

U.S. Fire Administration/Technical Report Series

Major Ship Fire Extinguished by CO₂

Seattle, Washington

USFA-TR-058/September 1991



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U.S. Fire Administration Fire Investigations Program

The U.S. Fire Administration develops reports on selected major fires throughout the country. The fires usually involve multiple deaths or a large loss of property. But the primary criterion for deciding to do a report is whether it will result in significant “lessons learned.” In some cases these lessons bring to light new knowledge about fire--the effect of building construction or contents, human behavior in fire, etc. In other cases, the lessons are not new but are serious enough to highlight once again, with yet another fire tragedy report.

The reports are sent to fire magazines and are distributed at National and Regional fire meetings. The International Association of Fire Chiefs assists USFA in disseminating the findings throughout the fire service. On a continuing basis the reports are available on request from USFA; announcements of their availability are published widely in fire journals and newsletters.

This body of work provides detailed information on the nature of the fire problem for policymakers who must decide on allocations of resources between fire and other pressing problems, and within the fire service to improve codes and code enforcement, training, public fire education, building technology, and other related areas.

The Fire Administration, which has no regulatory authority, sends an experienced fire investigator into a community after a major incident only after having conferred with the local fire authorities to insure that USFA’s assistance and presence would be supportive and would in no way interfere with any review of the incident they are themselves conducting. The intent is not to arrive during the event or even immediately after, but rather after the dust settles, so that a complete and objective review of all the important aspects of the incident can be made. Local authorities review USFA’s report while it is in draft. The USFA investigator or team is available to local authorities should they wish to request technical assistance for their own investigation.

This report and its recommendations were developed by USFA staff and by TriData Corporation, Arlington, Virginia, its staff and consultants, who are under contract to assist the Fire Administration in carrying out the Fire Reports Program.

The U.S. Fire Administration greatly appreciates the cooperation received from the City of Bessemer Fire and Rescue Service. Particular thanks go to Bessemer Fire Marshal Bill Avery and also Alabama State Fire Marshal John S. Robinson.

For additional copies of this report write to the U.S. Fire Administration, National Fire Data Center, 16825 South Seton Avenue, Emmitsburg, Maryland 21727.

Major Ship Fire Extinguished by CO₂ Seattle, Washington

Investigated by: Philip Schaenman

This is Report 058 of the Major Fires Investigation Project conducted by TriData Corporation under contract EMW-90-C-3338 to the United States Fire Administration, Federal Emergency Management Agency.



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Department of Homeland Security
United States Fire Administration
National Fire Data Center

U.S. Fire Administration

Mission Statement

As an entity of the Department of Homeland Security, the mission of the USFA is to reduce life and economic losses due to fire and related emergencies, through leadership, advocacy, coordination, and support. We serve the Nation independently, in coordination with other Federal agencies, and in partnership with fire protection and emergency service communities. With a commitment to excellence, we provide public education, training, technology, and data initiatives.



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Major Ship Fire Extinguished by CO₂ Seattle, Washington

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OVERVIEW

On September 16, 1991 the Seattle Fire Department successfully extinguished a major fire aboard a fish processing ship, the 324-foot *Omnisea*, which was docked and undergoing refitting at Pier 91. (See Area Map in Appendix A.) The fire started from a cutting and welding operation. It burned undetected in the absence of a firewatch while the crew took a coffee break.

Rather than fight the fire as a structure fire using water, the Seattle Fire Department's Marine Unit made the strategic decision to use carbon dioxide as the prime extinguishing agent. Handlines and monitors were used to cool hazardous materials stored on the deck, to cool the ship deck and hulls and to keep the fire from spreading to the pier. An interior defense was made of the aft third of the ship while the CO₂ was being set up. (See Appendix B for diagram of the *Omnisea*.)

Even though the Department had plans in place for CO₂ supply, the delivery of CO₂ was delayed and did not arrive for over four hours after the initial response. But the real delay in proceeding was caused by the time it took to button up the ship. The carbon dioxide was injected after five hours of effort to seal hatches and portholes to make the ship tight enough to hold the CO₂. It was pumped into five holes cut in the side of the hull. This successfully extinguished the fire. Ten truckloads of CO₂ were used because of the difficulty in making the ship airtight (less than two truckloads were needed in theory). Seattle had plans for using CO₂ in ship fires and had exercised with CO₂ but had never used it on a ship fire before.

SUMMARY OF KEY ISSUES

| Issues | Comments |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fire Origin | Cutting and welding in hold. Firewatch not used. |
| Reporting | Delayed by lack of firewatch and crew's attempt to extinguish fire. |
| Spread | Extensive use of polyurethane foam insulation. |
| Extinguishment | CO ₂ used successfully after a 5-hour effort to seal the ship enough to hold the gas. |
| Permits | Ship had appropriate permit. Seattle Fire believes that more stringent rules are needed; repairs above a minor extent should be done in a shipyard. |
| CO ₂ Availability | Despite prior training and arrangements, CO ₂ was slow in arriving at the scene. |
| Multi-agency Coordination | Done extremely well; used a bus as focal point for meetings throughout the fire. NOAA, EPA, Coast Guard and State Ecology participated along with several city departments. |
| Evacuation Plans | Cameo computer model used to predict movement of possible ammonia plume as input to an ad hoc evacuation plan. NOAA set up portable weather station. |
| Hazardous Materials | Large quantity of ammonia in tanks and refrigeration piping posed an air Hazmat threat; ship fuel oil posed a water pollution threat. Acetylene and aviation gasoline also present in drums. |
| Department Staffing Levels | The incident used 75 percent of the fire department's on-duty suppression force; mutual aid used extensively to fill-in. |

The ship had about 12,000 pounds of ammonia in five tanks that fed the refrigeration system used to store fish and fish products. The largest of the tanks, with 6,000 pounds of ammonia, was known to be directly in the flames in the area of origin in the hold. It was continually in danger of exploding, which could have endangered an affluent community a quarter of a mile away on the bluff overlooking the pier where the ship burned. In addition, the ship had just been filled with fuel oil and could have rolled over from taking on too much firefighting water. Further, the ship had a number of cylinders of acetylene on the deck and below decks, and over 10 drums of aviation gasoline and lubricants on deck. The ship had no automatic extinguishing system in the holds.

During the fire, the city prepared to cope with an ammonia cloud release and coordinated a variety of Federal, State and local agencies in an exemplary disaster preparation effort. Fortunately it wasn't needed.

The fire department extinguished the fire with the CO₂ and saved the entire superstructure and engine compartment in the aft third of the ship. Damage was assessed at \$7-10 million. There were no serious injuries.

THE SHIP

The *Omnisea* is a 324-foot seafood processing ship that acts as the mother ship to a fleet of 30 Alaskan fishing boats and was valued at about \$8 million. It was built in 1945 to haul military cargo. The ship is 50 feet wide and has a tonnage of 4,948 tons gross. It normally operated in the Alaskan waters but had returned early, on August 1, and had to be berthed at Pier 91, one of the largest piers in the United States, jutting out from Seattle into Elliot Bay. Overlooking this pier is an affluent residential community, Magnolia Bluff.

The ship had had an additional deck installed over its original top deck. At the time of the fire it was undergoing extensive refitting, which involved cutting and welding below decks. The ship had some hatches removed, leaving large vertical openings into the hold in addition to its usual openings for dropping in fish and where stairs went down. Below decks most of the holds were inter-connected horizontally with doors open or non-existent.

The ship's owner had obtained the appropriate permits for the cutting and welding operations. About 35 workers were on-board at the time of the fire. The ship was scheduled to leave on October 23 (about a month after the fire occurred).

Several parts of the ship had built-in fire suppression systems using CO₂: the engine room, the electrical room and the paint lockers. But the holds did not have any automatic systems.

The original ship had been insulated with 6"-8" spray-on polyurethane on virtually all walls and ceilings, and that provided the very high fuel load in this fire. The insulation had been sprayed with a fire retardant, but it was said to have worn off. Also, the insulation surfaces were breached. In addition, there were many plywood partitions, pallets and cabinets below decks. The new deck of the ship had rock wool insulation, which did not burn readily.

HAZARDOUS MATERIALS

The ship had numerous types of hazardous materials on board at the time of the fire:

Ammonia--One tank on deck and four tanks below decks, totaling about 12,000 pounds.

Aviation Gasoline--Several 55-gallon drums in a rack on the deck, for fueling helicopters.

Petroleum Products--Several drums in a rack on deck (a total of 20 drums of various types).

Fuel Oil--215,000 gallons of bunker fuel had been freshly loaded.

Acetylene tanks--Several above and below decks, for the cutting and welding operations in progress.

THE FIRE ORIGIN

About 9:30 a.m. on September 16, 1991 a work crew in the Number 3 tween (or middle) deck hold took a coffee break from cutting pipe with an acetylene torch and doing some welding. This was two decks below the main deck in an area used for flash freeze packaging. They did not have a firewatch standing by as required by Seattle Fire Code. It requires maintaining a firewatch during cutting and welding, and for at least half an hour after cutting and welding terminates. This requirement was further specified on the fire permit. (Failure to comply is a criminal violation.) The workers involved were reported to have said their operation was too small to use a firewatch.

About 7-10 minutes after the coffee break started, the first mate who was just returning to the ship noticed smoke coming up from the Number 3 hold in the center of the ship and advised everyone in the galley that there was a fire below decks. Crew members went to investigate and saw a fire rolling up from the vicinity of large plastic disposal bags near the wall. Apparently embers or sparks or the heat from the cutting/welding operation had ignited either the bags or insulation or something else in the vicinity. One person (the Vice President of the company that owned the ship) went up several decks to call the Fire Department. A few others attempted to fight the fire with carbon dioxide and water lines, but could not extinguish the fire, which was starting to roll up the walls and produce large quantities of smoke. The crew was equipped with oxygen masks for shipboard firefighting, but quickly had to retreat as the fire raged out of control. The crew was ordered off the ship by management, and the crew made sure everyone not yet aware of the fire had left the ship.

SEATTLE'S MARITIME FIREFIGHTING BACKGROUND

The Seattle Fire Marshal (at the time of the fire), Bobby Lee Hansen, was a Nationally known expert on marine firefighting, and headed a Seattle effort in the mid-1970s to train a contingent of 50 Seattle firefighters for use as a Regional marine response team. Each firefighter received 250 hours of training. Equipment was cached in three locations in the State. This project was funded by the United States Maritime Administration (MARAD) and included pre-fire planning for about 60 ships that frequently visited Seattle. Pre-fire plan booklets were kept on each ship and at each U.S. fire department where the ship frequently called. The MARAD project was followed by a joint U.S. Fire Administration/MARAD project to decide on a National approach to maritime fires in or near ports. Stanford Research Institute evaluated various approaches and concluded that a modified Seattle approach was the preferred choice.

Thus Seattle had made a major, nationally-recognized preparation effort for marine fires and had kept up their preparations over the years. They also had experience in fighting a similar ship fire with more conventional techniques a few years earlier and had come away from that feeling that a structure fire approach was not entirely satisfactory for ship fires.

The Seattle Fire Department had trained to use CO₂ for ship fires and had actually discharged CO₂ into a vessel in training. Their preparations and experience served them well in this fire.

THE INITIAL RESPONSE

The first call on the fire was received at 0939. Because the fire was not immediately discovered and the call to the fire department was further delayed by the initial firefighting by the crew, the fire was already of significant size below decks.

The Seattle Fire Department dispatched its full complement for a ship fire, which included "Unit 99," its marine unit. The marine unit includes an engine company (E-36) with a complement of one officer and four crew specially cross-trained for ship fires. They also have the Marine Firefighting Van, E-4, a fireboat, Battalion 7 and Battalion 1 (Deputy Chief of Operations). They had rehearsed extinguishment of large ship fires using carbon dioxide but had never done so in practice. The marine unit is dispatched for fires on ships over 50 feet long, pier fires, or when requested.

The initial response included the normal response of four engines and two ladders for the intersection nearest the ship plus the marine unit. (See the timeline in Appendix G for the specific units included.)

As the first units approached the ship they saw a huge column of smoke rising from midships and immediately called for a second alarm. It eventually went to five alarms.

The first units arrived at 0944. They immediately laid lines and began pumping water into the hold but could not get at the fire directly. The ship's first mate informed the firefighters of a small ammonia tank on the deck and various drums of aviation gasoline, other petroleum products, and acetylene bottles, but the full extent of the hazardous materials was not known until an hour later. Monitors were set up to cool the drums and the on-deck tanks. The water attack from the deck continued for about 30 minutes.

The marine unit arrived about 8-10 minutes after the first call to the fire department. Arriving with them was the Battalion 1 Deputy Chief and Acting Assistant Chief Dave Campbell who assumed the role of Incident Commander throughout the fire. They considered three main strategies: pushing the ship into the middle of the bay and letting it burn itself out; putting firefighters aboard for a structure-like attack (the approach used in the previous ship fire); or the CO₂ approach. The fire situation matched the requirements for a carbon dioxide attack, and the decision was made to start preparation for it at once. The key decision elements were that the fire was large but confined and was inaccessible to direct streams of water. (The Seattle Marine Firefighting Operations orders, shown in Appendix D, specify that CO₂ is to be used when there is poor access, undue risk to firefighters, water damage is intolerable, and/or on-board CO₂ has been exhausted.) The CO₂ would both smother and cool the fire.

One of the first responding ladder companies (L-4) happened to be videotaping a training session and the photographer went along; this led to a visual record of the early conditions faced and the initial stages of the firefighting.

The fireboat *Chief Seattle* arrived and nosed against the ship from the starboard side. It sprayed water on the hull and deck virtually throughout the fire.

Higher Alarms--A second alarm was called at 0945 soon after the first unit arrived.

Between 30 and 60 minutes into the fire, the ship started to list from the water being poured on board from above. The ship was empty of cargo and riding high in the water. Adding water to the top decks meant that it didn't take much water to cause the ship to list.

Approximately one hour into the fire, the first mate of the ship informed the marine unit that there was an ammonia tank in the hold in the vicinity of the fire with about 6,000 lbs. and one in another hold, in addition to a small one on deck. There actually were a total of four ammonia tanks below decks. They were part of the system used to refrigerate fish and fish products. The mate said there were approximately 8,000 - 10,000 pounds of ammonia on board.

The threat of an ammonia explosion plus the growing list of the ship triggered a decision by the Incident Commander to pull all fire crews off the ship and briefly stop the water flow. The crews on the pier then set up unmanned monitors which were used along with the Seattle fireboat *Chief Seattle* to pour water on the Hazmat tanks on the deck to cool them. The fireboat was also used as a platform from which to get onto the ship from the water side.

As the fire progressed, it spread horizontally, both forward and aft, and vertically, both upward and downward.

There were considerable flame and smoke showing from the hatches on deck, plus sufficient radiant heat from the sides of the ship to ignite the wooden pilings and side planks of the pier.

About 150 firefighters were used at the peak of the fire, about 75 percent of the 197 on-duty suppression staff. The off-duty shift was called back. Mutual aid was used extensively to fill in for deployed units in various places.

CO₂ OPERATIONS

Seattle had an agreement with a local CO₂ manufacturing firm (Liquid Carbonics) to provide CO₂ by truck to a ship fire at any time around the clock. They had practiced with the company's delivery truck and had arrangements to quickly obtain a truckload and to order additional truckloads if needed. Liquid Carbonics has a processing plant in Seattle that repackages bulk quantities into small containers. The bulk plant is 109 miles away, near Bellingham.

As Murphy's Law would have it, the only available CO₂ truck driver was not to be found for at least an hour, and the company could not provide CO₂ immediately. Further, local stores of CO₂ were low and it was estimated that it would take hours to obtain additional CO₂.

Over a six-hour period the Seattle Fire Department proceeded to prepare the ship for the CO₂ after careful study of the ship's plans which were obtained from the bridge. There were two major preparation tasks: sealing the many large openings from which the CO₂ could leak, and cutting holes to insert the CO₂. As it turned out, the actions needed to prepare to use the CO₂ took longer than the delivery of the CO₂.

The first CO₂ arrived by a tanker truck at about 1400 hours, an hour after it was expected. However, pumping of the CO₂ into the ship did not start until about 1600 hours.

Some steel hatch covers on the ship were missing because the ship was undergoing repairs, and some aluminum hatches had burned through. Some portholes had been broken by the initial firefighting and others were blown out by the fire. All of these openings plus many others had to be sealed.

Fortunately, the pier had a number of steel plates handy and a large mobile crane on treads that could be used to position the plates over the holes. It was also fortunate that it was daylight and the weather was good.

The steel plates had to be cut roughly to fit over the holes; this was done by a combination of city Water Department workers and skilled workers found on the pier. The plates were just laid over the large openings, not welded. Firefighters had to reboard the vessel, protected by hosestreams from others, to guide the plates into position. This was highly hazardous; the deck was hot enough to melt the treads of their boots, and a firefighter who knelt down had his knee pad melted. Also there was the danger of an ammonia explosion, though a strong smell of ammonia in the air suggested that it was venting at least to some extent.

Small steel plates also were cut and welded in place over broken portholes. Other portholes and small vents were covered or stuffed with tarpaulins and other handy materials.

The portholes on the water side were sealed by workers from a rented tugboat. The portholes on the pier side were sealed using ladders from the pier.

Late in the sealing operation just prior to starting the discharge of CO₂, it was discovered that a large, about 6-foot by 8-foot, vertical hole had not been sealed. It had been missed in a survey of openings

made early in the incident. To put a steel plate over it required cutting away sections of two catwalks, each about 10 feet long, that blocked the crane from lowering the plate in place. Firefighters barely able to stand the heat and protected by streams from others, succeeded in cutting away the catwalks, but only a poor rough fit of the plate was possible.

While the sealing operation was underway, small round holes were cut into the hull of the ship in six places using cutting torches. One of the lower holes was cut into the ship by two men on a narrow skiff that had to be moved into place in the slot between the ship and the pier--a dangerous operation. Fittings to receive the CO₂ tubing were welded in place in the holes. The holes were made on the pier side only. Three of the holes were placed at about 40-foot intervals on the level of the tween decks of holds #2 and #3, as spotted by the first mate; the other two holes were placed below them on a lower level, though not as low as the first mate desired. (The sixth hole was not used.) The multiple holes were intended to allow insertion of CO₂ into at least two tween decks holds where the fire started and into two lower holds. Although CO₂ is a gas and would spread out, there was concern that use of only one hole might inadvertently pump it into a closet or area from which it would not distribute. There also was a need to experiment to see where the best results could be obtained (in the hold of fire origin, the next hold, or holds not yet reached). In fact all were tried; the CO₂ was pumped intermittently into three upper and two lower holds. If the ship had been loaded it would have ridden lower in the water, and it would not have been possible to inject CO₂ into the lower holds.

A test discharge was made at the start of the CO₂ pumping operation to determine what effect the CO₂ would have on the products of combustion inside the vessel. They did not want the CO₂ to force smoke and heat into areas where firefighters were protecting exposures.

On either side of three of the CO₂ holes, another pair of small holes were cut to insert thermocouples. These were used to determine whether the CO₂ was making a difference by reading their trends over time, and observing them at times when the CO₂ was shut off to see whether the temperature stayed down or whether it rose. In one instance the temperature registered 100 degrees Fahrenheit but climbed to 800 degrees Fahrenheit when the CO₂ was stopped; it was then resumed. The thermocouples were inserted about one and a half to two feet into the ship. Of course they partly measured the temperatures of the CO₂ being pumped in near them and not the temperature further into the hold. But their readings were still highly useful.

At the outset, a rough estimate was made as to how much CO₂ would be needed to create a 60 percent CO₂ atmosphere. The estimate was 24 tons, based on a rule of thumb that one pound of CO₂ produced nine cubic feet of vapor. The volume of the *Omnisea* to be flooded was 433,000 cubic feet. Additional calculations estimated that 37 tons were needed to achieve a 80 percent CO₂ atmosphere (or allow for some leakage). Less than two truckloads were estimated to suffice. In fact, 10 trucks with 165 tons (330,000 pounds) of CO₂ were used. Most of the CO₂ escaped through a variety of leaks, even though CO₂ is heavier than air and might (erroneously) be thought to settle down.

It was positively determined that the CO₂ extinguished the fire and that the fire did not burn itself out. There was much more fuel available to burn in the holds than burned.

A concern during the fire was whether the CO₂ might accidentally be injected directly on the ammonia tank in the tween deck Number 3 hold and whether that would cause the tank to crack or lose strength and fail catastrophically. It turned out that they missed it by about five feet. The tank survived with its structure intact and was not deformed. The pressure relief valve apparently proved

adequate for this size tank, though there also may have been ammonia leakage from piping damage during the fire; there was considerable fire damage to the piping, gaskets and valve.

AFT FIREFIGHTING

While the CO₂ attack was being made, the Incident Commander decided to attempt to save the aft third of the ship, which included the 4-story superstructure above and the engine compartment below; this was the most valuable part of the ship.

Two 3-person land companies were put on each of the four levels of the superstructure, one down each of the two corridors leading forward. They were to try to hold the fire at a vertical bulkhead running top to bottom through the ship at that point, penetrated by sealable hatches leading to the forward two-thirds of the ship. The crews were able to do this successfully, though one company advanced further than ordered, more than halfway down the ship through a corridor over the burning hold, and then up to the deck. The interior crews had to wet each other down to keep cool.

OTHER ASPECTS OF FIREFIGHTING

The fire started in the Number 3 lower hold and spread to three lower level and three higher level holds. After the fire was thought to be extinguished, firefighters used infrared detectors to find any remaining smoldering embers. The fire crews also had to blow away toxic and explosive gases from each compartment.

One and three-quarter inch hoselines were used by the land companies to cool the areas where other firefighters were sealing fire doors, covering openings, and securing hazardous materials on deck. The water turned to steam; the deck was too hot to kneel on.

The Incident Command System was used successfully. Major sectors were: operations; planning (the attack); financial; logistics. The acting Assistant Chief for Operations was the Incident Commander.

During the fire the commandeered crane used to lift steel plates on board was also used to lift the ammonia tank off the deck and to take off the acetylene bottles.

FIREFIGHTER SAFETY

Shipboard firefighting poses one of the most dangerous environments imaginable, especially when one is unfamiliar with the ship and there are all sorts of work equipment, unfinished repairs and hazardous materials present. It has been likened to working a fire in a steel basement three or four levels below ground. Seattle went to great lengths to monitor the safety of their firefighters, but there was still great hazard in the face of high temperatures and hazardous materials. The deck was so hot that hoses caught fire if kept in one place too long.

The Seattle Fire Department firefighter accountability/passport system was used to keep track of all personnel working on the fireground. A department safety officer was on the scene throughout the incident.

The State Department of Labor and Industry sent occupational safety specialists to the scene to monitor the safety of the workers at the fire. They required that workers on ladders be given harnesses or use a cherry picker, and that welders taken on board wear bunker gear.

Engine 22 is assigned to operate the department's communications van. It went to this fire as it does to all major fires, monitored radio communications for calls for help or missed messages, and acted as a communications bridge if the intended recipients did not hear messages sent to them. On board the ship, crews protected each other with fog streams. Rescue crews were positioned in the aft section to assist the defensive crews on each level if that became necessary.

The engine companies and command post on the pier were relocated once the below deck ammonia threat was known.

Firefighting crews were rotated through a rehabilitation staging area; metro buses were used to provide seats and heaters.

Only about three companies were allowed on deck at one time. Firefighters were not allowed to go into the holds because of fear of getting trapped, especially if the ship started to capsize.

There were only minor injuries to firefighters. None were hospitalized. This was partly good fortune to those going in harm's way, but also a tribute to the safety practices and safety concerns from the rank- and-file firefighters up through the officer ranks, who take safety very seriously in light of past experiences in Seattle.

INVOLVEMENT OF LOCAL, STATE, AND FEDERAL AGENCIES

Early in the fire the department called for assistance from a number of local, state, and Federal agencies. Some contacted others in turn. The City's Department of Emergency Management was responsible for contacting them. It took about an hour for all to arrive. The agencies involved and their roles were as follows:

Early in the fire the **Coast Guard** was asked to monitor the tilt of the ship and to advise well in advance of any peril of tipover. Because the ship was unloaded, there was continual concern that it might roll over and that it might do so rapidly. The maximum list that occurred was five degrees, reached at about 30 minutes into the firefighting. It was thought that the ship could safely go to 15 degrees (26-30 degrees was considered the point it could capsize). The fire department checked the ship's inclinometer while the Coast Guard monitored inclination from the dock and the sea. If necessary, the ship's power could have been used for emergency off-loading of the water, but it was preferred not to power the ship.

Once the fire department was told about the ammonia tanks below decks, they called the State's **Department of Ecology** to set up a plume model using the CAMEO Hazmat computer model, which Seattle had helped develop. The concern was where the ammonia cloud would go if the tank exploded. The model showed that if low winds blew inshore, the plume would drift intact over the nearby Magnolia Bluff section of Seattle. The fire department would have about a half hour before the cloud reached the residential area.

Interestingly, because the ship fire was a quarter mile away from the nearest residential area, a strong wind would have broken up and diluted the plume, and a still atmosphere would have allowed it to disperse slowly. But a gentle wind back toward shore could have kept the plume intact enough to be a hazard to the nearby residential community, causing people to pass out. Preparations were made to evacuate any area of the city threatened by the plume.

The Department of Ecology, besides operating the CAMEO model, sent a spill response team to monitor any spill of the 215,000 gallons of bunker fuel should the ship capsize. This department was also asked to monitor particulate matter coming from the ship but was not equipped to do so. Consequently, they called in the (Federal) **Environmental Protection Agency (EPA)** which had a Regional office in Seattle. EPA set up a particulate monitoring system as requested.

The **National Oceanic and Atmospheric Administration (NOAA)** was called in to set up a portable weather station near the ship to monitor the wind and feed that important information to the CAMEO model. They were able to show that the winds would not blow the cloud toward the City for most of the duration of the incident.

The **Port of Seattle Police** and **Seattle City Police** were used to evacuate about 600 workers from Pier 91 and the adjacent Piers 89-90. Three ships were asked to get underway and leave the piers to protect themselves should the *Omnisea* explode or the pier catch fire.

The **Federal Aviation Agency (FAA)** was asked by the fire department to declare the airspace around the fire a prohibited flying zone to keep news helicopters away.

And as previously noted, the city's **Water Department** helped drill holes in the side of the ship for the CO₂.

Evacuation Plans--Once the ammonia tanks were discovered, plans were prepared to evacuate thousands from the Magnolia Bluff residential area. The police had the prime responsibility for developing and executing the plans, though other agencies participated. The details of the evacuation plan varied depending on which way the ammonia cloud might drift. City buses were brought to the Magnolia Bluff area, and five companies of firefighters were stationed in the area to assist the evacuation and be ready to extinguish fires if an explosion started spot fires. Seattle's **Police** and **Office of Emergency Services** staff also prepared to make announcements in the neighborhood and go door-to-door. Police were positioned around the perimeter of the area.

One extraordinary preparation by the City's Office of Emergency Services and the Fire Department's Public Information Officer (PIO) was to record a tape to be broadcast by the Emergency Broadcast System on radio and TV to alert the areas threatened. They were concerned that because of its rare use the citizens might overreact to the EBS or not heed it at all. The Office of Emergency Services feels that the EBS should be used more frequently for major weather problems and other events, enough to familiarize the citizens with it.

The potential EBS message would have told people to evacuate and would have provided public education on preparing to care for yourself for three days if you had to be evacuated and the condition in which you should leave your home (what to shut off, lock, etc.) prior to evacuation. If you could not escape you were to go to the highest level in the house and not go to the basement where the fumes would settle. You were to seal doors and windows of the refuge area of your house using wet towels. The message was prepared and ready to be transmitted by the King County Emergency Communications Center, which has responsibility for the EBS in the Seattle area.

The **Red Cross** and other private disaster relief agencies had been contacted about the possible ammonia explosion and had already identified a local high school as a first level shelter and other places for shelters if the danger was more widespread. Fortunately these plans did not have to be used.

Coordination of Multiple Agencies--The Incident Commander worked out a simple, highly effective method of keeping local, State and Federal agencies coordinated. A large city bus was brought to the scene and meetings were held on the bus of all agencies present. These meetings were scheduled at 30 to 60 minute intervals and assured that all parties touched base at least that often. A battalion chief was used as the liaison and coordinator. He encouraged the agencies to keep representatives on or near the bus, and not wander off. Each agency was asked for various resources--information, expertise, equipment--either to provide immediately or to get lined up in case it was needed. All cooperated well.

The bus offers a warm, sheltered, well-lit, reasonably pleasant place to meet and wait. It also has large glass windows so those on the bus can see what is going on without having to wander around the scene on their own.

Water Containment--A private company on the pier was contacted to provide a barge with pumping capability to off-load the firefighting water from the ship and prevent the chemical- and oil-contaminated water from being dumped into the harbor. That was accomplished successfully after the fire.

LOSSES

The cost of repairing damage to the ship was estimated at \$7-10 million. (The exact loss assessment was pending refined reconstruction estimates versus costs of a new ship.)

There were eight minor injuries to civilians.

Two of the decks of the ship had severe damage in the holds and crew quarters. Both decks were buckled in a number of places.

The ship owner was billed for the cost of the CO₂ and some other equipment costs. The fire still cost the fire department thousands of dollars for overtime and purchase or rental of special equipment, e.g., the crane.

LESSONS LEARNED

1. **Using CO₂ to extinguish a large ship fire is practical, but many preparations are needed to do it in a timely manner.**

Supplies of CO₂ in truckload quantity need to be arranged for as part of pre-fire planning. Ideally a truckload would be stored at the port.

The fire department needs to plan how to use the CO₂ and to practice the skills to hook it up. Ship plans needed to be found and understood quickly, and an inspection made to determine how best to seal the ship. Preparation to seal the ship may take longer than expected (as was the case here). It should be started at once and not delayed until arrival of the CO₂.

2. **Port facilities should be surveyed as to equipment, materials and skills routinely available for use in extinguishing ship fires with CO₂ (and by other means).**

Materials needed for CO₂ operations go beyond the CO₂. The availability of equipment, materials, and skills needs to be identified for weekend and night-time emergencies, not just during the normal work week. It was great luck that in this fire an adequate size crane was available, with an operator, that steel plates of adequate size were available, and that enough cutters and welders could be found quickly.

3. Fire departments engaged in shipboard firefighting should have standard operating procedures outlining the response and strategies for different types of ship fires.

These are complex fires that require considerable planning and training. They are dangerous to firefighters and need special safety considerations. The Appendix includes an example of an SOP from Seattle.

4. Interagency coordination was crucial both to give early warning of a potential disaster and to plan steps to mitigate it.

Besides the threat of the fire itself, there was potential for an airborne threat from an ammonia tank explosion and a water pollution threat if the ship leaked fuel oil or capsized.

Although the State of Washington had responsibility for monitoring air and water pollution, they could not bring their own weather station and particulate monitoring systems to the site, and had to ask EPA and NOAA. Fire departments need to know exactly where to go for such equipment and how fast it can be brought to the scene in practice. It is not enough to be told that an agency has the equipment. Find out where it is and how they would get it to the scene in a timely fashion at any time of year or any hour of the day.

5. Local agencies should consider more frequent testing and use of the Emergency Broadcast System in medium-size disasters and not just catastrophes.

The EBS is an effective means to quickly reach many people, but needs instant credibility to be effective. Seattle's Office of Emergency Services was concerned as to whether the EBS would be effective because they had not used it for a real incident. Exercising the system occasionally will increase its familiarity to the citizens and will train those who operate the system and those who need to trigger its use. An example of additional use would be to broadcast messages during snowstorms to stay at home and not to abandon cars in roadways. But it must not be overused or abused, lest it not be taken seriously when needed in an emergency.

6. Planning how to fight fires on various classes of ships that visit a port, and even particular ships that visit frequently, should be undertaken, as with other pre-fire suppression plans.

MARAD endorsed Seattle's plans of the 1970s whereby 50-60 ships that regularly visited the Seattle region had fire plans stored on the ship and at each of the ports the ships visited regularly. That can save a great deal of time in deciding on firefighting operations, having ship plans available, and knowing what resources will be needed.

7. Some further research information is needed by marine firefighting.

Understanding whether flame impingement will cause ammonia (or similar) tanks to blow or whether the venting is sufficient for different size tanks would be useful. Also, would CO₂ impingement on the heated tanks of hazardous materials cause them to crack while being heated?

8. Shipboard repair operations must take firewatches seriously: the watches should be continuous.

The fire got a head start because there was no watch for the required 30 minutes after welding had ceased. The smoldering insulation would have been detected at a much earlier state if there had been a firewatch.

9. Vessels often catch fire while undergoing repairs: special safeguards are needed.

Since the fire, Seattle has proposed a much more stringent set of rules regarding ship repairs. The idea is to require more repairs to be done by experts in shipyards than at dockside by crews. Vessels undergoing repairs often have cutting and welding operations, hatches open or missing, fire barriers breached and a skeleton crew--all conditions present in this fire. It is like a high-rise with holes between floors, all fire doors open and the fire protection system closed down.

Seattle's previous requirements were for trained safety experts to oversee welding and other metal work while a ship was in port. But there are not enough experts in the area for the large number of vessels seeking permits for such work. Seattle has now proposed that three levels of permits be considered. Level One would permit minor repairs with minimum regulations. Level Two would require stricter precautions, and Level Three must be done in a shipyard.

Level One welding and cutting is defined as work that does not require more than one cutting torch or welding machine, does not involve hazardous areas and is completed in 14 days.

Level Two is welding or cutting in hazardous areas, e.g., compartments with polyurethane insulation. It must be completed within 30 days. (This was the situation in this incident.)

Level Three is major repairs that require over 30 days or will place the vessel's fire protection systems out of service. The Appendix includes the complete definition and precautions proposed by Seattle for each level.

10. Planning city evacuation routes for all situations is not entirely feasible: the ability to plan the details in real time is needed.

In this incident, the choice of evacuation routes depended on where the ammonia cloud might drift. There were too many options to consider to have plans for all possibilities. While Seattle had practiced for disasters, the details of the plan had to be kept fluid as the estimated direction and size of the ammonia cloud changed.

The real-time plans involved where to place shelters as well as evacuation routes. Shelter locations preferably would be close to the neighborhood involved but obviously not in the path of the ammonia cloud--which meant they could not be prespecified.

Appendices

- A. **Area Map**
- B. **Ship Diagram**
- C. **Fire Investigator's Scene Report**
- D. **Seattle Fire Department's Marine Firefighting Operations SOP**
- E. **Marine Unit Training Courses and Equipment List**
- F. **Draft Regulations for Welding and Cutting on Marine Vessels**
- G. **Ship Fire Timeline**
- H. **Photographs**

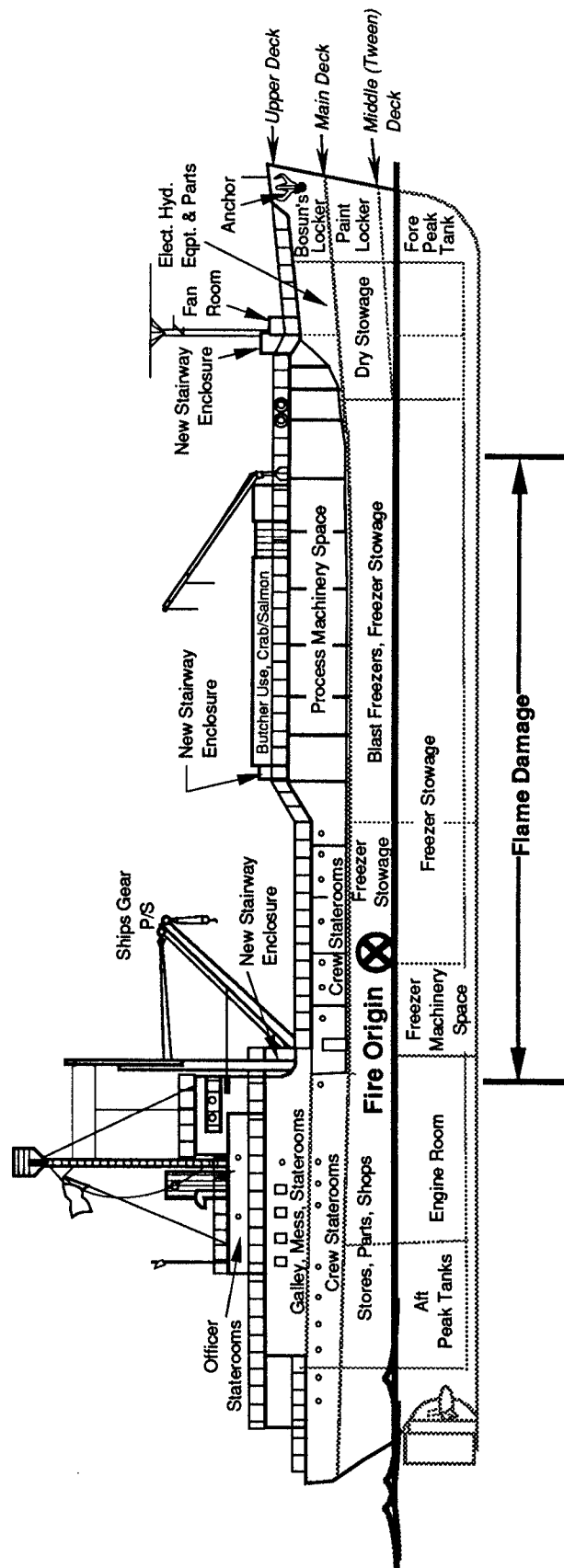
Appendix A

Area Map

Appendix B

Ship Diagram

The Omnisea



772-12-17-91-1

Appendix C

Fire Investigator's Scene Report

| | |
|---------------|-------------------|
| DATE: 9-16-91 | SFD INC# 91-31790 |
| ME: 0939hrs | SPD INC# |

SEATTLE FIRE DEPARTMENT FIRE INVESTIGATOR'S SCENE REPORT

| | | |
|------------------------------------------|--------------|-----------------|
| INC CLASSIFICATION: Accidental Ship Fire | | NO of alarms: 5 |
| INC LOCATION: PIER 91 Seattle | | CENSUS: 58 |
| BUILDING/PREMISE NAME: M/V OMNISEA | | |
| OCCUPANT: UNISEA Inc. | | |
| PHONE HM: 881-8181 WK: | INS INFO: | |
| OWNER: Dutch Harbor Sea Foods | | |
| OWNER ADDRESS: | | |
| PHONE HM: | WK: | INS INFO: |
| EST LOSS PREMISES: | CONTENTS: | OTHER: |
| INJURIES: 10 | DEATHS: none | TOTAL LOSS: |

DESCRIPTION OF PREMISES:

This is a 324' processing ship docked at Pier 91 Seattle for the purpose of refitting having just returned from Alaska.

INCIDENT SUMMARY:

Based on the facts and observations in the body of this report, it is the opinion of the investigators that this is an accidental ship fire. It was caused by workmen cutting pipe with an acetylene torch in the case up room on level "upper 3". (This is the flash freeze packaging area.)

Resulting fire destroyed or damaged approx 2/3 of the ship. The portion of the ship aft of the fire area was protected and undamaged by direct fire contact.

| | | | | |
|------------------|-------------|--------------|-------------|----------------------------------------|
| PRIMARY INV | SERIAL UNIT | INV | SERIAL UNIT | APPROVING OFFICER |
| Inv R Litchfield | 0029 997 | Inv D Faires | 0028 997 | <i>Capit</i> <i>RR</i> <i>0027/997</i> |

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SFD INC# 91-31790

SPD INC#

FIRE INVESTIGATOR'S SCENE REPORT CONT.

- | | | |
|------------------------|-------------------|-----------------------|
| 1) Scene Investigation | 2) Area of Origin | 3) Source of Ignition |
| 4) Casualties | 5) Evidence | |

1 EXTERIOR:

This fire occurred on board the M/V OMNISEA, official Doc#247493 while moored at Pier 91 on the Seattle waterfront. At the time the vessel was receiving electrical service from shore side facilities. The M/V OMNISEA is described as having a 323.9' length, 50.1' beam, displacing 4948 tons gross weight and operating as a refrigerated seafood processing ship. The vessel was moored port side to Pier 91 with the bow to Puget Sound.

This vessel was in port undergoing refitting related to conversion from Salmon to Crab processing. Approx 30-40 persons were on board at the time of the fire.

From the Pier, fire damage is noticeable on the hull of the ship in the midships area on both port and starboard sides. This damage is in the form of blistered paint, warped and deformed hull sections and metal discoloration from heat. The aft 1/3 of the vessel appears to be undamaged externally while the forward 2/3 shows the described hull damage. On the deck surfaces, the same type of damage is reflected with the rear 1/3 undamaged. All water tight doors and portholes on the forward exterior 2/3 of the ship showed smoke and heat damage. Heavy black smoke staining is seen coming from all openings and all deck areas have a mild to severe degree of warping and heaving due to heat.

A line of demarkation on the hull is clearly seen at the 19' draft mark with the fire damage above. This is noted on the port side with the greatest amount of exterior hull damage at a point approx 210' from the bow. Starboard side damage mimics the port side but to a lesser intensity. Viewed from the port side, the greatest degree of damage to the hull is located amidships at a point approx 2 decks below the main deck.

INTERIOR:

Internally, the damage to the vessel reflects that described on the exterior hull. From the bow of the ship to a point at approx the aft bulkhead of the butcher house which is frame

| PRIMARY INV | SERIAL UNIT | INV | SERIAL UNIT | APPROVING OFFICER |
|------------------|-------------|---------------|-------------|---------------------------------|
| Inv R Litchfield | 0029 997 | Inv D. Faires | 0028 997 | <i>Cap R. R. Riden</i> 0027/997 |

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SFD INC# 91-31790

SPD INC#

FIRE INVESTIGATOR'S SCENE REPORT CONT.

- | | | |
|------------------------|-------------------|-----------------------|
| 1) Scene Investigation | 2) Area of Origin | 3) Source of Ignition |
| 4) Casualties | 5) Evidence | |

#72 forward #92 aft, all compartments have been gutted by fire and show heat and smoke damage. This fire damage however is an extension of a fire aft and not an area of original fire.

A compartment known the "case up" room, or "upper 3" is located at the point where the greatest degree of fire damage is noted. The most severe exterior hull damage described earlier locates this compartment within the ship. The "case up" room is located 2 decks below the main deck amidships with the hull serving as the port side of the compartment. This compartment extends the width of the ship, is approx 50' in length and 10' deck to overhead. All surfaces of this compartment (other than the deck), as well as the surfaces in most forward compartments, were coated with 6-9" of rigid sprayed on polyurethane foam insulation with a fire resistant coating. Blast freezers and cold storage are located in the proximity of this compartment although one frame forward.

The forward bulkhead in the "case up" room has two openings in it. The first is a service door through which fork lifts and product pass moving forward to cold storage. This door is approx 8-10' in width, 7-8' in height and was open at the time of the fire. The second door is a watertight door located on the port side near the hull. It also was open at the time of the fire. To the rear of the compartment is a large hatch cover which provides the main access to the holds of the ship. This hatch cover is approx 20' long, 25' wide and is hinged on the aft edge. Directly above the hatch cover is another of the same size located at the main deck. These are the main cargo hatches of the ship. The hatch in the deck of "upper 3" was closed at the time of the fire while the hatch in the main deck was open. A door similar to the service door on the forward bulkhead is located in the center of the aft bulkhead. Aft of the "case up" room, is a boiler room. This room also suffered direct fire damage but less so than the "case up" room.

| IMARY INV | SERIAL UNIT | INV | SERIAL UNIT | APPROVING OFFICER |
|------------------|-------------|---------------|-------------|--------------------------|
| Inv R Litchfield | 0029 997 | Inv D. Faires | 0028 997 | <i>RR Riden</i> 0027/997 |

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SPD INC#

FIRE INVESTIGATOR'S SCENE REPORT CONT.

- | | | |
|------------------------|-------------------|-----------------------|
| 1) Scene Investigation | 2) Area of Origin | 3) Source of Ignition |
| 4) Casualties | 5) Evidence | |

Minor amounts of insulation remain on some of the aft sides of the vertical ribs on the hull of the compartment. The remaining insulation diminishes in the direction of the port forward corner of the room. Here, there is no insulation remaining and the greatest amount of warping and heaving in the bulkheads and decks is seen. Metal discoloration is also greatest in the port forward corner. It is in this area that workmen were cutting and welding prior to the fire. On the ceiling of the compartment, 2 equally spaced beams running forward to aft, carry the upper deck. They are "L" shaped beams approx 7/8" thick, 14' wide, and 20" high. The upper deck is welded to the beams. At a point approx 10' aft of the forward bulkhead on the port side of the "case up" room, this beam is broken. It is pulled apart in a straight line running perpendicular to its length and has a 3/4" - 1" gap between pieces. The exposed metal is clean and not discolored as surrounding metal, indicating breakage after the fire while in the cooling process. It should be noted that this breakage is very close to the point where the CO2 nipples were attached and CO2 introduced into the ship for the purposes of extinguishment.

An investigation of the port forward section of the "case up" room showed the room to have been relatively clear. A machine described as a "glazing machine" was located in this corner but no other bulky items were noted. Several brackets and pipe hangers (described to investigators as having been the focus of work being performed in the room) were found lying on the deck. Positions for these brackets were noted in the overhead and the work being done in the area was clearly recognizable. Approx 8' from the port hull and 12" from the forward bulkhead, a welders acetylene cutting torch was found lying in a position with the cutting tip facing away from the bulkhead. The torch knobs were examined and found to be in the "off" position.

| PRIMARY INV | SERIAL UNIT | INV | SERIAL UNIT | APPROVING OFFICER |
|------------------|-------------|---------------|-------------|-----------------------------|
| Inv R Litchfield | 0029 997 | Inv D. Faires | 0028 997 | <i>[Signature]</i> 0027/997 |

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SFD INC# 91-31790

SPD INC#

FIRE INVESTIGATOR'S SCENE REPORT CONT.

- | | | |
|------------------------|-------------------|-----------------------|
| 1) Scene Investigation | 2) Area of Origin | 3) Source of Ignition |
| 4) Casualties | 5) Evidence | |

- 2 Clearly the port forward corner of the "case up" room is the area of greatest damage and area of origin. The damage to the metal bulkheads and decks as well as the total absence of insulation or any other non-metal clearly shows a pattern of "greatest" damage. "Vee" burn patterns normally seen in combustible structures are not seen here although a clear "Vee" pattern can be seen in the insulation remnants on the vertical surfaces and ribs as well as a "vee" pattern of metal discoloration. These "vee" patterns have their base in the port forward corner of "case up" room. A defined point of origin is undetermined an area of origin can be defined. It would include the area in the immediate vicinity of the found cutting torch in the port forward corner of the "case up" room and have its center approx 8' from the port hull and 12-14" aft of the forward bulkhead.
- 3 The source of ignition in this fire is limited to two possibilities. One: molten metal slag produced by a welders cutting torch, or Two: residual or leaking flame from the same torch.
 *The position of the torch and its distance from the bulkhead would exclude the possibility of a hot torch tip as a source of ignition

INVESTIGATORS CONCLUSIONS:

Based on the noted facts and observations as well as the statements of the workmen in the room prior to the fire, it is the opinion of the investigators that this is an accidental fire. It was caused by metal slag or open flame from a welders torch igniting the polyurethane insulation present. A fire protective blanket was in use by the workmen to protect machinery but not vertical surfaces. No fire watch accompanied the workmen at the time of the fire.

| PRIMARY INV | SERIAL UNIT | INV | SERIAL UNIT | APPROVING OFFICER |
|------------------|-------------|--------------|-------------|--------------------|
| Inv R Litchfield | 0029 997 | Inv D Faires | 0028 997 | <i>RRB</i> 0027/87 |

Appendix D

Seattle Fire Department's Marine Firefighting Operations SOP

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MARINE FIRE FIGHTING OPERATIONS / UNIT 99

1.0 REFERENCE:

1.1 Department Operating Instruction:

I 401 - Fire Operations/General Rules

I 403 - Mutual Aid/Responses Outside City Jurisdiction

I 404 - Fireboat Operations

I 408 - Hazardous Materials Operations/Unit 77

I 409 - Bulk CO₂

I 413 - Emergency Incident Management

1.2 U.S. Coast Guard Fire Fighting Response Plan.

2.0 POLICY:

2.1 The Fire Alarm Center shall dispatch the following units to pier fires and marine incidents involving vessels larger than 50' that are accessible by land: Engine 38, Engine 4, Battalion 7, Battalion 1, Air Unit, a Medic Unit, the Marine Emergency Response Van, and the appropriate fire response listed on the F.A.C. response card for the incident location.

2.2 The Fire Alarm Center shall dispatch the following units to Station 3 for marine incidents involving vessels larger than 50' that are not accessible by land: Engine 38, Engine 4, Battalion 7, Battalion 1, Air Unit, a Medic Unit, the Marine Emergency Response Van, and a 2-1-1 response (2 Engines, 1 Ladder and 1 Battalion or Deputy Chief).

2.3 Incident Commanders, at their discretion, may request a Unit #99 response for marine incidents involving vessels smaller than 50'.

2.4 At significant marine incidents, the Incident Commander shall dispatch a Chief Officer to the U.S. Coast Guard "Operations Center" at Pier 38 to provide liaison with the U.S. Coast Guard Captain of the Port.

2.5 The Fire Alarm Center shall notify the Coast Guard of any marine or waterfront emergency incidents, including any fire that threatens the safety of vessels, bridges, waterfront facilities or navigable waterways. The Fire Alarm Center shall notify the U.S. Coast Guard Captain of the Port as soon as possible by phone via the Coast Guard Duty Officer (24-hour number: 442-7070).

2.6 Unit #99 Team Functions:

- a. Assist Incident Commander in locating and reading vessel plans/blueprints.
- b. Assist Incident Commander with formulation of tactics.
- c. Install/operate sound powered phone systems.
- d. Provide and operate air sampling equipment.

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- e. Provide and operate temperature sensing equipment in concealed spaces.
 - f. Provide and operate CO₂ application equipment (bulk CO₂ may be requested by the Incident Commander).
 - g. Provide and direct the placement of dewatering equipment.
 - h. Provide transportation for personnel and equipment to emergencies away from shore based operations.
 - i. Operate ships ventilation and fire protection equipment.
 - j. Assist in operation of ship's communications systems.
 - k. Assist in the use of ship's damage control plan.
 - l. Provide and direct the placement of underdock nozzles and equipment.
 - m. Provide and operate pneumatic breakers (jack hammers).
- 2.7 The Seattle Fire Department is responsible for the extinguishment of waterfront fires including fire on vessels, within the corporate limits of the City of Seattle, except as provided by the Memorandum of Understanding identified in Appendix 6.11 of this Section.
- 2.8 Orders for coordination of U.S. Coast Guard fire fighting activities shall be directed from the Seattle Fire Department Incident Commander to the on scene Coast Guard coordinator. The U.S. Coast Guard shall:
- a. Alert Port Operations and the Puget Sound Vessel Traffic Center.
 - b. Provide fire fighting services as able.
 - c. Control or restrict vessel traffic in the area.
 - d. Request vessel assistance from other civilian and government vessels in the vicinity for rescue and movement of personnel and equipment to an incident site.
- 2.9 The U.S. Coast Guard Captain of the Port, or designate, shall be responsible to determine if a burning vessel can be moved or sunk. The Coast Guard will contact all appropriate agencies and resolve all waterway traffic and pollution problems caused by any movement or sinking of a vessel.
- 2.10 The U.S. Coast Guard Captain of the Port, or designate, will contact and get permission from the Chief of the Seattle Fire Department before allowing any burning vessel to enter the corporate limits of the City of Seattle. When allowing a burning vessel to enter port, the Chief or his designate will approve a suitable pier (preferably non-combustible), or a fire fighting anchorage, and whenever possible, an on vessel inspection/evaluation shall be accomplished by the Fire Department and the Coast Guard. The evaluation team shall determine:
- a. Existing fire problem.

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- b. Hazardous materials exposure.
 - c. Vessel stability.
 - d. Status of ships fire fighting equipment such as CO₂, fire main, sprinklers, etc.
 - e. Necessary shore side resources for control and extinguishment.
- 2.11 Ordering of Contractor Services
- a. To avoid possible liability for contractor costs, the following guidelines shall govern our interaction with cleanup or disposal agencies or any contract service:
 - b. The responsible party is to be informed that he/she is financially responsible for the cost of the contractor or cleanup or disposal of hazardous materials.
 - c. When it is not possible to determine or contact the responsible party the Fire Department will contact one of the following persons or agencies, who in turn will make the arrangements for cleanup/disposal, or any other contract service.
 - *(1) The Seattle Fire Department Emergency Services Officer.
 - *(2) U.S. Coast Guard.
 - *(3) EPA.
 - *(4) Washington State Department of Emergency Services, Duty Officer (Olympia).
 - d. In the event the absence of, or delay in contacting a contract service will result in significant additional life and/or property loss, the Incident Commander should order contract services directly and not use the above procedure.
- 2.12 The Seattle Fire Department Policy is to extinguish a marine fire with the least damage to the vessel and its cargo, while avoiding injury to personnel. Full utilization of ships fire protection systems shall be implemented. Primary consideration should be given to bulk CO₂ smothering techniques in spaces equipped with or lend themselves to a CO₂ application system.
- 3.0 DEFINITIONS:
- 3.1 Marine Fire Response Team: The group of units that comprise the Marine Fire Response team designated by "Unit 99" shall include Engine 4, Engine 36, Battalion 7, Battalion 1, Air Unit, a Medic Unit, and the Marine Emergency Response Van.
 - 3.2 Staging: the stockpiling of resources/equipment at a location near fire fighting activities.
 - 3.3 Corporate limits of the City of Seattle: The area defined as extending westerly from the north and south City limits to the mid-point of Puget Sound.

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3.4 Memorandum of Understanding: A letter of agreement between the Chief of the Seattle Fire Department and the Commanding Officer of United States Naval Vessels which outlines the policy of the Seattle Fire Department with regard to fire fighting operations aboard Naval vessels while under construction, conversion, or repair in the City of Seattle.

3.5 Bulkhead: A term applied to the vertical partition walls which subdivide the interior of a ship into compartments or rooms.

3.6 Casing: Bulkheads enclosing the engine and boiler rooms.

3.7 Free Liquid: Liquid that partially fills a compartment in a ship. This liquid settles in the direction of list of a ship, causing a further reduction in stability.

3.8 List: A fixed angle of inclination of a ship, caused by an off-center distribution of weight.

3.9 Shaft Alley: A water tight enclosure of the propeller shafting, large enough to walk in, extending aft from the engine room to provide access and protection to the shafting.

3.10 Water Tight Bulkhead: A transverse bulkhead extending from the keel to a freeboard deck, either the second deck or the main deck, which lies well above the waterline. Each water tight bulkhead is designed so there will be no opening in the bulkhead, thereby preserving the water tight integrity of a bulkhead.

*3.11 Fire Fighting Pier: A prearranged non-combustible pier where a transient burning vessel can be docked for fire fighting. Pier 30 has been designated by the Port of Seattle as the priority fire fighting pier for Elliott Bay.

4.0 RESPONSIBILITY: N/A

5.0 PROCEDURE:

5.1 Unit #99 Personnel Requirements:

a. Engine 36

(1) When dispatched on a Unit #99 response and Engine 36 is in quarters, members of Engine 36 will respond with Engine 36 and the Marine Emergency Response Van.

(2) When Engine 36 is out of quarters, in-service, and dispatched to a Unit #99 response they shall return to quarters code red and complete requirements in 5.1 a. (1).

(3) When Engine 36 is out of quarters and "Out of Service," a fill in company shall be dispatched to their location. Once relieved and in-service, the Incident Commander shall return Engine 36 personnel as outlined in 5.1 a. (2) of this instruction.

b. Engine 5

(1) Engine 5 shall be placed "Out of Service" during a Unit #99 response, involving incidents not

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accessible by land, to coordinate activities of arriving units as outlined in Marine Equipment List "A" and "B" (see Appendix, this section).

(2) When Engine 5 is out of quarters, in-service they shall return to quarters code red.

(3) When Engine 5 is "Out of Service," the Officer of Engine 4 shall coordinate the activities of arriving units as outlined in Marine Equipment List "A" and "B".

5.2 Dispatching

a. If a second fireboat is required during a Unit #99 response, the Incident Commander shall direct the Fire Alarm Center to initiate off-shift calling procedures as outlined in Plan "G" of the Telephone Register.

b. When the second fireboat is to be manned, the Fire Alarm Center will dispatch one of the following companies to the location where the second fireboat is berthed. Engines 11, 6, 8 or 21 will be dispatched to provide a crew for the boat.

c. If a Unit #99 incident requires a multiple alarm response, multiple alarm companies shall respond as directed by the Fire Alarm Center.

d. During significant marine incidents, the Fire Alarm Center shall call Department members listed in Plan "E" of the Telephone Register.

e. For vessels underway or at anchor a full response and Unit 99 will be dispatched to Station 5 (Haz-Mat) companies excluded unless indicated. The first line fireboat will await arrival of the response and the loading of equipment on "Marine Equipment List A."

f. Second alarm companies shall respond to Station 5 or designated reserve area, possibly Pier 36 and secure equipment on "Marine Equipment List B."

*g. When dispatched to pier fires, E36 will request that the Water Department dispatch a truck and compressor to the incident site. At night or if the Water Department is unable to rapidly dispatch unit, E36 will travel to the Water Department Headquarters and pick up a truck and compressor unit in the yard. Water Department equipment will always respond code yellow.

5.3 Tactics

Tactics

a. The first arriving Chief or Acting Chief Officer shall establish a command post, reserve area, staging area, and initiate steps outlined in the Marine Incident commanders Checklist (see Appendix).

b. Primary Tactics/First Engine

(1) Position apparatus so as not to block additional fire apparatus access.

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- (2) Board vessel with masks, pump can, 200' of 1 1/2" or 1 3/4" hose and determine the exact location of the fire and extinguish incipient stage fires.
- (3) Provide Incident Commander with a full report.
- (4) Determine the material burning.
- (5) Evacuate the immediate area.
- (6) Close doors and shut down ventilation systems for confinement if applicable.
- (7) Determine the status of ships fixed fire protection systems.
- (8) Locate responsible ship's representatives.
- (9) Locate the ship's fire control and general arrangements plans (if available).

NOTE: Use caution when accessing areas subject to CO₂ flooding. Rapid reignition or dispersal of CO₂ gas may occur.

c. Primary Tactics/Second Engine Company

- (1) Place a manifold at the location designated by the Incident Commander or near the boarding ramp and extend supply/attack lines.

d. Primary Tactics/First Ladder Company

- (1) Ladder the vessel (if no boarding ramp) and take equipment aboard as directed by the Incident Commander.

- e. The Fireboat Pilot/Officer will monitor the marine radio frequency and relay additional information to responding units and standby as directed by the Incident Commander.

5.4

Staging

- a. The Incident Commander shall assign a Staging Area Commander and assign an adequate number of companies to move equipment to and from the vessel.
- b. The Staging Area Commander is responsible to coordinate all activities in the staging area and for requesting additional resources from the Incident Commander. The Staging Area Commander shall maintain a minimum of two companies in reserve for each company fighting the fire.
- c. The Staging Area Commander shall establish the following areas and functions:

- (1) Designate a Director/Recorder: An Officer/Fire Fighter responsible for briefing and directing companies to specific areas and recording times companies arrive at the staging area from the reserve area.
- (2) Designate Air Supply Coordinator and Area: An Officer/Fire Fighter responsible for the air supply

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area and for the segregation of full and empty air bottles and keeping the Staging Area Commander informed of air status.

- (3) Designate Equipment Coordinator and Area: An Officer/Fire Fighter responsible for establishing a equipment area as identified in equipment lists "A" and "B".
- (4) Designate a First Aid Area: An area used for the emergency care of Fire Fighters leaving the fire area. Paramedics dispatched on the initial Unit #99 response will normally report to this area.
- (5) Designate a Rest Area: An area to receive crews, rotated from the fire area.
- (6) Designate a Standby Area: An area for crews waiting for assignment located near or at the fire fighting area to allow for quick relief at the nozzle or work area.
- (7) Designate a Sound Powered Phone Operator: A Unit #99 team member responsible for establishing hard wire phone communication between the Incident Commander and Sector/Area Commanders.

d. Company Officers Responsibilities Upon Arrival from Reserve Area to the Staging Area:

- (1) Report to the staging area and notify the Director/Recorder of your unit designator and strength.
- (2) Deposit equipment/air cylinders in designated area.
- (3) Keep your unit together at all times unless specifically ordered otherwise by the Sector/Area Commander.

e. Company Officers Responsibilities Upon Arrival from Fire Area to Staging Area:

- (1) Check status of individual company members for possible heat exhaustion, burns and injuries.
- (2) Notify the Director/Recorder of your unit designator.
- (3) Replace air cylinders and report to rest area.
- (4) Keep your crew together at all times unless specifically ordered otherwise by the Sector/Area Commander.

5.5 Off Shift Calling:

- a. When necessary, selective off shift calling procedures shall be used to insure that supervisory personnel, trained in marine problems, are available when requested. These supervisory personnel will include the Chief Officers of Battalion 7 and the Company Officers and Fire Fighters of Engine 4 and Engine 38.

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6.0 APPENDIX:

- 6.1 Communication at Ship Fires.
- 6.2 Vessel Construction Considerations.
- 6.3 Vessel Stability Considerations.
- 6.4 Marine Fire Suppression and Protection Systems.
- 6.5 Typical Tanker Vessel Plan.
- 6.6 Typical Cargo Vessel Plan.
- 6.7 Marine Equipment List A and B.
- 6.8 Marine Incident Commanders Checklist.
- 6.9 Marine Use of CO₂.
- 6.10 Memorandum of Understanding.

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6.1 Communication at Ship Fires.

- *a. Fire Department Radios: Ship fire response personnel shall use P-2-B; P-2 will be reserved for the Incident commander. In the event that portable radios are unable to receive or transmit effectively within the ship, Company Officers must be prepared to establish other methods of communication.
- b. Portable Sound Powered Phone System: The Marine Response Unit (Unit 99) carries a sound powered phone system for use at ship fire incidents. This is a primary communication system and should be used to establish and maintain contact between the fire deck and the Command Post and/or Sector Command Post.
- c. Ships Sound Powered Phone System: This is an alternate emergency communications system found on military vessels, and some larger commercial vessels. The phones are generally located throughout the ship.
- d. Ships Portable Radios: Key crew members on most vessels have their own portable radio system. This system can be utilized as required.
- e. Ships Intercom: This is the most common communication system aboard ships. Stations are located throughout the vessel. Electricity must be available on board to power the system.
- f. Marine Radio: Limited to units with marine radios, such as fireboats and Coast Guard vessels.

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d.2 Vessel Construction Considerations.

- a. Fire fighting aboard ship is very difficult; ships are designed with very narrow passageways or companionways, and access up or down is limited to steep stairs or ladders. Passage through bulkheads and decks are limited to hatches and doors which in some instances are only large enough for one person to pass through at a time. These conditions make equipment and personnel movement through a ship extremely difficult.
- b. Ships are subdivided by water tight bulkheads with few, if any, access openings through them. These water tight bulkheads can be used as fire and flooding boundaries for confinement purposes.
- c. Openings in bulkheads on U.S.C.G. inspected vessels must be provided with a door rated for the application. Those doors are listed as follows:
1. A Class "A" door must prevent the passage of smoke and flame for 1 hour.
 2. A Class "B" door must prevent the passage of smoke and flame for 30 minutes.
 3. A Class "C" door must be non-combustible only and is not rated to hold back smoke and flames. A Class "C" door may be used anywhere that Class A or B bulkheads are not required.
- *d. Most ships are constructed of steel or other metals, which conduct heat very readily. In materials like aluminum or other alloys, the metal can burn through or contribute to the fire or cause early collapse. A fire in one compartment can conduct enough heat through the overhead deck or any of the four bulkheads to ignite combustibles on the other side. Investigation and exposure protection should be established as quickly as possible to prevent extension of fire.
- e. Air ducts, used for heating, ventilation and air conditioning, as well as wire runs, can allow heated gases and fire to travel to other areas of the ship.
- f. Ventilation of a fire must be well coordinated with the fire attack. Areas of exposure must also be protected along the ventilation route.
- g. Radio communications can be negatively affected by the steel construction of ships.
- h. Deck and frame numbers can be used to locate ship compartments. These numbers are uniform on all military vessels, with frame numbering starting from front to rear. Decks are numbered from the main deck in both directions with decks above the main deck being numbered 0-1, 0-2, 0-3, etc. Decks below the main deck are numbered 1, 2, 3, etc., as they travel down from the main deck toward the bottom of the vessel. On commercial vessels, the deck numbering system will vary from military vessels and in many cases the decks will be named rather than numbered. The frame numbering system will vary to almost any configuration. The ships fire fighting plan will be helpful in understanding how the vessel is numbered.

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d.3 Vessel Stability Considerations.

- a. Ships in Port: The stability of a ship in port can be compromised by a variety of factors, including ballast tank levels, access openings and unusual cargo loading. The Incident Commander, in consultation with the ships Officers, must evaluate these conditions and take corrective action as necessary.
- b. Fire Fighting Water: The introduction of large volumes of water can destabilize a ship, particularly if the water is introduced into large compartments high on the ship. Compartments that run from side to side are particularly vulnerable. This "free surface water" must be pumped out of the ship in a timely fashion, using the best means available.
- c. List Determination/Correction: Prior to corrective action, it is necessary to determine the cause of the list. If the list is caused primarily by free liquid settling to one side, attempts to counterweight will cause an even greater list in the other direction, and could even cause the ship to capsize. List correction shall not be initiated until the Incident Commander has consulted with the ship's Officer or other qualified professional.

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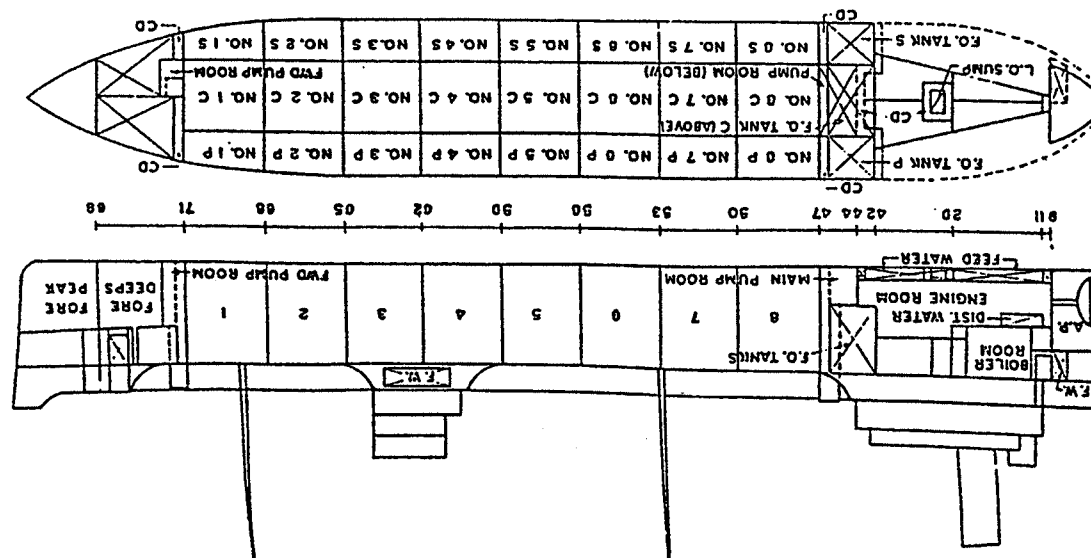
6.4 Marine Fire Suppression and Protection Systems.

- a. **CO₂ Systems:** The most common type of fire protection system found on ships. These systems are primarily used in engine rooms, special hazard areas and the main cargo holds. Unit 99 has the equipment to tie into onboard systems to supplement extinguishing agent in areas when the main system is empty.
- b. **Halon Systems:** Used in lieu of CO₂ on many new ships. These systems may be found in engine rooms and computer rooms; at this time halon is not used in large areas such as cargo holds due to its high cost.
- c. **Foam Systems:** Used primarily for flammable liquids, foam systems are available in a wide range of configurations. Manual stations are usually found near engine rooms, helicopter hangers and landing pads, and on the main decks of petroleum tankers. Since each ship will be different, it is important to access the foam system drawings found in the ship's fire fighting plans. In some military vessels the foam system is part of a dual agent extinguishing system where the foam is delivered to a nozzle that also delivers a dry chemical extinguishing agent. In the dual agent systems the nozzle operator can choose to use dry chemical or A.P.F.P. foam together or as a single agent to knock down and secure a fire.
- d. **Sprinkler System:** These are found on passenger ships and ferries. Sprinkler systems may also be incorporated with foam systems to protect aircraft hangers and cargo bays used to transport motor vehicles. In most cases sprinkler systems are deluge type systems that are part of the fire main system and must be manually started.
- e. **Ships Fire Main:** The fire main provides water for fire fighting handlines and special systems. In most cases, the fire main utilizes a closed loop system with isolation valves and cross piping. Hose stations will usually be found every 100 feet in all living areas. The main is supplied by the ship's fire pump and can be externally supplied with the use of a ship-to-shore connection. Before pumping the ship's fire main, the ship's engineering officer should be consulted to assure that there are no open valves/piping and that the proper pressures are used. On U.S. Government vessels, the 2 1/2" hose connection is compatible with Fire Department hose. On 1 1/2" connections, a special adaptor is needed. The 1 1/2" adaptor is available on Engine 4 or Engine 36. On foreign vessels Seattle Fire Department couplings may not be compatible with the couplings on the fire main.
- f. **International Shore Connection:** Is a universal maritime connector that can be used to supply a ship's fire main from Fire Department pumps. Available on Unit 99 companies and many waterfront companies.
- g. **Fire Alarm System:** Similar to on land alarm systems. The components of alarm systems may include smoke detectors, manual pull stations, and heat detectors, which are found throughout living quarters and interior work areas. Heat detectors may be especially helpful to the Incident Commander in the determination of fire spread.

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6.7 Marine Equipment List A and B.

Equipment List A

First Two Engine Companies

- 1. SCBA and spare bottles for each member.
- 2. One 1 1/2" Marauder nozzle each company.
- 3. 200' 1 1/2" or 1 3/4" hose each company.
- 4. One foam eductor each company.

Ladder Company

- 1. SCBA and spare bottles for each member.
- 2. Lead in lines (two "Way-out 100's").
- 3. One electric generator.
- 4. One electric fan.
- 5. All available fan socks.
- 6. One cord reel.
- 7. One gas fan.
- 8. 6 plastic tarps.
- 9. 6 canvas tarps.

Engine 36

- 1. SCBA and spare bottles for each member.
- 2. 5 hand lanterns.

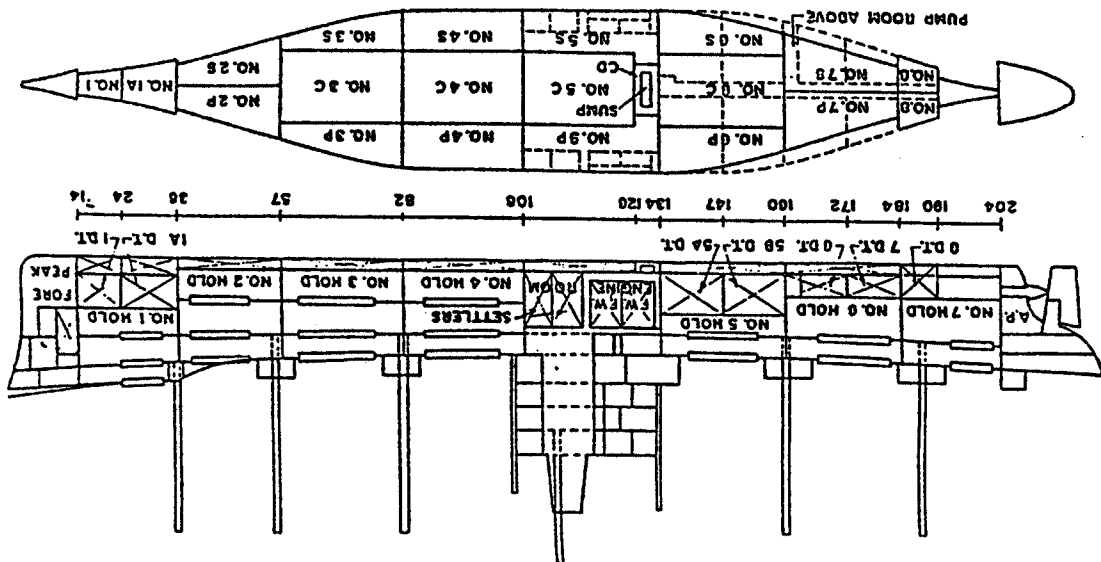
Unit 99

- 1. Life vests.
- 2. A pre-fire of the vessel if available.
- 3. Instrument box.
- 4. Advisor kit.
- 5. Line gun.
- 6. 2 dewatering eductors.
- 7. Red Devil electric fan and socks.

Station 5

- 1. Hand truck.
- 2. Life jackets for all members.

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Appendix 6.6 Typical Cargo Vessel Plan

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6.7 Marine Equipment List A and B.

Equipment List B

1. Survivair masks for all responders.
2. All spare air bottles on responding units.
3. Hose as requested.
4. One electric generator.
5. Light strings.
6. Extension cords.
7. Cord reel.
8. Rescue saw.
9. Chain saw.
10. Ten tarps.
11. One electric fan.
12. One gas fan.

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6.8 Marine Incident Commanders Checklist.

1. Request a Unit 99 response.
 - a. Utilize Unit 99 van with pre-fire books on most ships. Incident Commanders advisors kit which contains technical manuals, and worksheets for command post, fire boundaries, dewatering, CO₂ application, exposure protection, etc.
2. All portables switch to F-28.
3. Designate command post location.
4. Initiate priority tactics.
 - a. Determine location and type of fire.
 - b. Initiate search and rescue.
 - c. Extinguish incipient stage fire.
 - d. Establish fire boundaries.
 - e. Contact responsible ships party.
 - f. Locate ship plans.
5. Initiate secondary tactics.
 - a. Determine initial fire boundaries.
 - b. Designate location of manifold.
 - c. Provide access to the main deck at two separate locations.
 - d. Establish a reserve area.
 - e. Request multiple alarm if necessary.
 - f. Initiate confinement actions.
 - (1) Close all access to the involved space, doors, hatches, etc.
 - (2) Protect exposures on six sides.
 - g. Close all ventilation systems serving the space.
 - h. Set up sound powered phone system for below deck operations.
 - i. Establish a staging area and appoint a Staging Area Commander.
 - *j. Notify U.S. Coast Guard Captain of the Port, and request Coast Guard on scene Coordinating Office.
 - k. Monitor dewatering prior to noticeable list.

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6.8 Marine Incident Commanders Checklist. (continued)

1. Determine location of hazardous materials.
- m. Determine types, quantities and locations of fuel on vessel.
- n. Request the services of a marine chemist.
- o. Obtain predictions of weather and tidal actions.
- p. Establish a first aid area.
- q. Protect environment as needed.
- r. Order bulk carbon dioxide, after consultation with vessel owner or agent to confirm their financial responsibility.
- s. Order additional foam as needed.
- t. Order via vessel owner or agent or appropriate agency any specialized services such as translators, tugs, barges, cranes, etc.
- u. Review the Marine Information Checklist and Memorandum of Understanding for U.S. Navy vessels, both carried on the Unit 99 van.
- v. Obtain additional data on ship; i.e., ship's manifest, vessel pre-fire plans, etc.
- w. Notify appropriate agencies such as Metro, Port of Seattle Police, DOB, EPA, etc.

6.9 Marine Use of CO₂.

1. When to use CO₂
 - a. Poor access
 - b. Undue risk to Fire Fighters
 - c. Water damage intolerable
 - d. On-board CO₂ has been exhausted
2. Do not use CO₂ on
 - a. Oxidizers
 - b. Nitrates
 - c. Sulphates
 - d. Explosives
3. Ordering CO₂
 - a. Obtain permission from ship's agent or other responsible party.
 - b. Confer with chemist and verify private payment of material used.
 - c. Only the Incident Commander will authorize CO₂
 - d. For local supply, notify Liquid Carbonic, Mike Johnson at 631-5763 or 955-2085.
4. CO₂ Application
 - a. Amount (Area = Length x Width x Height)

$$\frac{\text{cu. ft.}}{9} = \text{Pounds of CO}_2 \text{ for 60\% concentration}$$
 - b. Provide electrical ground lines. Flow of CO₂ will cause a build-up of static electricity.
 - c. Plastic tarps can be used to seal off air leaks to confine CO₂ to problem area.
 - d. Monitor and protect adjacent spaces for fire extension.
 - e. Monitor CO₂ concentration and temperature change. Use CO₂ monitoring worksheet in Advisors Kit.

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8.10 Memorandum of Understanding.

Between the
Seattle Fire Department
and

Commanding Officer, U.S.S. _____

Date _____

This memorandum of understanding outlines the policy of the Seattle Fire Department with regard to fire fighting operations aboard Naval Vessels while under construction, conversion, or repair in the City of Seattle.

1. All accidental or hostile fires should be immediately reported to the Fire Department by dialing 911. This procedure should be followed regardless of the size of the fire, and whether or not the fire has been extinguished. Failure to report such fires is a violation of Section 11.301 of the Uniform Fire Code.
2. The Seattle Fire Department fully recognizes that Naval Vessels are Federal property and that the Commanding Officer is responsible for what takes place on his ship and has authority to carry out that responsibility. Additionally, the Fire Department will not board the vessel against the wishes of the Commanding Officer or his designated representative (Command Duty Officer).
3. If, in the opinion of the Seattle Fire Department Officer in Charge and the Naval Officer in Charge, it is necessary to commit Fire Department manpower and equipment, such manpower and equipment shall remain under the command of Seattle Fire Department Officers. Members of the U.S. Navy shall be under the command of their own Officers.
4. If the Fire Department's assistance is necessary, the first arriving Fire Officer should immediately be briefed concerning location and status of the fire and will request to be escorted to the fire location to make an assessment of the amount of equipment and manpower that should be committed to combat the fire.
5. The Fire Department shall work in a spirit of cooperation with the crew of the vessel in order to extinguish the fire. However, should a disagreement regarding fire fighting operations occur between the Fire Officer in Charge and the Naval Officer in Charge, and such disagreement cannot be immediately resolved, the Seattle Fire Officer in Charge shall withdraw Fire Department personnel and equipment to the pier, and prevent extension of fire from the vessel.

J. Claude Harris
Chief of Fire Department

Commanding Officer,
U.S.S. _____

Enclosure (1)

Appendix E

Marine Unit Training Courses and Equipment List

COURSES

INTRODUCTION TO MARINE FIRE PROTECTION

This session introduces the student to the subject of marine fire protection and describes the course of training to be given. It includes a general discussion of existing problems and provides a limited amount of statistical data regarding marine fires. This data includes which types of vessels have the most fires, where the fires generally start aboard ship, and subjects of a similar nature.

LEGAL CONSIDERATIONS OF MARINE FIRES

During a fire aboard ship, the authority and responsibility of the various agencies involved may differ substantially from those incidents involving shoreside fires. In addition, personnel from several agencies may be required to work cooperatively to extinguish the fire.

This class outlines the responsibility of various agencies that may become involved with a ship fire in port. It discusses the principles of comparative negligence, outlines problems which have been encountered at past fires, and suggest ways to avoid similar problems in the future. The primary objective is to familiarize the student with the responsibility and authority of those agencies that may be involved in marine firefighting operations. (The information presented is based on U.S. Law and Regulations.)

MARINE DRAWINGS

It is rare for emergency response personnel to be intimately familiar with the particular vessel on fire. It is important for the Firefighter to be able to quickly and correctly read basic marine drawings. While merchant seamen will be generally familiar with several classes of vessels, most will not have worked extensively with marine drawings.

This segment of training provides the basic skills needed to read general arrangement booklets, fire control plans, and similar documents. The skill to read such drawings is valuable during firefighting operations in order to improve understanding of the spaces which may have to be entered, and to better explain the general arrangement to shoreside personnel who may not be familiar with the vessel.

FOAM OPERATIONS

This is a more advanced class limited to the discussion of firefighting foam. The objective of this session is to acquaint the student with types of firefighting foams available, and those in common use aboard ship. Students are trained in the characteristics of each foam, their compatibility with each other, and the equipment available for its application. Students will be shown how to calculate application rates for various size fires involving different flammable liquids.

VESSEL CONSTRUCTION AND ARRANGEMENT

This session discusses the major components of breakbulk cargo vessels, their construction and arrangement. The class begins the process of making the student familiar with the shipboard environment, and prepares him/her for additional training to come.

EMERGENCY MOORING

This session is designed to familiarize students with typical mooring and anchoring system components in use aboard ship. The primary objective is to discuss emergency procedures which can be used to move a vessel under fire conditions.

VESSEL STABILITY IN FIREFIGHTING

Failure to have a proper appreciation for the vessel's stability has brought several firefighting efforts to an unsuccessful conclusion. The objective of this segment is to acquaint the student with the basic principles of vessel stability. It discusses the forces which affect stability and how firefighting can cause those forces to change. The class discusses basic terms, and presents steps which can be taken to improve the stability of a vessel under emergency conditions.

INTRODUCTION TO DAMAGE CONTROL

Not all of the incidents requiring emergency response personnel are the result of fire. In some cases, emergencies may involve uncontrolled flooding of the vessel due to equipment failure or structural damage. In other cases, uncontrolled flooding may be a part of the fire problem. This class introduces the student to procedures for the control of progressive flooding, and dewatering of vessels.

MARINE FIRE PROTECTION COURSES

There are numerous examples of ship fires where a major problem was the failure to use the fire protection systems built into the vessel. One reason for this has been the lack of knowledge on the part of firefighters and crew members of the system's capabilities and correct operating procedures. In many cases, this has made firefighting much more difficult and dangerous than it needed to be.

This session provides the student with information on several types of systems commonly found aboard ship. The segment discusses alarm, detection, confinement, and extinguishing systems. Emphasis is placed on the general operating procedures, and the advantages and limitations of each system discussed.

MARINE FIRE TACTICS

This session on Marine Fire Tactics includes training on how to size up the fire, gather data, and identify resources needed for successful extinguishment. This class discusses the establishment of fire boundaries and methods of direct and indirect extinguishment. Various methods of hoseline extinguishment are discussed along with the advantages and disadvantages of each. The class also discusses when to use the vessel's built-in fire protection systems, as well as when to supplement them.

COMMAND POST OPERATIONS

For a ship fire to be fought successfully, there must be a combined and coordinated effort, often involving several agencies. This session presents the students with information on the purpose of a Command Post. How and where to establish one aboard the vessel, who should be in the Command Post, and what jobs they should accomplish. The class also presents information on which documents should be in the Command Post, and communications and record keeping procedures.

PORT EMERGENCY PLANNING

This segment of training presents the student with information relating to preparation of port emergency plans. It discusses the roles of various agencies involved, locating needed equipment, and other factors to consider in the preparation of such plans. The objective is to encourage students to develop emergency plans for their own port.

INSTRUMENT OPERATIONS

Students are introduced to the operation of various instruments available to assist in the extinguishment of ship fires. The course discusses the operating features of various instruments, their advantages, and disadvantages. Students are taught basic techniques which can be used to obtain readings and how to interpret the readings.

TACTICAL WORKSHOP

In this classroom segment, the students are divided into groups of five to eight persons. Each group is made up of representatives from each category attending the training (port authority, fire service, ships crew, Coast Guard). Each group is given a separate fire problem to solve using the information presented in the class to date. Students are provided with various documents to assist in completing the exercise. Each group chooses a spokesperson who presents the group's solution to the rest of the class. The class as a whole is asked to critique each group's solution.

BULK CO₂ APPLICATION

This session compliments the session on instruments, and prepares the student for the field application of CO₂ aboard a training vessel. The class discusses procedures to follow when applying the CO₂ in bulk from tank trucks, including predischARGE preparation, grounding, sealing, ventilation, and testing readings.

BULK CO₂ DRILL

This session constitutes the field application portion of the previous segments of instrument operation, and bulk CO₂ application. The session requires the use of a vessel available for training, and involves the use of a bulk CO₂ tank truck. Students are required to extinguish a simulated Class A fire in the cargo hold by actually applying CO₂. Students will set up for application, apply the CO₂, obtain test readings, vent the CO₂, and assure the compartment is safe for personnel. Final testing must be conducted under the supervision of a certified Marine Chemist.

MARINE RESPONSE EQUIPMENT LIST

CO₂ Equipment

- a. Drager Multi-gas Detector Instrument
Measures the concentration of CO₂ from 5% to 60%
- b. 2, CO₂ nozzles (3') (4')
Attached at end of CO₂ hose
- c. 2, "C" clamps
For securing nozzles
- d. 2 safety chains
Securing nozzles where clamps won't work
- e. 300' CO₂ hose
To connect bulk supply to vessel
- f. 1, CO₂ MANIFOLD
To connect CO₂ hose to bulk tanker truck
- g. 1 box assorted threaded pipe fittings
Used in connecting various-sized fittings
- h. Assorted opened-end wrenches
Connecting CO₂ hose
- i. 1 large safety cable
Safety feature where CO₂ hose connects to bulk tanker truck
- j. 6 small safety cables
Safety feature for CO₂ hose connection to each other
- k. 1 grounding wire
For grounding CO₂ nozzle
- l. 4 rolls teflon tape
To seal threads at CO₂ hose connections

Measuring And Monitoring Equipment

- a. Drager Multi-gas Detector Instrument
To measure levels of CO₂, flammable and toxic gases
- b. Assorted sampling tubes
Used with the Drager Instrument as noted above
- c. 1 Explosimeter
To measure flammable vapor levels
- d. 1 Pyrometer
Taking temperature readings

- e. Assorted lengths of thermocouple wires
Used with Pyrometer to take readings at remote sites
- f. 3 heavy-duty magnets
For securing thermocouple wires
- g. 1 GasTechtor
Used to measure content of oxygen and flammable vapors
- h. 50' GasTechtor sampling lines
To take remote readings

Communications Equipment

- a. 4 sound power head phones
For telephone system that operate without electricity
- b. 1 amplifier for sound power phones
- c. 1 junction box
- d. 3, 200' wire reels and 2, 500' wire reels
For sound power phone communications at remote locations
- e. 1 portable radio
- f. 1 bull horn
Alternate communication method

Dewatering Equipment

- a. 1 gasoline portable trash pump (360 gpm)
For dewatering operations
- b. 1, 240 volt Prosser Pump (300 gpm)
For dewatering operations
- c. 4 educators with 3 ½" male couplings
For dewatering operations
- d. 1 dewatering syphon
For dewatering operations

Tools

- a. Tool box with: hacksaw, diagonal cutters, vise grips, channel locks, tinsnips, metal and wood chisels, screwdrivers, sparkplug wrench, tape measure, acetylene cutting tip, open-end wrenches
- b. 1, 36" pipe wrench
For ship piping, etc.
- c. 1, SCBA powered impact wrench
For ship hatches, etc.
- d. 1 Slice portable oxygen cutting torch
For cutting holes in steel bulkhead and decks.

Ventilation Equipment

- a. 2 “Coppus” Vano fans with 200 feet of electrical extension cord
Used to provide ventilation aboard vessels
- b. 220 feet of flexible exhaust tubing
Used with fans for smoke removal or providing fresh air

Breathing Equipment

- a. 4 MSA Hip-Air Masks
For confine space enter and rescue
- b. 900 feet of supply air hose
To supply the Hip-Air Masks
- c. 1 regular manifold
To control air pressure and supply to Hip-Air Masks.

Advisors Kit

- a. 1 camera for pictures
- b. 2 calculators
- c. 1 tide book
- d. Spare batteries and film
- e. List of contact people and telephone numbers used during emergency operation
- f. 1 hazardous materials guidebook
- g. 2 pocket tape recorders
- h. Incident Command Packets, includes check-off lists for: bulk CO₂ operations, CO₂ guidelines, temperature readings form CO₂ charts and tables, command post, fire boundary check list, exposure check list, dewatering check list, miscellaneous NFPA booklets.

Miscellaneous Equipment

- a. 3 cargo nets to haul aboard equipment
- b. 10 assorted sizes wood plugs for plugging small fuel leaks, etc.
- c. 1 gas can with fuel for portable trash pump
- d. 1 line gun for providing lines from one vessel to another
- e. Assorted size tie ropes for securing equipment, etc.
- f. 6 boxes duct seal for securing small fuel leaks, etc.
- g. 5 fog applicators
- h. 1 city and State map

- i. 1 ship to shore connection for supplying water from shore to ship's system
- j. 8 bulldozers for pier protection
- k. 100 feet of air line hose for pneumatic jack hammer operations at pier fires
- l. 1 first aid kit
- m. Assorted pre-fire books: shows layout of various types of vessels and ship extinguishing systems, etc.
- n. 6 utility straps for securing hose and equipment
- o. 6 life vests for safety (manufactured especially for fire fighters)
- p. 2 rolls plastic for sealing ship prior to CO₂ application
- q. 2, 6-foot by 6-foot wood blocks for propping open watertight doors when hose lines pass through
- r. 1 penetrating nozzle used to extinguish fires in baled cargo, etc.
- s. Low Expansion Foam Nozzle (9 to 1)
- t. Medium Expansion Foam Nozzle (65 to 1)
- u. 4, head lamps (miner type) with chargers
- v. 1 hand truck

Appendix F

Draft Regulations for Welding and Cutting on Marine Vessels

3-1-92**No. 49.101.1**

SEATTLE FIRE DEPARTMENT INSPECTION GUIDELINE

SUBJECT: WELDING AND CUTTING ON MARINE VESSELS**FIRE CODE REFERENCE: SFC ARTICLE 49****ADDITIONAL REFERENCE: NFPA 306**

A. PERMITS:

SCOPE: These regulations shall become effective on May 1, 1992. The regulations apply to operations involving the use of oxygen/fuel gas mixtures or electric arc welding on marine vessels within the Corporate Limits of the City of Seattle. The regulations apply regardless of the size of the vessel and regardless of whether or not the vessel is at anchor, moored, in drydock, or ashore.

GENERAL DEFINITIONS:

For the purpose of these regulations, the following words have the meanings set forth below.

| | |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Adjacent Spaces: | Those spaces in all directions from the subject space, including all points of contact, corners, diagonals, decks, tank tops, and bulkheads. |
| Confined Space: | Any compartment of small size and limited access such as double bottom tank, cofferdam, or similar space which by virtue of its small size and confined nature can create or aggravate a hazardous condition. |
| Class 1 | A pier, designated by the Chief, which by virtue of its construction, location, fire protection and fire hydrant availability, is suitable to permit certain repairs to vessels which are over 200 feet in length. |
| Class 2 Designated Facility: | A pier, designated by the chief, which by virtue of its construction, location, fire protection and fire hydrant availability, is suitable to permit certain repairs to vessels which are up to 200 feet in length. |
| Designated Facilities: | Those piers, designated by the chief, and by virtue of their construction, location, fire protection and fire hydrant availability, are suitable to permit certain repairs to vessels. |
| Enclosed Space: | Any space, other than a confined space, which is enclosed by a bulkhead and overhead. The term includes cargo holds, tanks, quarters, and machinery spaces. |

| | |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fire Watch: | A person designated by the supervisor of the welding operation to watch for signs of fire. Such persons shall be familiar with fire department permit conditions, the area where the welding and cutting is to take place, and procedures for sounding an alarm in the event of fire. |
| Gangway: | A ramp-like or stair-like means of access provided to enable personnel to board or leave a vessel including accommodation ladders, gangplanks, and brows. A gangway shall have a walking surface not less than 20 inches wide, be of adequate strength, maintained in good repair and safely secured. Each side of a gangway, and turntable if used, shall have a railing with a minimum height of 33 inches, with a mid-rail. Rails constructed of rope or chain shall be kept taught at all times. |
| Intervening Barrier: | Means a barrier which is an integral part of the vessel's structure, which when closed, will not permit the passage of flammable liquids or vapors. The length of the vessel as measured along the centerline. |
| Length of Vessel: | The length of the vessel as measured along the centerline. |
| Major Conversion: | Means a conversion that - <ol style="list-style-type: none">1. Substantially changes the dimensions or carrying capacity of the vessel;2. Changes the type of the vessel;3. Substantially prolongs the life of the vessel; or4. Otherwise so changes the vessel that it is essentially a new vessel as determined by the chief. In making such determinations, the chief may consult with the U.S. Coast Guard Officer in Charge of Marine Inspection, Puget Sound. |
| Marine Chemist: | The holder of a valid Certificate issued by the National Fire Protection Association in accordance with the "Rules for the Certification of Marine Chemists." |
| Powder Actuated Device: | Means a tool or machine which drives a stud, pin, bolt, or other type of fastener by means of an explosive charge. |
| Ship Repair: | Means any repair of a vessel including, but not limited to alterations, modification, conversion, installations, cleaning, painting, and maintenance work and includes ship building and ship breaking. |
| Vessel: | Includes every description of watercraft or other artificial contrivance used as a means of transportation on water, including special purpose floating structures not primarily designed for or used as a means of transportation on water. |

Shipyard Competent Person: Is an individual, registered with OSHA meeting one or more of the following requirements:

1. The holder of a valid Certificate issued by the National Fire Protection Association attesting that the holder has successfully completed a course of training as a Shipyard Competent Person.
2. The holder of a Certificate from the Seattle Fire Department attesting that the holder has successfully passed the Seattle Fire Department's Certification Examination for Shipyard Competent Person.
3. The holder of a Certificate attesting that the holder has successfully passed a course of instruction in Shipyard Competent Person training which is accepted by the chief.

PERMIT CONDITIONS:

Permit Classifications:

Fire Department Permits for Welding and Cutting on Marine Vessels shall be divided into three categories.

- Level I:** Those permits for welding and cutting operations which are minor in nature. (See below for further definition)
- Level II:** Those permits for welding and cutting operations which exceed the limits of a Level I permit but do not involve a major conversion of the vessel. (See below for further definition)
- Level III:** Those permits for welding and cutting which involve a major conversion of the vessel. (See below for further definition)

GENERAL CONDITIONS RELATING TO ALL WELDING AND CUTTING ABOARD VESSELS:

Permits Required:

A permit shall be obtained from the fire department prior to the commencement of any welding and cutting operations aboard any marine vessel.

A copy of the Fire Department Permit shall be displayed at the foot of the gangway or in such other location where it is readily visible from the pier or dock. The permit shall be displayed in such a manner as to be protected from the effects of weather.

Violation of Permit Conditions:

Violation of permit conditions shall be cause for immediate revocation of the Fire Department Welding and Cutting Permit. Permits which are revoked shall only be re-issued in accordance with the following schedule:

| | |
|---------------------------|------------------------------------------------------------------------------------------------------------------|
| First Revocation: | Permits shall not be re-issued for a period of 24 hours and shall require the payment of a new permit fee. |
| Second Revocation: | Permits shall not be re-issued for a period of 5 working days and shall require the payment of a new permit fee. |
| Third Revocation: | Permits shall not be re-issued for a period of 30 days and shall require the payment of a new permit fee. |

Notification of the Fire Department:

A means shall be provided to rapidly contact the fire department in the event of an emergency. Such means shall be available within 200 feet of the work site.

Preparations for Closure of the Vessel:

Prior to the commencement of repairs, arrangements shall be made to close the vessel as soon as possible in the event of fire. Closure time shall not exceed 30 minutes. Such arrangements shall not require the use of ship's power to make the closures. Such closures shall be sufficient to ensure the efficient use of carbon dioxide (CO₂) to extinguish the fire.

If it is not possible to prepare the vessel to be closed within 30 minutes, the person applying for the permit shall have cranes and crane operators **available within 60 minutes** whenever work is being performed. Such cranes must be capable of lifting not less than 10,000 pounds with a boom of sufficient length to reach the outboard side of the largest vessel at the pier.

EXCEPTION: During the construction of new vessels, when no combustible materials are present.

Gangways Required:

Gangways shall be provided for access to vessels in accordance with the following schedule:

1. Vessels less than 200 feet in length - One (1) gangway.
2. Vessels 200 feet or more in length - Two (2) gangways.

EXCEPTION: Gangways are not required for vessels whose size or design permit boarders to step directly aboard from the dock and where the vessel is moored in such a way to prevent falling between the vessel and the dock during periods of poor visibility.

Prohibited Activity

The following activities are prohibited during welding and cutting operations:

Fuel transfer operations aboard the vessel on which the welding is to take place or aboard any other vessel located within 100 feet in any direction.

Transfer, loading or unloading of hazardous materials shall take place in accordance with the following requirements:

1. Welding and cutting shall not occur within 200 feet of a transfer of flammable liquids or gases by means of a hoseline.
2. Welding and cutting shall not occur within 100 feet of a transfer of combustible liquids by means of a hoseline.

EXCEPTION: Welding and cutting shall not take place within 50 feet of the transfer of Class IIIB Combustible liquids by means of a hoseline.

3. Other transfers shall not occur within 50 feet of welding and cutting operations unless an intervening barrier exists and is fully closed during the welding and cutting operation.
4. Other transfers shall not occur within 100 feet of welding and cutting operations when no intervening barrier exists or if an existing barrier cannot be fully closed.

Spray painting or the application of other flammable compounds unless sufficient ventilation is provided to maintain the atmosphere at not more than 10 percent of the lower explosive limit for the particular material being applied as determined by a marine chemist or shipyard competent person. Monitoring of such areas shall be carried out by a shipyard competent person.

Fire Watches:

Whenever welding and cutting operations are taking place above or within ten (10) feet of combustible material, a responsible individual shall be appointed as fire watch and shall be on duty continuously during such operations. If during any hot work operation there will be a transmission of heat through a bulkhead, or above or below a deck where any such work is being done, a fire watch shall be maintained on both sides of the deck or bulkhead.

Such persons **shall have no other duties** other than to watch for fire. Fire watches shall remain on duty for not less than 30 minutes after welding and cutting operations are completed.

Welders and cutters may **not** serve as their own fire watch.

Persons appointed as fire watch may be a member of the vessel's crew or other person designated by the individual in charge of the work.

Persons appointed as fire watch shall read and sign a copy of the fire department permit conditions indicating that he or she understands them.

Fire Extinguishing Devices Required:

One or more fire extinguishers with a rating of not less than 2-A 40-BC shall be kept at the location where welding and cutting is being done. Extinguishers aboard the vessel which are protecting hazardous areas (such as galleys and engine rooms) may not be used for this purpose.

A firehose of not less than 3/4 inch diameter shall be laid out and charged in the vicinity of welding and cutting operations. Such hose shall be of sufficient length to reach all areas within the compartment or space being worked on.

Additional 1-1/2 inch fire hoses shall be available in the immediate area. Such hoses are not required to be charged. See below for special requirements involving combustible insulation.

Special Safeguards Relating to Combustible Insulation:

When it is necessary to cut or weld on an area which is covered with combustible insulation, such insulation shall be removed in accordance with the following requirements:

1. Remove foam 36 inches in all directions, and clean all foam bits and pieces from the area prior to starting welding and cutting. The remainder of exposed combustible insulation to be wet down or covered with wet tarps or other suitable materials for a distance of not less than five (5) feet past the most distant point where sparks or slag will fly or fall.

Alternate: Remove foam 12 inches in all directions and coat exposed edges with No Char or equivalent substance. Clean all bits and pieces of foam from the area prior to start of welding or cutting. The remainder of exposed combustible insulation to be wet down or covered with wet tarps or other suitable materials for a distance of not less than five (5) feet past the most distant point where sparks or slag will fly or fall.

2. An 1-1/2 inch fire hose shall be immediately available in areas where welding and cutting is being done on combustible insulation other than polyurethane foam insulation.
3. When welding and cutting is being performed in areas where poly-urethane foam insulation is present, one fire hose not less than 1-1/2 inch in diameter shall be laid out and charged in the vicinity of welding and cutting operations. One other uncharged 1-1/2 inch hoseline shall be immediately available. Such hose shall be of sufficient length to reach all areas within the compartment or space being worked on and/or into immediately adjacent spaces.
4. Fire watch to remain 30 minutes past completion of welding and cutting.
5. Any sign of fire will result in an immediate call to the Fire Department 9-1-1 number.
6. When welding on an area that has combustible insulation sprayed on the other side it will be permitted to leave the insulation in place if the following conditions are met:
 - a. Use a shipyard competent person as a fire watch and maintain the fire watch one hour past work completion.
 - b. One charged 1-1/2 inch hoseline shall be available in the area of the combustible insulation. One uncharged line shall be immediately available. Such hose shall be of sufficient length to reach all areas within the compartment or space being worked on and/or into immediately adjacent spaces.
 - c. The weld will be made in small sections, cooled with water, and then another small section welded, cooled, etc.
 - d. Any oil contaminated foam will either be removed completely or removed back to clean foam prior to welding.
 - e. Any sign of fire will result in an immediate call to the Fire Department 9-1-1 number.

Removal and/or Relocation of Materials:

The following materials must be removed from or relocated within the vessel if welding and cutting operations are to be performed at any location where the risk of rapid fire spread is high and the materials are so arranged that they cannot be adequately cooled by Fire Department hoselines

in the event of a serious fire without entering the hull or superstructure. Areas where the risk of fire is deemed to be high include, but are not limited to:

1. Compartments insulated with poly-urethane foam.
2. Compartments which contain highly combustible interior finishes.

The following materials must be removed from the vessel prior to welding and cutting operations in high risk areas:

1. Compressed gas cylinders except those needed for welding and cutting.
2. Drums of flammable and combustible liquids.
3. Explosives.

The following materials must be relocated within the vessel prior to welding or cutting in high risk areas.

1. Flammable refrigerant gases shall be pumped back into the main receiver(s) of the system.

Ventilation:

Forced draft exhaust ventilation of adequate capacity to remove welding and cutting vapors and any accumulation of flammable vapor shall be installed prior to performing any work in an enclosed or confined space.

Fuel Cylinders and Hoses:

All cylinders or containers used for the storage of compressed gases shall be constructed, charged and marked in accordance with Nationally recognized safe practices. [1988 SFC 49.101(b)]

Cylinders shall be stored in locations where they are not subject to excessive rise in temperature, mechanical injury, or tampering. All cylinders (including empty ones) shall have their caps in place and all valves tightly closed. [1988 SFC 49.104(b)]

Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials (especially oil and grease) by not less than 20 feet.

Cylinders, valves, regulators, hose and other apparatus and fittings shall be kept free of oil or grease of any type. Such devices shall not be handled with greasy or oily hands, gloves or other greasy/oily materials.

All compressed gas cylinders, including those in use, shall be adequately secured to prevent falling or being knocked over. [1988 SFC 49.104(c)]

Hose lines shall be inspected frequently for leaks, burns, torn or worn areas, loose connections or other defects which may render the hose unfit for service. Defective lengths of hose shall be discarded. [1988 SFC 49.106(e)]

Oxygen and fuel gas cylinders shall be placed far enough away from the welding or cutting operation to ensure that they will not be unduly heated by radiation from heated materials, sparks or slag, or by misdirection of the torch flame.

All torches and hose shall be disconnected from the cylinders at the end of work and shall not be left below deck or in confined spaces.

Fuel gas cylinders shall not be placed below the main deck, in confined spaces, or under overhanging decks where flammable gases which are lighter than air may accumulate.

Fuel Gas Manifolds:

Shall bear the name of the substance they contain in letters at least 1 inch high which shall be either painted on the manifold or located on a sign attached to the manifold.

Shall be placed in a safe and accessible location in the open air. They shall not be located within enclosed or confined spaces.

Shall have hose connections, including both ends of the supply hose that leads to the manifold, of a type that will prevent the hose from being interchanged between the fuel gas and oxygen manifold and supply header connections. Hose connections shall be kept free of grease and oil.

When not in use, manifold and header hose connections shall be capped.

Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.

Other Precautions Against Fire:

Flammable or combustible liquids may not be stored within 50 feet of welding and cutting operations. Combustible materials shall not be located within 25 feet of welding and cutting operations. (Including the opposite side of surfaces on which welding or cutting is being performed.)

Welding and cutting shall not be done in or near compartments or spaces where flammable liquids or vapors, lint, or loose combustible stocks are so located or arranged that sparks or hot metal from the welding or cutting operation may cause ignition or explosion of such materials.

When welding or cutting must be done above or within 10 feet of combustible construction or material, or above a place where workers are employed, or where persons are likely to pass, non-combustible shields shall be interposed to protect such materials or persons from sparks and hot metal or oxide.

Inspection Required (Applies to Level II and Level III Welding and Cutting):

For Level II and Level III welding and cutting, regular inspections shall be made by a Shipyard Competent Person during the entire repair period to note and eliminate fire hazards and to implement work procedures to keep such hazards to a minimum.

The types and amounts of fuel oils and other flammable or combustible liquids in all cargo, bunker, deep, settler and double bottom tanks shall be determined. Such determination shall include associated piping systems.

The information obtained from such inspections shall be distributed to the department or individual responsible for fire safety of vessels while under repair. Such information shall be readily available to the fire department in the event of a fire.

Prior to the commencement of welding and cutting operations, an inspection shall be made of the area in which the work is to occur to assure that:

1. The work to be performed is not prohibited for Level II welding and cutting.
2. Prohibited activity is not taking place elsewhere on the vessel. (See the section entitled Prohibited Activity.)
3. The area is safe for the welding and cutting to take place and Fire Department Permit Conditions are being complied with.

Such inspection shall be made by the shipyard competent person or a certified marine chemist. Such inspections shall include the opposite sides of bulkheads or decks on which welding or cutting operations are to be performed.

Tests for Flammable Vapors and Gases (Applies to Level II and Level III Welding and Cutting):

The permissible level of concentration of flammable vapors or gases shall not exceed ten percent (10%) of the lower explosive limit in all parts of the spaces in which welding and cutting is to be performed.

Pipe lines which may convey hazardous substances into the spaces which have been certified as "Safe For Men - Safe For Fire" shall be disconnected or blanked off, or other positive means shall be taken to prevent the discharge of hazardous substances from entering the space.

Manholes and other closures which were secured at the time of tests shall remain secured. If it is necessary to open secured spaces or to manipulate any valves which may tend to alter conditions, welding and cutting operations shall stop and not resume until further tests have certified the space is "Safe for Men - Safe for Fire."

SPECIAL CONDITIONS RELATING TO LEVEL I WELDING AND CUTTING:

Definition:

Level I welding and cutting is work which involves repairs or modifications which are minor in nature and which **do not involve any** cutting or welding on or near hazardous areas of the vessel.

Level I Permit Application and Renewal:

Permits for Level I welding and cutting shall be issued for a period not to exceed fourteen (14) calendar days. At the time of application the person applying for the permit may indicate their intent to apply for an extension of the permit at the end of that period.

Permits for which an extension will be requested shall be placed on a special inspection schedule by the Fire Marshal's Office. Such inspections shall be random and unannounced.

Extensions may be granted only to those applicants who are found to be in full compliance with the conditions of their permit during the special inspection. Permit fees for extension of existing permits shall be 50% of the fee for a new permit.

Level I Limitations:

Level I welding and cutting must not require the use of more than one cutting torch or one welding machine.

Level I welding and cutting must not involve work on hazardous areas or compartments of the vessel. Such hazardous areas include, but are not limited to:

1. Fuel systems (including tanks and piping and compartments adjacent to such tanks and piping).
2. Compartments which are insulated with combustible or flammable insulation, including insulation which has a fire resistive barrier installed over the surface.
3. Engine rooms.
4. Cargo or storage areas which contain or have contained hazardous materials (including flammable liquids and gases or combustible liquids).
5. Work on surfaces directly adjacent to those compartments listed above (i.e., The opposite side of an insulated space which might expose the insulation to heat).

Examples of Level I welding and cutting include work on:

1. Standing rigging
2. Replacement of cleats and pad eyes
3. Work involving deck machinery
4. Similar repairs or modifications

Authorized Locations:

Level I welding and cutting may be performed at the vessel's normal berth.

EXCEPTION: Level I welding and cutting shall not be performed at fuel terminals, passenger terminals, or terminals or piers at which the use is primarily residential or recreational in nature.

Vessel's Fire Protection Systems:

During welding and cutting operations all of the vessel's fire protection systems shall remain in service.

Inspection Required:

Prior to the commencement of welding and cutting operations, an inspection shall be made of the area in which the work is to occur. Such inspection shall be made **by the person in charge of the repairs** or modifications and shall assure that:

1. The work to be performed does not involve an area of the vessel prohibited for Level I welding and cutting.
2. Prohibited activity is not taking place elsewhere on the vessel.

3. The area is safe for the welding and cutting to take place.

Such inspections shall include the opposite sides of bulkheads, overheads or decks on which welding or cutting operations are to be performed.

SPECIAL CONDITIONS RELATING TO LEVEL II WELDING AND CUTTING:

Definition:

Level II welding and cutting includes that work which exceeds the limits of Level I welding and cutting but is less than a major conversion of the vessel or that work which involves welding or cutting on or near areas of the vessel which are hazardous in nature.

Such hazardous areas include:

1. Fuel systems (including tanks and piping and compartments adjacent to such tanks and piping).
2. Compartments which are insulated with combustible or flammable insulation.
3. Engine rooms.
4. Cargo or storage areas which contain or have contained hazardous materials (including flammable liquids and gases or combustible liquids).
5. Work on surfaces directly adjacent to those compartments listed above (i.e., The opposite side of an insulated space which might expose the insulation to heat).

Level II Permit Application and Renewal:

Permits for Level II welding and cutting shall be issued for a period not to exceed 30 calendar days. At the time of application, the person applying for the permit may indicate their intent to apply for an extension of the permit at the end of that period. Permits for which an extension will be requested shall be placed on a special inspection schedule by the Fire Marshal's Office. Such inspections shall be random and unannounced.

Extensions may be granted only to those applicants who are found to be in full compliance with the conditions of their permit during the special inspection. Permit fees for extension of existing permits shall be 50 percent of the fee for a new permit.

Authorized Locations:

Level II welding and cutting may only be performed at designated marine facilities.

Designated facilities shall be divided into classes and shall comply with the following requirements:

Class I Facilities:

1. Repairs, other than major conversions, may be performed on vessels of any length.
2. Such facilities must have a valid facility permit from the fire department for welding and cutting operations to take place.

3. Shall have not less than two (2) fire hydrants one of which is located within 500 feet of the vessel under repair, each capable of delivering not less than 2,000 gallons per minute. Additional hydrants capable of delivering 2,000 gallons per minute shall be required for each 100 feet of vessel length for vessels over 300 feet in length up to a maximum of 5 hydrants. Such hydrants shall be so located that two-company hose lays by the fire department are not required to reach them in the event of fire.
4. Be equipped with fire lanes not less than 20 feet wide and shall be capable of supporting a 50,000 pound vehicle or 30,000 pounds per axle. Such fire lanes shall be so located to provide vehicle access to within 75 feet of the vessel.

EXCEPTION: This requirement may be waived where the facility is so arranged that the fire department will not be delayed in the deployment of equipment.

Class II Facilities:

1. Repairs, other than major conversions, may be performed on vessels less than 200 feet in length.
2. Such facilities must have a valid facility permit from the Fire Department for welding and cutting operations to take place.
3. Shall have not less than two (2) fire hydrants one of which is located within 500 feet of the vessel under repair, each capable of delivering not less than 2,000 gallons per minute.

Prohibited Locations:

*Level II welding and cutting permits **shall not** be issued for the following piers and terminals:*

1. Combustible piers which are not equipped with automatic sprinklers.
2. Combustible piers which are not equipped with firefighting standpipes or hydrants.
3. Fuel Terminals.
4. Passenger Terminals
5. Piers where use is primarily residential or recreational in nature.
6. Piers or any type where a welding and cutting facility permit was not issued from the fire department.

Vessel's Fire Protection Systems:

During welding and cutting operations, all of the vessel's fire protection systems shall remain in service.

Special Personnel Required:

Depending on the exact nature of the work, Level II welding and cutting must be performed under the supervision of an NFPA Certified Marine Chemist or a full-time employee with responsibility for safety, or both. Full-time safety persons shall meet the requirements for Shipyard Competent Person.

Examples of Level II welding and cutting include:

Removal or replacement of major components of the vessel's propulsion system. Replacement of deck houses or other large structural components. Replacement of hull or deck plating.

SPECIAL CONDITIONS RELATING TO LEVEL III WELDING AND CUTTING:

Definition:

Level III welding and cutting is that work which involves a major conversion or work which will place a major portion of one or more of the vessel's fire protection systems out of service.

Authorized Locations:

Level III repairs may only be performed in a shipyard.

Vessel's Fire Protection Systems:

Whenever welding and cutting operations are to occur, the vessel's fire protection systems shall remain in service or other steps shall be taken to provide a level of fire protection equivalent to the protection provided by the vessel's systems. Such alternate measures shall meet the approval of the chief.

Special Personnel Required:

Level III welding and cutting must be performed under the supervision of an NFPA Certified Marine Chemist or a full-time employee with responsibility for safety. Full-time safety persons shall meet the requirements for Shipyard Competent Person.

CONDITIONS RELATING TO BOTH LEVEL I AND LEVEL II WELDING AND CUTTING:

Duties of Shipyard Competent Persons (Applies to Level II and Level III Welding and Cutting):

For Level II and Level III welding and cutting operations Shipyard Competent Persons shall:

1. Be continuously on duty at the job site during the time work is being performed.
2. Personally make such inspections and tests as are necessary to assure that the area in which the work is to be performed is safe for welding and cutting. Such inspections and tests shall be performed prior to the commencement of welding and cutting operations.
3. Make frequent inspections of those areas in which welding and cutting operations are being performed to assure that hazardous conditions have not developed.
4. Personally make an additional inspection at the end of each work shift or upon completion of the work, whichever comes first, in order to assure that conditions are safe and no fire will start in the area.
5. Ensure that the conditions contained in any fire department permit are being complied with by those individuals performing welding and cutting operations.

6. Ensure that any conditions contained in a Marine Chemist Certificate are being complied with by those individuals performing welding and cutting operations.
7. Ensure that required ventilation is in place and operating correctly.
8. Stop the repair work if permit conditions are not complied with, or if unsafe conditions are discovered or develop during the repair job. Such repair work shall not resume until unsafe conditions have been eliminated.

Marine Chemist Certificate Required (Applies to Level II and Level III Welding and Cutting):

No person shall engage in hot work or the use of powder actuated fastening tools in or on the spaces listed below until a certificate setting forth that such work can be done safely is issued. Such certificates shall be valid only if they are issued by a Marine Chemist certified by the National Fire Protection Association (NFPA).

A Marine Chemist Certificate shall be required prior to welding and cutting operations on any vessel:

1. Within or on the boundaries of cargo tanks which have been used to carry combustible or flammable liquids and/or gases, or within spaces adjacent to such cargo tanks.
2. Within or on the boundaries of fuel tanks.
3. On pipe lines, heating coils, pumps, fittings, or other appurtenances connected to cargo tanks, fuel tanks or fuel systems.
4. Within the boundaries of engine rooms.
5. Within the boundary of any machinery compartment or space in which the machinery uses a flammable or combustible liquid or flammable gas in its operation.

Marine Chemist Certificates shall be issued in strict accordance with the requirements of NFPA 306 Standard for the Control of Gas Hazards on Vessels.

B. CODE:

C. APPLICABILITY:

D. OCCUPANCY REQUIREMENTS: N/A

E. GUIDELINES--OPERATIONS:

Appendix G

Ship Fire Timeline

Appendix G

Ship Fire Timeline

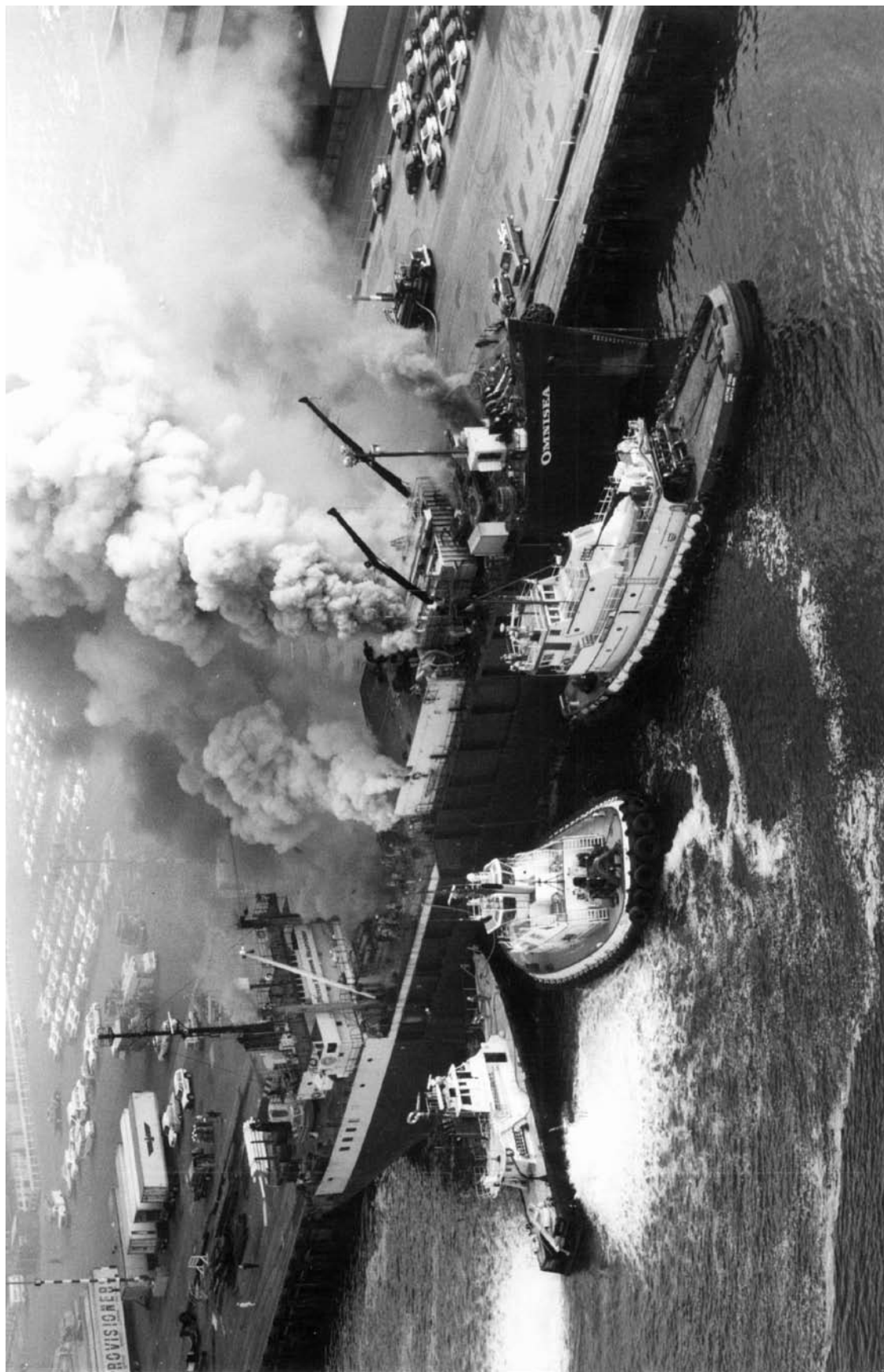
September 16, 1991

| | |
|----------|-----------------------------------------------------------------------------------------------------------------------|
| 09:30:00 | Crew takes coffee break |
| 09:39:00 | Fire reported to fire department. |
| | UNITS INITIALLY DISPATCHED |
| | E-20, E-41, E-8, E-2, E-9, L-4, L-6, B-4, B-1, U-99, Marine Response Team (E-36, E-4, B-7), Medic 10, Medic 16, Air 9 |
| 09:44:00 | First units on scene (E-20, E-41) |
| 09 45:00 | SECOND ALARM |
| | E-18, E-5, E-10, L-8, L-1, B-2 |
| 09:50:00 | Added: Air-26 |
| 10:02:00 | Added: Aid-5 |
| 10:08:00 | THIRD ALARM |
| | E-21, E-16, E-6, E-22, L-3, L-10, B-5 |
| 10:14:00 | Assistant Chief of Operations |
| 11:49:00 | Added: E-3 (Second Fireboat) |
| 12:07:00 | FOURTH ALARM |
| | E-35, E-24, E-17, E-25, L-7, L-11 |
| 12:11:00 | Added: B-55 (Off-shift BC) |
| 12:38:00 | Added: B-3 |
| 13:27:00 | Added: Aid 14 |
| 13:31:00 | Added: E-38, E-30, E-34, E-13 |
| 13:35:00 | Added: Aid 31 |
| 14:52:00 | Added: Medic 1 |
| 15:00:00 | Approximate time CO ₂ applied |
| 15:21:00 | Added: L-304 |
| 15:32:00 | Added: E-32 |
| 16:36:00 | Added: E-37 |
| 20:54:00 | Added: E-31, E-29, E-11, E-28 |
| 21:14:00 | Added: Foam 1, E-27 |

Units kept on scene two more days.

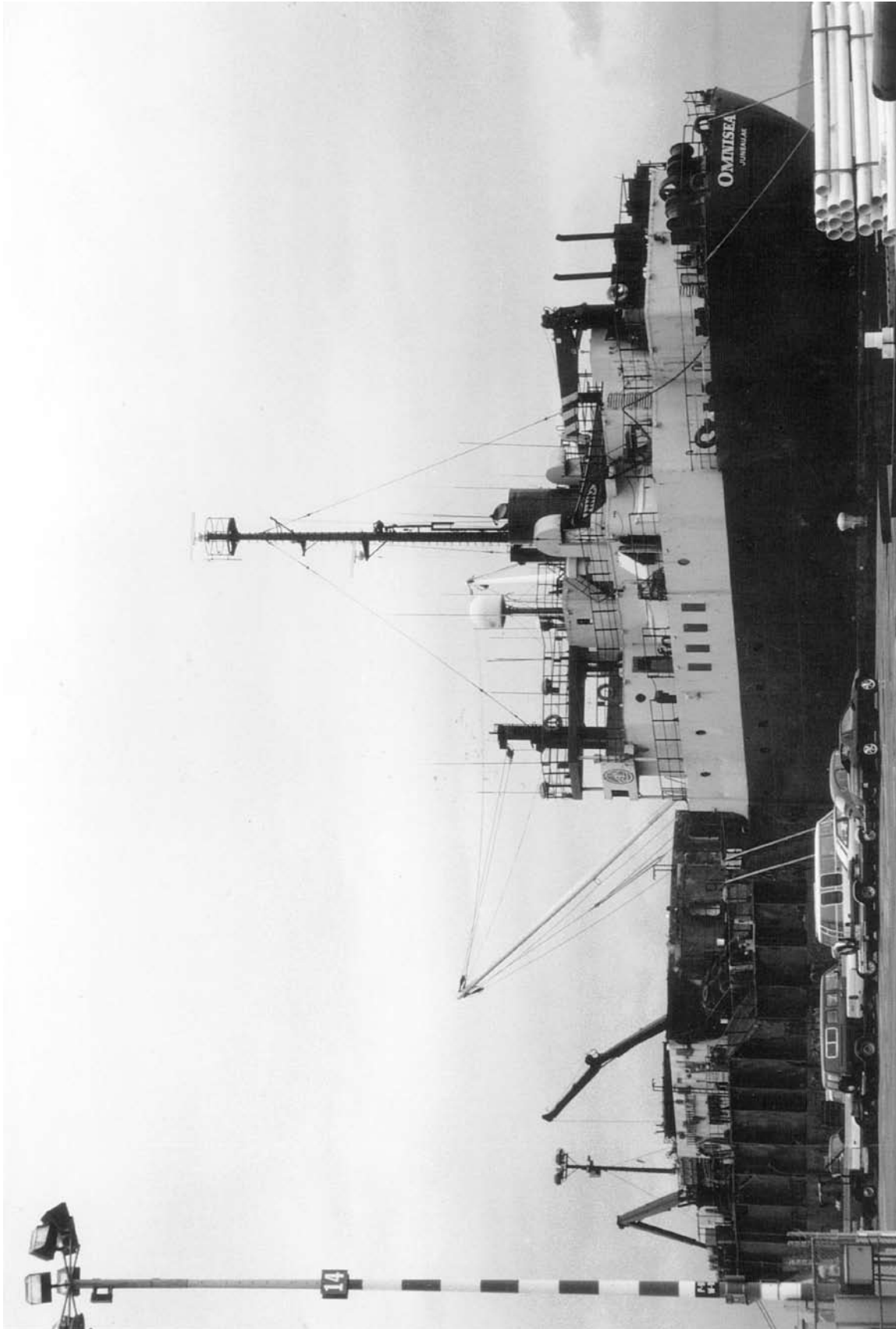
Appendix H

Photographs



(Photo by Benjamin Benschneider/Seattle Times)

A tug and two fireboats alongside the Omnisera during the fire.
Note at least nine firefighters visible on board on the starboard side amidships.



(Photo by Philip Schaeffer)

The Omnisea tied up to the pier as it was during the fire.



(Photo by Philip Schaeffer)

Drums of aviation gasoline and other petroleum products.



(Photo by Philip Schaenman)

View from superstructure looking aft. Fish receiving house on deck. Major columns of fire and smoke came up from tween deck through square hole in the center of the "house." Another hatch and that hold had to be sealed.



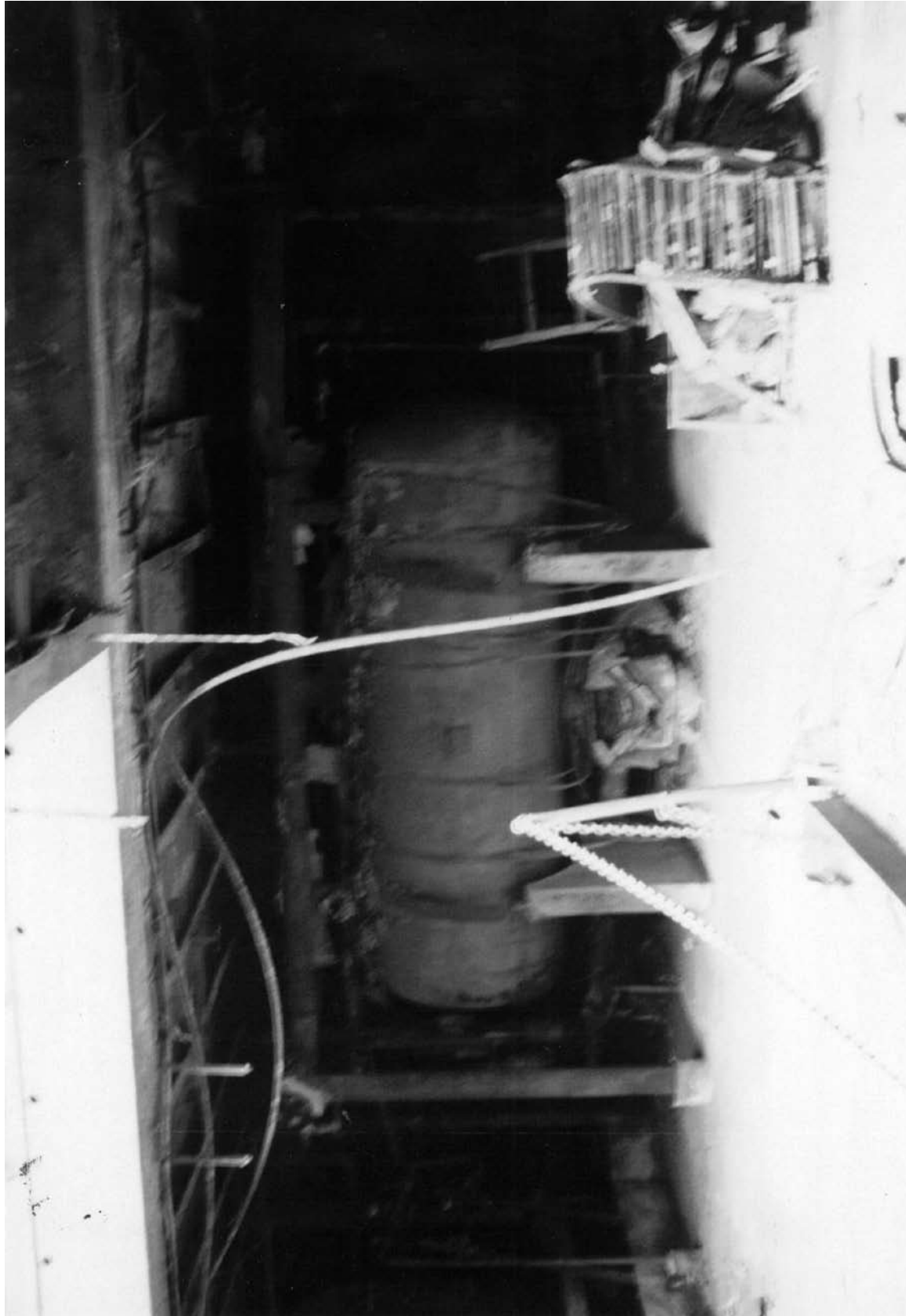
(Photo by Philip Schaeffer)

Looking across center of ship to nearby residential community.



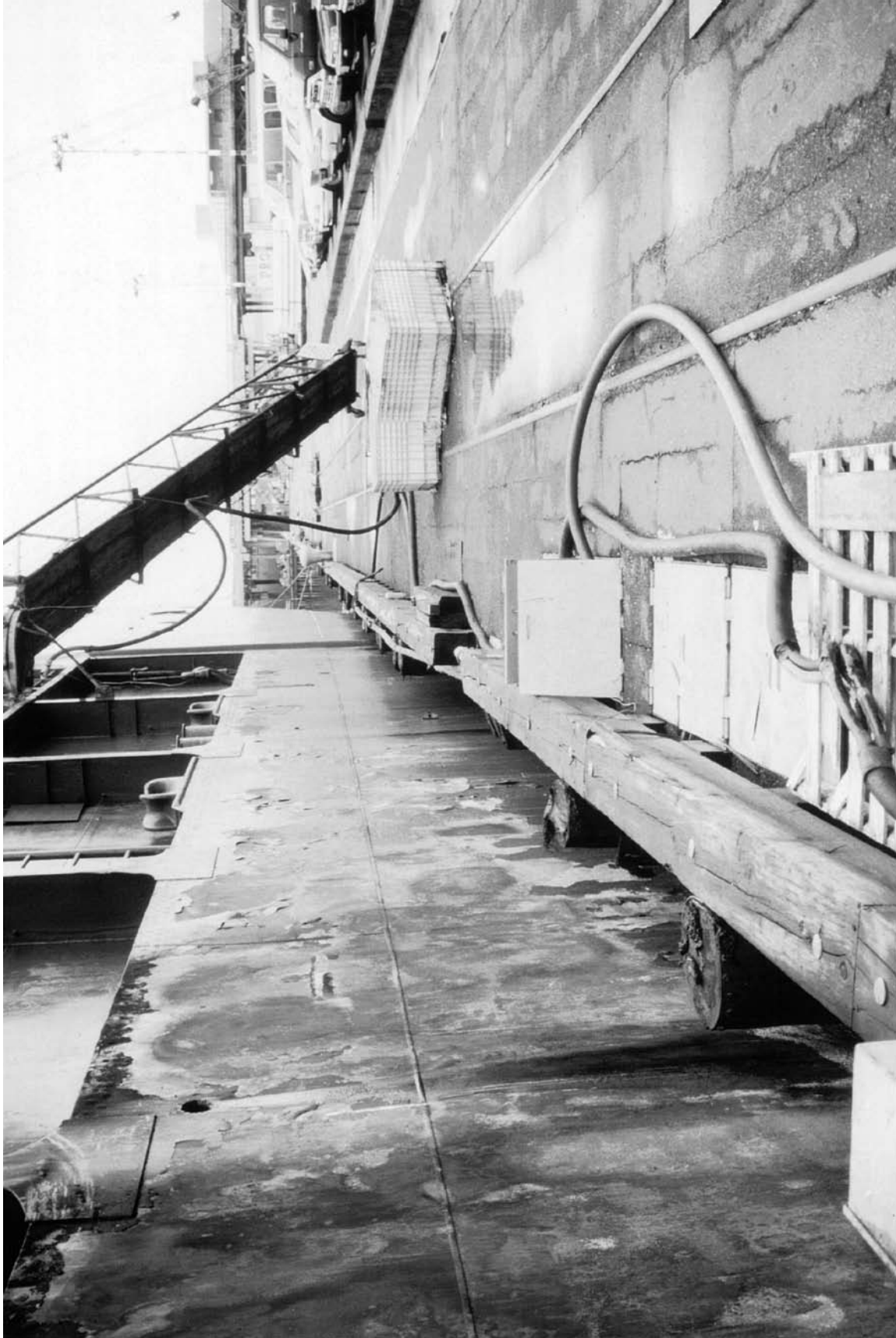
(Photo by Philip Schaenman)

Closeup of hole used to insert CO₂ with coupling welded into place.



(Photo by Philip Schaenman)

Ammonia tank in hold near fire origin.



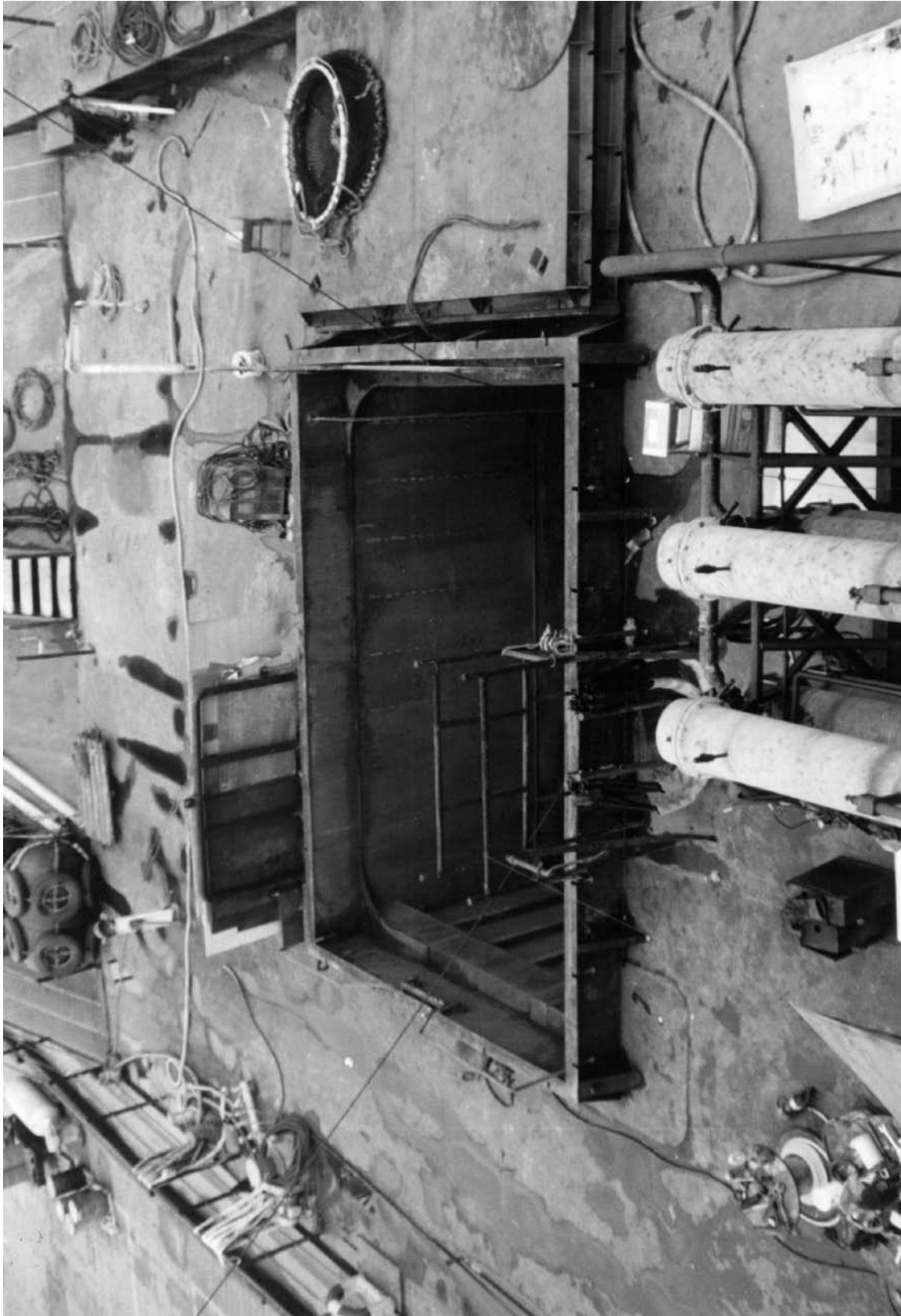
(Photo by Philip Schaeffer)

Port side – maximum discoloration near Hold #3; paint in good condition toward bow; note that the hull did not buckle.



(Photo by Philip Schaeffer)

Steel plate welded over porthole as part of buttoning up the ship prior to CO₂ insertion. Adjacent portholes were stuffed with materials to seal them. Note buckling of deck and railing from heat.



(Photo by Philip Schaefferman)

Hatch opening to holds; it, too, had to be sealed.



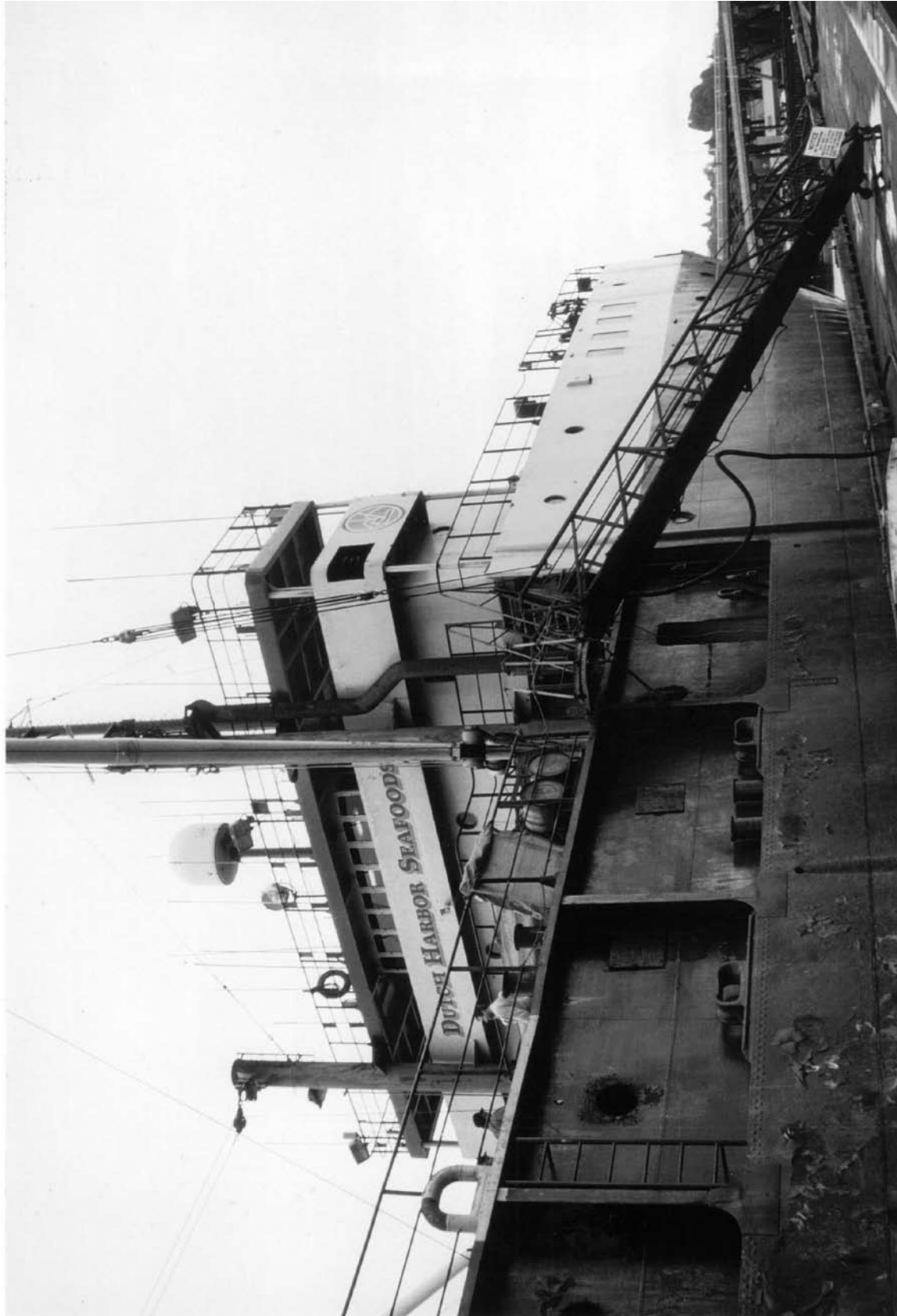
(Photo by Philip Schaeffer)

Bow of Omnisea. Note amount of compartments and equipment on deck – a complex area for firefighting.



(Photo by Philip Schaefferman)

Crane used to lift steel plates on board.



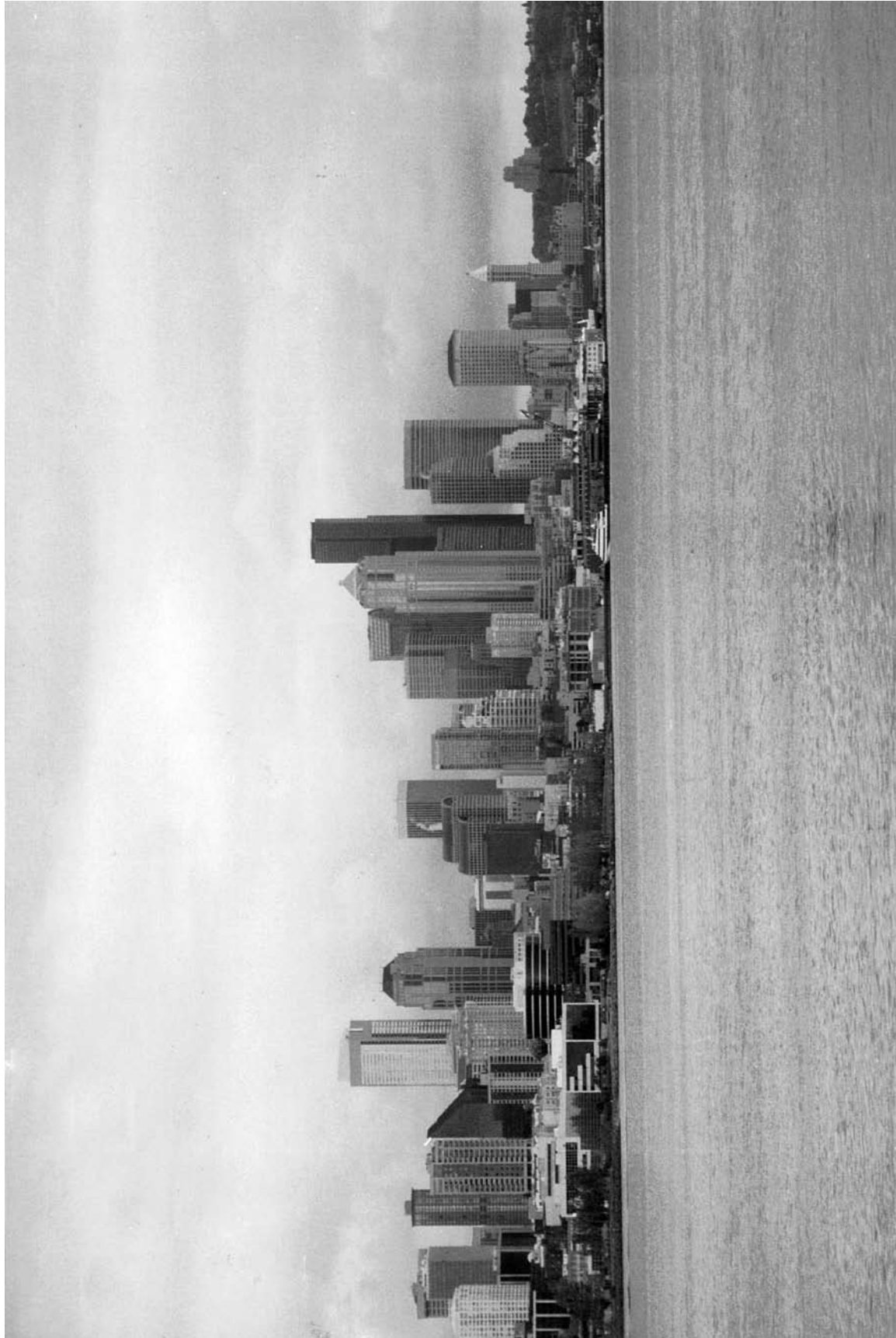
(Photo by Philip Schaeffer)

Aft third of the ship was saved, including ship controls, electronics, and engine room.



Bow end of ship.

(Photo by Philip Schaeffer)



(Photo by Philip Schaeffer)

Seattle harbor looking from pier where Omniseu was docked.