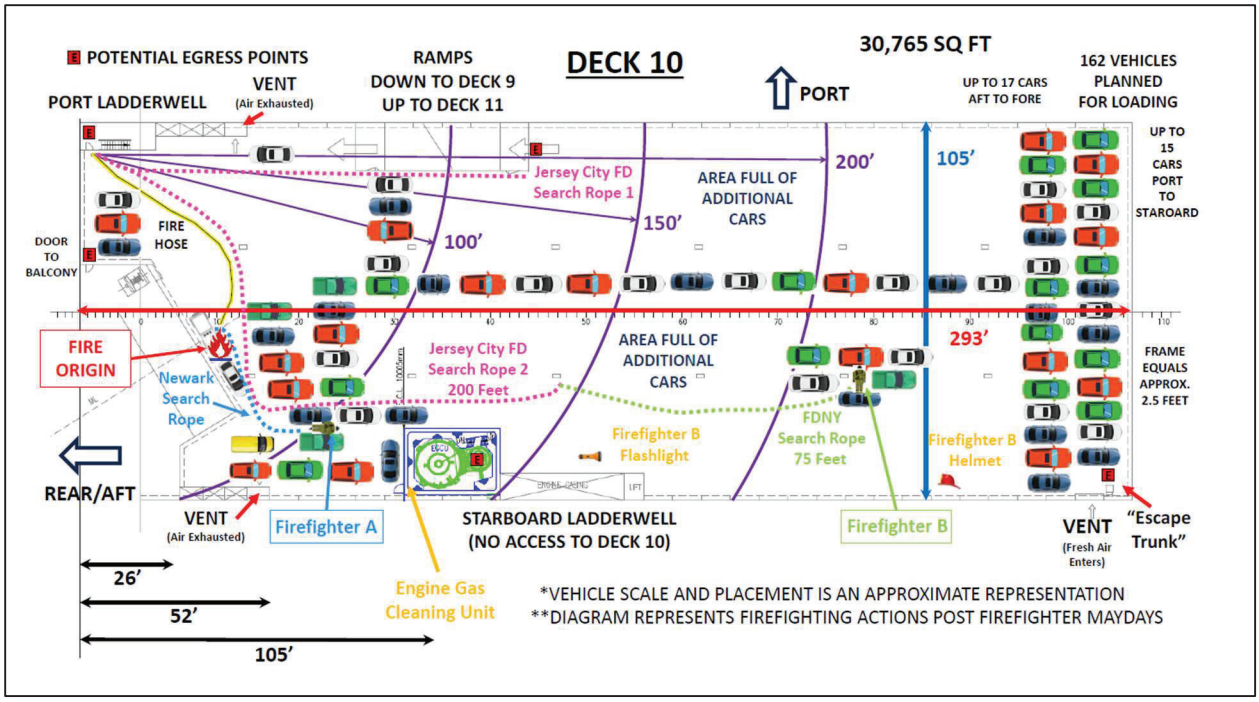

Figure 5. Diagram of fire departments' rescue efforts on deck 10. Generated through NIOSH FFFIPP Investigator.

4.1.43. Through his Thermal Imaging Camera (TIC), Capt L-4 noticed an overhead I-beam above the JEEP deforming and with a very hot heat signature. This I-beam is visible post-fire in the following Figure 6. He attempted to give a report to BC-4 via radio, but his transmission was unsuccessful.

Figure 6. The JEEP and Toyota Venza post fire. Photograph taken by ATF on July 10, 2023. Developed by Coast Guard Investigators.

4.1.44. At 2217, BC-4 directed Capt E-16 to enter deck 10 with FF A. Both were wearing their full firefighter ensembles, carrying their radios, and donned their SCBAs. Capt E-16 recounted limited visibility. Capt E-16 and FF A proceeded to follow the hose line to the nozzle.

4.1.45. Simultaneously, Capt L-4 gave FF B his TIC and then followed the hose line back to the ladderwell to verbally brief BC-4 of the conditions.

4.1.46. At 2219, upon arrival at the hose nozzle, Capt E-16 was surprised to find FF B alone operating the hose line and holding a TIC. Capt E-16 gave a status report via radio of his location on the line with Ladder-4 and that there were no visible flames.

4.1.47. Upon returning to the ladderwell from the space, Capt L-4 verbally reported the conditions he experienced on deck 10 to BC-4. Capt L-4 experienced a boot failure when the soles separated from the leather casings of his boots, which exposed him to high heat at the ladderwell. BC-4 ordered him out of the space and to rehabilitate on deck 12.

4.1.48. Capt L-4 proceeded to deck 12, but due to standing scalding water on the deck from the boundary cooling, he took refuge in a minivan that was stowed as cargo on the vessel.

4.1.49. At the order of BC-4, the remaining crew from Ladder-4 entered deck 10. The entering Ladder-4 crew noticed kinks in the hose line, so they flaked[18] it out further into the space. The Ladder-4 crew did not verbally communicate at any time with FF A, FF B, or Capt E-16 who were still on the hose line.

4.1.50. The remaining crew of Ladder-4 proceeded with a partial overhaul[19] of the Toyota Venza and the JEEP to help extinguish the remaining fire on deck 10. They exited the space and gave an updated verbal report to BC-4 of high heat conditions and worsening visibility within the space due to smoke.

4.1.51. At 2220, BC-4 radioed Capt E-16 to bring the line back out of the ladderwell door where the line entered deck 10. BC-4 banged on the bulkhead to give the crew inside an audible indication of the direction of the exit.

4.1.52. Capt E-16 heard the order over the radio and proceeded to orient his fellow firefighters to follow the hose line out towards the ladderwell door on deck 10.

4.1.53. The Ladder-4 crew in standby next to BC-4 in the ladderwell outside of deck 10 experienced a large volume of smoke and heat that flooded the ladderwell. In response, they went down the ladderwell to take refuge a few decks below. BC-4 went up to deck 12 to relay information directly to BC-5.

[18] Flaking a Hose Line: to neatly lay out a fire hose to prevent kinks before and during firefighting operations.
[19] Overhaul: the process of searching for and extinguishing pockets of fire that remain after a fire has been brought under control. Fire is not considered fully extinguished until overhaul is complete.

4.1.54. FF B's mask started to vibrate due to a low air alarm. Capt E-16 directed him verbally and physically in front of FF A to lead the crew out of the space. Visibility worsened to near zero. Capt E-16 repeatedly said to stay on the hose line.

4.1.55. At some point during his egress of the space, Capt E-16 lost physical contact with FF A and FF B. Capt E-16 reported hearing the statement "the line is going this way" from FF A or FF B. Capt E-16 stated that he came to a bend in the line that was not present when he entered the space and became disoriented in his egress. He then attempted to broadcast a mayday[20].

4.1.56. At 2222, BC-4 gave a second order to bring the hose line back out, this was followed by a mayday call from FF A stating that "we cannot find our way out, we are lost."

4.1.57. NFD Dispatch radioed DC-1 to inform him of the mayday received from FF A. DC-1 advised the crew via radio to follow the hose line out and immediately evacuate deck 10.

4.1.58. Disoriented, Capt E-16 left the hose line and found a bulkhead on deck 10. He recalled proceeding along the bulkhead in the direction he believed to be the exit.

4.1.59. At 2227, Capt E-16 stated that he found the ladderwell empty and proceeded to deck 12.

4.1.60. At 2228, an unidentified firefighter made a broadcast and named three firefighters as missing, including FF A and FF B. The third firefighter named heard the broadcast and confirmed his location as outside the deck 10 space.

4.1.61. At 2230, DC-1 conducted a Personnel Accountability Report (PAR)[21] in response to the maydays. Capt E-16 reported that FF A and FF B were unaccounted for. Two additional firefighters from Ladder-4 were also reported as unaccounted for.

4.1.62. DC-1 deployed Ladder-5 and Rescue-1 to report to BC-4 on deck 10 as the Firefighter Assist Search Team (FAST)[22].

4.1.63. The two additional firefighters from Ladder-4 made their way down the ladderwell and reported directly to the ICP to attain accountability.

4.1.64. At 2234, the search commenced on deck 10 to locate FF A and FF B. This search focused around the areas marked as "fire hose" and "Newark Search Rope" in Figure 5.

[20]Mayday: called when a firefighter needs immediate help, such as when they are lost, trapped, injured, or are missing/unaccounted for.
[21] PAR: a system used by fire departments to account for all personnel at the scene of an incident. Conducted via radio.
[22] FAST: a team of two or more firefighters dedicated solely to the search and rescue of other firefighters in distress.

4.1.65. BC-5 informed the Chief Mate and Master that the fire department was converting efforts from firefighting to solely search and rescue.

4.1.66. At 2240, members of the FAST team located FF A in the approximate location marked in Figure 5 as "Firefighter A." FF A was standing upright wedged between two vehicles on deck 10 and unresponsive. The FAST team immediately placed a Rapid Intervention Team (RIT) airpack[23] on FF A. When located, FF A had his face mask at nose level and his helmet off with visible soot on his face.

4.1.67. The members of the FAST team made several attempts to free FF A but were unsuccessful. The FAST team then exited the space and briefed the next group ready for entry.

4.1.68. Between 2241-2358, efforts by multiple rescue teams were focused singularly on extracting FF A. BC-4 relayed to DC-1 the need for additional manpower, battery powered extrication equipment, and cribbing[24].

4.1.69. At 2254, the Fire Chief of NFD (FC) arrived on-scene. However, he did not assume incident command.

4.1.70. At 2306, the vessel's crew became aware that the fire had fully rekindled in deck 11. The vessel's crew continued efforts to boundary cool and put out recurring vehicle fires on deck 12.

4.1.71. The Master requested to DC-1 to discharge the remaining CO_2 from the vessel's installed system to combat the fire. DC-1 declined due to the continued search and rescue efforts that were taking place on deck 10 as priority in their efforts.

4.1.72. At 2313, FC directed NFD Dispatch to request mutual aid assistance from Elizabeth Fire Department (FD) and Jersey City FD. Then, at 2335, FC made an additional mutual aid request through NFD Dispatch for fire departments in the Urban Area Security Initiative (UASI)[25] network. In response, the following UASI departments deployed to the scene: North Hudson FD, Bayonne FD, Hackensack FD, Hoboken FD, and Patterson FD.

4.1.73. At 2345, BC-4 requested to the Third Mate and Master to turn on the exhaust system for deck 10 to assist with search and rescue efforts taking place. The Master, though initially expressing concerns to BC-4 regarding the request because turning on ventilation would increase the severity of the fire through oxygenation, ordered the Chief Engineer to reset the dampers and turned on the ventilation extractors on deck 10.

4.1.74. At 2349, firefighters conducted a secondary search to locate FF B.

[23] A RIT airpack supplied approximately 120 minutes of breathable air.
[24] Cribbing: a stabilization technique and tool used to transfer the weight of a load into a simple temporary support during rescue operations.
[25] *See* section 4.2.4.6. for discussion on the UASI.

4.1.75. At 2358, the crew from Ladder-5 freed FF A by cutting the vehicles' lashings[26] and using spreaders to separate the vehicles. Several firefighter teams supported the transport of FF A out of the space and up the port ladderwell to deck 12.

4.1.76. On July 6 at 0001, prompted by local media reports about the incident and in consultation with the Non-Tank Vessel Response Plan (NTVRP)[27] designated Qualified Individual (QI)[28], the NTVRP designated Salvage and Marine Firefighting (SMFF) Provider[29] contacted the vessel by phone to conduct a remote situational assessment. At that time, the NTVRP had not been activated[30]. The Second Mate on the navigation bridge answered the phone and advised the SMFF Provider that the local fire department continued to fight the fire on deck 10 and 11, and that no additional resources were needed.

4.1.77. At 0005, firefighters arrived on deck 12 with FF A but were unable to place him on the deck due to heat conditions and standing scalding water. FF A was then carried to a flatbed truck stowed as cargo on deck 12 where Emergency Medical Services (EMS) personnel conducted an assessment and initiated Cardiopulmonary Resuscitation (CPR).

4.1.78. At 0015, a mayday was called for a downed Elizabeth Rescue firefighter on deck 9, requesting the RIT team.

4.1.79. At 0021, BC-5 requested to turn off the deck 10 exhaust system because the smoke was venting out onto deck 12 in the vicinity of the deck 12 staging area. The Master complied.

4.1.80. BC-5 notified DC-1 that they expended all extra SCBA air bottles in the staging area. A separate request was made by Engine-29 for oxygen bottles to deck 12 for a struggling firefighter.

4.1.81. At 0030, mutual aid assistance was requested from the New York City Fire Department (FDNY).

4.1.82. At 0045, firefighters carried FF A across deck 12 to the vessel's provision crane. They placed FF A in a stokes basket[31] and the vessel's crew lowered him to the pier. An ambulance took him to a local hospital. The Medical Examiner's Autopsy Report listed

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[26] Lashing: in this instance, webbed strapping placed over the vehicles tires and secured to a lashing point or hole on the deck plating to secure the vehicle in place. Other lashings can include a variety of materials (chain, rope, wire rope) used to secure cargo to the vessel to prevent movement while at sea.
[27] *See* section 4.2.1.7.1. for a discussion on the NTVRP.
[28] QI: as designated in the NTVRP, a preidentified shore-based representative of a vessel owner or operator who meets the requirements of 33 CFR § 155.1026. Once notified by the vessel or owner/operator of an incident, the QI was authorized to further activate provisions and resources of the NTVRP.
[29] SMFF Provider: an entity that provided personnel, equipment, supplies, and other capabilities necessary to perform salvage and/or marine firefighting services identified in the NTVRP and had been arranged for by contract or other approved means in accordance with 33 CFR Part 155, Subpart I.
[30] *See* section 4.2.1.7.1.1. for a discussion on the NTVRP activation.
[31] Stokes Basket: a device used to both immobilize and transport a victim, similar to a stretcher.

the time of death at 0111. The primary cause of death was smoke inhalation including carbon monoxide intoxication.

4.1.83. At 0049, the search continued for FF B. DC-1 sent firefighter companies to the port and starboard ladder wells to search for possible areas of refuge[32].

4.1.84. At 0052, DC-1 ordered all NFD companies off the vessel to regroup.

4.1.85. At 0114, the UASI fire departments established a second command post at the bottom of the vessel's stern ramp. An FDNY Fireboat arrived on scene and stood by for orders.

4.1.86. From 0122 to 0208, firefighters returned to deck 10 to conduct search and rescue operations for FF B including multiple UASI and FDNY companies. As depicted in Figure 5, the companies used two separate search rope paths. The UASI Command established a staging area on deck 8.

4.1.87. At 0146, the vessel's crew made another unsuccessful attempt to close WTD-12 using a manual method of releasing pressure from the hydraulic rams; however, the door rested on its securing devices and was too heavy for this method to be effective.

4.1.88. At 0208, FDNY Rescue-5 located FF B in the approximate location depicted in Figure 5. FF B was found with his SCBA face mask off and without his helmet. His flashlight was found by a FDNY search team along the starboard bulkhead at the location depicted in Figure 5. His helmet was found during post-fire inspection at the marked location forward of the flashlight along the starboard bulkhead as depicted in Figure 5.

4.1.89. From 0209 to 0305, firefighters conducted what they described as a "manpower intensive" operation to extract FF B from the space, up the ladderwell, and across deck 12 to the provision crane.

4.1.90. At 0209, FDNY Marine BC (hereinafter "FDNY BC") arrived and reported to the command post at the stern ramp.

4.1.91. At 0255, FDNY BC met with the Chief Mate on the stern ramp. FDNY BC noted a language barrier but was able to understand the Chief Mate regarding the origin of the fire and the expended use of the CO_2 system. FDNY BC requested to speak with the Master via the vessel's phone. The Master relayed to FDNY BC during the phone call that there was an issue closing WTD-12 and that it remained open.

4.1.92. At 0305, firefighters and the vessel's crew lowered FF B to the pier via the provision crane. An ambulance took FF B to a nearby local hospital. The Medical Examiner's Autopsy Report listed the time of death at 0341. The primary cause of death was smoke inhalation with carbon monoxide intoxication.

[32] Area of Refuge: an area protected from the hazards to life safety posed by the emergency.

4.1.93. At 0315, firefighters organized a plan to combat the fire on deck 11. FDNY BC advised against accessing the space because he found it unjustified to risk sending more people into deck 11 since all personnel were out of the fire space and CO_2 had been previously released.

4.1.94. At 0325, FDNY BC proceeded to deck 12 and met with the vessel Master. The Master requested SCBAs from the fire department to attempt closure of WTD-12. FDNY BC viewed this as a life-threatening operation due to heavy black smoke and heat coming from WTD-12 and denied the request. Firefighters and vessel crew made several attempts to close WTD-12 using jacks and timber. All attempts to close the door remained unsuccessful. At 0446, FDNY BC requested tarps from NFD Special Operations Division to cover the opening of WTD-12. They were received on deck 12 at 0500, but after being positioned across WTD-12 they provided little impact on sealing the opening.

4.1.95. At 0347, UASI units demobilized.

4.1.96. At 0358, the Second Mate, who was alone on the navigation bridge, answered a phone call from the QI's responder, who was enroute. Noting the Master was unavailable, the Second Mate provided a brief situational update and took down the QI responder's contact information.

4.1.97. At 0400, DC-1 ordered all NFD personnel to exit the vessel and start demobilization. At this time, fire remained active on deck 11.

4.1.98. At 0413, upon the Master's return to the navigation bridge, the Second Mate informed him that the QI responder had called and was enroute to the vessel.

4.1.99. At 0446, while on the navigation bridge, FDNY BC reviewed the NTVRP with the Master and asked if the designated SMFF Provider had been contacted. The Master subsequently advised that the SMFF Provider had not, but that the QI was notified. FDNY BC then contacted the QI by phone and requested SMFF Provider assistance with securing WTD-12.

4.1.100. At 0515, most responding fire department personnel were off the vessel. Shortly after, the fire began to intensify on deck 11.

4.1.101. At 0521, the Master contacted the FDNY Fireboat via VHF radio to request boundary cooling of the vessel's hull.

4.1.102. At 0530, the SMFF Provider contacted the Master via phone and conducted a remote assessment of the situation. The Master advised the SMFF Provider that the situation was worsening, that the local fire department had departed the vessel, that WTD-12 was still open, and he requested manpower and resources to fight the fire. The SMFF Provider advised that resources were forthcoming.

4.1.103. At 0540, the Master requested via VHF radio the FDNY Fireboat to direct a stream of water at WTD-12. The vessel's crew noted that the fire spread on deck 11.

4.1.104. At 0542, the Master emailed the QI requesting assistance and manpower. He also advised that the fire was on decks 10 and 11, WTD-12 was unable to be closed, there was a fireboat on scene, and the fireboat and vessel's crew were cooling deck 12 area.

4.1.105. At 0615, the QI responder arrived at the scene.

4.1.106. At 0628, the SMFF Provider personnel and assets began arriving and eventually assumed the primary fire response.

4.1.107. At 0630, DC-1 temporarily relinquished command to FDNY until the arrival of additional NFD personnel.

4.1.108. At 0639, the fire had visible flames coming from deck 12 where the vessel's crew was actively boundary cooling. This boundary cooling had continued through the entire incident.

4.1.109. At 0640, the Master ordered Abandon Ship, to include the vessel's crew and any remaining land-based firefighters.

4.1.110. At 0930, a Unified Command was established to oversee the continuing response efforts. These efforts continued until the fire was officially declared extinguished on July 10, 2023.

4.1.111. In addition to the deaths of two NFD firefighters, two NFD, two Elizabeth FD, and two University EMS personnel were injured and transported to the hospital with non-life-threatening conditions. Injuries consisted of heat exhaustion, fatigue, and smoke inhalation. One Elizabeth firefighter sustained a head injury after falling in a ladderwell and Capt L-4 sustained burns to his feet after his boots failed.

4.1.112. The GRANDE COSTA D'AVORIO sustained extensive fire damage to decks 6 through 12, including Ro-Ro cargo decks, crew accommodation spaces, and navigation bridge. Damage was estimated at over $23 million. In September 2023, the vessel was towed to a repair facility in Yalova, Turkey.

4.1.113. *Drug and Alcohol Testing*. On July 14, 2023, following procedures in 46 CFR Subpart 4.06, all vessel crewmembers deemed to be directly involved in the incident were tested for drugs and alcohol. All vessel crewmembers tested negative. 46 CFR § 4.06-3(b)(1) required drug test specimens to be collected within 32 hours of the incident occurrence. 46 CFR § 4.06-3(a)(1) required alcohol test specimens to be collected within two hours of the incident occurrence, but if safety concerns prohibited collection, alcohol testing was not required beyond eight hours after occurrence.

4.2. Additional/Supporting Information.

4.2.1. Grimaldi and GRANDE COSTA D'AVORIO.

4.2.1.1. *Corporate and Operational Framework*. The owner and operator/International Safety Management Code (ISM) Manager[33] responsible for the GRANDE COSTA D'AVORIO was Grimaldi Deep Sea SPA (IMO Company Number 1468650). The manager of local operations and scheduling was Atlantic Container Line (ACL).

4.2.1.2. *Regulatory Compliance and History*. The last Coast Guard Port State Control Exam conducted on the GRANDE COSTA D'AVORIO was in Brooklyn, Red Hook, New York on January 4, 2023, with no deficiencies noted. The vessel was enrolled in the QUALSHIP 21[34] program through September 23, 2026. The previous Port State Control Exam occurred in Valencia, Spain on July 11, 2022, with no deficiencies noted. All required certificates and documentation were current and approved by the appropriate authorities. The flag State of the GRANDE COSTA D'AVORIO, Italy, was considered a "high-risk targeted[35]" flag administration by the Coast Guard. There were no conditions of class or flag dispensations for the vessel pertinent to this incident.

4.2.1.3. *Construction*.

4.2.1.3.1. *General Arrangement*. GRANDE COSTA D'AVORIO was a combination Ro-Ro/container vessel that had 12 decks connected by vehicle ramps throughout the vessel with mechanically operated doors as depicted in the following Figure 7. Vehicles were loaded onto the vessel using a stern ramp that led up to deck 3. Deck 11 was partially exposed and had a cargo vehicle deck, weather deck, and crew accommodation space. There was a provision crane located near the lifeboat on the starboard side as depicted in the following Figures 7 and 8. The provision crane was used to load and unload packaged supplies for the vessel and its crew such as food and spare parts. There were designated means of escape and portable firefighting equipment throughout the vessel as indicated by the Fire Control Plan and corresponding placarding required by the IMO. The GRANDE COSTA D'AVORIO was considered a sister vessel[36] to the GRANDE ANGOLA (IMO Number 9343156). A fleet of six sister vessels was based off the GRANDE ANGOLA.

[33] *See* ISM, Part A, Section 4; *see also* Revised Guidelines for the Operational Implementation of the ISM by Companies, MSC-MEPC.7/Circ.8.
[34] QUALSHIP 21: A Coast Guard initiative to identify high-quality ships and provide incentives to encourage quality operations.
[35] The Coast Guard conducted additional Port State Control Exams on vessels of flag administrations whose three-year detention ratio scores were higher than one percent with more than one detention in the preceding three years and considered those qualifying as "high-risk targeted" vessels.
[36] A ship built by the same yard from the same plans as defined by the International Convention for the Safety of Life at Sea (SOLAS), Chapter II-1, Regulation 22.

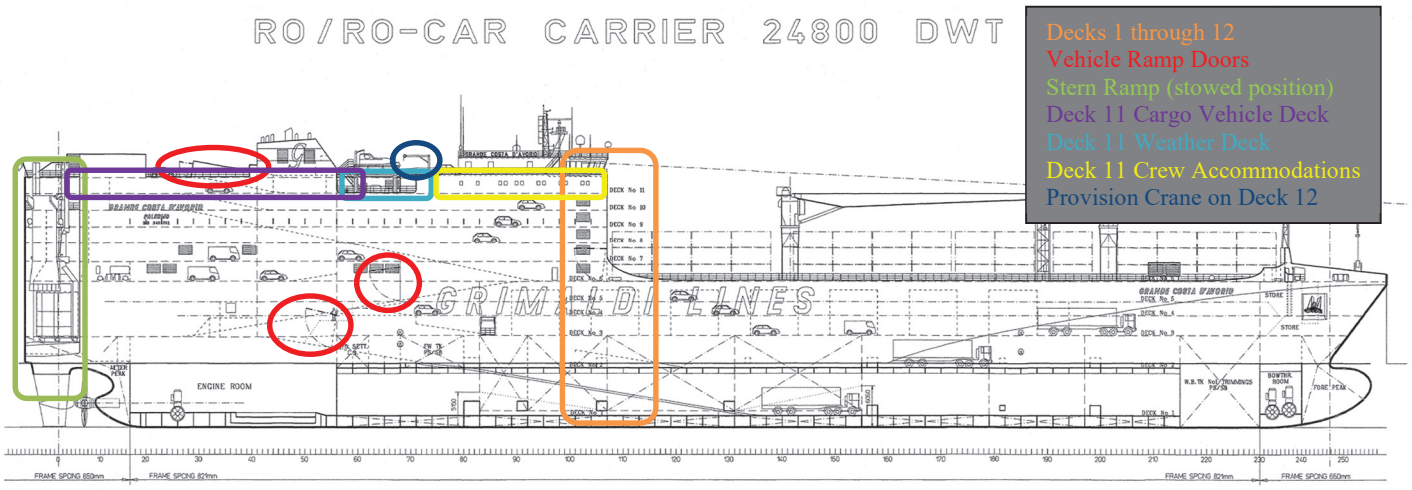


Figure 7. General arrangement of GRANDE COSTA D'AVORIO. Developed by Coast Guard Investigators.

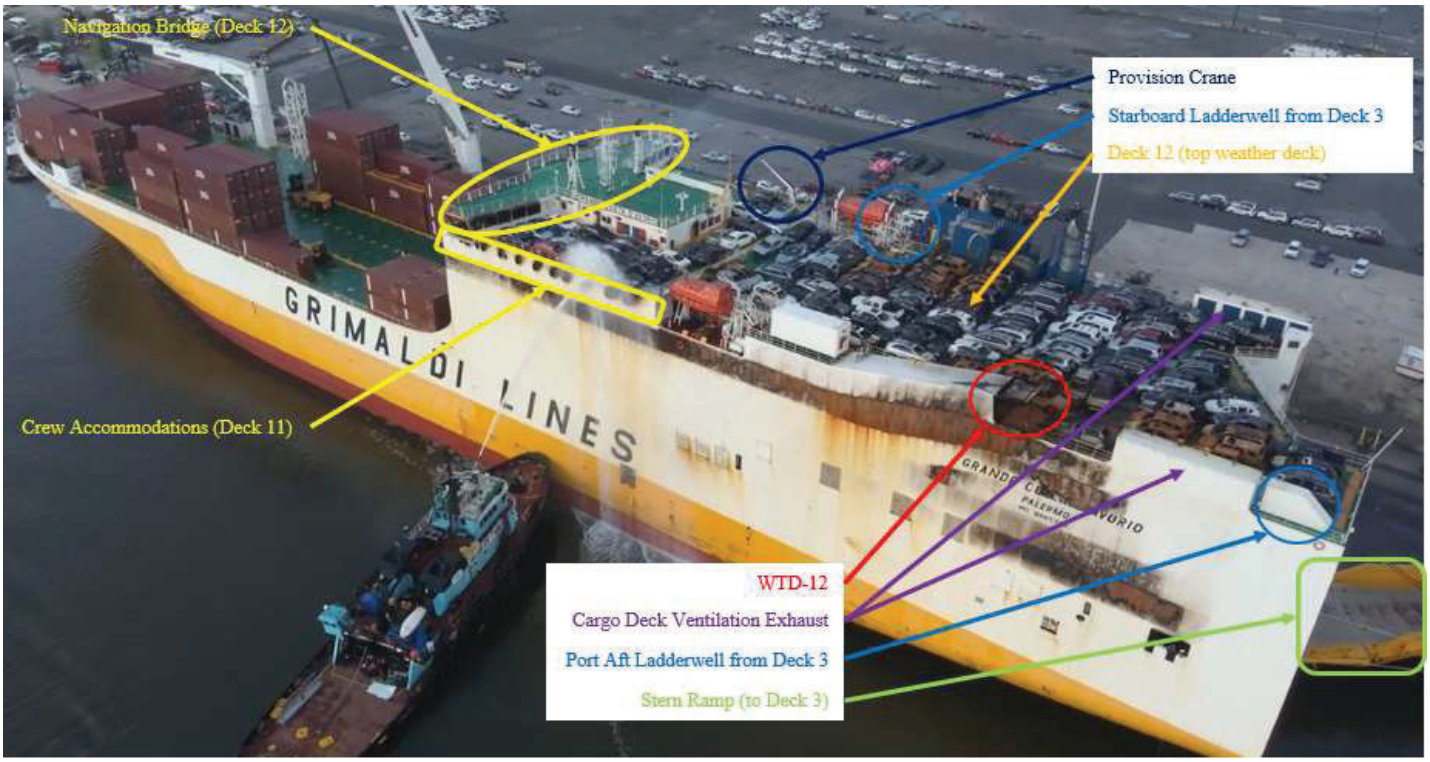


Figure 8. Port aspect of GRANDE COSTA D'AVORIO post-fire indicating significant areas of the vessel. Developed by Coast Guard Investigators.

4.2.1.3.2. *Lashing Points*. Vehicle decks contained various lashing points to secure vehicles per the vessel's load plan. The lashing points on some decks, including deck 10 and 11, consisted of approximately two-inch diameter holes spaced approximately every three feet, which allowed the free flow of air between decks. Decks with lashing holes were all contained within the same low-pressure CO_2 fire protection zone.

4.2.1.3.3. *Fire Detection System.* The vessel was equipped with an installed fire detection system that alarmed visually and audibly on the bridge. The alarm was automatically triggered by the detection of smoke or heat depending on the area and had the capability of manual activation. The activation history showed, and the crew recalled, that the system alarmed at 2100 on July 5, 2023.

4.2.1.3.4. *Firefighting Equipment*. The vessel was outfitted with the systems required by the IMO's International Convention for the Safety of Life at Sea (SOLAS) for fighting fires on board. This consisted of standard sized hydrants, hoses, and nozzles located in designated areas throughout the decks of the vessel as indicated on the Fire Control Plan. Further, the vessel was equipped with International Shore Connections as required under SOLAS. This connection was a standard flange size that allowed vessels to receive additional water for fighting fires from shoreside water supplies. The vessel was designed to SOLAS standards and capable of fighting fires on board using its own fire pumps and hoses. The fire pumps and hoses were used during the incident by both vessel crew and land-based firefighters. Witnesses described the water supply as adequate throughout the incident, therefore the International Shore Connection was not used.

4.2.1.3.4.1. *Fixed Fire Suppression System*. The vessel was fitted with a low-pressure CO_2 fire suppression system that served Ro-Ro cargo decks 1 through 11 and three engineering spaces. It was designed by Pastor Inzenjering and then reviewed and approved by the vessel's classification society on November 7, 2007. Before the discharge on July 5, 2023, the system was loaded with approximately 34.5 metric tons of liquified CO_2 as designed. The available quantity of CO_2 was designed in accordance with the IMO's Fire Safety Systems Code and governed by the quantity necessary for the largest volume fire protection zone, Zone B. On July 16, 2023, Coast Guard Investigators observed the CO_2 storage tank level indicator showing approximately 14 metric tons of CO_2 in the tank, similar to the Chief Engineer's observation immediately after discharge on July 5, 2023. Then, on November 2, 2023, a marine surveyor, contracted by Grimaldi, observed the CO_2 storage tank level indicator showing approximately four metric tons of CO_2 was in the tank. Later, on April 18 to 19, 2024, while the vessel was undergoing repairs in the shipyard, a certified technician from Pastor Inzenjering observed the indicator showing a quantity of approximately 4.2 metric tons of CO_2 in the storage tank. The same technician also certified that the level indicator was "in correct working condition." While preparing the system for recharge, all primary system components in the CO_2 Room were tested and found in working

condition.

4.2.1.3.4.1.1. *Fire Protection Zones.* The vessel's low-pressure CO_2 fire suppression system was organized into six fire protection zones as depicted in the following Figure 9.

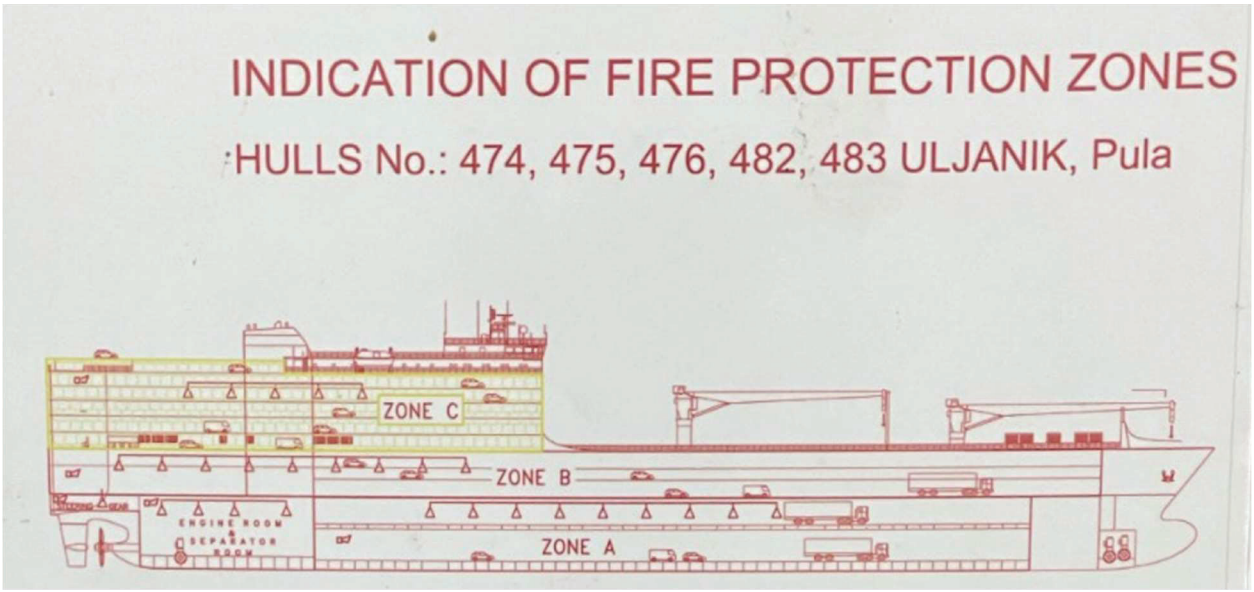


Figure 9. Depiction of fire protection zones on GRANDE COSTA D'AVORIO.

Fire Protection Zones A through C were designed to discharge for ten minutes when activated, and the Steering Gear Room, Engine Room, and Separator Room were designed to discharge for two minutes. The quantity discharged during the automated period was based on the zone's volume. During the ten-minute discharge, the system was designed to release 30.3 metric tons of CO_2 into Fire Protection Zone C. Discharge times were an automated function of the system once manually activated. Primary controls for activating the system were in the CO_2 Room on deck 3, which could control a discharge into any of the six zones. There were secondary controls capable of discharging into Fire Protection Zones A through C located in a space behind the navigation bridge on deck 12. Secondary controls capable of discharging into the Steering Gear Room, Engine Room, and Separator Room were located at the Cargo Control Room on deck 3. Each set of controls included an "Add CO2" button that could be used to activate manual second discharge of CO_2. Various boundary openings (e.g. doors, WTDs) existed in each fire protection zone

that were required under SOLAS to be designed and constructed to seal prior to CO_2 activation to ensure effectiveness.

4.2.1.3.5. *WTD-12*. The vessel had a hydraulically actuated WTD at the top of the vehicle ramp from deck 11 to deck 12 as indicated by the red circle on deck 12 in Figures 7 and 8 and pictured in the following Figure 10. This door was opened at 0554 after the vessel arrived in port and remained open throughout the loading of the vessel and the incident. No policy or regulation existed to prohibit this door from remaining open while not in use in port and this was common practice throughout the Ro-Ro industry. IMO regulation only required this door to be closed before proceeding to sea and at all times while underway. The door functioned to close-off and protect the vehicle ramp and cargo vehicle garage spaces from weather while at sea. It was considered a watertight door by the vessel's Damage Control Plan[37] and served as part of the boundary for sealing Fire Protection Zone C.

Figure 10. Post-fire photo of WTD-12. Taken by Coast Guard Investigators.

4.2.1.3.5.1. *WTD-12 Operation Procedures*. The door could only be closed locally using a control panel inside the space as depicted in Figure 10 and the following Figure 11. A manual for all hydraulically operated doors on the vessel included details on the normal and emergency (manual) means of operation. The manual labeled this door as "RAMPWAY DOOR DK 12." The door was arranged in one section hinged at the top with an operation effected by direct acting hydraulic cylinders.

[37] Approved by the vessel's classification society on July 1, 2011.

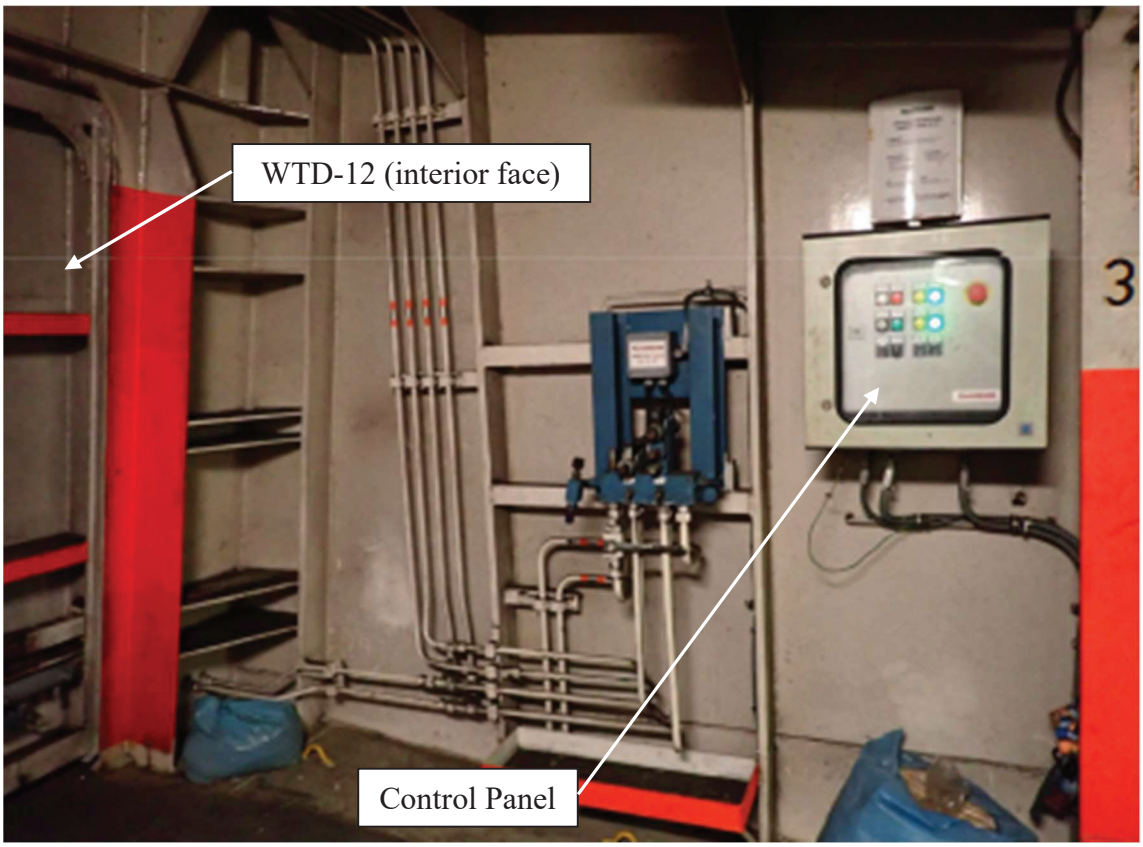


Figure 11. WTD-12 PLC control panel on sister vessel. Taken by Coast Guard Investigators.

The hydraulic system power pack was in the engine room and serviced all hydraulic doors and adjustable decks throughout the vessel. The door was secured whether in the open or closed position by means of hydraulically actuated cleat bolts and additionally by fixed wedges that engaged automatically in the closed position. Under normal operating conditions, the control panel pictured in Figure 11 was the only means to activate the system necessary to open or close the door. To do so, the operator needed to insert a key (depicted in the following Figure 12 as "Off / On") and physically press and hold the "open" or "close" button at the panel until the desired position was achieved. There were multiple keys for this door carried by certain crewmembers including the Chief Mate and Chief Engineer.

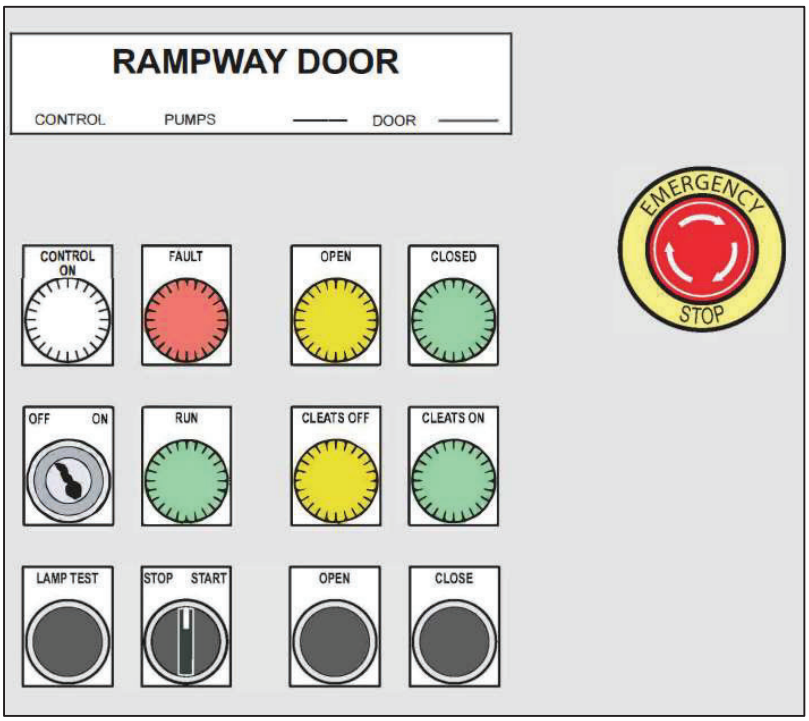


Figure 12. Rampway door control panel diagram from the MacGregor Door Manual extracts contained in CG-EX-10.

4.2.1.3.5.2. *Emergency Operation Procedures*. Before emergency operation of WTD-12 could proceed, the motor had to be disconnected from the electric securing bolt. Manual actuation of the valve spool was an option for emergency operation if the hydraulic power pack was working and hydraulic circuits were intact. The manual also listed emergency operations by means of a portable hand pump unit for releasing securing devices/locking and lifting lugs on the door for operation by external means. The crew indicated that no such portable hand pump was available in the vicinity of WTD-12 during the incident. No attempt was made during the incident to utilize the emergency operation in closing WTD-12.

4.2.1.3.5.3. *Bridge Panel*. The vessel's navigation bridge had a panel indicating the status of the ramps and doors throughout the vessel. If a ramp or door was not closed and cleated, a corresponding red light would illuminate. The panel had two operation modes, "sea" and "harbour". Sea mode disabled operation of any solenoid valve to prevent the opening of WTDs and the stern ramp underway. The vessel's crew and vessel's VDR indicated the panel was in "harbour" mode at the time of the incident. The panel also contained a fault indicator for the PLC.

4.2.1.3.5.4. SOLAS II-2, Regulation 10.4.2 (Closing appliances for fixed gas fire-extinguishing systems) required "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** [emphasis added]."

4.2.1.3.5.5. The IMO's International Convention on Load Lines (ICLL) Regulation 12.1 (Doors) required:

"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 means for securing these doors weathertight shall consist of gaskets and clamping devices or other equivalent means and shall be permanently attached to the bulkhead or to the doors themselves, and the ***doors shall be so arranged that they can be operated from both sides of the bulkhead*** [emphasis added]*."*

4.2.1.3.6. *Ventilation*. Each cargo deck of the vessel was equipped with a ventilation system[38] that consisted of ducts on both sides at the aft end that exhausted to the weather deck on deck 12. Each duct had an electrically powered exhaust fan (extractor) and damper. In the event of a fire, dampers were installed to seal off the fire protection zone for activation of the low-pressure CO_2 system. Each cargo deck also had air intake louvers located on both sides at the forward end. As a result, when the ventilation system was in operation, air flowed in through the louvers and flowed aft to the exhaust fan ducts and exhausted out onto deck 12.

4.2.1.4. *Crew Composition and Experience*. The vessel's crew were properly credentialed for the positions they filled onboard and held all appropriate flag State endorsements. The vessel was manned in compliance with the Minimum Safe Manning Certificate. On July 5, 2023, there were 28 crewmembers attached to the vessel.

4.2.1.4.1. *Master*. The Master trained at a nautical school in Italy for five years then completed Navy service until he joined commercial service as a deck officer in 1999. He worked for several companies during that time before joining Grimaldi in 2005. He started his first contract on the GRANDE COSTA D'AVORIO on March 12, 2023. Prior to this, he sailed on Grimaldi vessels as Master since 2017. During his career, the Master previously experienced fires onboard other vessels to which he was

[38] A ventilation system was installed on the vessel to prevent the buildup of hazardous vapors from vehicles during loading.

attached and interacted with land-based fire departments to successfully extinguish them.

4.2.1.4.2. *Chief Mate*. The Chief Mate had over ten years of experience sailing on vessels in the deck department. His initial credential was issued in 2013. He began employment with Grimaldi in 2017 as a Third Mate. His Chief Mate's license was issued in 2020. Up to the date of the incident, he completed five contracts as a Chief Mate with Grimaldi. All his experience was on Ro-Ro vessels. This was his first contract on the GRANDE COSTA D'AVORIO, and he sailed under one contract previously on a sister vessel GRANDE BENIN. The Chief Mate completed his initial firefighting training during nautical schooling and received a certificate required by the IMO Standards of Training Certification and Watchkeeping (STCW)[39] three years before joining the GRANDE COSTA D'AVORIO crew. Further, he completed refresher training every five years after receiving the initial certificate.

4.2.1.4.3. *Chief Engineer*. The Chief Engineer trained in the Philippines for his nautical schooling and graduated in 1995. He began sailing on merchant vessels upon graduation and had been a Chief Engineer for five years. He had 12 years of experience on Ro-Ro vessels all with Grimaldi.

4.2.1.4.4. *Bosun*. The Bosun began his career in the maritime industry in 2001 with 15 of those years as a bosun. He started employment with Grimaldi in 2013. His first contract on GRANDE COSTA D'AVORIO in 2013 was as an Able-Bodied Seaman. This contract as bosun on GRANDE COSTA D'AOVIO started May 21, 2023.

4.2.1.4.5. *Third Mate*. The Third Mate graduated from a maritime university in 2017 after which he began sailing on commercial cargo vessels. His credential was issued by Romania and endorsed by the flag State, Italy. He began employment with Grimaldi in April 2023 as a Third Mate. This was his first contract on GRANDE COSTA D'AVORIO, and he joined the vessel in the port of Dakar, Senegal. During the months between his initial hiring and the incident, the vessel completed more than ten port calls all with cargo operations. The Third Officer completed his initial firefighting training during nautical schooling where he received his STCW certification.

4.2.1.5. *Crew Training and Drills.* The vessel's crew completed training and drills as required by the Safety Management System (SMS). Drills were always conducted at sea and ranged from lifesaving to firefighting topics. None of the drills conducted by the crew involved operation of the watertight and weathertight doors that isolated the fire protection zones throughout the vessel. Records of drills

[39] STCW VI/3 requires training in procedures for coordination with shore-based fire fighters.

were unrecoverable due to the damage caused by the fire, but the crew indicated they completed drills weekly and the last fire drill was within the preceding month. The crew never completed a fire drill while in-port.

4.2.1.5.1. *Fire Drills*. SOLAS Chapter III, Regulation 19.3.4. required: "Fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ships and the cargo." Regulation 19.3.2. required every crew member to participate in at least one fire drill every month.

4.2.1.6. *Key Maintenance Requirements.*

4.2.1.6.1. *Watertight and Weathertight Doors.* In accordance with the vessel's SMS, weekly checks were completed on the ramp doors to assess operating conditions by opening doors and checking the related signaling on the navigation bridge. Six-month checks consisted of a visual inspection, a functional check of sliding and blocking systems, and a check of visual signaling on both the local control panel and bridge panel. The dry-docking (36-month) maintenance required a general visual inspection, cleaning and washing with water followed by a restoration of painting, and a check of hinges and seals. The rampway door on deck 12 underwent all these checks per the schedule with the last weekly inspection occurring on June 24, 2023, the last six-month check on March 14, 2023, and the last dry-docking maintenance on August 24, 2022.

4.2.1.6.2. *Fixed Firefighting Systems*. The SMS required the vessel's low-pressure CO_2 system be checked at weekly, monthly, three-month, 12-month, and 120-month intervals. The checks ranged from visual inspection to simulated operation and testing. All checks were conducted and documented for the low-pressure CO_2 system and the last weekly check before the incident occurred on June 24, 2023.

4.2.1.6.3. *Ventilation System*. The ventilation damper system (manual and automatic) inside and outside the engine room were required by the vessel's SMS to be checked every three and 12 months. The check included the general conditions, cleaning all moving parts as necessary, a functional test of local and remote signaling, and a functional test of local operation of all fire dampers. The ventilation system underwent all these checks per the schedule, the last before the incident occurring on April 28, 2023.

4.2.1.7. *Pertinent Emergency Response Policies.*

4.2.1.7.1. *NTVRP*. In accordance with 33 CFR Part 155, the vessel was required to have an NTVRP that included provisions for SMFF. The purpose of the plan was to provide guidance to the crew, identify a QI ashore, and predesignate oil spill and SMFF response organizations

available in each U.S. port of call. On the day of the incident, the vessel had a valid NTVRP that met the regulatory requirements and was approved by the Coast Guard. The NTVRP section titled "Required Incident Notifications in United States Waters" specified "In the event of an incident, emergency, spill or threat of a spill in the U.S.A. or Canada, **the Master must notify the QI immediately via telephone** [emphasis added]…" followed by the QI and Alternate QI 24-hr emergency contact information. Per the NTVRP, Chapter 2, Section 2.1, "Incident/Emergency" was defined to include shipboard fire/explosion. The NTVRP further directed the Master to follow-up with the QI by phone within 40 minutes of the initial call to confirm the QI made appropriate notifications, update the incident status, and provide the QI with information exchanged during the SMFF Remote Assessment/Consultation, if performed. The NTVRP directed the QI to make notifications, including to the SMFF Provider, and mobilize the SMFF Provider if needed based on the QI's assessment of the situation.

4.2.1.7.1.1. NTVRP Activation. By 2144, the Grimaldi Designated Person Ashore (DPA)[40] was aware of the incident and informing company management via email. The DPA was initially notified by the on-call vessel Superintendent, who received a phone call from the Master at 2132. The QI was not notified at this time. Separately, beginning at 2317, the designated SMFF Provider became aware of the incident from local media coverage and contacted the QI and DPA to inquire if resources were needed. This prompted a series of phone and email correspondence between the QI/SMFF Provider and DPA, during which the DPA repeatedly directed that NTVRP activation was not needed. The DPA further emphasized that he was to be the QI/SMFF Provider's primary point of contact vice the vessel's Master. On July 6, 2023, at 0256, the DPA requested QI on-scene response to assist with possible risk of pollution, but directed NTVRP SMFF resources were not needed. At 0518, without direction from the DPA, the QI mobilized the SMFF Provider in response to the 0450 call for assistance from FDNY BC. At 0534, the DPA officially requested mobilization of the NTVRP SMFF Provider via email.

4.2.1.7.2. *Emergency Checklist – Cargo Ship Fire.* As part of the vessel's SMS, a four-page, 47-step checklist was available to guide the crew during a vessel fire. The checklist revision 1, dated December 20, 2021, was utilized by the Master and filled out by the Second Mate on the

[40] DPA: A shore-based, company-level position established by the ISM to monitor safety and environmental aspects of each vessel's operations. Intended to provide a link between the company management and those onboard to ensure adequate support and shore-based resources were provided for vessel operations.

vessel's navigation bridge during the fire response on July 5, 2023. Page 1 of the checklist was filled out with checks marking "yes" through Step 12, although additional steps were completed. The Second Mate also kept a separate page of notes that further documented actions/events occurring once NFD was onboard. Step 10 directed "Close automatic and manual fire doors of the affected area" and Step 11 directed "Close watertight doors." On page 3, Step 26.1 provided further direction for fire in a cargo area protected by CO_2 and on page 4, Step 31-33 provided further direction for vessels in port if the fire was not extinguished.

4.2.1.7.3. *Muster List.* The vessel's Muster List defined crewmember duties by position for different types of emergencies. Regarding emergency fire response, the Muster List did not delineate between fires at sea and fires in port nor did it identify specific crewmembers responsible for the tasks associated with closing watertight doors. The Muster List was posted in various locations around the ship for crew reference. On July 5, 2023, the crew responded to the fire in accordance with their assigned duties.

> 4.2.1.7.3.1. *Firefighter Team List.* This list summarized fire response duties found on the Muster List for crewmembers assigned to Firefighter Team No. 1 and Firefighter Team No. 2. This list identified assigned duties by both crew position and crewmember name. For Firefighter Team No. 1, the Chief Mate was assigned as Team Leader and the Bosun, as the Operator, wore the firefighter outfit and SCBA. For Firefighter Team No. 2, the Second Engineer was assigned as Team Leader and the Fitter, as the Operator, wore the firefighter outfit and SCBA.

4.2.1.7.4. *SMS Section 7 - Emergencies.* The vessel's SMS Section 7 contained guidance on fires in the cargo area as shown in the following Figure 13.

FIRE IN THE CARGO AREA

In the event of a fire in the garage, it is necessary to check that all watertight and fire doors are closed, shut down ventilation, close the dampers and disconnect the electrical power supply in the area concerned. Depending on the nature of the fire, use one or all the items of fire fighting equipment listed below:

(i)	Water for the use of hydrants and hoses
(ii)	Sprinklers in the garages/decks (if installed-eg. Drencher system)
(iii)	CO2: When the inert gas has been discharged, the room shall be kept closed for as long as is necessary to ensure that the temperature inside is adequately reduced in order to avoid a resumption of fire.
(iv)	Foam extinguishing system (if installed)
(v)	Handheld fire fighting equipment (various extinguishers, foam backpack etc.)
(vi)	Portable fire protection equipment (various fire extinguishers, foam backpack, etc.)
(vii)	The designated personnel shall, under instructions from the Master and the Chief Officer will cool the areas adjacent to those of inception to limit the propagation.
(viii)	The Master shall ensure that the adjacent areas (garages, accommodation and etc.) must be inspected by personnel in such a way as to indicate any fire propagation.

Figure 13. Extract from Grimaldi Safety Management Manual Rev. 1 (October 31, 2020), section 7, page 8 of 13.

4.2.1.8. *Operations in Newark, New Jersey*. On July 2, 2023, the vessel left the dock in Baltimore, Maryland and docked starboard side to Berth 18 on July 5, 2023, at Port Newark, New Jersey. The vessel planned to shift to the Red Hook Container Terminal in Brooklyn, New York on July 6, 2023, to discharge some containers that were onboard and load additional containers and vehicles for export. From Brooklyn, the vessel was scheduled to sail to Rhode Island. There were over 1,200 vehicles and 50 containers loaded on board at the time of the incident. The vessel frequented ports around the world since its delivery in 2011.

4.2.1.8.1. *Loading Operations*. The vessel began Ro-Ro loading operations at 0700 on July 5, 2023. At the time of the incident the loading operations were approximately 95 percent complete, with Ro-Ro cargo spaces on decks 11 and 12 fully loaded. According to the cargo plan, the average car, van, and truck loaded onto the vessel weighed approximately 3,600 pounds.

4.2.2. *Ports America and AMS.*

4.2.2.1. *Operational Framework.* Ports America was the stevedoring company hired by the GRANDE COSTA D'AVORIO interests to load cargo onto the vessel on July 5, 2023. They were the owners of the shoreside equipment used to load the vessel. Ports America provided unionized longshore labor directly hired from the International Longshoremen's Association to perform cargo operations. Additional labor was contracted with AMS who provided lashers and mechanics to further support this evolution. Ports America and AMS used loading plans provided by Grimaldi to guide where vehicles were loaded onto the ship.

4.2.2.1.1. *Shipping Guidelines.* Ports America and AMS used the ACL "Policy for receiving self propelled vehicles / units for the USA – West Africa Service" to determine the acceptable condition of vehicles processed at the terminal for loading onto Grimaldi vessels. Per these guidelines "All autos propelled by gasoline must be delivered with a minimum of 10 liters (2.5 gallons) of fuel inside. Trucks and other heavy RoRo must have a minimum of 35 liters (9 gallons) of fuel inside." These guidelines were posted at the berth 16-18 terminal for reference by Ports America and AMS employees. Based on witness testimony, there was no established process in place for Ports America or AMS employees to check fuel levels in cargo vehicles upon receipt at the terminal or before/during loading onto the vessel.

4.2.2.1.1.1. Vehicles loaded into designated Ro-Ro spaces of a vessel were excepted from requirements of 49 CFR Part 176 (Carriage by Vessel) and the IMO's International Maritime Dangerous Goods Code (IMDG)[41] provided they were not leaking any liquids. This included exception from requirements

[41] *See* 49 CFR § 176.905(i) and IMDG, Dangerous Goods List Special Provision 961.1., respectively.

on the maximum amount of fuel allowed to be in the vehicles fuel tank during carriage.

4.2.2.1.2. Longshoremen, directly hired by Ports America, loaded both rolling cargo able to be driven onto the vessel and containerized cargo.

4.2.2.1.3. AMS, as contracted by Ports America, provided lashers and mechanics to support vessel loading. Lashers secured all rolling cargo to the vessel's decks using the vessel's lashing equipment, disconnected all rolling cargo batteries, and pushed non-operating rolling cargo onto the vessel. Lashers also jump-started rolling cargo in the storage yard, which if able to be started, the cargo vehicles were then driven onto the vessel by Ports America direct-hired longshoremen. Mechanics provided preventative and repair services to the Ports America owned shoreside equipment. Maintenance capabilities were limited to actions that did not require a vehicle lift. Preventative maintenance was in the form of equipment checks prior to commencement of loading operations and consisted of checking fluids, tire pressures, and that the vehicles ran. Repair services mainly consisted of repairing flat tires.

4.2.2.2. *Training*. There was no formal training program for lashers regarding the operation of pusher vehicles or response to shipboard emergencies. Lashers were trained through on-the-job training by more senior/experienced employees. Junior lashers started out jump-starting vehicles, disconnecting batteries, and securing rolling cargo. As they gained seniority, lashers would promote to steering the non-running rolling cargo vehicles being pushed onto the vessel and then eventually driving the pusher vehicles. Lashers were required to hold a state issued driver's license for employment. Mechanics were trained through on-the-job training. They were not required to hold a professional mechanic certification and described themselves as a "roadside assistance" role. Ports America and AMS did not provide shipboard fire response training to their employees.

4.2.2.3. *Experience*.

4.2.2.3.1. *Lasher 1*. Lasher 1 worked for AMS in that position since July 2021. He began his shift on July 5, 2023, at 0700. His initial tasking was to disconnect cargo vehicle batteries once they were loaded onboard the GRANDE COSTA D'AVORIO. At 1600, the AMS Foreman reassigned him to a push team[42]. He selected the JEEP from the storage yard as the only available pusher vehicle he came across. As the sole operator of the JEEP from 1600 to 2100, he pushed approximately 11 cars onboard the vessel.

4.2.2.3.2. *Mechanic 1*. Mechanic 1 started working as a lasher in 2003 and progressed to a mechanic in 2008. He did not hold a professional

[42] A "push team" consisted of a pusher vehicle with a driver and a driver for non-running vehicles.

mechanic certification and did not complete extensive repairs on vehicles.

4.2.2.4. *Pusher Vehicle Fleet Information.* Ports America owned a fleet of five pusher vehicles used at Port Newark Berths 16-18 to load non-running cargo vehicles onto vessels. Four of the pusher vehicles were small pick-up trucks and the fifth was the JEEP. As one of the older pusher vehicles and without air conditioning, the JEEP was often chosen last out of all the pusher vehicles according to the statements of multiple AMS employees.

4.2.2.4.1. Ports America had a large metal bumper installed on the front of the pusher vehicles to enable the pushing of non-running cargo vehicles without sustaining damage. Many also had weights installed in the back to provide better traction during pushing operations.

4.2.2.4.2. Ports America purchased the JEEP (vehicle identification number 1J4FA24168L610382) in 2012. The vehicle was not titled to be driven on public streets and had 71,282 miles on the odometer at time of purchase. Between 2009 and 2016, the vehicle was the subject of five safety recalls. No unresolved safety recalls existed for the vehicle on the date of this incident. The JEEP was designed by the manufacturer for towing 2,000 pounds maximum from the rear of the vehicle and had 202- maximum horsepower[43].

4.2.2.4.3. The JEEP was subject to the Chrysler J30 safety recall launched in February 2010. The Chrysler J30 safety recall, titled "Transmission Fluid Temperature Warning," identified the problem as:

"*The transmission fluid in your vehicle may overheat under certain driving conditions. Continuous operation under these conditions may cause the transmission fluid to boil over and come in contact with hot engine or exhaust components. This could cause an underhood fire without warning."*

The remedy was to "reprogram the Cabin Compartment Node module to add a transmission temperature warning feature ['HOTOIL' cluster message] to the vehicle." The suggested recall remedy work was completed on the JEEP in August 2010 prior to purchase by Ports America.

An owner's manual addendum was provided by the manufacturer on the operation and function of the new feature advising:

"*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. It may also occur when operating the vehicle in a high torque converter slip condition, such as 4-wheel-drive operation (e.g., snow plowing, off-road operation). If this 'HOTOIL' message accompanied*

[43] *See* CG-EX-03 for additional design features and specs of a 2008 Jeep Wrangler X 4WD 2 Door.

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."

It also advised "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."

4.2.2.4.4. Lasher 1 and Mechanic 1 stated that they never saw the owner's manual or the aforementioned addendum for the JEEP.

4.2.2.4.5. Lasher 1 stated that he never observed any visual warnings nor heard any audible chimes while operating the JEEP on July 5, 2023.

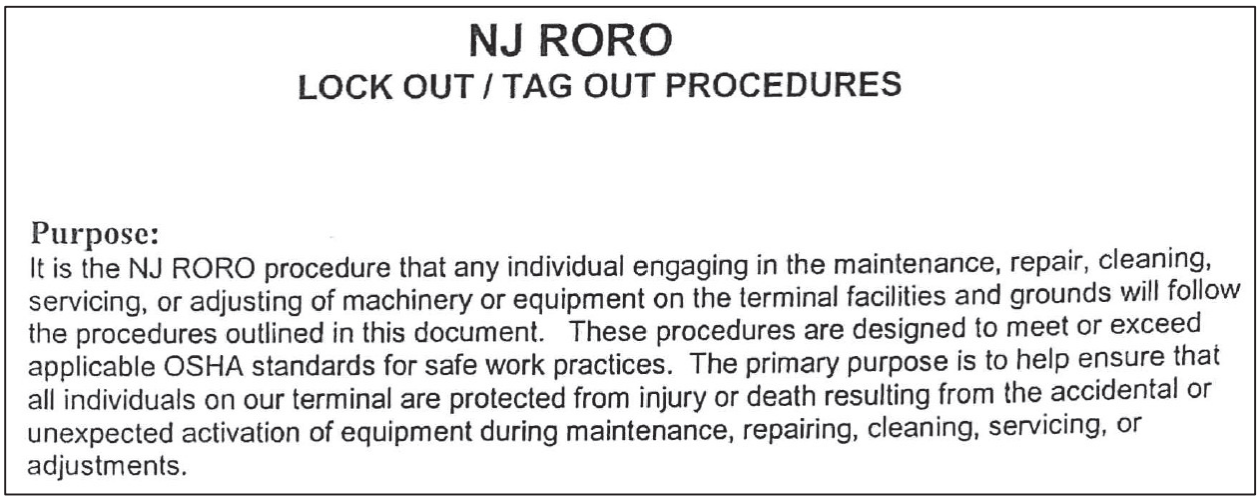
4.2.2.5. *Pusher Vehicle Maintenance.* Ports America did not have a routine preventative maintenance schedule for the pusher vehicles. For significant repairs that could not be completed in the field, the vehicles were towed to a local vehicle service facility. While at the service facility, standard preventative maintenance would also be completed (e.g. oil change, tire replacement, etc.).

4.2.2.5.1. In June 2022, the JEEP's radiator assembly was replaced by the AMS mechanical staff onsite.

4.2.2.5.2. In August 2022, Ports America sent the JEEP to a local vehicle service facility with 80,814 miles on the odometer. It underwent an oil change, had suspension work completed, a backup alarm was installed, the transmission oil was changed, the engine air filter was replaced, and two new tires were installed.

4.2.2.5.3. When pusher vehicles experienced a mechanical (e.g. overheating, punctured tire) issue, the vehicle would reportedly be parked "to the side" or left in place, at times unattended, depending on the issue. Notification of the experienced issue would be made to the Foreman or directly to the Mechanic. The Mechanic would then tend to the vehicle. There was no formally designated area in the terminal yard where vehicles were placed "off to the side" if in disrepair or experiencing any issues.

4.2.2.5.3.1. *Lock-Out / Tag-Out Procedure.* Ports America had a written Lock-out/Tag-out procedure document titled "NJ RORO", which applied to machinery or equipment maintenance at the Berth 16-18 terminal. The procedure's stated purpose was as shown in the following Figure 14. Lock-out/Tag-out supplies were reportedly kept in the Mechanics work shed located around berth 20.



NJ RORO
LOCK OUT / TAG OUT PROCEDURES

Purpose:
It is the NJ RORO procedure that any individual engaging in the maintenance, repair, cleaning, servicing, or adjusting of machinery or equipment on the terminal facilities and grounds will follow the procedures outlined in this document. These procedures are designed to meet or exceed applicable OSHA standards for safe work practices. The primary purpose is to help ensure that all individuals on our terminal are protected from injury or death resulting from the accidental or unexpected activation of equipment during maintenance, repairing, cleaning, servicing, or adjustments.

Figure 14. NJ RORO Lock-Out/Tag-Out Procedures extract. Collected from Ports America by Coast Guard Investigators on February 2, 2024.

4.2.2.5.3.2. The lashers interviewed as a part of this investigation did not have knowledge of an implemented program designed to identify pusher vehicles with mechanical issues to prevent their use before repairs were made.

4.2.2.6. On July 5, 2023, the JEEP was used to push 37 non-running cargo vehicles onto the vessel starting at 0729 as shown in the following Figure 15. Some movements were conducted in two-wheel drive while others, particularly for non-runners that were difficult to push, were conducted in four-wheel drive.

Vehicle Pushing Instance	Time Pushing Vehicle Up Ramp	Time Off Vessel	Time Elapsed on Vessel (minutes)
1	0729	0735	6
2	0739	0742	3
3	0758	0805	7
4	0815	0824	9
5	0833	0837	4
6	0843	0846	3
7	0853	0856	3
8	0902	0906	4
9	0916	0923	7
10	0928	0932	4
JEEP Parked for Break 0936 - 1003			
11	1010	1015	5
12	1020	1028	8
13	1033	1042	9
14	1049	1052	3
15	1105	1119	14

JEEP Parked for Break 1119 - 1301			
16	1317	1324	7
17	1328	1335	7
18	1339	1342	3
19	1348	1353	5
20	1400	1403	3
21	1408	1411	3
22	1424	1427	3
23	1433	1436	3
24	1443	1446	3
25	1453	1456	3
26	1502	1516	14
JEEP Parked for Break 1539 - 1611			
JEEP Parked in Cargo Storage Yard 1614 - 1725			
JEEP Shifted then Parked in Cargo Storage Yard 1728 - 1752			
JEEP Shifted then Parked in Cargo Storage Yard 1753 - 1806			
27	1811	1816	5
JEEP Parked in Various Locations Along Side of Vessel/Near Stern Ramp 1816 – 1914 (Workers Take a Break 1848 – 1914)			
28	1923	1927	4
29	1931	1951	20
30	1954	1957	3
31	2000	2003	3
32	2006	2010	4
33	2013	2022	9
34	2039	2041	2
35	2046	2049	3
36	2051	2054	3
37	2058	[redacted]	

Figure 15. Activity of the JEEP on July 5, 2023, as observed on security camera footage "Export_Berth 16 E", "Export_Berth 16 NE", and "Silo 2". Developed by Coast Guard Investigators.

4.2.3. *Port Newark.* The City of Newark owned the port of Newark, New Jersey. The Port Authority leased Port Newark from the City of Newark. They operated Port Newark as a lessee from the City of Newark. The Port Authority managed berth 16-18 at which the GRANDE COSTA D'AVORIO was docked. They provided law enforcement response through the Port Authority Police Department, but fire response capabilities were handled by local municipalities.

4.2.3.1. The Port Authority was a landlord port authority which had three auto processors amongst its tenants. Multiple Ro-Ro services connected to North America and international markets called[44] on Port Newark. Ro-Ro vessels could

[44] To "call" on a port means to make an intermediate stop on a scheduled voyage for various purposes like loading/unloading cargo.

dock at one of several public berths in the Port Newark Channel. The GRANDE COSTA D'AVORIO docked at Berth 18, which was a public berth. The Port Authority did not engage in cargo operations. The Port Authority managed the property and the berths utilized by Ro-Ro vessels and maintained a close relationship with the local Coast Guard Sector and its Captain of the Port. In this case, Port Newark was within Sector NY's area of responsibility.

4.2.3.2. Berth 18 was part of a facility that fell under the Facility Security Plan of the Port Authority which was regulated under the Maritime Transportation Security Act. No deficiencies were recorded during Coast Guard facility compliance inspections, the most recent occurring in August 2022.

4.2.3.3. Land-based firefighting hydrants were installed along the dock near Berth 16-18.

4.2.4. *NFD*. The NFD, officially known as the Newark Fire Division, fell under the Newark Department of Public Safety. The division was headed by the FC who reported directly to the Public Safety Director. Both positions were appointed by the Mayor of Newark. Port Newark, Berth 16-18, was within the jurisdiction of the NFD to respond to a fire as local responsibility and authority.[45]

4.2.4.1. Engine-27 and Ladder-4 were the first due[46] fire response companies to Berth 16-18 at Port Newark. Engine-27 and Ladder-4 were also the companies responsible for manning NFD's two fireboats. They were a part of Batallion-5. Batallion-5 also consisted of Engines-5, 14, and 16, and Ladder-8.

4.2.4.2. *Company Staffing.* To accommodate shift work, each company had four tours. NFD company tours were made up of one company officer in the grade of Capt and at least two firefighters. A fully staffed company tour would have had four firefighters. On July 5, 2023, Engine-27 had a company officer and two firefighters, Ladder-4 had a company officer and three firefighters, and Engine-16 had a company officer and three firefighters.

4.2.4.2.1. FF A was assigned to Engine-16 Tour 1. He started with the NFD in November 2013 and with Engine-16 in January 2014. He did not attend the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023[47].

4.2.4.2.2. FF B was assigned to Ladder-4 Tour 1. He started with the NFD in October 2006 and with Ladder-4 in June 2011. FF B attended shipboard fire training given by the NFD in 2014 and fireboat simulator training in 2016. He also attended the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023.

[45] *See* the Federal Fire Prevention and Control Act of 1974 (PL 93-498), stating that it was local FD's authority and responsibility to respond to in-port shipboard and waterfront facility fires in their jurisdiction.
[46] First due indicates the primary fire department or company assigned to respond to an emergency in a specific area.
[47] *See* section 4.2.4.5.1. for discussion on the Maritime Electric Vehicle Fire Seminar.

4.2.4.2.3. Capt E-16 had served in that position for approximately eight years and with the NFD for approximately 22 years. He did not have any tactical shipboard fire training, nor had he ever been onboard a cargo vessel before. He attended the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023.

4.2.4.2.4. Capt L-4 was assigned to that company under a mutual swap agreement with the regularly assigned company officer. He filled in as the Ladder-4 company officer several times before and was familiar with the crew. He was with the NFD for approximately 22 years and had been a Capt for two years. Capt L-4 did not have any fireboat training. Capt L-4's normal assignment was Ladder-11 Tour 4.

4.2.4.2.5. BC-5 had served in that position for approximately eight years and with the NFD for approximately 22 years. As a Capt, he attended shipboard fire training given by the NFD in 2014. He also attended the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023. Upon arrival at the GRANDE COSTA D'AVORIO, as the first chief officer on scene, he assumed initial incident command until relieved by DC-1, at which time he oversaw shipboard operations from deck 12.

4.2.4.2.6. BC-4 was a battalion chief since 2015, assigned to Battalion-4 for one and a half years, and with the NFD for approximately 35 years. He did not have any tactical shipboard fire training, nor had he ever been onboard a cargo vessel before. He attended the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023. Upon arrival at the GRANDE COSTA D'AVORIO, as the second BC on scene, he assumed the role of safety officer, a position that he continued to hold during the entire incident even while managing tactical operations on deck 10.

4.2.4.2.7. DC-1 was assigned to that position for approximately seven years and with the NFD for approximately 27 years. He did not have any tactical shipboard fire training, nor had he ever been onboard a cargo vessel before. He attended the Maritime Electric Vehicle Fire Seminar classroom training mandated for all NFD personnel in June 2023. As the DC on duty, he assumed incident command upon his arrival at the GRANDE COSTA D'AVORIO. He maintained this role until the NFD departed the scene.

4.2.4.2.8. The FC assumed that position in an acting capacity in October 2016 and was sworn in as the FC in January 2017. He started with the NFD in 1995. He became a BC in 2009 and a DC in 2012. As a Capt, he worked with Rescue-1 where he participated in a technical rescue exercise in the port simulating the extrication of the operator from a gantry crane;

this was his only maritime or shipboard response experience or training. Upon his arrival to the incident, he did not assume command but rather served in an advisory capacity to DC-1. Standard operating procedures only specified that the FC **should** assume command upon arrival at a fire scene. FC stated that it was not his common practice to take over a scene from the DC, but rather guided the DC when needed.

4.2.4.3. *Firefighter Equipment.* NFD provided each firefighter with equipment, including firefighter turnout gear (jacket, pants), hood, gloves, helmet, boots (rubber with stitched soles), SCBA, and VHF radio. Some firefighters elected to wear personally purchased boots, that were leather with glued soles. Equipment, including boots with glued soles, met the standards established by the National Fire Protection Association (NFPA).

4.2.4.3.1. *SCBAs.* SCBAs were equipped with Personal Alert Safety System (PASS) devices and 30-minute[48] rated air bottles. PASS devices sounded a loud audible alarm if a firefighter did not move for over 60 seconds. They could also be manually activated. SCBAs were issued to each firefighter at the start of their shift based on their riding position in the apparatus.

4.2.4.3.2. *SCBA Pack Tracking Devices*. NFD possessed three SCBA pack tracking devices each kept at a different station. These devices were handheld receivers used to detect the location of a firefighter in distress by giving audible and visual feedback on their location based on a signal from their SCBA. NFD members reported that these devices were not routinely used, in any response, because of their limitations and effectiveness, particularly between floors in a high-rise. No witnesses recalled these devices being used during the search for FF A or FF B.

4.2.4.3.3. *Mobile Cascade Unit.* The NFD's mobile cascade unit was used to refill SCBA bottles on-scene and was operated by Special Operations. On July 5, 2023, the unit was out of service because the system was being overhauled. It had been out of service for approximately one month. While the unit was down, NFD relied on mutual aid departments' mobile cascade units upon request. No mobile cascade unit deployed to this incident.

4.2.4.3.4. *Radios*. Firefighter radios were equipped with an Emergency Action Button (EAB) to be used in a mayday situation. When depressed, the EAB gave the user's radio priority on the repeater to avoid a mayday call from being blocked or broadcast over by dispatch or other radio user transmissions and enabled automatic logging of the user as distressed. The EAB activated radio identification number would appear on digital screens

[48] SCBA minute-ratings are derived by NIOSH testing where the SCBA was placed on a machine that simulated an average adult male's breathing rate at a moderate workload. Actual available airtime may be reduced based on the wearers exertion level and respiratory rate which was frequently higher than average in firefighters.

of other firefighter radios. As indicated by NFD records and witness testimony, neither Capt E-16, FF A, nor FF B activated an EAB during this incident.

4.2.4.3.4.1. As a standard, NFD radios transmitted over the city's repeated fire frequencies to enable communications with dispatch and logging of radio traffic. Firefighter radios had the ability to be switched to local channels that transmitted direct to radios in near proximity without going through the repeaters. On July 5, 2023, some firefighters working on the GRANDE COSTA D'AVORIO switched to local channels attempting to overcome communication challenges caused by the vessel's steel hull.

4.2.4.3.4.2. NFD issued a radio to every firefighter at the start of their shift that was based on position within the Company. Once assigned, firefighters performed a radio check to ensure the equipment functioned properly, this was recorded on the Dispatch repeater system. The issuance and return of the radios were documented in NFD records. There was no documentation of FF B's radio being returned after the incident, however records show its issuance at the beginning of his shift.

4.2.4.3.5. Responding NFD apparatus were equipped with 2.5-inch hose lines for fire attack. The responding firefighters expected that their hoses would be able to tie into the vessel's water supply like they would in a high-rise structure. The GRANDE COSTA D'AVORIO was equipped with 45-milimeter (approximately 1.75-inch) hose lines and hydrants. NFD did not possess adapters to enable their hoses to fit hydrants of different sizes.

4.2.4.4. *Fireboats*. NFD had two fireboats that were at least partially federally funded using Federal Emergency Management Agency Port Security Grants. On July 5, 2023, dispatch directed Engine-27 to respond to the scene with Fireboat 2. BC-5 cancelled the order since Engine-27 was already on scene and heading onto the vessel to investigate the situation. Neither NFD fireboat responded to the fire onboard GRANDE COSTA D'AVORIO.

4.2.4.4.1. Fireboat 1 was a 51-foot vessel with two deck water cannons. On July 5, 2023, it was placed out of service after the engines were unable to start that morning during the unit inspection.

4.2.4.4.2. Fireboat 2 was a 27-foot vessel with minimal water pumping capabilities. On July 5, 2023, it was fully operational. Fireboat 2's minimal pumping capability made it an ineffective resource for a large ship fire and was therefore never deployed to this incident.

4.2.4.4.3. NFD did not have written doctrine on the training or operational requirements for the fireboats. The boats were part of the New Jersey Regional Fireboat Task Force.

4.2.4.5. *Maritime Firefighting Training.* NFD did not have a formal routine training program established for shipboard firefighting. Fire companies located near Port Newark did not routinely visit the port facility or go onboard cargo vessels to establish familiarity. NFPA Standard 1405 (*Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires*, 2020), Chapter 10, Section 10.3 recommends "Training of land-based fire fighters in the unique aspects of combating vessel fires should include the following: (1) Vessel types, (2) Vessel construction pertaining to firefighting, (3) Stability and dewatering, (4) Strategy, (5) Command, (6) Suppression and ventilation, (7) Available resources for assistance."

4.2.4.5.1. In twice-daily sessions on June 19 to 22 and June 26 to 29, 2023, the Port Authority, in conjunction with the New Jersey Office of Homeland Security and Preparedness, provided a Maritime Electric Vehicle Fire Seminar to the NFD. The FC issued Notice No. 2023-059 on May 10, 2023, mandating all members of the department to attend the training, but some NFD personnel did not attend this training for various reasons such as planned leave. The training was delivered in three-hour classroom sessions and consisted of a slide presentation aimed at providing awareness of dangers presented by lithium-ion batteries. The training provided awareness of shipboard dangers through an eight-minute video that gave a virtual walk through of a Ro-Ro vessel cargo deck. This seminar was not intended to provide training on shipboard firefighting tactics. On June 9, 2023, NFD arranged for on-board walkthroughs of a vessel for sessions from July 10 to 20, 2023. These sessions were cancelled due to the impacts of this incident on staffing.

4.2.4.5.2. The last documented formal shipboard firefighting training provided by the NFD was in July through August 2014. The training was held at the Middlesex County Fire Academy and consisted of two courses of marine firefighting training and a practical exercise.

4.2.4.5.3. In June 2016, Boat Simulator Training was provided for Marine Companies, which included members of Ladder-4 and Engine-27. This training was held at the New York Police Department Counterterrorism Division and was focused on the navigation of small watercraft similar to the NFD's fireboats.

4.2.4.5.4. NFPA Standard 1005 (*Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters*, 2019) identified minimum job performance requirements for land-based firefighters operating at marine firefighting incidents. The standard specified that to be a Marine Firefighter, the individual must first meet the requirements of

Firefighter II[49]. Requirements for the Marine Firefighter qualification included: 1) knowledge on marine vessel types, terminology, and location of Fire Control Plans; 2) making safe access to the vessel; 3) connecting to the water supply for fire-fighting operations, establishing effective incident communications, and protecting exposures; 4) using marine facility and vessel communications equipment to receive and relay verbal information at an incident; 5) controlling and extinguishing fires on vessels, including fire attack, ventilation, reconnaissance operations, dewatering operations, and rescue of vessel occupants.

4.2.4.5.5. On July 5, 2023, no NFD personnel responding to the GRANDE COSTA D'AVORIO fire met the minimum maritime firefighting training standards or qualifications of NFPA 1005.

4.2.4.6. *UASI.* The City of Newark was a member of the Jersey City – Newark Metro UASI group, which also included Jersey City and the counties of Bergen, Hudson, Essex, Middlesex, Morris, Passaic, and Union. The UASI included a Fire sub-committee and a Metro Urban Search and Rescue (USAR) sub-committee, of which NFD was a part. The USAR strike team 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. The USAR provided capabilities for technical rescue services to catastrophic situations that would exceed the equipment and training of an individual FD's rescue units. Each USAR member department was provided the same technical rescue equipment.

4.2.4.6.1. The Rescue-2 truck was NFD's primary USAR asset. Rescue-2 was not staffed full time, but rather staffed as needed by Ladder-5 and Engine-10. Since this incident was initially a fire response, Ladder-5 and Engine-10 responded on their primary apparatus. When Rescue-2 became needed, those companies were already on scene and engaged in operations. NFD Rescue-2 never responded to the scene.

4.2.4.6.2. Upon arrival at the incident, USAR units established their own ICP and developed their own incident action plan within the tasking provided by the Incident Commander. USAR leadership planned and directed their search operations for FF B on deck 10.

4.2.5. *Coast Guard*. Sector NY, as the Captain of the Port; Officer in Charge, Marine Inspections; and Federal On-Scene Coordinator, provided regulatory oversight of marine safety activities, including search and rescue, incident management, contingency planning, pollution response, and vessel and shoreside facility safety and security inspections. Sector NY's area of responsibility included Port Newark. Sector NY fell under the operational command of the First Coast Guard District which fell under the Coast Guard's Atlantic Area.

[49] *See* NFPA Standard 1001, *Standard for Fire Fighter Professional Qualifications*, 2019.

4.2.5.1. *Area Contingency Plan (ACP)*. Sector NY managed the ACP. This plan was built around the principles of the National Incident Management System and formatted as a baseline plan with supporting incident annexes. It provided a framework to communicate, identify risks, and coordinate resources. The plan noted that cooperation was essential to prevent and respond to incidents in the marine transportation system.

4.2.5.1.1. *Marine Firefighting Section*. The ACP contained guidance for responding to marine fires occurring at any location within the Sector NY area of responsibility. It noted that if not properly managed, a fire may result in significant loss of life. It served two main purposes: to protect lives, property, and the marine environment; and to establish and facilitate a positive relationship among responsible Federal, State, and Local response agencies and commercial facilities to ensure an efficient and coordinated response. The ACP noted that firefighting should remain a state and local function. The plan noted the Coast Guard's role as an advising agency during marine fires in the state of New Jersey.[50]

4.2.5.2. *New Jersey Fireboat Task Force*. Sector NY coordinated the creation of a regional fireboat task force called the New Jersey Fireboat Task Force. The mission was aimed at coordinating resources amongst several local municipalities for dispatch to marine fires. The participating municipalities received grant funding to purchase equipment and train their members for response to marine fires. Regional training assets were available for both piloting these fireboats and tactics for fighting shipboard fires. Fireboats were expected to be maintained and inspected by their respective departments to keep an accurate account of available resources throughout the region for response to a marine fire. All member departments and municipalities actively participated in the task force and attended meetings except NFD.

4.2.5.3. *Initial Response to Incident*. At 2127, the Sector NY Command Center was initially notified by the vessel Master about the fire on the GRANDE COSTA D'AVORIO via a radio call on VHF channel 16. Command Center personnel followed all applicable quick reference cards and duty policies to both monitor and respond to the incident.

[50] *See* the Coast Guard's Marine Safety Manual, Volume VI, Sec. 86-6, COMDTINST M16000.11, which stated "while it is clear that the Coast Guard has an interest in fighting fires involving vessels or waterfront facilities in or along the navigable waters of the United States or fires in the vicinity of Coast Guard property, this interest does not extend to preemption of local responsibility and authority for firefighting. The involvement of Coast Guard forces in actual firefighting shall be to a degree commensurate with our personnel and equipment levels. The Coast Guard intends to maintain its historic 'assistance as available' posture without conveying the impression that we stand ready to relieve local jurisdictions of their responsibilities. Additionally, the response actions taken shall pose no unwarranted risk to Coast Guard personnel or equipment."

4.2.5.3.1. At 2148, the Sector NY Command Center was notified by a Port Authority Police Department officer of the fire via phone.

4.2.5.3.2. At 2152, Sector NY issued the first Urgent Marine Information Broadcast over VHF channel 16 notifying mariners of the vessel fire at Port Newark. This broadcast was repeated every 15 minutes.

4.2.5.3.3. At 2206, a Coast Guard Station New York small boat was diverted to the incident. The boat arrived on scene at 2247.

4.2.5.3.4. The first shore-based Sector NY personnel arrived at 0029 on July 6 and included the duty Investigating Officers who were closely followed by the duty Port State Control Officers and Pollution Responders. The Coast Guard eventually opened the Oil Spill Liability Trust Fund to cover costs associated with oil spill clean-up monitoring.

4.2.6. *Previous Incidents.* The following incidents involving in-port vessel fires and land-based firefighter injuries were reviewed and the related facts are included below.

4.2.6.1. *HOEGH XIAMEN – June 4, 2020*. The Ro-Ro cargo vessel experienced a fire caused by a failure to disconnect vehicle batteries during the loading process. The NTSB report identified issues with training and oversight for vehicle battery securement, regulatory exceptions for used and damaged flammable-liquid powered vehicles, fire detection system deactivation during cargo loading, and effective emergency distress calls. The probable cause was identified as ineffective oversight of longshoremen by the vessel owners, operators, and charterers. Specifically, that the shipping guidelines provided by the shipper were not being followed. Injuries consisted of nine burn injuries to the responding land-based firefighters.

4.2.6.2. *USS BONHOMME RICHARD – July 12, 2020*. At Naval Base San Diego, a fire consumed the USS BONHOMME RICHARD after burning for five days. The Navy's Command Investigation report highlighted deficient training and readiness of the Federal Firefighting Department (FEDFIRE) and the ship's crew in addition to the materiel condition of the vessel. The integration between the vessel and supporting land-based firefighters was inadequate to respond to the fire. Specifically, the training and management of land-based firefighters was called out as a significant need to execute a shipboard fire response. This included planned use of a vessel's installed equipment as a primary response apparatus to ensure timely and sufficient response to prevent significant spread of fire onboard a vessel. Additionally, a discussion on the improvement of the Incident Command Structure was a recommendation from this report. Further, the Navy had not established clear standards for what land-based firefighters would specifically provide during a fire response to all vessels across the fleet. Injuries were reported for 68 uniformed and civilian personnel as well as 19 land-based fire fighters

which were related to smoke inhalation, dehydration and heat injuries, impact injuries, and others.

4.2.6.3. *SPIRIT OF NORFOLK – July 22, 2022*. The small passenger vessel experienced an engine room fire while underway and the crew determined the fire was too large to fight. The vessel lost propulsion and the passengers and crew evacuated to a Good Samaritan vessel. It was towed to a pier and the fire spread throughout the vessel before being extinguished four days later. During land-based firefighting efforts onboard the vessel, a team of four firefighters declared a mayday when they became trapped just outside the engine room. They were able to self-extricate without sustaining significant injury. Identified causal factors included a lack of fire detection and fixed fire extinguishing systems in the engine room and ineffective response communications.

5. **Analysis**

5.1. *Fire Origin, Cause, and Spread.* Based on the totality of evidence, it is certain that the fire originated in the JEEP. With consideration to the ATF Certified Fire Investigator's determination that informed this investigation, it is most probable that the fire was caused by a mechanical failure that expelled a flammable fluid onto a nearby hot engine or exhaust system component. More specifically, this investigation concurs with the ATF's finding that it was most likely that the JEEP's transmission overheated, and its transmission fluid expelled from the transmission fluid filler tube encountering a hot surface within the JEEP's engine compartment (approximate location shown in the following Figure 16).

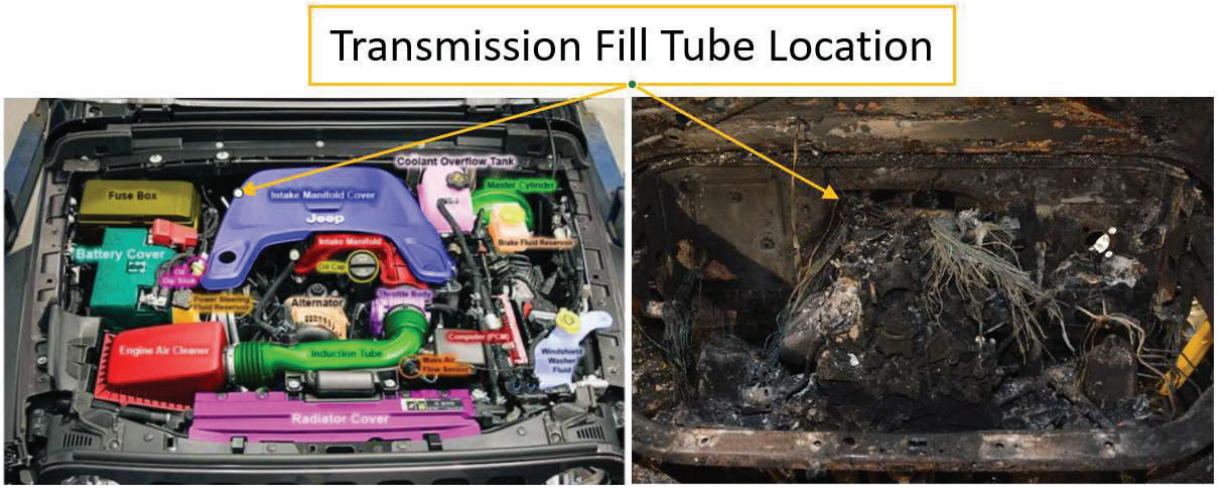


Figure 16. Exemplar JEEP engine compartment layout (left) compared to the post-fire JEEP (right). Derived from CG-EX-06.

When this flammable fluid and competent ignition source came into contact, hot surface ignition occurred. Witnesses, who described fire dripping from beneath the JEEP, likely saw burning flammable fluid that dripped from the vehicle onto the deck beneath the JEEP thereafter creating a pool fire. This pool fire allowed elevated flame heights and increased flame temperatures in the engine compartment. Burning fluid then dripped through the lashing holes onto deck 9 as witnessed by vessel crewmembers. The fire began to cause convective, conductive, and radiant heat transfer to surrounding vehicles and decks. Then it progressed

and involved available combustible materials in these spaces and the fire intensified. With WTD-12 open, convective buoyant heating allowed the hot fire gases to rise and eventually ignite vehicles on deck 11 and exhaust up the vehicle ramp to deck 12 essentially acting as a chimney. The fire was fuel limited as it progressed through decks 10 and 11 until available ambient air entrained from the lower decks was consumed at which point it became ventilation limited. The fire was suppressed by the release of CO_2 into Fire Protection Zone C, but with WTD-12 open, CO_2 levels on deck 10 and 11 quickly decreased. As additional air was introduced into the space when firefighters opened boundary doors as well as when the deck 10 ventilation system was turned on, the fire was able to progress. Conductive heating continued as ambient air was consumed and eventually ignited vehicles on decks 6 through 8 and 12 and then eventually spread to the accommodation and navigation spaces on decks 11 and 12. Based on these circumstances and evidence, this investigation classified the fire as accidental[51]. Other fire causes examined were catastrophic failure of an engine or drive train component, fuel system leak, lithium-ion battery failure, electricity, spontaneous heating, accidental disposal of smoking materials, animal activity, and incendiary causes. All other causes were ruled out by ATF as part of their investigation through the scientific method, and this investigation concurs.

5.2. *Improper Use of the JEEP Exceeding Design Specifications*. The JEEP was designed by the manufacturer to tow 2,000 pounds maximum from the rear of the vehicle and was rated by the manufacturer to have 202 maximum horsepower. This investigation could not identify a design specification for maximum weight able to be pushed by the vehicle but recognized that it is likely similar to the towing capacity. Based on the cargo plan, the average vehicle loaded onto the vessel weighed approximately 3,600 pounds. The JEEP was operated for an average of 12 hours per loading day and often given minimal break between consecutive loadings. As a result, it is estimated that the JEEP would load 30-50 vehicles onto a vessel in a single loading day. Based on the weight of the average cargo vehicle and repeated use of the JEEP to push these vehicles up steep ramps and around tight turns inside the vessel, this investigation finds this use to be beyond the manufacturer's designed and stated intentions. Research did indicate that JEEP Wranglers were capable of being used as snowplows. Ports America retrofitted the JEEP to include a metal push bar on the front bumper which is the area where an aftermarket snowplow would typically be mounted. Pushing vehicles is also similar in nature to snowplowing operations, whereby both actions involve exerting forward force to compel movement of a heavy object or substance. Nevertheless, the JEEP's owner's manual warned of excessive prolonged use in high torque converter slip conditions and severe usage specifically naming operations like snowplowing and towing. Lasher 1 recalled that on the date of the incident, he occasionally had to press the gas pedal all the way down to push vehicles onto the GRANDE COSTA D'AVORIO. Though routinely operated in two-wheel drive, the JEEP was switched to four-wheel drive when struggling to move a vehicle. Based on terminal security camera footage where the JEEP was observed pushing a non-runner in tandem with another pusher vehicle less than ten minutes before the fire originated, this investigation finds it is likely that the JEEP was switched to four-wheel drive. The repeated demands put on the JEEP outside intended manufacturer parameters undoubtedly caused the

[51] NFPA 921 Guide for Fire and Explosion Investigations defines a cause of "accidental" to involve all those for which the proven cause does not involve an intentional human act to ignite or spread fire into an area where the fire should not be.

transmission to work in a severely high torque condition. This is known to elevate the transmission fluid temperature, and in severe cases, cause it to overheat. Had the JEEP been used within the design parameters specified by the manufacturer or equipment of appropriate pushing capacity been used for this operation, it is reasonable to believe that the pusher vehicle would not have experienced a mechanical failure that resulted in a fire.

5.3. *No Routine Preventative Maintenance Program for Pusher Vehicles*. Neither Ports America nor AMS had established routine preventative maintenance programs for pusher vehicles. All maintenance was reactive to problems that occurred and were reported during operation of the vehicles. Beyond checking and topping off oil, other fluids, and tires of the pusher vehicles by the AMS Mechanics ahead of a vessel arriving at the berth, no other routine documented preventative maintenance was conducted to ensure pusher vehicles could keep up with the high demand and high torque operation of pushing non-running cargo vehicles onto vessels. According to witness testimony, maintenance items like fluid changes and tire replacements were only conducted when the vehicle was taken to an outside service facility for an emergent issue that exceeded the AMS Mechanic's on-site capabilities. Records provided to this investigation revealed that the last time the JEEP was at an off-site service facility was in August 2022, which was also the last time records showed the transmission fluid was changed in the JEEP, nearly one year prior to the incident in July 2023. Frequent use in high torque operations, particularly while on inclines, can cause elevation of transmission fluid temperature that can degrade the fidelity of the fluid over time, particularly if not allowed to cool properly after an overheating event. Due to the severe nature of pusher vehicle operations, reliance on common personal vehicle maintenance practices/intervals or even the more frequent intervals specified in the owner's manual when performing prolonged periods of towing, would not guarantee a sufficient practice for the JEEP's operations. There was no established routine preventative maintenance program by Ports America that required periodic fluid changes based on manufacturer or mechanical expert recommendations that considered the vehicles' pushing operations. Additionally, no witness could recall the presence of a transmission fluid dip stick and it was not located during post-fire inspection of the JEEP. The lack of a dipstick, used to check transmission fluid level, calls into question whether the transmission fluid level was even being monitored at all, and provided an unhindered path for transmission fluid expulsion. Preventative maintenance programs require close monitoring of equipment conditions, allowing potential mechanical problems to be addressed before they become a more serious issue during operations. However, this investigation determined that a "run it until it dies" culture existed for pusher vehicles used during this incident. This investigation firmly believes that if Ports America prioritized preventative maintenance through a formally established and documented program, the JEEP would have been maintained in a better operating condition and the chance of a fire would have been minimized.

5.4. *Degradation of the JEEP Transmission Prior to Fire*. On July 5, 2023, the JEEP was used for approximately 13 hours prior to the initial fire at 2100. During this time, it pushed 37 vehicles onto the vessel as identified in Figure 15. Figure 15 also indicates that the intervals between pushing these 37 vehicles, aside from the breaks, never exceeded 15 minutes. Repeatedly pushing 3,600-pound vehicles, particularly if doing so in four-wheel drive, is a high torque converter slip operation that required continued maximum effort from the transmission system. The JEEP was especially susceptible to overheating transmission fluid

issues in high torque operations, such as snowplowing, trailer towing, and off-road operation, as warned about in the J30 safety recall and associated owner's manual addendum. It is important to note that the J30 safety recall remedy did not make a mechanical change to reduce the likelihood of overheating under these conditions, rather it updated the vehicles dashboard warning module to give a visual and audible alert to the driver of the developing conditions that could lead to a fire. As transmissions begin to overheat, they display physically observable symptoms such as clanging noises, sluggish operations, and sometimes smoking. While conflicting testimony prevents this investigation from firmly determining whether the JEEP was experiencing overheating conditions preceding the incident on July 5, 2023, several witnesses did identify some of these symptoms observed with the JEEP that day. There was also conflicting witness testimony as to whether the JEEP regularly experienced overheating issues during its lifespan as a pusher vehicle, and specifically, whether overheating issues were the reason the JEEP was "put to the side" during cargo operations on the day of the incident. However, since no lasher confirmed familiarity with the owner's manual or otherwise understanding of the prescribed cool down process when the vehicle was overheating, this investigation finds it unlikely a cool down process was utilized, which over time, further degraded the transmission fluid fidelity and transmission condition.

This investigation did recognize that the JEEP had been used as a pusher vehicle since 2012 without previously experiencing a catastrophic mechanical failure that caused a fire. But the continued use of a vehicle over time, especially in these conditions, does not necessarily suggest the vehicle is in good working order. Rather, it may suggest that the JEEP's transmission system, especially in light of the poor preventative maintenance procedures, likely had experienced significant degradation due to heightened wear and tear. Moreover, security camera footage revealed that on the day of the incident the JEEP assisted another pusher vehicle that had trouble moving a non-running cargo vehicle up the vessel's stern ramp. The non-running vehicle appeared so difficult to move up the ramp, that it eventually required both pusher vehicles to work in tandem after a running start to move it up the incline, a situation where Lasher 1 would likely have utilized four-wheel drive. This was likely a high-torque event that would cause extreme overheating of the JEEP's transmission and preceded the fire initiation by only about nine minutes. During that time, the transmission was also not given an opportunity to cool down because the JEEP continued to work pushing a Toyota Venza up to deck 10 shortly after. Lasher 1 testified that he did not see the "HOT OIL" warning message on the JEEP's dashboard nor hear the audible warning chime, as described in the J30 safety recall remedy, preceding the fire. However, due to conflicting witness testimony about the condition of the JEEP's dashboard instrument cluster, this investigation is unable to confidently determine whether the warning lights and chime were in working order or if there were any obstructions to visibility on the day of the incident. Had the JEEP been better maintained, allowed to cool after high torque events, and taken out of service upon showing signs of overheating, it most likely would not have caught fire.

5.5. *Unclear Guidance on Out-of-Service Pusher Vehicle Protocols*. There were varying understandings of what to do if a pusher vehicle experienced mechanical problems during cargo operations, and no specification on types of conditions that necessitated a pusher vehicle to be put out of service. Some witnesses believed the vehicle should be "put to the side" in a designated area to indicate to all drivers that there was a problem with the vehicle, and to cue the AMS mechanic to check on the vehicle's operational suitability before it

returned to service. In some extreme cases where the vehicle became undrivable, it would be left in its existing position with notification made to the foreman or mechanic. A secondary witness interpretation was a "lock-out/tag-out" process where the driver would bring the problematic pusher vehicle to the AMS mechanic office on the pier, a visual indicator by way of a sticker was placed on the vehicle, which informed all drivers to leave the vehicle out of service until it was cleared by a mechanic and the sticker was removed. During the initial phase of this investigation, including initial interviews with lashers, Mechanic 1, and Ports America Superintendents, there was never mention of a lock out/tag out procedure when the witness was asked about protocols for pusher vehicles with issues. However, at the public hearing, the Ports America Lead Superintendent testified that such a policy existed, and subsequently, Ports America produced the "NJ RORO Lock-Out/Tag-Out Procedures" previously described in section 4.2.2.5.3.1. of this report. While this investigation does not question the existence of these procedures on and before July 5, 2023, it questions whether these procedures were applied to pusher vehicles. This is based on the fact that the procedures are intended for machinery or equipment that is undergoing maintenance to keep it from unintentionally activating and causing injury to the person performing work. This is the traditional application of a Lock-out/Tag-out program under federal Occupational Safety and Health Administration (OSHA) regulations. Therefore, these procedures likely, and more appropriately based on their stated purpose, were applied to heavy machinery (e.g. forklifts, cranes, etc.) or other facility equipment in use at the terminal that could be unintentionally activated while work was being performed, unlike standard work vehicles. This investigation's belief is further bolstered by the fact that the operators of pusher vehicles were unaware that there was a system to designate pushers as out of service. Instead, based on witness testimony, it seemed to be the more common practice to put a pusher vehicle "to the side" if it was experiencing an issue without any visual indicator of such to cue another driver to avoid use. Some witnesses testified that the JEEP was "off to the side" and visually displaying indications of overheating throughout the day of the incident. Due to conflicting testimony and lack of visual evidence, this investigation was not able to determine with certainty whether the JEEP was experiencing issues before the fire erupted. However, if the JEEP was in fact put "to the side" due to overheating without indication of the issue to other lashers, it is likely a subsequent lasher may have used the JEEP before it sufficiently cooled down. Continued use in this state would cause long-term degradation of the JEEP's transmission. Formalized guidance on actions to take when a pusher vehicle experienced problems during loading operations, including specifically, conditions warranting removal of the vehicle from service and appropriate cues of its removal, may have resulted in the JEEP being removed from service prior to the fire.

5.6. *Untrained Pusher Vehicle Drivers*. AMS employees received no formal training on how to operate pusher vehicles. There were no requirements to be familiar with the various dashboard warning lights and signals for each pusher vehicle in the fleet or a requirement to review the owner's manuals and addendums. While all AMS employees who drove pusher vehicles had driver's licenses and experience driving personal vehicles, they were not aware of the various warning signals and their meaning specific to the JEEP. Some drivers also indicated trouble seeing any lights on the JEEP dashboard. It is unclear if the dashboard illumination and chime were operable or possibly obscured. However, lashers interviewed during the course of this investigation were unable to even identify the correct "HOT OIL" warning message and chime installed on the JEEP's dashboard as part of the J30 safety recall.

Therefore, even if functional, lashers were not trained, nor aware, to look for this indicator. This is especially concerning if, as reported by at least one witness, the JEEP historically overheated. The "HOT OIL" indicator in an overheating vehicle scenario should significantly dictate the lasher's actions, to include a cool down of the vehicle, as prescribed by the owner's manual addendum. But, the required corrective actions cannot follow if there is no awareness of the indications requiring it. Therefore, this investigation finds that if AMS employees were trained on the various warning lights and signals for the pusher vehicles, required to review the owner's manual and addendums prior to operation, and understood when to take vehicles out of service, this heightened awareness may have resulted in removing the JEEP from service prior to the fire.

5.7. *Lack of Vehicle Fuel Tank Level Restriction and Verification*. Grimaldi and ACL's vehicle shipping guidelines for West Africa service did not restrict fuel levels in cargo vehicles. These guidelines only mention a minimum amount of fuel required to be present in vehicle fuel tanks, which was presumably to ensure enough fuel to load and discharge the operable rolling cargo. There was also no procedure at the terminal to verify cargo vehicle fuel tank levels during the intake process or loading of the vessel. In contrast, 49 CFR § 176.905 and the IMDG Dangerous Goods List required an inspection of cargo vehicles to ensure fuel tanks did not exceed ¼ tank full of flammable liquid. However, cargo vehicles were excepted from this requirement if there were no signs of leakage from the battery, engine, fuel cell or fuel tank and they were being stowed in designated vehicle or Ro-Ro cargo spaces on the vessel. A post-fire sampling of unburned cargo vehicles removed from the GRANDE COSTA D'AVORIO identified that many vehicles had fuel levels above ¼ tank full, but none showed issues that would have prevented their exception from the fuel level regulations. Further analysis of the low-pressure CO_2 system design specifications indicated that, in an ideal CO_2 suppression system discharge scenario (WTD-12 and all other boundary doors closed, full design quantity of CO_2 discharged, and space remained sealed until cooled) the fuel levels within cargo vehicles would not have significantly impacted the effectiveness of the low-pressure CO_2 system in fire suppression, in contrast to an initial theory that the low-pressure CO_2 system may not have been adequate to overcome the given or maximum potential fire load. Therefore, this investigation finds that the lack of fuel tank level restriction or verification was not a causal factor or unsafe condition as it related to this incident.

5.8. *Lack of Duplicate WTD-12 Controls*. WTD-12 was located on the top weather deck of the vessel along the port side at the top of the ramp that provided vehicle access from deck 11 to deck 12 (see Figures 7 and 8). It served to close-off the vehicle ramp and cargo vehicle garage spaces from weather while at sea. It further served as the top-most exterior boundary to the low-pressure CO_2 fire suppression system's Fire Protection Zone C. The door was designed and constructed to have a single set of operating controls located just inside the door slightly down the ramp. To open or close the door, the operator had to insert a key and keep the corresponding button on the control panel depressed until the door reached the desired position. As a result, operation could only occur from within Fire Protection Zone C. The ICLL in effect at the time of the vessel's construction required doors located on the ends of superstructures to be weathertight and have operating controls located on both sides of the door. Further, SOLAS Chapter II-2 in effect at the time of the vessel's construction required that doors creating boundaries for CO_2 protected spaces have the capability of being closed from outside the space. When queried as part of this investigation, the classification society,

approved by the flag State of the vessel, did not interpret WTD-12 to fall under either of these regulations. This interpretation was further indicated by their continued issuance of a valid International Load Line Certificate. Also, it is apparent that this was how the door was interpreted by classification society surveyors during construction oversight as the vessel was built and approved with only the one set of door controls. However, the Damage Control Plan for the vessel, approved by the same classification society in July 2011, classified WTD-12 as watertight demonstrating the inconsistency of the classification society's interpretation. Moreover, a review of sister vessels and other Ro-Ro/Container vessels of the same owner/operatorship revealed that these same doors on the sister vessels only had one set of controls while other vessels built in different shipyards had door controls located on both sides. It is unclear why the door construction including only one set of controls was approved despite ICLL and SOLAS requirements and the approved Damage Control Plan designation. However, if either of these regulations were correctly applied during design and construction of the GRANDE COSTA D'AVORIO, WTD-12 would have included more than one control panel. As such, this investigation is confident that ICLL and SOLAS have appropriate regulations to ensure duplicate door controls and therefore, this investigation makes no recommendation to update these international standards.

Testimony from the vessel's Master, corroborated by other crewmembers, indicated WTD-12 was unable to be closed before discharge of the CO_2 system because there was heat and smoke coming out of the door opening. This was further exasperated by the risk to life of the person who would have to remain in the space depressing the control panel button until the door was closed. This person would then have to exit through the fire space on cargo deck 11, with the closest exit being across deck 11 on the starboard side nearly 200 feet away as depicted in the following Figure 17. Had WTD-12 been built with controls located outside the space, as discussed above, it would have eliminated the only barrier to getting the door closed in the first hour following ignition.

Additionally, based on VDR data, the cargo door hydraulic control system did not experience any type of documented fault or mechanical issue until 2208, approximately 45 minutes after the CO_2 system had been released. This indicated that WTD-12 could have been closed if a crewmember was able to access the control panel in the early hours of the fire. Fire modeling by the ATF indicated that WTD-12's open state had significant effect on depleting CO_2 levels on deck 10 and 11 beginning 30 minutes after discharge as depicted in the following Figure 18. In fact, this was found to be the most significant factor in this incident that prevented the effectiveness of the CO_2 system. Therefore, if WTD-12 was closed, Fire Protection Zone C would have been fully sealed off, the chimney opening that excelled fire spread would have

been eliminated, and effectiveness of the CO_2 in suppressing the fire would have increased, all without any additional crewmembers or firefighters entering the space.

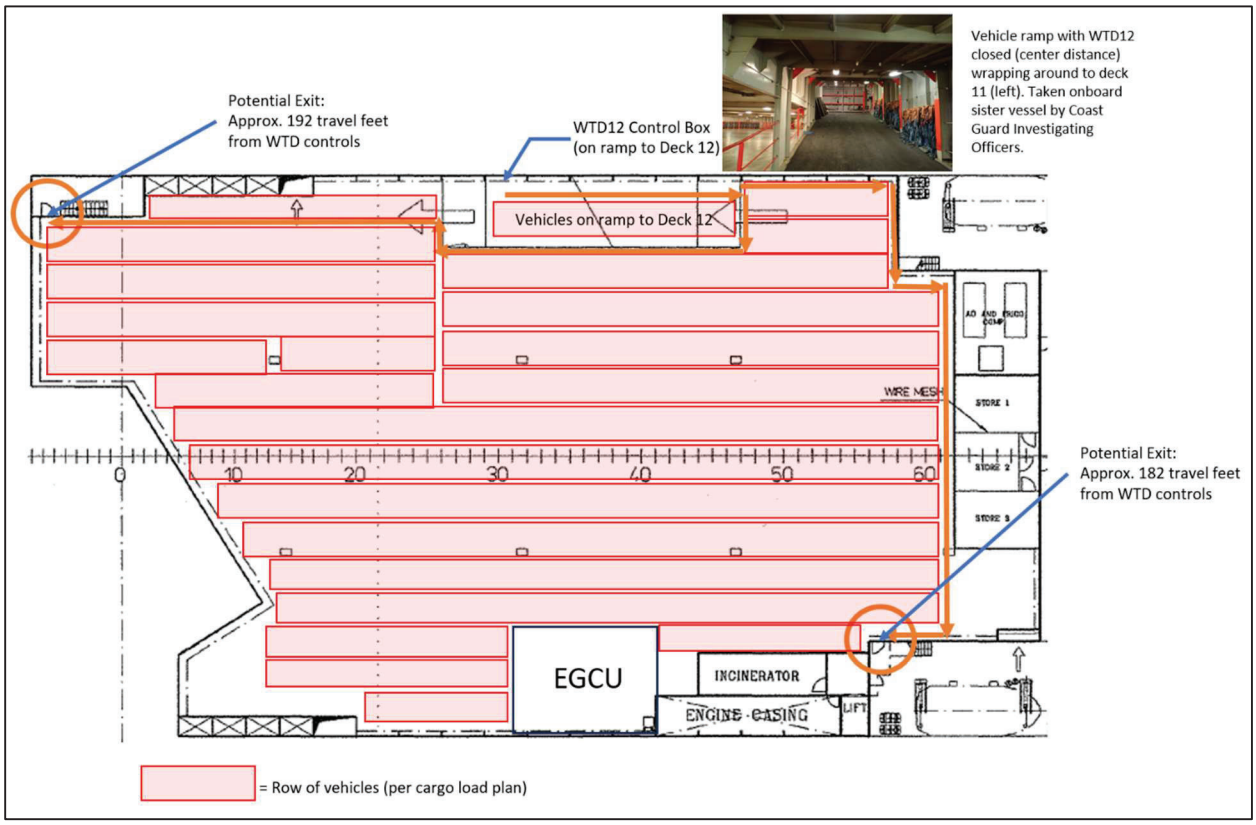


Figure 17. Potential paths from WTD-12 controls to an exit on deck 11. Developed by Coast Guard Investigators.

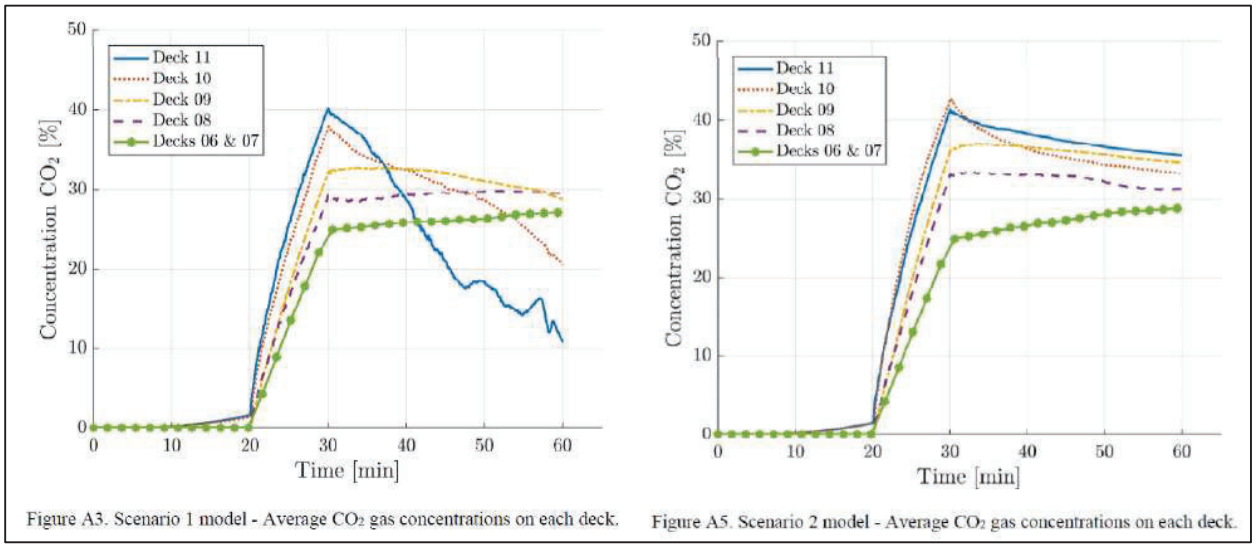


Figure 18. Graphs from ATF Fire Modeling Report showing impact of WTD-12 on CO_2 system effectiveness. Scenario 1 ran with WTD-12 open; Scenario 2 ran with WTD-12 closed. Developed by ATF.

5.9. *Failure to Close WTD-12 Once No Longer Needed for Cargo Operations.* WTD-12 remained open for an extended period after the last cargo vehicle was loaded onto deck 12 and even after deck 11 was completely loaded. At that point, the door could have been closed

without impacting cargo operations. There were no regulations or policies in place at the time of the incident that specifically prohibited WTD-12 from remaining open until the vessel departed for sea, an apparent common practice amongst Ro-Ro vessels. During this investigation, no explanation was given as to why WTD-12 was left open after decks 12 and 11 were fully loaded. However, once the vessel experienced the fire and the decision was made to close the door it was too late to do so. Had WTD-12 been closed when loading of deck 12 and 11 were complete, the initial fire spread would likely have been minimized by reducing the chimney effect, and the CO_2 system would likely have been effective at extinguishing the fire as depicted in Figure 18.

5.10. *Lack of In-Port Fire Planning and Training for Vessel's Crew.* Evidence indicated that plans for shipboard fire response had been developed by the vessel's owner through their SMS. The vessel's posted Muster List and corresponding Firefighter Team List indicated the assigned duties of each crewmember during a variety of different emergencies, including fire. Additionally, there was an Emergency Checklist for Cargo Ship Fire available to the navigation bridge watch. While the emergency checklist did have a line item for "10: Close automatic and manual fire doors of the affected area" as well as another "11: Close watertight doors", neither the checklist, Muster List, nor Firefighter Team List contained specific crewmember(s) pre-assigned to perform these tasks. Based on the expansive distance between the multiple doors in the boundary of the large cargo deck fire protection zones and considering only certain crewmembers had keys to operate the WTD PLCs, it would have been reasonable to expect one of these lists to specifically assign multiple crewmembers to ensure these doors were closed immediately. In response to the fire on July 5, 2023, evidence showed that the vessel's crew responded as assigned on the Muster and Firefighter Team Lists, and the emergency checklist was used and filled out by the Second Mate and the Master. Further, testimony from the vessel crewmembers, including the Master, indicated that the vessel routinely conducted fire drills that at least met, if not exceeded, the requirements of SOLAS. At the time of the casualty, SOLAS required fire drills to be conducted at least every month, but did not specify location on the vessel, scenario to be tested, or when the drill was to be conducted, stating only that fire drills should be conducted in preparation for "various emergencies that may occur."[52] The broadness of this term often results in the exclusion of in-port fire drills as demonstrated by the GRANDE COSTA D'AVORIO, where all fire drills were conducted when the vessel was at sea. This practice was not out of the ordinary for a cargo vessel because it avoided delay during in-port cargo operations. The SMS also did not require in-port drills to be conducted because it did not specify locations or scenarios that must be tested, stating only "The Master is responsible for ensuring that the crew receive adequate training and for checking that fire drills are conducted as needed and when due." This was further supported by testimony from the Master who stated that fire drills were conducted every 15 days as prescribed by the company, but that the subject of the drill was left to the discretion of the Master, which he always elected to perform at sea.

While many components in responding to a shipboard fire are the same no matter the vessel's location, when at sea, the WTDs in the cargo deck fire protection zone boundary are always closed by regulation. However, the need to close the WTDs proved to be a crucial element to

[52] SOLAS Chapter III, Regulation 19.3.4.1

the fire response on July 5, 2023, particularly for WTD-12. Since none of the vessel's fire drills were performed while in port, the crew never trained in the action of actually closing the WTDs during an emergency, either in normal or emergency actuating mode. Though actions taken by the crew for routine underway fire drills were performed without error and in accordance with the Firefighter Team and Muster Lists, training specifically for in-port fire scenarios, to include the closing of WTDs, would have instilled the necessary preparedness and muscle memory to respond swiftly in real-life scenarios. Additionally, due to recent in-port ship fires, an update is recommended to IMO fire drill requirements in SOLAS and/or the U.S. port State regulations. This recommended update should include a requirement for periodic in-port fire drills to reflect this emerging risk. Since this investigation found that the GRANDE COSTA D'AVORIO met all SOLAS fire response requirements and U.S. vessel arrival regulations, this investigation believes that, had they existed, such requirements would have been properly implemented on the vessel. Therefore, training for an in-port fire, to include the actual closure of all WTDs, would likely have resulted in the assigned crewmember(s) closing WTD-12 ahead of the intense spread of the fire and PLC fault, despite the lack of duplicate operating controls for the door, as previously discussed.

5.11. *Ineffective Initial Firefighting Efforts.* The vessel's crew and Lasher 1 responded to the initial fire onboard as expected utilizing portable fire extinguishers and then hose lines. As a result of their routine fire drills and professional training, the vessel's crew were well-trained in these aspects of fire attack, which are no different in-port than at sea. However, testimony from lashers indicated they were never trained in shipboard emergency response protocols, to include basics on where and how to muster for accountability.

5.11.1. *Portable Fire Extinguishers.* As specified in the approved Fire Control Plan, all portable fire extinguishers nearby on deck 10 were of the dry-chemical powder type suitable for extinguishing a flammable liquid fire, and all five in near reach were utilized. However, these efforts were likely hindered by the fire's rapid growth that prevented personnel from getting close enough to the JEEP. Additionally, the design of the JEEP's engine compartment hood overhung the side of the engine compartment, obstructing the extinguishing powder from reaching the fire base. Therefore, this effort was ineffective at extinguishing the fire.

5.11.2. *Fire Hydrant and Hose Lines*. Once the ship's hose lines were readied, the use of water to combat the fire also proved ineffective. It is typical practice for foam to be used, delivered by the hose line, in a flammable liquid fire, as it starves the fire of oxygen and has a cooling effect. Per the Fire Control Plan, there was a supply of portable firefighting

foam and an applicator located near the port aft stairwell inside of deck 10 and nearby the fire hydrant used as depicted in the following Figure 19.

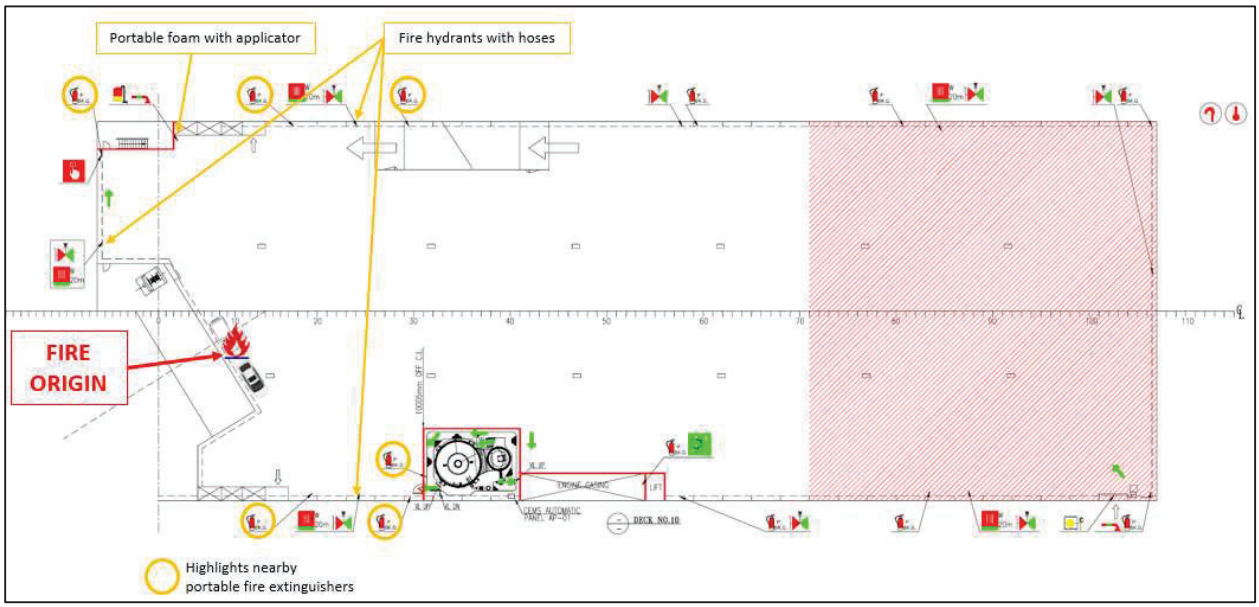


Figure 19. Deck 10 fire suppression equipment locations. Developed by Coast Guard Investigators using CG-EX-07B.

The use of foam was also mentioned in the Grimaldi Safety Management Manual as a recommended option for use in cargo space fires. However, the vessel's crew never attempted to utilize the foam. Based on their testimony, the Chief Mate and Master believed foam would have been ineffective due to the lashing holes in the deck, which would have allowed leakage of the foam down into deck 9. Given the proximity of the foam to the fire hydrant used in the initial fire attack and ability for quick integration into the original hose line setup, this investigation finds a rational basis for its use, regardless of the potential impact such leakage may present. Accordingly, this investigation finds that the fire may have been potentially controlled and/or extinguished before it spread further if the foam had been used in the fire response.

5.11.3. *Low-Pressure CO_2 Fire Suppression System.* Once portable fire extinguishers and hose lines failed to suppress the fire, the Master correctly ordered all personnel out of the space and had the fixed low-pressure CO_2 fire suppression system discharged into Fire Protection Zone C, with immediately observable results at suppressing the fire. Unfortunately, despite efforts to close WTD-12 prior to discharge, it remained open and had significant effect on the ability of the CO_2 to fully extinguish the fire. CO_2 is only capable of starving the fire of oxygen, it does not have a cooling effect on the hot materials within the space. As such, to be truly effective, the space would have either needed to be kept fully sealed for a prolonged duration to allow the space to cool before the reintroduction of oxygen, or the space would have needed to be fitted with a water deluge or sprinkler system where water would provide a cooling effect. Although enough CO_2 remained in the storage tank for a "manual" second discharge, which was not contemplated until after NFD firefighters were working in the space and the fire began to reflash, it is unlikely that the remaining quantity of CO_2 would have had any significant

effect on the fire at any point throughout the incident without sealing WTD-12.

5.11.3.1. *System Performance.* Based on space volume and use, the system was designed to discharge approximately 30 metric tons of CO_2 into Fire Protection Zone C during a ten-minute period. A disparity in actual versus anticipated post-discharge tank level indicator readings called into question the actual quantity of CO_2 that the system released. The Chief Engineer, who activated the system and was present in the CO_2 Room during discharge, testified that the system released agent into Fire Protection Zone C for the full ten minutes as anticipated. However, he also testified that only 20 metric tons of CO_2 were discharged based on his reading of the tank level indicator after the ten-minute automated release concluded. On July 16, 2023, Coast Guard Investigators personally observed the CO_2 storage tank level indicator[53] showing that approximately 14 metric tons of CO_2 remained in the tank, as indicated by the red bar in the following Figure 20, corroborating the Chief Engineer's testimony.

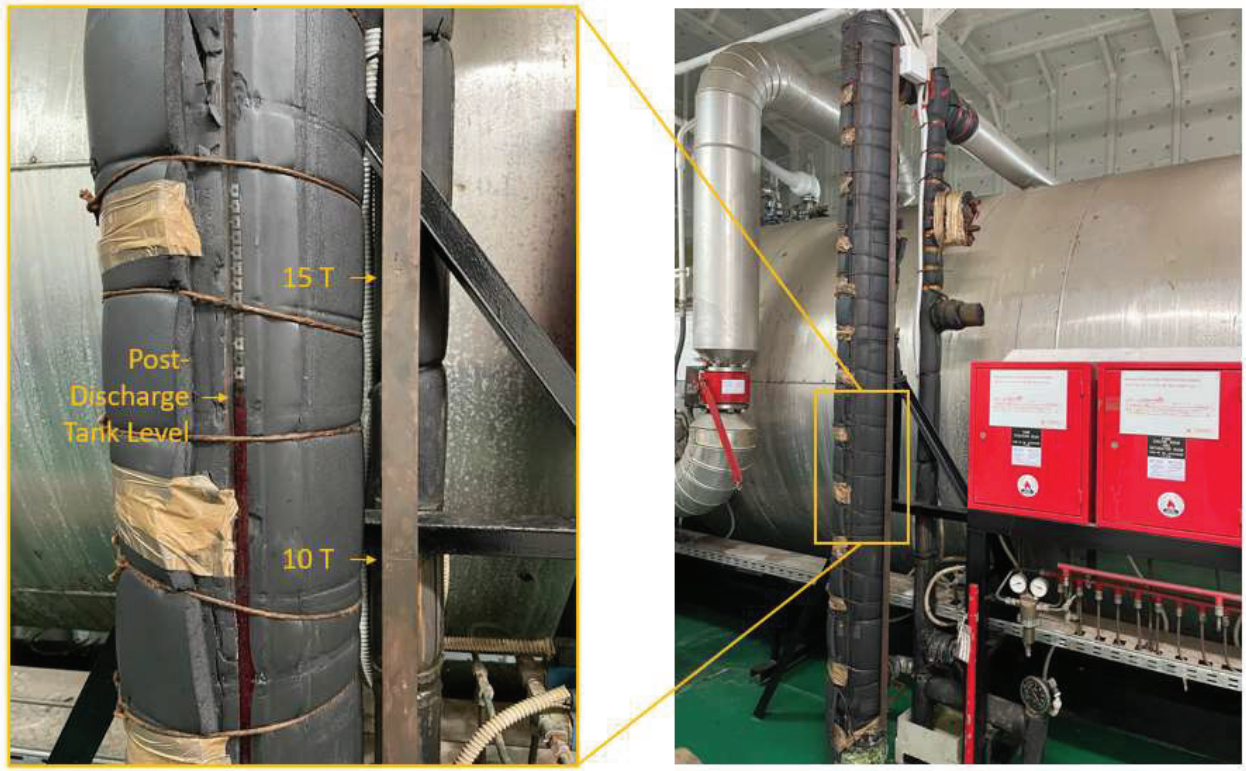


Figure 20. Low-pressure CO_2 storage tank level indicator post-discharge. Developed by Coast Guard Investigators from photographs taken by the same on July 16, 2023.

This investigation later learned that a surveyor, acting on behalf of Grimaldi, observed the tank level indicator on July 13, 2023, at which time it showed a solid red bar up to approximately 14 metric tons like seen in Figure 20, but then a break and additional red bar above the 15 metric ton mark. Daily inspection records of

[53] Verified as "…in correct working condition…" by a certified technician of Pastor Inzenjering who attended the vessel in the shipyard on April 18 to 19, 2024. Pastor Inzenjering report dated July 25, 2024.

the tank level indicated that approximately 35[54] metric tons of CO_2 were stored in the tank prior to the July 5, 2023, discharge. As such, the post-discharge observations and testimony would indicate that the system failed to release the full 30 metric tons of CO_2, instead discharging only 20 metric tons. However, on November 2, 2023, a marine surveyor, acting on behalf of Grimaldi, observed the level indicator reading approximately four metric tons, which was then substantiated by the Pastor Inzenjering technician's observation on April 18, 2024, while attending the vessel in the shipyard. These later level indicator readings showed that the system had indeed discharged the full 30 metric tons of CO_2. This investigation considered the possible reasons for the disparity in the level indicator readings including: 1) the system failed to discharge the full design quantity and remaining CO_2 leaked from the storage tank between July 16, 2023, and November 2, 2023, or 2) the level indicator initially read inaccurate and the system did discharge the full design quantity. The Coast Guard Marine Safety Center's fire protection engineer and the Pastor Inzenjering's technician were consulted. The first scenario, while unable to be completely ruled out, was determined unlikely since no repairs were made to the low-pressure CO_2 system prior to the Pastor Inzenjering technician's inspection, and the level indicator continued to read approximately four metric tons between November 2, 2023, and April 18, 2024. Had there been a leak in the system, it would have been extremely coincidental that it stopped leaking exactly at the quantity expected to remain after a full designed discharge. The second scenario was determined to be most probable, with the level indicator initially reading inaccurate due to effects from the violent nature of CO_2 being released from the tank. When asked about the disparity, the Pastor Inzenjering technician stated, "Our assumption is that the system after the activation, due to the release and fast flow of the liquid CO_2 phase (CO_2 was additionally cooled) towards the protected zone, some magnetic sheets [in the level indicator] may have frozen for this reason (and vibrations may have occurred due to activation) and they remained in position (red), as the system warmed up after the extinguishing was finished, the sheets thawed and returned to the correct state by themselves." This is further supported by the sequential change in observations from the surveyors "mixed" reading on July 13, 2023, to the Coast Guard Investigators observation on July 16, 2023, to then the surveyors reading on November 2, 2023, indicating settling of the gauge over time. Regardless, whether 20 or 30 metric tons of CO_2 were discharged was of minimal significance in this incident since, based on the ATF modeling previously discussed in section 5.8, with WTD-12 open, either amount of agent would have dissipated well before the space was able to cool.

5.12. *Lack of Shipboard Firefighting Training for NFD Firefighters.* The last shipboard tactical firefighting training that NFD members attended was in July 2014, nine years prior to the fire onboard GRANDE COSTA D'AVORIO. Of all the NFD chief officers that responded to the GRANDE COSTA D'AVORIO, only one had attended the 2014 training, however. The syllabus for the July 2014 training described a tactical shipboard firefighting curriculum

[54] The system had a design capacity of 34.5 metric tons. The difference in recorded readings and actual design capacity was likely the result of course level indicator markings hindering the ability to distinguish .5 units.

rooted in NFPA 1005 and 1405 standards. It covered many aspects of combating a fire onboard a vessel and ended with an eight-hour hands-on exercise to reinforce the principles learned. The following sections address concepts that firefighters would have learned through any shipboard tactical firefighting training developed using NFPA 1005 and 1405 standards and how it would have enabled them to better respond to this incident.

5.12.1. *Lack of Jurisdictional Awareness*. When notified of a fire aboard a vessel, there are many complex jurisdictional aspects with which the Incident Commander should be aware. These include the roles, responsibilities, and authorities of the Master of the vessel, the Coast Guard, and the local land-based fire department. Initial actions taken by the NFD upon notification of the fire on the vessel indicated they were unclear with the typical chain of command on vessels and the critical information that the vessel's crew and terminal employees could provide in planning a response. Only one firefighter asked for a Fire Control Plan at the onset of the response, a document that provides invaluable information in understanding the vessel and its installed equipment and systems. But as testified, DC-1 had no familiarity with the document. He also did not seek the assistance from the vessel's crew in deciphering it. For these reasons, DC-1 found little utility in the plan and put it to the side. Further, none of the firefighters could identify a crewmember by title or describe their responsibilities during the incident. Of particular concern to this investigation was the seeming unawareness by NFD personnel that the vessel Master retained full authority and control over everything that occurred on the vessel. While some engagement was made with the Master by BC-5 upon his arrival on deck 12, the Master was never fully integrated into the decision making for the fire response on the vessel. Had the firefighters been trained in jurisdiction and vessel crew roles and responsibilities they would have understood the value each crew member, and most importantly the Master, in collectively planning and responding to the fire.

5.12.2. *Lack of Vessel Familiarity*. Port Newark was an expansive busy port complex with many large vessels arriving and departing each day. Establishing vessel familiarization was critical for the fire companies within whose area of responsibility the port resided. Vessel familiarization should have covered, at a minimum, the vessel's crew organization and responsibilities, structures and layout of the vessel, the vast array of machinery and fire suppression systems and equipment that can be found onboard, fire protection zones and boundaries, and shipboard documents, such as the Fire Control Plan, that could be used to formulate firefighting strategies. NFD personnel's unfamiliarity with commonly used documents and lack of experience with the construction and layout of vessels was apparent by the failure to utilize the vessel's multiple stairwells, failure to inquire about vessel equipment to more efficiently transport NFD equipment to deck 12, the unfamiliarity with marked egress routes and how to identify possible areas of refuge, the significance and hazards associated with the discharge of the low-pressure CO_2 system, and the lack of planning for radio communication interruptions from the steel construction of the vessel.

5.12.3. *Failure to Utilize Available Resources*. There are many available external entities that can provide assistance through resources and knowledge when approaching a shipboard fire. These entities include, but are not limited to, the vessel's QI, Port Captain, designated marine salvage companies, Port Authority personnel, Coast Guard personnel,

and interpreters. During the response, NFD primarily utilized internal assets and other metro-area mutual aid fire departments. Knowledge gained from training may have helped the NFD to initially be aware and request partner organizations that would have been useful in constructing and implementing a firefighting plan at the onset of their response.

5.12.4. *Lack of Shipboard Incident Management Knowledge*. Tactical shipboard firefighting training would also likely have addressed how to approach a fire passively utilizing the vessel's fixed fire suppression systems and how to actively engage with both the vessel crewmembers and shipboard fire equipment. Also taught would be the requirement that a risk analysis be conducted comparing the safety of life to the vessel and cargo before an offensive attack would be attempted. However, the risk to the vessel and cargo versus personnel safety was not adequately considered by the NFD. This is highlighted by the decision to actively engage the fire despite full accountability of the crew and after CO_2 had been discharged. Through training, the NFD may have gained the necessary knowledge that a passive/defensive approach to shipboard fires is often preferred. If a defensive approach was taken in this incident, the need to enter the space further safeguarding the Newark firefighters would be greatly minimized.

5.12.5. *Common Problems Associated with Marine Firefighting.* Common problems are identified and the need to factor these in while responding to and planning for shipboard fires would be stressed. Some common problems encountered are confined space, access and egress limitations, language barriers, and radio communication challenges. The NFD was unaware of the common stowage practices on Ro-Ro vessels and the limited egress available from the cargo decks, which led to operating in a hazardous environment with very limited maneuverability. The NFD was also unfamiliar with the crew structure and that the standard working language of the vessel was English[55]. Having preemptive knowledge and knowing some common obstacles to expect would have helped develop an adequate strategy for the shipboard environment and may have led to better solutions to these common challenges associated with foreign vessels.

5.12.6. *Pre-Fire Plan*. Training courses of this type also emphasize the importance of the development of a Pre-Fire Plan for shipboard fires well before the actual response. A sample Pre-Fire plan checklist can be found in NFPA 1405: annex C, which encourages identification of vessel specifics, area resources, and response tactics. NFD had no Pre-Fire Plan and were unaware of the reference materials available to them to support making such a plan. Through training, this investigation believes that they would have gained the requisite familiarity with resources to develop a Pre-Fire Plan for their section of Port Newark, greatly benefitting the NFD in the early stages of the shipboard fire response.

Additionally, the NFD held a "Maritime Electric Vehicle Fire Seminar" for their firefighters in June 2023. This classroom training only provided awareness of some shipboard hazards

[55] A designated working language of the crew was required by SOLAS (20) Chapter V, Regulation 14. It was intended to ensure effective crew performance in safety matters. Each crewmember was required to understand and, where appropriate, give orders and instructions and to report back in that language, but did not guarantee fluency.

through an eight-minute video, however. This training did not include shipboard firefighting tactics, information on installed systems, or use of a vessel's Fire Control Plan. As follow-up, a vessel familiarity tour was also scheduled for their personnel in later July 2023. Unfortunately, this tour was scheduled to take place after the GRANDE COSTA D'AVORIO fire occurred. However, this seminar and tour alone would not ensure NFD was adequately prepared to respond to future incidents. For the reasons discussed above, training that meets the NFPA 1005 and 1405 standards at a minimum is necessary to ensure the crucial knowledge, procedures, and tactics are gained. The absence of this training and knowledge with respect to the vast majority of the NFD, had a considerable negative impact on the fire response aboard the GRANDE COSTA D'AVORIO.

5.13. *Poor Tactical Planning During Shipboard Fire Response.* Shipboard fires have been cited as "among the most difficult of all fires to extinguish and they can grow complex very quickly taxing resources of entire regions" (NFPA 1405 9.5). Shipboard fires also are very different than structure fires fought on land and therefore, should be approached differently. A well-established incident command structure and tactical plan are essential for fire response in the shipboard environment. These fires should be approached slower and more methodically than a typical structure fire with tactics planned out before entry, for reasons described by the NFPA guidance below:

NFPA 1405 - *Guide for Land-Based Fire Departments That Respond to Marine Vesel Fires*, section 1.3.1 stated:

"The tactics and strategies utilized to attack a fire aboard a vessel are in many ways similar to those used routinely in structural firefighting. However, there are many aspects of marine firefighting that warrant special attention because of the unique environment encountered aboard a vessel. Ships often are compared to high-rise buildings. This is not an altogether inappropriate comparison. However, the ventilation of a vessel fire can be more difficult to achieve and the spread of a fire more difficult to check. The fire fighter's natural response when confronted with a structure fire is to act immediately. This is because most structure fires exhibit similar characteristics that have been encountered before and thus there is a source of knowledge and experience from which to draw. However, a major fire aboard a ship seldom occurs, and very few fire fighters have experienced such a fire. Therefore, fires aboard ship should be approached in a quick but safe and prudent manner. Fire fighters have come to realize that when they approach hazardous material incidents, it is preferable to proceed slowly rather than to react too quickly, thus increasing risks and jeopardizing success. The same is also true when fighting vessel fires."

5.13.1. *ICP*. Establishing a robust and cohesive ICP is vital for planning and engaging fires onboard vessels. The ICP should include a wide variety of resources, specialists, and the vessel's Master, to assist the Incident Commander during a shipboard fire response. These components were not present in NFD's established ICP:

5.13.1.1. The NFD Incident Commander called off the self-dispatched New Jersey Fireboat Task Force, a mutual aid asset having many members trained in marine firefighting, after receiving a report from Engine-27 that the fire had been "knocked down." This methodology contradicts NFPA 1405 16.1.1. "Incident Commanders are cautioned to avoid haste decision when certifying that a fire has been extinguished."

5.13.1.2. It was apparent from witness testimony that the Master of the vessel was neither asked nor encouraged to assist with firefighting efforts or planning. The lack of a vessel crewmember(s) integrated into the ICP was an overlooked asset during this response, as NFPA 1405 5.4.1.2. specified:

"*Liaison with the ship's captain is to be established as a priority item at the outset of any incident. Courtesy and cooperation with the captain greatly enhance any operations aboard the ship. The captain will provide information on the sequence of events and the actions taken prior to the fire department's arrival. The captain should also know which systems aboard the ship are available and can be used.*"

The underutilization of the vessel's crewmembers may have been the result of a perceived language barrier. BC-5 did not receive a brief from the Master until after firefighting operations began, but more timely and meaningful engagement with the Master in the tactical planning process would have been beneficial.

5.13.1.2.1. *Perceived Language Barrier.* The majority of NFD firefighters interviewed during this investigation expressed an inability to clearly communicate with vessel crewmembers due to a language barrier. DC-1 even recalled having his Spanish-speaking aide unsuccessfully attempt to communicate with the Italian-speaking Chief Mate since messages were not being clearly conveyed in English. Communication with foreign crewmembers can certainly be a challenge. While, in this case, the vessel's working language established under SOLAS regulations was English, it did not require the crewmembers to be fluent in that language. Further, it is understood that non-native English speakers' ability to convey and understand concepts spoken in a second language become further challenged during high-stress, fast-paced emergency situations and when accents and unfamiliar technical jargon may be used. There was a variety of native languages spoken by crewmembers on the GRANDE COSTA D'AVORIO, including Italian, Romanian, and Filipino. There was also varying English-fluency amongst the crewmembers, with the officers, and particularly the senior officers, being the most well-spoken based on interviews conducted by this investigation. Despite the stress that comes from interacting with foreign law enforcement officers and testifying at a formal public hearing, it is recognized that a shipboard fire at night posed an even more stressful and fast-paced scenario that could stress anyone's ability to clearly communicate. FDNY BC was the only firefighter interviewed who recounted no difficulty communicating with the vessel's Master, but he did so after the initial NFD response and subsequent search efforts in the calmer setting of the navigation bridge. That said, many NFD personnel, including BC-5 and BC-4, were able to communicate important messaging, such as the need for hoses and deck 10 ventilation, when deliberate attempts were made. In fact, every NFD firefighter indicated that the vessel's crew successfully assisted with everything that was asked of them. As such, this investigation has described it as a "perceived

language barrier" since the crewmembers were able to be communicated with, but initial fast-paced high-energy failed interactions left NFD personnel, including DC-1, discounting the value of interacting with the crew rather than taking the time to have a deliberate slower-paced conversation.

5.13.2. *Developing a Plan*. As in all fires, the Incident Commander must choose between actively engaging a fire offensively or taking a defensive approach. Danger to firefighters and safety of life must be weighed against the dangers to the vessel and cargo in making this decision. An adequate tactical strategy considering these factors was not developed by NFD before engaging the fire offensively, however. Marine firefighting requires development of strategies and tactics in order to engage a fire effectively. There are several documents and guides, which are highlighted in the following paragraphs, available to local fire departments that assist in developing these plans.

5.13.2.1. *Pre-Fire Plans*. To assist in the development of shipboard firefighting strategy, NFPA 1405 annex C contains an example Pre-Fire Check Sheet for local fire departments to modify as needed to create locally specific Pre-Fire Plans. Multiple witnesses testified that the NFD had no written doctrine on marine firefighting. This plan could have helped prepare the NFD Incident Commander in identifying outside resources necessary for a shipboard fire situation.

5.13.2.2. *Fire Control Plans*. Fire Control Plans are internationally required and standardized documents to assist in the identification and lay-out of a vessel's fire system components. These documents are required for vessels on international voyages, and they are required to be available at vessel access points for shoreside fire department use. The Fire Control Plan onboard the vessel was a vital resource the Incident Commander could have used to develop a strategy in combatting the fire and provide the ICP a more comprehensive operational picture. NFPA 1405 9.1 notes that "one of the most valuable assets on the ship is the Fire Control Plan." While the Fire Control Plan was initially requested by BC-5 through NFD dispatch, once received at the ICP, it was not understood and subsequently not utilized. There were also no adequate attempts to request resources or engage with the vessel's crew, Port Captain, or Coast Guard to assist in interpreting the information. It is recognized by this investigation that Fire Control Plans are large and cumbersome documents, often containing all the vessel's decks on a single page, that are rolled and/or folded multiple times. This difficulty can be overcome through training however, where firefighters gain comfortability and familiarity with its use. The fact that this incident occurred primarily at nighttime also likely resulted in further difficulty reading the Fire Control Plan. The investigation believes however, that if the NFD understood the crucial information this plan contained, all efforts would have been taken to enable its review in informing a slow and methodical response to the fire.

5.13.2.3. *Lack of Understanding the Implications of Fixed CO_2 System Discharge*. The installed low-pressure CO_2 system that was discharged aboard the GRANDE COSTA D'AVORIO was designed to displace oxygen to the affected area and extinguish the fire. For this reason, NFPA 1405 5.5.7.1. classified spaces in which CO_2 was discharged as a "life hazard" that should not be entered without an SCBA. With respect to effectiveness, the fire protection zone in which the CO_2 was discharged needed to remain sealed and any "entry into [the space]…should be delayed to allow the agent to perform its function."[56] NFD demonstrated a lack of understanding both these implications regarding the vessel's CO_2 system during this incident.

5.13.2.3.1. *Life Hazard.* NFD personnel's actions after making their way onboard the vessel clearly demonstrated a lack of understanding for the potential life/health hazards resulting from CO_2 being discharged into a closed space. Engine-27 crew attempted to access deck 11 cargo space without donning their SCBAs. It was not until after the Third Mate emphasized the hazardous condition several times that they donned their SCBAs to enter. Further, as BC-4 made his way up the starboard ladderwell, he stopped and opened the door to deck 6 cargo space, stating that his breath was then taken away by what he assumed to be CO_2 gas. Making this of particular concern was the fact that BC-4 was the Safety Officer and should have been actively considering all hazards. Instead, he proceeded onto the vessel where CO_2 had been released without his SCBA. While at less risk in this incident, BC-5, who had attended the 2014 shipboard tactical firefighting training, proceeded onto the vessel and up to deck 12 without any personal protective gear, to include his SCBA. Several vessel crewmembers, including primarily the Chief Mate, recalled having briefed multiple firefighters in white shirts[57] about the CO_2 release, so this investigation believes NFD personnel should have had awareness that CO_2 was discharged. As such, their disregard for planning and implementing mandatory safety measures to mitigate the associated health risks demonstrated a lack of clear understanding for shipboard extinguishing systems. It was truly fortunate that no NFD personnel experienced issues from CO_2 exposure, or the results of this already tragic incident could have been far worse.

5.13.2.3.2. *Keeping the Space Sealed.* After receiving information from the vessel's crew that the fixed CO_2 system had been released, the NFD failed to analyze the boundaries of Fire Protection Zone C. Less than ten minutes after the CO_2 system had completed its discharge, Newark firefighters accessed Fire Protection Zone C through deck 11 which allowed the introduction of oxygen. At 2142, further oxygen was added to the space on deck 10 where Engine-27 left a fire hose that led from deck

[56] NFPA 1405 12.11.5.1.2.
[57] FD chief officers (BC, DC, FC) wear white uniform shirts to distinguish their leadership position.

12 and into the open doorway to the deck 10 cargo space. This door remained open for the duration of the response.

5.13.2.3.3. *Assessing the Fire Boundary.* By not properly assessing the fire zone boundary, or inquiring with vessel crewmembers about its integrity, NFD was not aware of the significance of WTD-12 being left open. No attempts were made by NFD to assist the vessel's crew in closing the WTD-12 to fully seal Fire Protection Zone C. During Engine-27 crew's initial entry into deck 11 cargo space, Capt E-27 reported crossing cargo deck 11 from the starboard access door and reaching at least the bottom of the vehicle ramp to deck 12, less than 100 feet away from the WTD-12 PLC. This presumably occurred prior to the WTD-12 PLC fault and represented a significant missed opportunity to have fully sealed the fire protection zone. Such coordination with the vessel's crew to close WTD-12, prior to the PLC fault, would have had a significant impact on the initial fire suppression during this incident, especially since the low-pressure CO_2 fire suppression system remained charged with at least 4.2 metric tons of agent, which could have been manually discharged into the space.

5.13.2.4. *Vessel Crewmember Accountability*. The safety and preservation of life was justifiably a top priority for the NFD. Upon arriving at the top deck, BC-5 had a brief conversation with the Master regarding the accountability of the vessel's crew. BC-5 stated that he could not visually confirm the presence of the vessel's crew, however. Based on past experiences, primarily with shoreside structure fires, BC-5 also believed that the accountability of persons was often misrepresented. In response to this suspicion, BC-5 determined it was necessary to continue with investigating and suppressing the fire on deck 10. However, if BC-5 more closely coordinated with the Master in crew accountability and appreciated his authority and knowledge of the vessel and crew, a modification of NFD's strategy in investigating and engaging the fire on deck 10 may have resulted.

5.13.2.5. *Poor Resource Planning*. As already highlighted, vessel fires are very taxing for fire departments and require a plan to ensure ample resources of both equipment and personnel. The NFD demonstrated a failure to adequately resource plan and accommodate for the shipboard environment, however.

5.13.2.5.1. *Lack of Provision Crane Use.* During this incident, NFD created a staging area on deck 12 of the vessel to conduct operations on deck 10. The method for moving equipment from the dock to deck 12 was manpower. Carrying equipment like SCBA bottles, hoses, and rescue equipment up nine levels of stairs is physically demanding task, as demonstrated by the fact that many responders had to go on air during the transit. NFPA 1405 13.6.5 states that "logistics should develop a system to mechanically transfer equipment and supplies from the dock to the vessel using the vessel cargo-handling gear…" Such mechanical means were available on the vessel through the provision crane. However, no members

of the NFD engaged with the vessel's crew to utilize this crane to transfer supplies to deck 12 and preserve the stamina of the firefighters.

5.13.2.5.2. *Air Management.* NFD's onboard response was challenged by use of their standard 30-minute rated SCBA bottles, rather than employing larger 45-minute or 60-minute rated bottles. This limited the time firefighters were able to spend within the space both during the initial fire investigation and attack, as well as during the search and rescue of FF A and FF B. It was only FDNY rescue crews using 60-minute rated SCBA bottles that were able to reach FF B's location in deck 10. Witness testimony did identify that NFD possessed longer rated bottles, many of which were equipped on the Rescue-2 apparatus, the NFD's UASI asset, which did not respond to the incident since the crews required to man it had already deployed to the scene. Additionally, the NFD resources were further constrained due to a non-functioning mobile cascade unit. This was a vehicle equipped to rapidly refill SCBA cylinders. While the NFD's mobile cascade unit was out of service, they relied on mutual aid response from neighboring FDs, primarily Elizabeth FD or Jersey City FD. However, this investigation understands that at the time of this incident, neither mobile cascade unit was available to respond. Better planning for air management in the shipboard environment and mitigation of an out-of-service mobile cascade unit would have helped prevent the air shortages NFD experienced and extended their functional operational time onboard.

5.13.2.5.3. *Personnel Staging.* NFD did not plan for an adequate number of personnel staged to engage the fire. The NFD utilized one fire hose with a two-man team of firefighters with an additional team staged for relief. However, NFPA 1405 13.6.3 recommends "a minimum of three teams of personnel dedicated for each fire attack hoseline: One operating the hoseline, one ready to relieve the attack team, and a third changing its air cylinders and preparing to be operational again. Each attack team should have a minimum of two hoselines…allowing one for fire attack and one for personnel heat protection." NFD's adherence to such a recommendation may have impacted the effectiveness of their response.

5.13.2.5.4. *Radio Communications*. NFD had a pre-set protocol to unify the radio communication during incidents which was followed. During the response there were multiple reports from NFD members that they experienced radio communication issues in both transmitting and receiving. This was likely due to the steel construction of the GRANDE COSTA D'AVORIO which can interfere with and redirect radio waves. NFPA 1405 Chapter 11 addressed these issues stating that "it should not be presumed that because a fire department's radio procedures and systems meet its routine needs that they automatically meet its needs during a shipboard fire." It further recommended that "alternate means of communications should be considered in pre-fire planning." The NFD did not identify adequate alternative means of communications in planning for

or during the tactical response to the fire. If it was considered by developing a plan of operations these issues may have been addressed.

The NFD was not foreign to fighting fires on land, establishing an ICP, developing tactical plans, or accounting for resources in support of these efforts. Based on the unique characteristics of a shipboard fire discussed above however, it may have benefited the department to incorporate more specialized personnel and vessel representatives at the ICP. The NFD also could have benefitted from ensuring all the basic information was gathered to create a comprehensive incident plan before putting personnel onboard, to include, the Fire Control Plan, vessel fire zones, actions taken by the vessel's crew before NFD's arrival, and accountability of the vessel's crew. Such preparation on part of the NFD may have had a significant impact of the effectiveness of their response to the fire.

5.14. *The Attack and Firefighters Lost.* Relying on their known structure fire procedures and tactics, the decision was made by the NFD to assess and quickly engage the fire in an offensive attack. The fire teams were made up of two members on a fire hose to be switched out with a relief team when available. The fire hose originated from deck 12 and went down the ladderwell through the door of deck 10 to where operations were being conducted. BC-4 was staged in the ladderwell immediately outside the door to deck 10 and directed teams to enter for relief. Before entry, teams were not briefed on who was in the space, plans for future teams entering, or conditions to be expected upon entry. This lack of communication led to confusion during the fire response and a lack of situational awareness for the teams actively responding to the fire, overall. For example, the first Ladder-4 team, made up of FF B and Capt L-4, was not briefed on who would be relieving them, and Engine-16, made up of FF A and Capt E-16, was not briefed on who else was in the space. This lack of physical accountability and access control for NFD members that were entering and exiting the fire area on deck 10, likely led to further confusion when maydays were called and potentially increased the response time to search for the disoriented firefighters.

5.14.1. *Maintaining Team Integrity*. NFD operated on a "two-in, two-out" rule where a two-person fire team enters the space together and exits the space together. This rule helped to maintain accountability, enhanced the safety of fire personnel, and ensured nobody was left in an active fire space alone. While conducting operations in deck 10, Capt L-4 tried radioing BC-4 to brief him on the fire condition. When unable to reach BC-4 via radio, he decided to brief him verbally. Capt L-4 saw another crew following the line in and left FF B with his TIC to continue fire suppression operations while he proceeded to brief BC-4 at the exit. However, as per NFPA 1001 4.3.5, hazardous areas should be exited as a team, especially given vision-obscured conditions, so that a safe haven can be found before exhausting the air supply, others are not endangered, and the team integrity is maintained. When traveling to the exit, Capt L-4 experienced a loss of traction and stated it felt like he was slipping on the deck. Upon reaching BC-4 to give his brief, his boot's outer soles became separated[58], as pictured in the following Figure 21. When this occurred, he was ordered out of the space by BC-4 because he lacked full

[58]It is this investigation's understanding that NFPA equipment testing standards do not address use of boots in the maritime environment, but the maritime environment includes such unique hazards and conditions that such standards may be necessary. In this case, the firefighter boots that failed had glued soles, which were likely impacted by the standing, near boiling salt water, on deck 12 from boundary cooling.

protection to continue in the fire response. Not recognizing his boot failure when Capt L-4 left the space and FF B on the line, the investigation believes that Capt L-4 anticipated that he would return and rejoin FF B. Regardless, Capt L-4 did not adhere to the "two-in, two-out" rule when he departed the space and doing so would have impacted the outcome of this incident.

Figure 21. Photographs of failed firefighter boots. Provided by NIOSH FFFIPP Investigator.

5.14.2. *Confusion of Personnel Actions in the Space*. Capt E-16 was not briefed that any other crews were actively in the space prior to entry. Upon arrival at the nozzle however, Capt E-16 was surprised to find FF B alone on the line. It is customary by training and protocol that a hose line is maintained by a team of at least two firefighters. Therefore, FF B manning the nozzle alone was a deviation from common practice of the NFD. Due to limited visibility, Capt E-16 did not observe Capt L-4 exiting the space to gather that FF B was no longer accompanied. The second crew for Ladder-4, which was not observed by Capt E-16 either, entered the space shortly after Engine-16 did so. The Ladder-4 crew noticed a kink in the line and flaked it out further into the space to correct the kink. During the short time they were working in deck 10, they had no verbal communications with the three firefighters actively on the line. The lack of communication about the actions performed by the other crew in deck 10 may have led to the confusion encountered by FF A, FF B, and Capt E-16 when finding the line laid out differently when following it to egress.

5.14.3. *Following the Fire Hose*. BC-4 ordered the team on the fire hose to bring the line out. When this communication was received, Capt E-16 oriented the team to follow the fire hose back to the ladderwell. Around this time was when FF B's SCBA mask started to vibrate due to a low air alarm. Capt E-16 directed FF B in front of FF A to lead the group out. Due to a lack of visibility, Capt E-16 lost contact with FF A and FF B. He heard the team in front of him state "the line is going this way", this was the last contact Capt E-16 had with FF A and FF B. Capt E-16 assumed this was stated because he felt a bend in the hose. Capt E-16 also left the hose at this point and found a bulkhead where he eventually made his way safely to the ladderwell. While it will never truly be known what happened to FF A and FF B while trying to exit deck 10, the evidence suggests they became disoriented, lost track of the hose, and attempted to follow the line of cargo vehicles they believed would take them back to the ladderwell from which they originally entered. Unfortunately, they instead followed the vehicle line the opposite direction further into the space.

5.14.3.1. *Reliance on Emergency Extrication Procedures for Structures.* It is believed that FF B followed the vehicle line to the starboard bulkhead and began to

follow it looking for an exit. This is based on FF B's helmet and flashlight being found post-incident along the starboard bulkhead as depicted in Figure 5. It is likely that FF B relied on his structure fire training which engrained in him to follow the closest wall until an exit was located. This approach was described during hearing testimony by the two firefighting expert witnesses as the standard way land-based firefighters were taught to egress from a space when lost. This method is not necessarily effective in the shipboard environment as an obvious exit may not be available at the end of each bulkhead. In the case of FF B, based on his helmet and flashlight location, he found the starboard bulkhead and followed it forward. However, it was not easily known that there was an area of refuge/egress inside of the Engine Gas Cleaning Unit (EGCU) room on the starboard side of deck 10 and an emergency escape ladder to deck 9, whose opening was covered by safety grating, at the forward end of the starboard bulkhead. This is evidenced by FF B having likely not continued to the EGCU room door and then not making it far enough down the starboard bulkhead before he turned around and headed between stowed vehicles. While remaining with the hose line is certainly the best method for exiting out of a fire space, awareness of the deck layout, information attainable from the Fire Control Plan, could have aided FF A and FF B in knowing where to look for an emergency exit.

5.14.4. *Lack of Personnel Accountability*. Upon finding the ladderwell to exit deck 10, Capt E-16, testified that he found the ladderwell empty, likely because of the black smoke that had billowed into the ladderwell just before. While there is some conflicting testimony, BC-4 may have left the deck 10 area unattended. Since BC-4 was maintaining accountability based on memory, he would have lost track of personnel entering or exiting the space. This lack of access control and accountability for the members that were in the space led to the initial confusion when a PAR was called. This initial confusion was compounded by a couple other firefighters having gone down the port ladderwell after the smoke incident instead of up to deck 12 with the others. If BC-4 had an adequate method for accountability and access control for the members he directed into deck 10 this confusion may have been avoided.

Operations on deck 10 were run similar to a standard structure fire response. Methods to identify the unique hazards of deck 10 associated with marine firefighting were not used at the onset of the response. The lack of an adequate fire plan, accountability and operational briefs to the members engaging the fire on deck 10 added lack of situational awareness. If cohesive briefs, communications, and accountability had been achieved, the catastrophic results of the fire may have been avoided.

5.15. *Perceived Lack of Sufficient Vessel Firefighting Equipment*. The land-based firefighters arrived and expected their own equipment to interface with the vessel's hose stations and they did not carry adapters to enable fitting of their hoses to other-sized hydrants. As a result, they were forced to rely on the vessel's crew to provide the necessary hose lines to complete their firefighting efforts. The vessel was equipped with required fire pumps, fire mains, hydrants, and hoses that complied with the applicable requirements of SOLAS. The vessel's crew activated and staged all equipment needed for their initial response to the fire and continued to provide equipment as requested by the land-based firefighters upon their arrival. No evidence

suggested that the equipment used onboard was insufficient to complete the tasks they were designed for, and witnesses testified that throughout the duration of the fire response, the fire pump pressure remained adequate to support multiple boundary cooling lines as well as two attack lines, all running from hydrants on deck 12. Therefore, there was no need for NFD to utilize any of their own hose lines. Even if the vessel had lost sufficient water pressure, only a hose from a dockside hydrant to the International Shore Connection, located at the top of the stern ramp, would have been needed. However, during witness interviews with NFD personnel, it was obvious that the firefighters would have been more comfortable operating had they been able to use their own equipment. While it was not a significant factor in this incident, it would have been reasonable that NFD equipped at least their first-due companies to the port with hose-to-hydrant adapters of various sizes, something which could have been factored had pre-fire planning and shipboard familiarity evolutions occurred prior.

5.16. *Unfamiliarity with the International Shore Connection*. None of the responding NFD members were aware of the vessel's International Shore Connection. The GRANDE COSTA D'AVORIO was equipped with International Shore Connections as required under SOLAS. This connection was a standard flange size that allowed vessels to receive additional water supply for fighting fires from shoreside water supplies. The vessel was designed to SOLAS standards and capable of fighting fires on board using its own fire pumps and hoses. There were no reports of a water pressure deficit throughout the response to the fire, so the lack of knowledge about the International Shore Connection did not impact firefighting efforts in this incident. However, had the vessel lost electrical power or experienced another source of fire pump failure, lack of awareness could have slowed the remedy actions and endangered personnel working in the space.

5.17. *Disuse of "Mayday" Button (EAB) to Alert of Distress and SCBA Pack Tracking Devices for Search*.

5.17.1. *"Mayday" Button.* Radios carried by land-based firefighters were equipped with a specialized EAB, also commonly known as a mayday button, to prioritize a mayday distress call amongst all other radio traffic. Evidence indicated that both Capt E-16 and FF A were carrying radios on deck 10 and had them available to use as they became disoriented. However, there was no direct evidence whether FF B carried his radio. FF B's gear collected by investigating agencies did not include a radio, a thorough search by multiple investigative agencies and later the contracted salvors of deck 10 did not locate any evidence of a radio, and NFD Dispatch records did not record any transmission by FF B's radio during the response to this incident. Regardless, based on NFD Dispatch records and witness testimony, the EAB was not used by anyone calling a mayday over the radio. There may have been some benefit in the initial use of these buttons for identifying the personnel in distress, but the verbal maydays were received, and the Incident Commander was notified of distress calls quickly by NFD Dispatch. The interference from the steel structure of the vessel, that inhibited a vast amount of radio traffic from being transmitted or received, was also taken into consideration. There was no evidence to suggest that the reporting of or the response to maydays were significantly delayed because of not utilizing the radios installed EAB.

5.17.2. *SCBA Pack Tracking Devices.* Witness testimony revealed that NFD possessed three SCBA pack tracking devices, but none were utilized during the search for FF A or FF B. Witness testimony from some NFD personnel described limitations of the devices in high rise structure environments where they were ineffective floor to floor. Additionally, testimony from a firefighting expert witness questioned whether the devices, which worked off radio signals, would be effective in the shipboard environment, especially considering the radio communication challenges NFD experienced. The decks of Ro-Ro ships are full of metal structures, equipment, and cargo that can interfere with radio signals. This investigation agrees that there is no clear indication that a SCBA pack tracking device would have been effective in the search on deck 10, but since NFD possessed the devices, when the search for FF B became prolonged, it would have been reasonable to have attempted using the device. However, knowing how long FF B had already been in the space, the device's use would have only impacted the outcome if FF B was able to find an area of refuge, but likely that area would have been obstructed by steel structure anyway. Pre-testing and consideration for use of these devices in the shipboard environment should be a part of the Pre-Fire planning implemented by NFD as previously described in section 5.13.2.

5.18. *Lack of Fire Protection for WTD-12 Control Wires and Hydraulic Lines.* SOLAS regulations do not address the survivability of electric control wires and hydraulic lines for doors in fire protection zone boundaries. In this case, wires and hydraulic lines necessary for the operation of WTD-12 ran between the door control panel and the hydraulic power unit in the engine room through the CO_2 protected space. The PLC fault that was experienced approximately an hour after the fire originated could have been the result of the fire's heat on decks 10 and 11, affecting the control panel wiring. The wires and hydraulic lines on this vessel were of standard design for the shipboard environment. Better protection of the wires and hydraulic lines from fire may have given crew members additional time to actuate door controls to potentially seal Fire Protection Zone C before the PLC fault. But as discussed, the configuration of WTD-12 did not include controls outside of the space, leaving the only option to close the door from the inside where the fire was active. Therefore, the investigation finds that more fire-resistant wires and hydraulic lines still would not have avoided the challenges the crew faced in closing WTD-12.

5.19. *Inadvisable Decision to Operate Deck 10 Exhaust System Post-CO_2 Release.* In response to increasing smoke and decreasing visibility on deck 10, BC-4 requested the vessel's crew turn on the cargo deck exhaust system isolated to deck 10 at 2345. The Third Mate and Master advised BC-4 against doing so because it would impact the effectiveness of the released CO_2 in the space. In order to facilitate the ongoing search and rescue efforts for their missing personnel, the NFD insisted on activating the ventilation, however. To satisfy the request, the Chief Engineer had to reset the breaker in the engine room to reenergize the system because the emergency shutdown of the ventilation system had been activated shortly after the fire originated. After reset of the system, the air intake louvers were opened and the exhaust fan for deck 10 was turned on. Despite some conflicting witness testimony, a preponderance of the evidence suggests the system remained on for approximately 35 minutes, at which point BC-5 requested it shut down because the smoke exhausting from the vents on deck 12 was "smoking out" the fire crews at the staging area. As far as the advisability of turning on the ventilation, from the land-based firefighter's perspective, it was

justifiably pursued for the preservation of life. They also were operating during this incident from the basis of their experience, largely being from structure fires, where ventilating the fire space was not an uncommon practice in order to remove the products of combustion that can otherwise hinder the fire fight. However, in the shipboard environment, it is not a best practice to ventilate the space because it will introduce oxygen into the environment, further stoking the fire. Additionally, when a CO_2 system has been deployed, ventilation will remove the fire suppression agent and prematurely enable a possible reflash. However, in this incident, CO_2 levels were already significantly depleted and oxygen reintroduced due to the open WTD-12 into the deck. For this reason, and because there was no active fire on deck 10 at the time, this investigation does not dispute the decision to turn on the ventilation because it served to facilitate the rescue of human life, a paramount prerogative in incidents such as this. Unfortunately, using the ventilation to clear smoke from the space ultimately did not alter the outcome for FF A and FF B, and likely stoked the fire on deck 11.

5.20. *Delayed NTVRP Activation.* The first request originating from the vessel to the QI for SMFF Provider assistance was made by FDNY BC at 0446 on July 6, 2023, rather than by the Master immediately after incident occurrence as required by the NTVRP. In fact, the first direct contact between the vessel Master and the QI and/or SMFF Provider was when the remote situational assessment was completed at 0530 on July 6, 2023, approximately eight hours after the fire originated. However, VDR audio from 2132 on July 5, 2023, although not fully discernable due to overwhelming alarms sounding in the navigation bridge, indicated the Master made a call using the vessel's satellite phone, speaking in Italian, to notify an authority figure of the incident. That, coupled with witness testimony and timestamps on Grimaldi email records, suggests that was the phone call to the Grimaldi on-call Superintendent in Italy who then notified the DPA. The DPA was then making company-wide notifications by 2144 on July 5, 2023. Additional records gathered as part of this investigation indicated that by 2336 on July 5, 2023, the DPA was engaged by the QI and SMFF Provider in a series of phone calls and emails about the incident status, but the DPA insisted that no NTVRP activation was required nor assistance needed at that time.

Coast Guard regulations surrounding the NTVRP[59] did not dictate timing for "activation" of the plan. Instead, that requirement was directed by the NTVRP itself, which was approved by the Coast Guard. The approved Grimaldi NTVRP in effect on the date of the incident[60] required that "in the event of an incident, emergency, spill or threat of a spill in the U.S.A. or Canada, the **Master must notify the QI immediately via telephone** [emphasis added]." The plan defined "incident/emergency" to include a shipboard fire, like that onboard the GRANDE COSTA D'AVORIO on July 5, 2023. The NTVRP, Chapter 2, Section 2.5 titled "Master's Notifications" further stated:

"In U.S. waters, the Master shall make the following notifications, in order, to the:
1) Qualified Individual (QI): Direct the QI to make all necessary notifications.
2) Company Designated Person Ashore (DPA).

[59] *See* 33 CFR §§ 155.5010 – 155.5075.
[60] Dated March 2016, with revisions as recently as May 2023.

3) If necessary, after consulting the QI, Master should speak to the Salvage and Marine Firefighting (SMFF) Provider so SMFF Provider can perform Remote Assessment & Consultation.
4) QI within forty minutes after the initial notification. QI will pass notification information and will need the Master's incident update including information from Page 4 – Section 2.6 of this Chapter."

In accordance with the National Contingency Plan[61], the Coast Guard considered an NTVRP activated when the person in charge of the vessel contacted the designated QI. In this case, the Grimaldi approved NTVRP was explicit that the Master shall "immediately" notify the QI, though "immediately" is not defined in the approved NTVRP. Emergent safety issues and time necessary to sufficiently assess the situation are likely reasons that QI notification may not be made instantly after the occurrence of an incident/emergency. However, prompt notification by the Master would ensure the QI was provided with timely and first-hand factual information to make their own assessment of the situation, make their required notifications, and mobilize the SMFF Provider for consultation and necessary response. In this case, the Master attempted to manage the initial emergency onboard the vessel and determine if onboard resources like the low-pressure CO_2 fire suppression system were adequate for the response. However, by 2132, approximately 30 minutes after he first learned of the fire, the Master was able to make phone notification to the on-call Superintendent, indicating that these initial actions did not preclude him from making the required notification to the QI telephonically in accordance with the approved NTVRP. Rather, the NTVRP was not activated until the DPA emailed the QI at 0256 on July 6, 2023[62], requesting assistance with the incident. However, the DPA still directed no SMFF resources were to be mobilized at that time, a decision that resided with the QI in accordance with the approved NTVRP. Finally, at 0518, the QI proactively mobilized SMFF resources following the call from FDNY BC stating assistance was needed to secure WTD-12. The DPA did not "officially" request activation of the NTVRP and mobilization of SMFF resources until doing so at 0534 by email, over eight hours after fire origin.

Unfortunately, the evidence available does not indicate the Sector NY command center or Federal On-Scene Coordinator (FOSC) representative(s) asked about NTVRP activation in the early phases of the response. Had they done so, this question from a regulatory agency may have prompted earlier activation and response, however responsibility to do so still solely resided with the person in charge of the vessel.

Though NTVRP activation was delayed, the QI and SMFF Provider had extremely quick response times once activation actually occurred. The SMFF Provider's response commenced less than 15 minutes after mobilization with a remote assessment and continued with resources beginning to arrive on scene within one hour. This investigation recognizes that

[61] National Contingency Plan: The federal government's blueprint for responding to both oil spills and hazardous substance releases (www.EPA.gov). Mandated by 33 USC § 1321.
[62] NTVRP activation occurs when the person in charge of the vessel contacts the QI identified in the NTVRP. *See* the Coast Guard Maritime Commons BLOG Post "Activating a Vessel Response Plan" dated January 23, 2018, available at https://homeport.uscg.mil/Lists/Content/DispForm.aspx?ID=87159&Source=/Lists/Content/DispForm.aspx?ID=87159#:~:text=A%20VRP%20must%20be%20activated,QI)%20identified%20in%20the%20VRP.

such a quick response time was the result of proactive communication and engagement by the QI and SMFF Provider and may not have been as prompt if triggered by an immediate call from the Master at 2132, the stipulated method of notification in the vessel's NTVRP. Further, based on 33 CFR § 155.4030, "Required Salvage and Marine Firefighting Services to List in Response Plans", for vessels pier-side, the SMFF on-site assessment was to be conducted within two hours of mobilization, and external firefighting resources were to be on site within four hours. Therefore, even if the NTVRP had been promptly activated after fire origin, the required resources still may not have arrived on scene before FF A and FF B became lost around 2222 on July 5, 2023, to impact the outcome. However, prompt activation of the NTVRP may have prevented further fire growth during the early morning of July 6, 2023, thereby enabling quicker fire suppression and limiting the damages incurred to the vessel.

5.21. *Adequacy of Coast Guard ACP Marine Firefighting Annex*. NFD did not consult the Marine Firefighting Annex of the ACP prior to or during the response to the GRANDE COSTA D'AVORIO fire. Incident Commanders used minimal to no marine firefighting training and experience to make decisions on tactics for the incident response which proved to be ineffective. The Marine Firefighting Annex contained valuable information and resources that could have better managed the fire scene and protected lives. Specifically, it addressed available resources with experience in marine firefighting. Further, it listed tactical priorities to aid in the response to shipboard fires. One of these priorities warned of the effects of venting a fire in the shipboard environment. While these portions would have assisted the NFD in identifying resources and tactics, the annex would not have provided substantial assistance for the immediate response phase. There are limited requirements for training and exercising the Marine Firefighting Annex of the ACP, therefore it becomes an "as needed" document. Additionally, the Annex aligned with Coast Guard marine firefighting doctrine in specifying that the Coast Guard was available to assist the local land-based fire department, if requested, but would not preempt local authority and responsibilities of land-based Fire Departments. This occurs most frequently through consultation and guidance. This "assist as needed" posture may have fostered a culture where land-based fire personnel overlooked Coast Guard assistance, eliminating the opportunity for Coast Guard responders to provide guidance to the initial land-based firefighting Incident Command. Land-based fire departments are generally the experts on firefighting tactics, but a Coast Guard representative immediately deploying to any shipboard fire command post as an Agency Representative (AREP), could bring maritime specific knowledge and value. If the Annex was a valuable product to the local fire departments who were expected to use it, and there were trainings and exercises associated with the contents, they would have been more likely to use the Annex and may have protected lives.

6. Conclusions

6.1. Determination of Cause.

6.1.1. The initiating event for this casualty occurred when the JEEP experienced a mechanical failure, likely an overheat of the transmission, causing it to expel a flammable

fluid, likely transmission fluid. The causal factors were:

6.1.1.1. Improper use of the JEEP routinely exceeding designed and stated operating parameters.

6.1.1.2. Lack of a routine preventative maintenance program to prevent degradation of pusher vehicle engine and drivetrain components.

6.1.1.3. Lack of a formally implemented system to remove pusher vehicles with mechanical issues from use until receiving corrective action.

6.1.1.4. Lack of training and workplace guidance for pusher vehicle drivers on specific vehicle warnings, alarms, and conditions requiring vehicles to be put out of service.

6.1.1.5. Continued use of the JEEP after a high-torque evolution after which it began exhibiting physical signs that can be associated with transmission overheating, without conducting the prescribed cool down process specified in the JEEP's owner's manual addendum.

6.1.2. Subsequently, the flammable fluid contacted hot surfaces within the engine compartment causing a fire. The fire quickly spread to nearby vehicles and upwards to vehicles located on deck 11. Factors contributing to the initial fire ignition and spread included:

6.1.2.1. Ineffective initial firefighting efforts by vessel crew and Lasher 1, including specifically, the failure to use available portable foam.

6.1.2.2. Lashing holes in the decks allowed quicker transfer of burning liquid and heat to adjacent cargo decks.

6.1.3. This was followed by the inability to close WTD-12, which prevented fully sealing the low-pressure CO_2 Fire Protection Zone C. It also acted as a chimney promoting fire spread through deck 11. Factors preventing the closure of WTD-12 included:

6.1.3.1. Failure to close WTD-12 once no longer needed for cargo operations.

6.1.3.2. Lack of operating controls outside the door.

6.1.3.3. Lack of redundant operating controls for the door.

6.1.3.4. Delayed attempts to close the door prior to the PLC system fault due to lack of specific in-port fire emergency response planning and training for the vessel's crew relating to roles and responsibilities, including closure of WTDs.

6.1.3.5. Lack of training for personnel to close WTD-12 manually.

6.1.4. Regardless, the CO_2 was initially effective at suppressing the fire. Based on computer modeling, this effectiveness likely continued for at least 40 minutes. Before the space could cool, the discharged CO_2 on deck 11 and then 10 eventually dissipated below effective levels due to the open WTD-12, and additional oxygen was reintroduced into the space by the NFD firefighters who opened fire boundary doors, causing the fire to reflash. Factors allowing the fire to reflash included:

6.1.4.1. Lack of shipboard firefighting planning and training for NFD members, specifically in ensuring the effectiveness of installed fire suppression systems.

6.1.4.2. NFD members were unaware that the Master retained authority over actions taken onboard the vessel and inadvisably accessed Fire Protection Zone C. Additionally, failure to fully engage with the vessel's senior crew members as part of the tactical planning resulted in a missed opportunity for Engine-27 to potentially close WTD-12 upon their initial entry on deck 11 that occurred prior to the PLC system fault.

6.1.4.3. Perceived language barrier by NFD personnel limited engagement with the vessel's crew.

6.1.4.4. NFD firefighter's opening of the doors to Fire Protection Zone C minutes after the release of the CO_2, reintroducing oxygen back into the space where heat and fuel were still present.

6.1.4.5. Inability to perform a secondary discharge of remaining CO_2 due to NFD personnel present in the space.

6.1.4.6. Use of the vessel's ventilation system to clear smoke from deck 10 to search for FF A and FF B introduced additional oxygen into the hot space.

6.1.5. Upon arrival, and despite CO_2 having been released into Fire Protection Zone C, NFD personnel entered decks 10 and 11 to investigate the fire and suppress as necessary. As a result, two firefighters became disoriented and lost in the space for a prolonged period. They both subsequently ran out of SCBA-supplied air and succumbed to inhalation of carbon monoxide. Factors contributing to the two firefighter deaths included:

6.1.5.1. Challenged radio functionality that prevented clear communication between firefighters inside the vessel, dispatch repeaters, and the Incident Commander.

6.1.5.2. Failure of FF B to carry his radio during the response, the presence of which may have allowed him to transmit his own mayday and enable search efforts.

6.1.5.3. Failure to engrain the use of SCBA PASS alarms in the event of a mayday through training. Neither FF A nor FF B manually sounded their PASS alarm during the initial mayday period which likely delayed the search and recovery.

6.1.5.4. Use of lower capacity (30-minute rated) SCBA bottles by the NFD in a shipboard environment. Larger capacity air bottles could have provided FF A and FF B longer survivability in the hazardous environment on deck 10 and enabled more duration for search crews.

6.1.5.5. Unfamiliarity with the vessel's Fire Control Plan and resulting lack of knowledge about the vessel layout for NFD personnel entering deck 10. Had FF A and FF B been made aware of the deck 10 layout, through reference of the vessel's Fire Control Plan which depicted exit points and areas of refuge, they may have been able to self-extricate.

6.2. *Evidence of Act(s) or Violation(s) of Law by Any Coast Guard Credentialed Mariner Subject to Action Under 46 USC Chapter 77*. There were no Coast Guard Credentialed Mariners involved in this incident.

6.3. *Evidence of Act(s) or Violation(s) of Law by U.S. Coast Guard Personnel, or any other person*. There was no evidence indicating acts of misconduct, incompetence, negligence, unskillfulness, or willful violation of law by members of the Coast Guard or other federal, state, or local agencies that contributed to the casualty.

6.4. *Evidence of Act(s) Subject to Civil Penalty*.

6.4.1. Evidence indicated a potential violation by Grimaldi of 46 CFR § 4.06-3(b)(1) for failing to conduct drug testing on crewmembers determined to be directly involved in a serious marine incident within 32-hours of the occurrence, or as soon thereafter as safety concerns were addressed. Since safety concerns continued eight-hours after occurrence, no violation of 46 CFR § 4.06-3(a)(1) occurred based on the consideration contained in 46 CFR § 4.06-3(a)(1)(iii).

6.4.2. Evidence indicated a potential violation by Grimaldi of 33 CFR § 155.5012 for deviating from their approved NTVRP. These deviations included: the Master failing to immediately notify the QI by phone to activate the NTVRP, eventual NTVRP activation by the DPA via email rather than the Master by phone, and restriction of the QI from mobilizing SMFF resources earlier in the incident by the DPA. None of the actions were communicated to or approved by the cognizant FOSC.

6.5. *Evidence of Criminal Act(s).* There was no evidence to support referral of a potential federal criminal violation for this incident.

6.6. *Need for New or Amended U.S. Law or Regulation*. Recommend an amendment to 33 CFR, Chapter I, to include a periodic requirement for cargo vessels to conduct in-port fire drills while dockside. This is further addressed in Section 8.1.2. of this report.

6.7. *Unsafe Actions or Conditions that Were Not Causal Factors*.

6.7.1. *Lack of Shipboard Emergency Training and Protocol for Ports America and AMS Employees.* Ports America and AMS employees did not receive training or conduct drills on how to respond to an emergency onboard the vessel where they were conducting loading operations. In the scenario that a fire erupts onboard the vessel and there are no vessel crew members to assist, it is critical that shoreside personnel are trained to mitigate the situation. Additionally, there were no formalized muster or accountability procedures for shoreside personnel working on the ship in the event of an emergency. Failure to account for all shoreside personnel could be fatal if, for example, a CO_2 system was discharged while an employee unknowingly remained in the space. Further, uncertain accountability of personnel could also prompt firefighters to inadvisably enter a shipboard space to search for unverified missing persons. This ideal was supported by BC-5's thinking in relation to the vessel's crew. Formal and recurrent training on these protocols for employees working at a marine terminal and on vessels could prove essential in saving lives and property during future incidents.

6.7.2. *Lack of Fire Protection for WTD-12 Control Wires and Hydraulic Lines*. Due to the factors surrounding the development of this fire and having only one set of door controls interior to WTD-12, the protection of the control wiring and hydraulic lines may have afforded more time for the crew to close the door but would not have eliminated the eminent life-safety dangers associated with having to do so from inside the space.

6.7.3. *Unfamiliarity with the International Shore Connection*. The vessel's fire main water pressure remained adequate throughout the fire response during this incident, therefore failure to utilize the International Shore Connection did not impact firefighting efforts. However, NFD's lack of awareness of the International Shore Connection could have been impactful if the vessel's fire pumps ceased working because the shore supply for water would have then been the only option available. Therefore, the use of International Shore Connections is a topic that should be addressed during tactical shipboard fire trainings and exercises.

6.7.4. *Disuse of the "Mayday" Button (EAB) to Alert of Distress and SCBA Pack Tracking Devices for Search*. This investigation revealed that the distressed firefighters did not use the EAB and instead verbalized their distress over the radio. As verified by multiple responding firefighters, radio communications were significantly hindered by the vessel's steel structure. Therefore, even if the distressed firefighters had attempted to use the EAB, it is uncertain whether the signal would have even reached the radio repeating system to alter the outcome of the incident. However, it is unquestioned that firefighters should use all available means to signal distress and this notion should be engrained in general firefighter training and tactical shipboard firefighting training. Similarly, since SCBA pack tracker devices rely upon the transmission of a signal, it is unknown whether their use during this incident onboard the vessel would have had a significant impact on the outcome. However, it is reasonable to utilize all available and functional means to search in a mayday situation. Since they possess the devices, it is

recommended that the NFD test its SCBA pack tracking devices onboard a vessel to assess their utility in shipboard searches.

7. Actions Taken Since the Incident

7.1. On November 10, 2023, NIOSH FFFIPP, as a part of their own investigative process, delivered their report of preliminary findings related to the firefighter line of duty deaths (LODD) to NFD leadership and the local firefighter union representatives. The preliminary investigation findings addressed issues within the five primary categories of personnel professional development including equipment, environment, policies/procedures/guidelines, leadership, and incident management.

7.2. On November 16 to 17, 2023, in response to this and other vessel fire incidents, the Port of Virginia, in conjunction with the American Association of Port Authorities, hosted a *Port Authority Emergency Response Summit* attended by representatives from Port Authorities and land-based fire departments around the country. The stated goal of the summit was to invigorate the conversation about in-port shipboard fire preparedness and to share best practices and case studies. Representatives from the Port Authority of New York and New Jersey and the NFD attended.

7.3. On November 20, 2023, the Coast Guard issued Safety Alert 9-23 '*By Land and Sea – Firefighting Preparation is Key!'* The alert advised land-based fire departments to: 1) engage with their local port stakeholders and Coast Guard Captain of the Port to drill and train in shipboard firefighting, 2) develop written shipboard firefighting doctrine implementing the NFPA 1005 and 1405 standards, and 3) establish a plan to obtain translation services if language barriers are experienced with foreign crewmembers. The safety alert is available at: https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/Inspections-Compliance-CG-5PC-/Office-of-Investigations-Casualty-Analysis/Safety-Alerts/.

7.4. Since the incident, Sector NY conducted marine firefighting outreach through direct coordination and collaboration with local firefighting agencies and cooperatives. They focused on engagement with the Area Maritime Security Committee and Area Committee. A member of their Emergency Management and Force Readiness Division was selected by the Coast Guard Office of Marine Environmental Response (CG-MER) to participate in a working group on Salvage and Marine Firefighting. This group is charged with identifying best practices and improvements to port preparedness for shipboard fire response.

7.5. A Findings of Concern titled '*Overlooked Fire Boundary Doors*' has been submitted for release to address the need for a fleet-wide review of doors that function as fire protection zone boundaries, particularly vehicle ramp doors on Ro-Ro vessels. This review will ensure compliance with SOLAS and ICLL requirements for door control locations and can be accomplished through fire emergency planning and testing during in-port fire drills.

7.6. A Findings of Concern titled '*The Master's Ultimate Retention of Authority'* has been submitted for release to clarify the Master's authority over operations taking place onboard the vessel, including those by land-based firefighters. It also encourages incorporation of the

vessel Master/senior crewmember, shoreside vessel's representative, Coast Guard, and Port Authority representative in the land-based firefighting incident command structure.

7.7. A Findings of Concern titled '*Marine Firefighting Expert Needed for Port Authorities*' has been submitted for release to address the need for Port Authorities to establish a qualified Marine Firefighting Expert to liaise with local land-based fire departments both in training and the actual response to shipboard fires.

7.8. A Findings of Concern titled 'S*hipboard Emergency Training for Shoreside Personnel*' has been submitted for release to address the lack of formalized shipboard emergency response and accountability protocol and training for shoreside personnel (stevedores, longshoremen, lashers) that routinely work on vessels moored dockside.

7.9. A Findings of Concern titled '*Maintenance Programs for "Pusher Vehicles" and Equipment'* has been submitted for release to address the need for stevedoring companies to establish formal preventative maintenance programs and out-of-service protocols for all terminal vehicles and equipment.

8. **Recommendations**

8.1. Safety Recommendations.

8.1.1. Safety Recommendation #1 – *Update SOLAS Fire Drill Requirements to Include Training for Fires in Port.* Recommend the Commandant work with the IMO to update SOLAS Chapter III, Regulation 19.3.4.1. to further define that "various emergencies that may occur" includes fires both at sea and in port. As currently worded, the regulation affords interpretative discretion to the vessel's operator and Master as to the types of "various emergencies that may occur." As a result, most, if not all, shipboard fire drills are conducted only during an "at sea" scenario. This is because, while at sea, the vessel's crew is self-reliant for fire suppression, and it avoids the delay of cargo operations. However, fire drills underway are incapable of fully simulating the conditions that may be presented during in-port cargo operations, which, as this incident demonstrates, are an inherent fire risk. It is the vessel crew's initial actions that would likely prevent a fire from becoming uncontrollable. This update will ensure that vessel crews are conducting training to adequately prepare them to perform initial firefighting during in-port cargo operations.

8.1.2. *Safety Recommendation #2 – Add U.S. Regulatory Requirement to Conduct In-port Fire Drill Prior to Commencing Cargo Operations.* Recommend the Commandant amend 33 CFR Chapter I to include a requirement that all large cargo vessels, regardless of its flag state, cargo type, or frequency in U.S. ports, periodically conduct a shipboard fire drill dockside prior to commencing cargo operations. The drill scenario should be required to focus on the probable emergency type(s) associated with cargo operations, and include checking the operation of watertight doors, weathertight doors, fire doors, fire dampers, and main inlets and outlets of ventilation systems in the drill area. It is recommended that the drill also simulate notification of land-based fire authorities, the Coast Guard, and the Port Authority, activation of the Vessel Response Plan, and

interaction with land-based fire response personnel upon arrival. For the reasons discussed above, and as this incident particularly demonstrated, underway drills are inadequate at preparing vessel's crew to respond to an in-port fire. This requirement will ensure that vessel crews are prepared to respond swiftly to in-port emergencies to protect the vessel, human life, cargo, port, and the marine transportation system overall.

8.1.3. *Safety Recommendation* #3 *– Strengthen Role of Vessel Crew in NFPA 1405.* Recommend the Commandant work with the NFPA to update NFPA standard 1405, *Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires*, to expand and specify the roles, responsibilities, and required coordination by the vessel's crew with land-based firefighters and vessel shoreside representatives, during a response to a shipboard fire in port. Specifically, it is recommended that the Master or other senior vessel officer and/or Port Captain/Engineer be directly incorporated into the land-based firefighting ICP to assist in interpreting the vessel's Fire Control Plan and provide advice on shipboard tactical firefighting efforts. This incorporation will ensure that land-based fire departments understand the various positions and roles on a vessel, have a direct representative to effect orders relating to the ship and its installed systems, and benefit in the expertise they can offer to the vessel's particulars and response, overall.

8.1.4. *Safety Recommendation #4 – Incorporate Shipboard Firefighter's Outfits Standards in NFPA 1970.* Recommend the Commandant work with the NFPA to update NFPA standard 1970, *Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)*, to include provisions for firefighter protective equipment used by departments who may encounter vessel fires. It is recommended that standards and testing be developed to ensure the protective clothing, gloves, boots, and helmets used by land-based fire departments responding to shipboard fires can withstand the unique conditions of that environment, as this incident presented with reported boot failures. This testing will ensure that land-based fire departments are equipped to respond to shipboard fires that may pose more strenuous and extreme conditions than the typical structure fire they are accustomed to.

8.1.5. *Safety Recommendation #5 – Update Marine Firefighting Contingency Plans.* Recommend the Commandant issue a directive for all Coast Guard Captains of the Port to update their port's Marine Firefighting Contingency plan(s) to include the following:

> 8.1.5.1. For any vessel fire, the Coast Guard will immediately provide an in-person AREP to the land-based firefighting ICP during the firefighting response. The AREP should be well versed in shipboard layout, Fire Control Plans, fire suppression equipment, and vessel crew relations.
>
> 8.1.5.2. Upon establishment of a land-based firefighting ICP, a senior vessel crewmember or Port Captain should be embedded to help the Incident Commander interpret Fire Control Plans for the vessel and provide advice during tactical planning.

8.1.5.3. Establish a shipboard firefighting drill and exercise program at least annually that brings all land-based fire departments within the port's area of responsibility, Coast Guard (specifically the designated AREP(s)), and other response agencies port-wide for scenarios focused on testing the marine firefighting contingency plans and improving response.

8.2. Administrative Recommendations.

8.2.1. *Administrative Recommendation #1* – Recommend the First Coast Guard District Commander refer elements of this case to OSHA, who implemented their authority over marine terminal operations and equipment in 29 CFR § 1917 and longshoremen safety and health in 29 CFR § 1918, to conduct a compliance inspection on Ports America operations at Port Newark berth 16-18. Particular attention should be given to pusher vehicle use and modification, maintenance procedures, and out-of-service or "lock-out/tag-out" protocols. Additionally, recommend further attention be focused on shipboard emergency action planning, procedures, and training for both Ports America and AMS employees working at this terminal.

8.2.2. *Administrative Recommendation #2* – Recommend the Commandant establish an MOU with NIOSH FFFIPP to formalize their support of Coast Guard marine casualty investigations involving land-based firefighter fatalities and "near-misses" (maydays). Similar to the benefit the Coast Guard gains from our MOU with ATF in their expertise on fire cause, origin, and spread analysis, NISOH FFFIPP presents expertise to land-based firefighting. The phraseology, culture, doctrine, equipment, and tactics of land-based firefighting varies significantly from shipboard firefighting. This investigation is testament to the professional insight and subject matter expertise of the NIOSH FFFIPP, where the investigator formulated diagrams for public release of the firefighting response and testified at the formal public hearing. NIOSH FFFIPP's engagement in this incident was triggered by an LODD, but still required an invitation from the NFD or firefighter union to investigate. A formalized partnership between the two agencies will ensure future marine casualty investigations, whether involving a LODD, "near miss," or invitation from the local Fire Department or union, can benefit from NIOSH FFFIPP's expertise and enable informed recommendations to prevent fatalities and injuries sustained by land-based firefighters in the shipboard environment.

8.2.3. *Administrative Recommendation #3* – Recommend the Commandant join the Tokyo and Paris MOU on Port State Control in their joint Concentrated Inspection Campaign (CIC) on Fire Safety that occurred from September 1 to November 30, 2023. The CIC examined specific areas related to fire safety in conjunction with regular Port State Control inspections using a pre-defined questionnaire. This questionnaire should be adopted and expanded upon to include a check of all types of closures that create the barrier for CO_2 fire protection zones on all vessels, both foreign and domestic, to which SOLAS applies. A campaign of this nature would help identify any vessels that have similar risk factors to those impacting this incident that prohibited the crew from sealing off CO_2 protected spaces and rendered the fixed fire extinguishing system ineffective. The results of the campaign should be shared with relevant flag States to best rectify

deficiencies for their vessels.

8.2.4. *Administrative Recommendation #4* – Recommend the Commandant develop or update policy, command center Quick Response Cards, job aids, and tactics, techniques, and procedures related to commercial vessel fires to prompt Command Center watch standers, Pollution Responders, and FOSC representatives to discuss activation of the Vessel Response Plan and SMFF resources. While Coast Guard responders are adept at asking about plan activation during a pollution incident, this case shows that the same proficiency may not exist for doing so with vessel fires. Just as Oil Spill Removal Organizations are critical to mitigating environmental impacts, the predesignated SMFF Provider is essential to ensuring that vessels receive fire mitigation assistance. While still the sole responsibility of the person in charge of the vessel, prompting by the Coast Guard as a regulatory agency would likely reinforce timely activation of these critical resources.

8.2.5. *Administrative Recommendation #5* – Recommend the First Coast Guard District Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation of 46 CFR § 4.06-3(b)(1) described in section 6.4.1.

8.2.6. *Administrative Recommendation #6* – Recommend the First Coast Guard District Commander pursue civil penalty enforcement action against Grimaldi for the alleged violation of 33 CFR § 155.5012 described in section 6.4.2.

CHRISTIAN J. BARGER
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