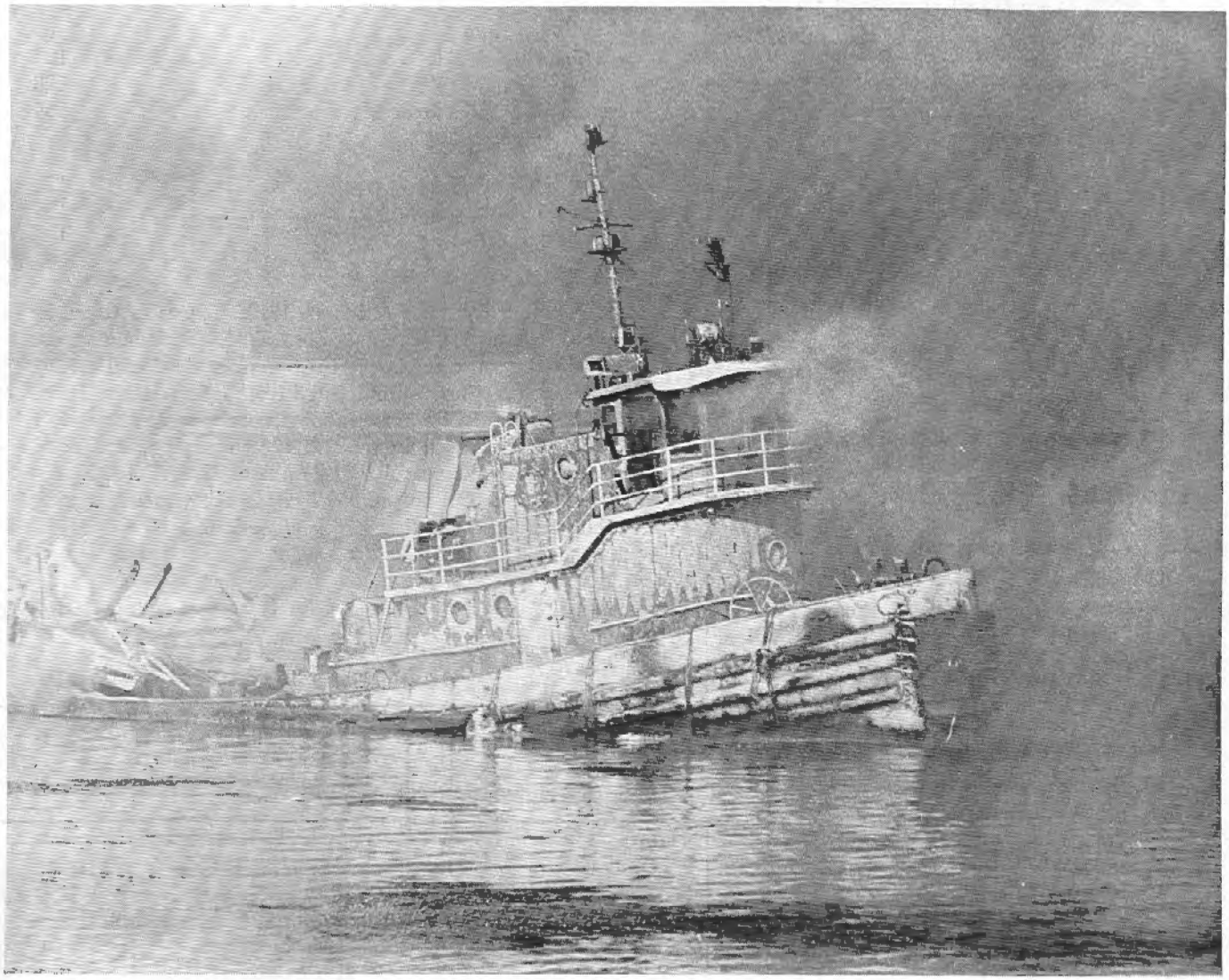
PROCEEDINGS
OF THE MARINE SAFETY COUNCIL



DEPARTMENT OF TRANSPORTATION UNITED STATES COAST GUARD

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PROCEEDINGS

OF THE MARINE SAFETY COUNCIL

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COVERS

The afternoon quiet of March 17, 1975, was shattered by a blast which left the tank barge ATC 3060 a sunken mass of twisted steel. The blast left two persons dead and several more seriously burned or injured from flying debris. Three towing vessels which were moored nearby were extensively damaged by the explosion and accompanying fire. Total property damage exceeded $1.2 million. The ATC 3060, engaged in the transportation of crude oil, was undergoing minor repairs at the time of the explosion.

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maritime sidelights

ICEBREAKERS

A research team from the Japanese Maritime Safety Agency and representatives from Japan's shipbuilding industry recently visited Coast Guard Headquarters to study our icebreakers. Briefings were provided in the areas of icebreaker design, construction, operations, and maintenance. While this group was in the United States, they also visited the USCGC *Westwind* and USCGC *Polar Star*. During their visit to the *Westwind*, icebreaking operations in the Straits of Mackinac were conducted. Comprehensive briefings on the construction of *Polar Star*, concepts of operation, and icebreaking techniques were provided by *Polar Star* personnel.

STEERING GEAR FAILURE

The Merchant Vessel Inspection Division of the Office of Merchant Marine Safety continues to receive reports of steering gear failures aboard U.S. merchant vessels. Two recent casualties serve to amplify the importance of thorough tests and inspections by ship's personnel.

In December 1975 a 20,000-gross-ton tankship suffered a failure of the port steering gear motor coupling while operational tests were being conducted during a Coast Guard inspection. Examination of the starboard steering gear motor coupling showed it to be worn and near failure. This casualty was attributed to improper installation of the couplings and lack of periodic lubrication.

In January 1976, a second 20,000-gross-ton tankship suffered a steering gear failure while underway. In this case the hydraulic pump sliding control shaft which controls the tilting box position broke off. The floating ring remained off center, causing the rudder to swing hard over to port crushing the ram guide stops on both sides. This failure was attributed to worn control link rod ends transmitting a vibration to the sliding control shaft which ultimately resulted in failure of the metal.

In order for tests and inspections to be effective, shipboard personnel must be thoroughly familiar with the equipment. Instruction manuals are the best source for determination of a system's design capabilities. Periodic examination by the ship's force must include operation and visual inspection of the entire system. Problem areas which have been discovered by, or reported to, the Coast Guard include the following:

(1) port and starboard steering cables, motors, and pumps;

(2) emergency pumps;

(3) bridge, local, and secondary controls;

(4) trick wheel and remote trick wheel;

(5) emergency power supply through both manual and automatic operation of a bus transfer system.

Remember that excessive oil leakage, abnormal hydraulic pressures, worn ram guides and linkages, unusual noise, vibration, and erratic or sluggish movements should be a cause for concern. Steering gear failures are like collisions; they can ruin your whole day.

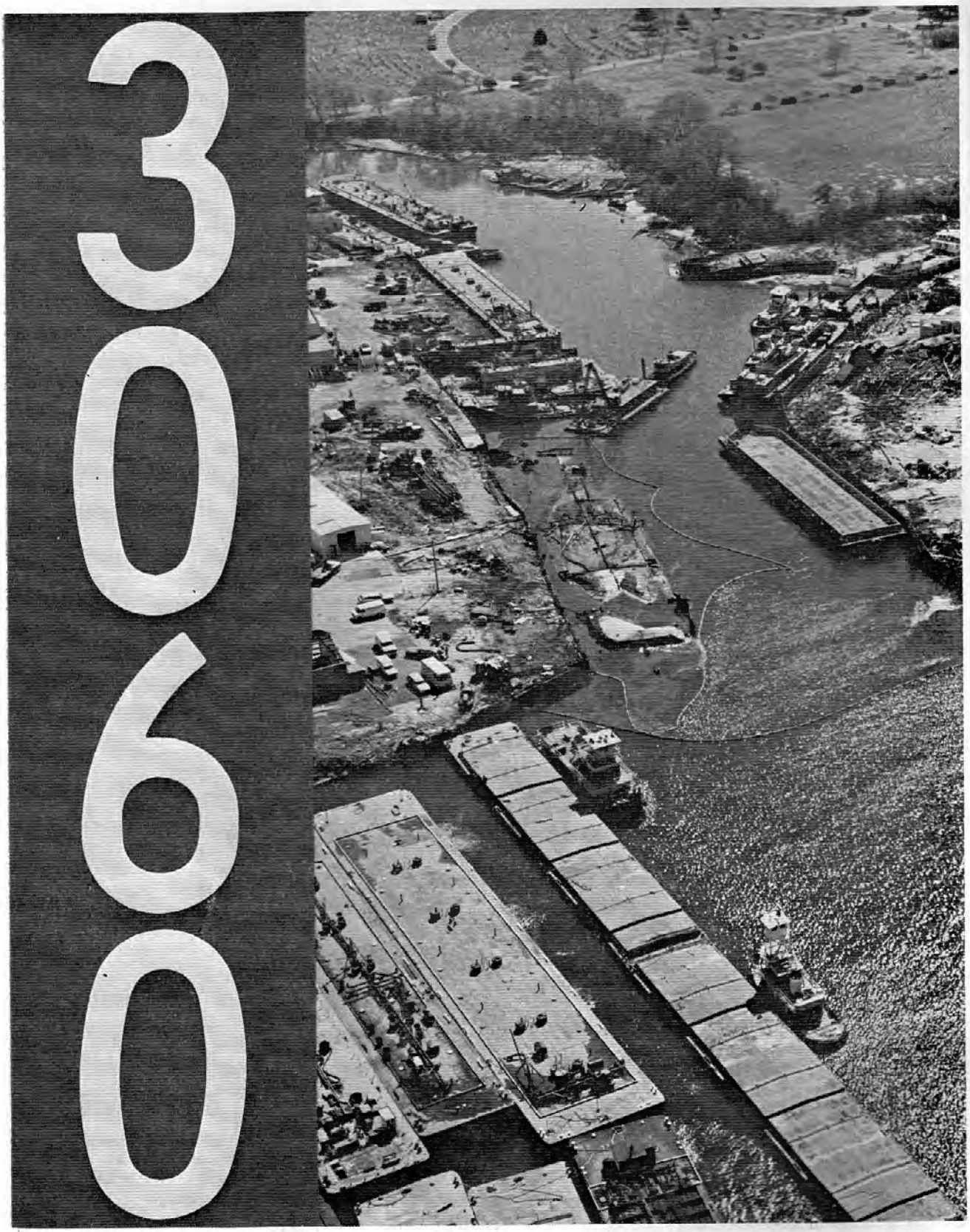
DAVITS . . . AGAIN!

Many mechanical lifeboat davits are presently in use aboard merchant vessels. Decades of use, lax maintenance programs, and layers of paint can result in latent weakness and increase the potential for tragedy. The Mechant Vessel Inspection Division at Coast Guard Headquarters recently reviewed a casualty report involving a sheathed screw davit pivot pin failure aboard a T2 tanker. This pin secured the davit arm to the deck and allowed davit rotation when the lifeboat was lowered. The pin sheared as the boat was being exercised, and the forward davit arm collapsed. Fortunately, there were no personnel injuries, but the whole situation could have been avoided by simply replacing the old pin by driving a new one into position. Casualty records reflect many davit failures due to component weaknesses which were not readily apparent. Worn davit arm pivot pins, wasted straps on fall blocks, and corroded foundation attachments require diligent inspection if their weaknesses are to be detected. Any doubt about the adequacy of davit components is justification for disassembly and thorough examination. The seaman's last line of defense cannot be allowed to become a hazard in itself. When was the last time the pivot pins were inspected or renewed on your vessel?

OPERATION FITZGERALD

The wreck of the SS *Edmund Fitzgerald* which sank with all hands on 10 November 1975 in Lake Superior was recently the scene of an underwater survey ordered by the Marine Board of Investigation using the CURV III (Cable-controlled Underwater Recovery Vehicle). It was used to scan the wreckage and produce video tapes and still photographs in an effort to assist the board in determining the cause of the casualty.

The operation was successful in documenting the condition of the vessel, although efforts were hampered somewhat by mud which was considerably softer than anticipated. The *Fitzgerald* was lying in two sections as previously determined by side-scanning sonar, but the stern section was inverted and there was more damage than expected. A report on the survey is under preparation and will be delivered to the Board shortly.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At 1527, 17 March 1975, while welding repairs were in progress on the tank barge ATC 3060 at the Allied Towing Corp., Norfolk, Va., the vessel exploded, burned, and sank. The welder and his helper, standing on a float between the barge and the dock, were killed. A fire watchman who was in No. 3 starboard tank at the time of the explosion and a laborer tending the welding machine on the dock were seriously burned. Two persons standing on a tug astern of the ATC 3060 suffered minor burns and injuries. Three employees within terminal buildings were injured by falling objects during the blast. The master of another tug in the vicinity suffered a heart attack during the incident. Three towing vessels moored at the Allied Towing Corp. facility were damaged extensively by fire and missiles. Damage to vessels and shore facilities was estimated at $1.2 million.

On 15 March 1975, the ATC 3060 was consigned to lighter a portion of the cargo from the Liberian-registry tankship SS *Amoco Yorktown* to the American Oil Co. Refinery Terminal at Yorktown, Va. Lightering began at 1930 hours and was completed at 0220 hours on 16 March 1975. A barge loading report showing ullages, total quantity of 27,462 barrels, loading times, and designation of the cargo as crude oil was verified by the tankerman and the shipboard representative.

The ATC 3060, in tow of the tug *Carville,* arrived at the Amoco Terminal at 0925 hours on 16 March 1975. Ullages were verified by a terminal representative and discharge of the crude oil cargo began at 0955. The cargo transfer was uneventful until 1450 hours when a sheen of oil was noted on the water in the vicinity of the barge. A check of the area around the barge by the terminal dockmaster and the tankerman revealed droplets of oil rising in the area of No. 3 starboard wing tank. The dockmaster notified the Marine Safety Office, Hampton Roads, concerning the pollution incident at 1510 and was advised that a pollution investigator was en route.

The Coast Guard investigator arrived on scene at about 1700 hours and discussed the oil sheen with the tankerman and the terminal representative. Although the barge was empty, small droplets which dissipated into a sheen were noted intermittently rising off the stern. The tankerman later expressed the opinion that the source of the oil sheen may have been the SS *Amoco Yorktown* which was moored across the pier. The investigator checked the area after the ATC 3060 left the dock but no further oil droplets or sheen were noted in the area where the barge had been moored.

The tankerman contacted the Allied Towing Corp. dispatcher and advised him of the suspected leakage and evidence of pollution. The dispatcher in turn called the vice president in charge of maintenance, and advised him of the reported leakage. Normally, Allied Towing Corp. assigns a port engineer and a shop supervisor to an around-the-clock watch of a week's duration to handle emergencies which arise after the yard closes. On this weekend the general forman and the dock labor supervisor were the assigned duty personnel. They, however, were involved in another assignment and could not be reached. At about 1515 it was decided that the barge should complete discharging to prevent further pollution and, since the vessel was scheduled to return to the Allied Terminal upon completion of discharge, the suspected leak would be taken care of after the barge arrived. The decision to continue offloading was relayed to the tankerman and the cargo discharge was completed at about 1610. The tanks were verified as empty of cargo by the terminal representative.

At 2230 on 16 March, the ATC 3060, in tow of the tug *Carville,* arrived at the Allied Towing Corp. dock on the Eastern Branch of the Elizabeth River at Norfolk. The barge was moored in the general fleeting area and was moved alongside the dock at about 1000 the next morning, docking starboard side to the dock.

When in normal service, the ATC 3060 was under the control of the operations department, but on the morning of 17 March it was turned over to the maintenance department.

In accordance with established company procedures, an assistant port engineer was assigned to supervise the repairs. The engineer was assigned about 0830 the morning of the 17th and was advised to conduct an air test to determine the source of the suspected leak. The tankerman said he thought there was no leak in the barge since the barge was within 45 minutes of completing discharge and the oil level in the tanks was below the surface of the water. The engineer advised the operations department that he felt there was no leak in the barge. It was requested that the general foreman send a man to the fleet to check for the presence of water in the bottom of the barge tanks; if no water was found, no further action would be taken.

After the ATC 3060 was shifted from the fleeting area to the dock a workman entered No. 3 starboard tank to check for the presence of water. None was found. However, oil described as "black oil" about an inch deep was noted in the tank. The workman reported his findings to the yard superintendent, who ordered that an air test be put on No. 3 starboard tank. The labor supervisor met the port engineer and told him that no water had been found.

Shortly after lunch, about 1330, an air test was applied to No. 3 starboard cargo tank. Some difficulty was experienced in obtaining a sufficient volume of air due to an insufficient length of airhose and kinking of the hose. The airhose problem was corrected and the tank was tested at about 1½ lb/in². The welding shop supervisor and a laborer soap-tested the seams of the No. 3 starboard tank. The port engineer returning to the yard, rejoined the group when bubbles were observed forming in a small indent about 3 or 4 feet above the waterline. The No. 3 starboard tank area of the barge was about 7 feet from the dock because of an offset in the dock line, and thus the suspected leak area was inaccessible. The assistant port engineer left the scene and a float was brought to the location so that the suspected leak could be examined more closely.

Shortly afterward the welding shop supervisor called the general foreman and asked him to provide a firewatch. The foreman asked if the barge had been "checked" or "certified," to which the supervisor replied that the barge carried "black oil" and he would take care of it. The general foreman's knowledge of tank barges was limited and although he was aware of company safety rules he had only recently become involved with barges and their repair. Because of the rain which fell that morning a number of yard labor workers were sent home early. A laborer was assigned to serve as firewatch to assist the welding shop supervisor.

About 1510 the firewatch boarded the barge and was told to use the charged water hose hanging in the tank if fire extinguishment was necessary. The supervisor and another man were then on the float between the barge and the dock adjusting the welding cables. Another yard laborer was standing on the dock attending a portable welding machine parked about 15 feet from the dock edge where the float was located. He was instructed to stand by the welding machine to adjust the amperage setting.

The firewatch entered No. 3 starboard tank and stood on the shell plating at the bottom of the ladder which was located against the forward bulkhead. There was about 1 inch of oil residue in the bottom of the tank. The ladder was approximately 6 feet from the starboard side shell. He could see a glowing red spot where the welding was being done on the side shell about 4½ feet off the bottom plating and about 2½ feet aft of the forward No. 3 starboard bulkhead. He was in the tank about 3 minutes when he noticed the strong odor of fumes and began to feel overcome. He yelled as a signal to stop welding, and came out and sat on the edge of the tank top and told the supervisor the fumes were pretty bad in the tank. The supervisor indicated that he had been in the tank previously for about 2 minutes and the fumes bothered him a "little bit." He stated that he was almost through and instructed the firewatch to go back in the tank; if the fumes became too strong he was to yell and come back out. They would follow this procedure until the job was finished.

The man reentered the tank and was standing at the ladder on the bottom of the tank. He had no tools or flashlight in his possession when he entered the tank and was able to see the area in which he was standing by the light entering through the open hatch cover. He observed the red mark where the welding was being done and in about 2 minutes he again felt overpowered by the fumes. He yelled to the supervisor and was on the second rung from the bottom of the ladder when the explosion occurred. He was dazed and found himself in the water after the explosion. He swam to shore where he climbed out and was promptly given first aid treatment by plant personnel. He suffered extensive third-degree burns on his face and hands and also suffered a noticeable loss of hearing.

The dockworker standing by the welding machine had seen the supervisor weld a flat bar to the hull, to which was attached the welding ground cable. That procedure took about 3 minutes. The firewatch was observed to come out of the tank, sit on the edge of the tank opening, and speak to the supervisor. No welding took place for an interval of about 5 minutes after which time the firewatch was seen to reenter the cargo tank. Welding began on a wet spot about 3 feet above the waterline of the side shell, and while he turned his head to shield his eyes from the welding glare the explosion occurred. He was knocked over by the blast and was burned by the flames which immediately engulfed the barge and the dock area. He crawled away from the

fire scene and was promptly treated by plant personnel. He suffered extensive second-degree burns of his hands and face.

The vice president of special projects and the assistant port engineer in charge of the ATC 3060 repairs were standing on the stern of the tug *Frank Jackson* at about 1520 attempting to measure the stern of the ATC 3060 for a proposed modification. As the assistant port engineer stepped aboard the tug he observed the welding supervisor on the float along the starboard side of the barge and saw a welding arc flash about 3 to 5 minutes before the explosion. As both men were taking measurements they felt a rumble on the barge and then witnessed an explosion. Both men dived into the water and subsequently reboarded the tug and escaped to shore. Both men suffered scattered burns on the face and hands.

The ATC 3060 became engulfed in high flames and in about 2 minutes a second explosion occurred. Fire spread on the surface of the water and covered the area halfway between the riverbanks. The barge continued to burn and City of Norfolk Fire Department units responded to a two-alarm fire signal at 1528 and extinguished the flames using fog water streams. The barge sank in place with only a small portion of the main deck above the water surface. The fire was fought mainly from the dock area since there are no fireboats in the Port of Norfolk. Coast Guard floating units responding were able to provide only token fire extinguishing capability from the river side of the facility. Coordination between the fire department and Coast Guard units on scene was accomplished through the use of portable transceivers provided by the first Coast Guard personnel to arrive on scene.

The tug *Frank Jackson,* moored port side to the dock immediately astern of the ATC 3060, was pinned against the stern of the barge by hull structural members which were disrupted by the force of the explosion. The superstructure of the *Frank Jackson* was extensively damaged by the fire. The tug *Southern Cross,* moored alongside and outboard of the *Frank Jackson,* suffered above-deck structural damage from missiles and fire. The tug *Sandpiper,* moored within the floating drydock ahead of the *Frank Jackson* and *Southern Cross,* suffered extensive structural damage from missiles including a large section of plating from the ATC 3060.

Four buildings within the Allied Towing Corp. property were extensively damaged by both blast and missiles. The sidewall of a prefabricated warehouse located about 120 feet from the dock was severely distorted by the blast effect. A similar building on the north side of the property, about 150 feet from the dock, was extensively damaged by a 15- by 13-foot section of side or deck plating which passed completely through the building. The path of the plate section as indicated by the damage to the building showed that the plating probably came from the direction of No. 3 starboard tank. Other buildings within the Allied property complex and nearby buildings had windows broken by the blast and small sections of the barge were found over a wide area—some fragments more than a thousand feet from the barge.

The body of the workman who was assisting on the float between the ATC 3060 and the dock at the time of the first explosion, was found on the dock approximately 10 feet from the dock edge in the vicinity of the midlength of the barge. The cause of death was listed as massive head injury.

The body of the welder was recovered on 4 April from the water in the general area of No. 3 starboard tank. The cause of death was listed as presumed drowning due to blast injury.

On 15 February 1975, a month prior to the casualty, while the ATC 3060 was offloading a cargo of Bunker C at a power company terminal at Chesterfield, Va., a sheen of oil had been noted in the vicinity of the half-unloaded barge. The State of Virginia Water Control Board representative investigated the reported 1-gallon spill which was believed coming from below the water surface. However, no leak in the hull was noted after the barge was unloaded. Since a positive determination of the source of the leakage could not be made, no pollution violation report was processed.

The next day, a Coast Guard officer from the Hampton Roads Marine Safety Office boarded the empty tank barge at the Exxon Sewells Point Terminal to determine if it was damaged, based on the suspected pollution incident noted at Chesterfield. He inspected the hull externally and found no suspected areas of leakage. In view of the absence of any damage, the barge was permitted to load cargo without further testing or repair.

The barge was previously certificated on 14 November 1974 for the carriage of "grade A not to exceed 25 pounds of Reid vapor pressure (RVP) in wing tanks. Specific gravity of the cargo not to exceed 1.05; D in center tanks." An amendment to the certificate of inspection was issued by the Hampton Roads Marine Safety Office permitting the carriage of grade A and lower cargo in all tanks.

On 16 September 1974 the owners, Allied Towing Corp., advised the Coast Guard Marine Safety Office that the ATC 3060 had operated in "black oil" service since November 1972 and that the vessel was expected to be kept in this service for the next 2 years. The owners, based on that information, requested a 1-year extension of the drydocking and internal tank examination which were routinely due in November 1974.

Under letter of 19 November 1974, the Coast Guard Marine Safety Office granted deferral of drydocking and internal examination as requested by the owners until November 1975, provided the operational area and

product transported remained the same.

The ATC 3060 was inspected for recertification by the Coast Guard Marine Safety Office in Norfolk on 15 November 1974 and based on the deferral of the drydocking and tank internal examination, the barge was approved for carriage of grade D with the restriction of the specific gravity of the cargo not to exceed 1.05. There were no outstanding requirements other than drydocking and tank internal examination pending as a result of this examination.

The last cargo carried in all the cargo tanks aboard the ATC 3060 was loaded from the SS *Amoco Yorktown* on 16 March 1975. During normal operations, samples of cargo are routinely drawn and saved by the tank barge operators. A sample of the cargo aboard the SS *Amoco Yorktown* which was under registry was drawn as the cargo was being offloaded at the Amoco Refinery. A portion of the sample was deposited with the U.S. Bureau of Customs and, in addition, a sample was kept by the Amoco Refinery. The bill of lading of the SS *Amoco Yorktown* listed the cargo as light Iranian crude oil equal to 557,287 U.S. barrels, having an API at 60° F of 33.88.

Crude oil cargoes arriving from foreign countries are not normally tested for all characteristics by the Amoco Oil Co. Sufficient tests are conducted to determine that the cargo has the general characteristics of Iranian light crude oil and also to determine the percentage of impurities such as water and sand.

At the request of the Coast Guard investigating officer, a Reid vapor pressure and flashpoint analysis of the cargo sample held by Amoco Oil Co. was conducted. The results indicate the sample had an API at 60° F of 31.03, a Reid vapor pressure of 5.3 lb/in²a and a flashpoint of less than 68° F which was the room temperature at the time of the sample analysis. A sample of the crude oil cargo from the SS *Amoco Yorktown* provided to the investigating officer was tested by an independent laboratory whose results indicated the sample to have an API at 60° F of 31.08, a Reid vapor pressure of 4.2 lb/in²a and a flashpoint below room temperature of 58° F. The sample contained a concentration of 3.6 percent pentanes and 6.6 percent hexanes by weight in addition to 0.16 cc methane, 0.54 cc ethane, 32 cc propane, and 335 cc butane per liter of oil.

The terminal property encompasses an irregular area approximately 1,350 feet in length and 400 feet in width. Tank barge washing and gas-freeing facilities were located on the property. Two tank truck trailers and six above ground permanent fuel storage tanks used for the storage of products recovered from cargo tank washing were located in the same general area, approximately 450 feet from the stern of the ATC 3060 at the time of the explosion. The Allied Towing Corp. was not designated under 33 CFR 126.13 as a waterfront facility for the handling, storage, or transfer of flammable combustible liquids in bulk. No approval was either requested or granted by the Captain of the Port of Norfolk for any welding or hot work to be done at the Allied Towing Corp. facility on 17 March 1975 as required under 33 CFR 126.15(c).

On 10 February 1975, the facility safety engineer was designated by Allied Towing Corp. as their ship repair sole competent person, with limits of application "to ascertain that the atmospheres remain gas free and contain sufficient oxygen for certification by the N.F.P.A. certified marine chemist. Also, to conduct initial survey in vessels for oxygen and combustible atmospheres prior to entry of employees."

On 17 March 1975, the safety engineer was neither notified of the arrival of the ATC 3060 at the Allied Towing Corp. facility nor was he requested to conduct any initial survey of the vessel prior to the explosion. At about 1500, the safety engineer was aboard the ATC 185 which was located along the pier bulkhead between the drydock and the gas-freeing area. As he left the barge he noted the ATC 3060 moored at the pier, but as he started to walk toward that direction he was summoned to give first aid to one of the plant employees. The safety engineer completed treating the employee after which time he prepared for a daily maintenance department meeting which was scheduled for 1600, and so did not visit the ATC 3060 prior to the explosion.

In addition to his duties as competent person and first aid administrator he is responsible, as safety supervisor, for noting and correcting safety infractions. During normal rounds of the yard he has cited various employees for not observing prescribed safety standards such as wearing of hardhats in designated areas, using defective welding cable, and improper access between vessels and the shore. About 27 February 1975, he redrafted existing Allied Towing Corp. safety regulations. Copies of the revised instructions were included with each plant employee's paycheck and were also posted in various parts of the plant. Several labor and supervisory witnesses who testified at the investigation were only vaguely aware of having received the safety instructions and were unaware of them except in a cursory fashion.

Company safety rule 7 indicates, "Employees shall not enter any tank, compartment, or rake aboard vessels until it has been ascertained by a competent person that the compartment, tank, or rake is safe for men." From the time the ATC 3060 moored at the Allied Towing Corp. property on the morning of 17 March 1975, the No. 3 starboard tank was repeatedly entered without the tank being checked as "safe for men."

Company safety rule 8 reads, "Hot work shall not be performed in compartments, closed pipelines, and in tanks or rakes until they have been certified by the marine chemist 'safe for men—safe for fire' and a gas-free certificate displayed on the vessel

specifying in which areas hot work may be conducted." The ATC 3060 was not checked on 17 March 1975 to determine if the welding could be safely undertaken as required under 46 CFR 35.01–1, and no request for such determination was initiated by the assistant port engineer assigned to the barge repair or by any supervisory personnel who were directly or indirectly advised that preparations for hot work on the ATC 3060 were being made. No precaution signs were displayed in the area other than the "No open lights, no smoking, no visitors" sign required by 46 CFR 35.30–1.

On the morning of 17 March 1975, the assistant port engineer telephoned the Norfolk Marine Safety Office to determine if any Coast Guard requirements relative to the pollution incident were forthcoming. He was advised that based on an evaluation of the pollution investigator's report, an inspection by the Coast Guard was not considered necessary at that time.

Conclusions

That the primary cause of the casualty was the ignition of volatile vapors within No. 3 starboard tank when hot work (welding) was performed on the side shell of the ATC 3060.

The light Iranian crude oil contained volatile light ends consisting of propane, methane, butane, etc., and during normal carriage the ullage space could be expected to be rich in these light ends and gases. After discharging at Yorktown, all the cargo tanks, although empty, had sufficient residual cargo to continue to generate vapors and reach an equilibrium so that the tanks contained various explosive atmospheres most probably above the explosive limit.

After completion of discharge, the tank was entered twice and examined for water, a 1½ lb/in² air test was applied to check the tank for leaks, and the tank was subsequently entered twice by the firewatch while welding was in progress prior to the explosion. During all these procedures the tank atmosphere was probably diluted with air to some degree. The localized heat from the welding in No. 3 starboard tank generated additional vapors and stimulated convection currents within the tank which caused further dilution of the vapors with the air from the open hatch, bringing them into the explosive range. In the presence of the intense heat from the localized welding, the ignition occurred.

That the second explosion resulted when the boundaries of the other tanks containing volatile vapors were broached and the volatile vapors were exposed to the fire resulting from the first explosion.

That the Reid vapor pressure of the crude oil while onboard the ATC 3060 was in the range of 5.3 lb/in² which placed the light Iranian crude oil within the flammable range of grade C as defined by 46 CFR 30.10–22. Although a subsequent Reid vapor pressure test placed the crude oil sample in a lower range (4.2 lb/in²) the difference in results can be attributed to a dilution of the volatiles in the second crude oil sample. The carriage of Iranian crude grade C cargo in the ATC 3060, which was permitted by the certificate of inspection to carry grade D and lower cargo, constituted evidence of violation of 46 CFR 31.05–1. The ATC 3060 was previously approved for the carriage of grade A and lower cargo; however, the inspection of the ATC 3060 prior to the issuance of the last certificate was predicated on the fact that grade D or lower cargo would be carried until the barge was drydocked and the tank internals examined.

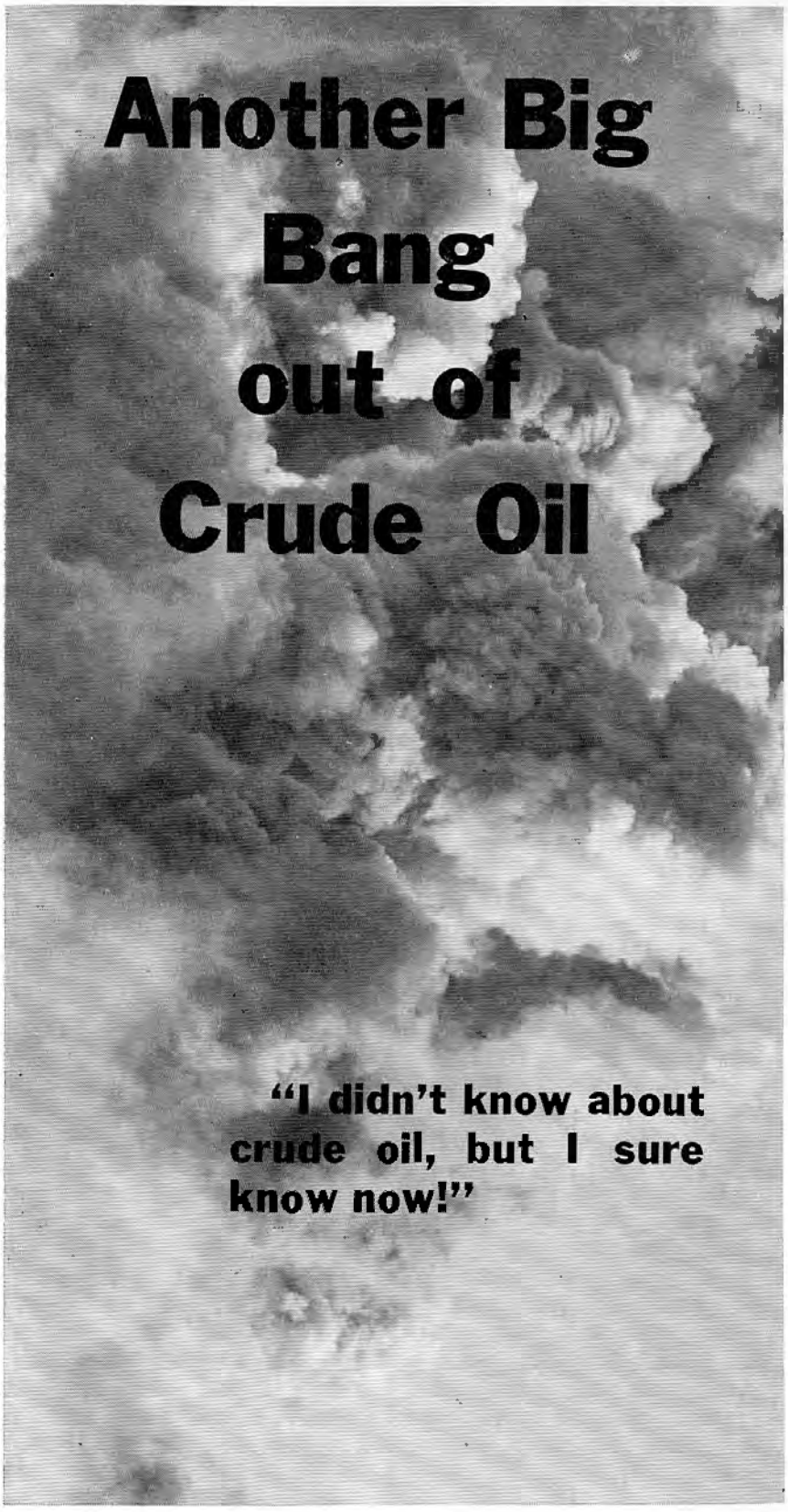
That no constructive efforts were made by the owners or any of the Allied Towing Corp. maintenance department or the safety engineer to determine that the welding repair could be undertaken on the ATC 3060 with safety as required by 46 CFR 35.01–1. The fact that the welding was going to be accomplished on the ATC 3060 was known to the welding supervisor and the three persons who assisted him in the actual welding operations. That welding was to be done or was in progress was known to supervisory personnel.

That the Allied Towing Corp. procedures in regard to personnel securing the services of a certified gas chemist or notifying the company's OSHA "Competent Person," the safety engineer, to determine if the barge was safe for fire and safe for men were undefined and were a major contributing factor in this accident.

That the actions of the assistant port engineer assigned to oversee the repairs of the ATC 3060 were not responsible, prudent, or in accordance with outlined company safety procedures. He apparently was predisposed to believe, based on the tankerman's statement, that there was no leak in the barge and that the pollution incident at Yorktown the previous day was unfounded. When no water was found in No. 3 starboard cargo tank an air test was performed by repair yard personnel and a leak in the side shell of No. 3 starboard cargo tank was found in his presence. He was aware of welding being done on the barge just moments prior to the accident and his failure to question the propriety of this action constitutes evidence of negligence.

That the failure of the welding supervisor or any of the supervisory personnel to notify the safety supervisor, who is designated as a competent person as required by the Department of Labor regulations, either prior to personnel entering the tanks or before welding was started is inexplicable since the ATC 3060 was in the Allied Towing Corp. yard for several hours prior to the accident. It is ironic that when the safety supervisor became aware of the presence of the ATC 3060 and was on his way to investigate the circumstances, he was diverted to provide first aid treatment to another employee.

(*Continued on page 132.*)



Why It Happened

The preceding accident report describes how an explosion occurred in an "empty" cargo tank on a single-skin petroleum tank barge. Very simply, the tank was not gas-free and the heat or sparks from hot work on an external tank wall ignited the flammable vapors within. Contributing causes of the accident were improper documentation of the cargo, failure by responsible personnel to have the tank certified gas-free, and failure of the yard workers to recognize an extremely hazardous situation. Thus, ignorance and lack of concern for safety must also be cited as contributing causes to the accident.

To insure that we all recognize the gross safety violations which led to 2 deaths, 10 injuries, and property damage in excess of $1.2 million, let's briefly review the steps leading to the accident:

1. The barge had been in "black oil" service for some time. (See description of "black oil" below). The flammable properties of black oil, a grade E combustible, were considered minimal, and apparently upon other occasions repairs involving hot work had been accomplished on the barge without obtaining a gas-free certificate from a certified marine chemist.

2. When the ATC 3060 loaded crude oil from the SS *Amoco Yorktown*, it was loading a grade C flammable cargo—in violation of the certificate of inspection of the ATC 3060. Although the barge was originally certificated by the Coast Guard for "grade A flammables (not to exceed 25 pounds RVP) and lower," 7 months prior to the accident the owner had requested that the barge be recertificated for "grade D combustibles and lower." The purpose of the recertification was to allow greater intervals between required Coast Guard internal examinations. The local OCMI granted the request provided the operational area and product transported remained the same. At the time of the request the owner

stated the barge would be kept in black oil service.

The SS *Amoco Yorktown* is a Liberian-flag vessel and was not required to comply with our classification scheme for flammable or combustible liquids. However, since this crude oil was routinely received, company officials were aware that the flashpoint of the crude oil was well below room temperature and the Reid vapor pressure (RVP) was approximately 5.0 lb/in²a. Thus, they should have been aware they were violating the certificate of the ATC 3060 when loading the crude oil, a grade C flammable.

3. In the repair yard, a violation of OSHA regulations occurred on at least three occasions, when yard workers entered the cargo tank aboard ATC 3060 without a "competent person" certifying the tank as safe for entry. In fact, if a competent person had checked the tank, he could not have permitted entry of men into the tank since the tank atmosphere would have been found to contain a flammable concentration of vapor. OSHA regulations (29 CFR 1915.11 entitled "Precautions before entering") require that the tank atmosphere be tested and if it is found to contain a concentration of vapors greater than 10 percent of the lower flammable limit, then the tank must be ventilated until the atmosphere is reduced to less than 10 percent of the lower flammable limit *prior* to entry by personnel.

4. Prior to hot work, no marine chemist certified the tank as "Safe for Fire," another violation of OSHA regulations (29 CFR 1915.13, entitled "Certification before hot work is begun"). Hot work should not have begun until the marine chemist certified the tank in question, *adjacent tanks,* and the attendent *pipelines* and *heating coils as* "Safe for Fire."

5. As a last resort, the welder, his assistant, or the firewatch should have recognized an inherently dangerous situation, had they been better informed. It is not normal for vapors from a grade E combustible liquid to cause dizziness when inhaled. It is not normal to enter a tank without a competent person certifying the tank safe. It is not normal to weld on a vessel when cargo residues remain in the tank.

Thus, the stage was set for the accident—mistake compounding mistake. The system for safety which was specifically required at each step was forgotten or consciously discarded.

It is important to note that this accident happened due to the presumption that the cargo residue on the barge was "black oil." We recognize that the gross safety violations which occurred would probably have gone unnoticed if the cargo had been only "black oil." Unfortunately, crude oil was the cargo residue aboard the barge.

Just One More Accident

The explosion and fire aboard the tank barge ATC 3060 unfortunately was not unique. A number of recent accidents involving crude oil in U.S. waters have claimed a total of 56 lives, caused numerous injuries and real property loss approaching $100 million. Additionally vessel traffic in major port areas was disrupted causing yet more economic loss. We must recognize that crude oil is a dangerous, highly flammable, sometimes extremely toxic material. Let's consider some of the recent accidents.

June 2 1973–New York Harbor—The outbound U.S.-flag container vessel SS *C.V. Sea Witch* suffered a steering casualty and rammed the anchored and fully loaded petroleum tanker SS *Esso Brussels* at about 15 knots over the ground. The angle of impact was approximately 30° from the perpendicular, at a position just aft of amidships on the *Brussels*. The force of the collision carried the *Sea Witch* into two cargo tanks, a distance of about 30 feet, releasing a total of about 31,000 barrels of a light Nigerian crude oil. There was no explosion but the oil spreading over the water ignited almost immediately. A total of 16 persons died in the subsequent fire, most of them on the crude carrier. It is of interest to note that no tanks aboard the *Brussels,* other than those breached in the collision, were involved in the fire. While the tanks vented gas due to the external fire, they retained their structural integrity.

The flashpoint of light Nigerian crude oil which was aboard the *Brussels* is characteristically well below ambient temperature. The Reid vapor pressure (RVP) of this crude oil would probably be such that it would be a grade C flammable (RVP between 5.0 and 8.0 lb/in²a). Thus, the vapor space in closed cargo tanks would contain flammable vapors well above the upper flammable limit and be inherently safe from fire. However, when those tanks were breached and the vapor diluted with air, a flammable concentration of gas resulted. This gas then contacted an ignition source and flashed back and the crude oil caught fire.

April 6, 1974–Delaware River, Philadelphia, Pa.—Around midnight the 650-foot Greek-flag petroleum tanker MV *Elias* exploded without warning while moored to the ARCO facility at Fort Miflin. The vessel was in the last stages of offloading a cargo of crude oil from the Bachequero Field in Venezuela. Thirteen persons aboard the vessel were killed including all persons involved in cargo transfer. The force of the explosion knocked down the reinforced concrete dock and propelled large portions of the hull and dock hundreds of feet from the accident site.

On *Elias* an open-type offloading system was used where tank ullages were opened and covered with flame screens. As the liquid level was drawn down, air entered the tanks. The particular cargo of crude oil on *Elias* was a thick, viscous crude with a flashpoint of 62° F. The RVP was 1.4 lb/in²a at 100° F and 3.5 lb/in²a at 125° F. The oil was heated to 125°

F prior to offloading to reduce the viscosity and thus facilitate pumping. At 125° F, the equilibrium concentration of vapors would have been well above the upper flammable limit and the vapor space of the tanks inherently safe from fire or explosions. However, the type of offloading, which is that normally used aboard petroleum tankers, permitted dilution of the vapors into the flammable range. The source of ignition of the flammable vapors could not be determined.

The fire, which resulted from an estimated 13,000 barrels of oil remaining on board, eventually burned itself out. Pollution was only moderate since most of the oil was consumed in the fire.

January 31, 1975–Delaware River, Philadelphia—At about 0030 the bow of the fully loaded U.S.-flag chemical carrier SS *Edgar M. Queeny* briefly touched the outboard side of the moored Liberian-flag petroleum tanker S/T *Corinthos* at Marcus Hook. *Corinthos* had just commenced offloading a cargo of relatively light and volatile crude oil from the Hassi Messaoud Field in Algeria. During the brief contact between the two vessels the port anchor of the *Queeny* apparently breached the hull of the *Corinthos* in the area of No. 4 or No. 5 port cargo tank. An explosion immediately resulted, followed within 1 minute by an explosion of much greater magnitude. Flames and burning oil were propelled an estimated 400 to 500 feet in the air and the entire deck area of the *Corinthos* was immediately covered with flames. This explosion was followed by additional explosions of varying intensity over the next 12 hours. Twenty-six persons died or are missing and presumed dead as a result of this accident, all but one from the *Corinthos*. The *Corinthos* was a total loss and the entire crude oil cargo on the *Corinthos* was either burned or spilled into the river. Pollution in the Delaware River because of this accident was extensive.

Like the *Elias*, the *Corinthos* used an open-type offloading system. Prior to offloading, the ullages were opened and flame screens placed over the openings. As the liquid level was drawn down, air entered the tanks diluting the crude oil vapors into the flammable range. The ignition source was provided by the rending of the metal in the collision, or by electrical fixtures on the bow of the *Queeny*.

The particular crude oil on *Corinthos* was a very volatile crude with a RVP of 8.9 lb/in²a and flashpoint well below ambient temperatures.

What Is "Black Oil"?

"Black oil" is a synonym for residual oil. Black oil can be characterized as thick, black, and dirty. It has a characteristic odor, and its density approaches that of water. Black oil or residual oil is so named because it is the tailings or residue remaining in the distillation column after the distilling process has been completed on crude oil. The substance may be liquid or semiliquid and contains mostly asphaltic hydrocarbons. Asphaltic hydrocarbons are complex high molecular weight compounds of varying properties. A common use of the heavier components of this material is road surfacing. The lighter grades are mostly used to fire stationary boilers. In bulk, the flammable properties of black oil are minimal. The Coast Guard would classify this material as a grade E combustible because of the high flashpoint, usually well above 150° F. "Black oil" is *not* a proper shipping name and any cargo manifest or shipping paper should indicate "Grade E Combustible." The term "black oil" could be added as amplifying information, however.

Under the supervision of a marine chemist, it is permissible to perform hot work in tanks containing residues of grade E combustibles since the material will not readily catch fire. However, under no circumstances should work be performed without obtaining a gas-free certificate. In no case should hot weld metal be permitted to drop into the liquid since this could easily initiate a fire.

The vapors given off by grade E combustibles are readily flammable and there have been instances of explosions in land tanks storing these liquids. Over a long period of time sufficient vapors evolved from the liquid and were trapped and concentrated in the vapor space. When an ignition source was provided, the vapor space suffered an explosion. Grade E combustibles do not evolve sufficient vapors for an explosion under normal transportation conditions and one would not expect that the vapor space would be dangerous. However if the tanks are heated—as they might be to reduce the viscosity of some thick liquids—sufficient vapors can be evolved to be ignited.

What Is Crude Oil?

Like black oil, crude oil can be thick, black, and dirty. At that point, however, all similarity ends.

Crude oil is the term applied to almost any liquid petroleum product taken from the ground. It can vary in color from yellow to dark reddish brown or black. Crude oil is a complex mixture of paraffinic, naphthenic, aromatic, and asphaltic hydrocarbons which varies greatly in composition depending on the geographical origin. And its properties vary according to the composition. Most crudes have a distinct odor.

Crude oils must be considered highly flammable! Of that we can be

certain. We have but to review the death and destruction in the accidents of the *Esso Brussels-Sea Witch, Elias, Corinthos-Edgar M. Queeny* and now the ATC 3060 to convince ourselves of this fact.

Crude oil may contain small quantities of low-molecular weight hydrocarbon gases dissolved in the liquid. These light gases readily evolve and if confined will form a flammable and possibly explosive mixture with air. The proclivity of a crude oil to evolve these gases is more or less indicated by the Reid vapor pressure (the Reid vapor pressure test is described later). The higher the RVP the greater the proclivity of the crude oil to evolve vapor.

Most crude oils evolve sufficient vapor to be classed as grade C flammable liquids and in some cases are even classed as grade A flammable liquids. In a cargo tank containing such crude the vapor space under ordinary conditions would be "over-rich." That is, the concentration of flammable gas would be well above the upper explosive limit. This is a safe condition—as along as the tank remains intact and air does not enter.

However, dilute this mixture with air, provide an ignition source, and . . . BOOM!

Crude oil vapors can also be toxic! In November of 1975, the Officer in Charge, Marine Inspection, noted that the crew aboard a U.S.-flag tank vessel were wearing gasmasks while offloading a cargo of crude oil. Upon investigation, it was found that the crude oil was a "sour crude" and the gasmasks were required to protect the crew from hydrogen sulphide (H_2S) gas. The measured concentration of H_2S in the liquid phase was reported to be 95 ppm (by weight). The measured concentration of H_2S in the vapor phase was about 10,000 ppm (by volume) or 1 percent.

The immediately "fatal" concentration of H_2S is about 1000 ppm, and even during offloading relatively high concentrations of hydrogen sulphide were present on deck.

H_2S is detectable by smell in very low concentrations, having the characteristic rotten egg odor. However, at concentrations above 200 to 300 ppm the gas immediately causes paralysis of the olfactory nerves and thus is not detectable by smell. Persons can voluntarily remain in toxic concentrations of the gas until overcome. If a stricken person is not immediately removed from the toxic environment and given artificial respiration he will certainly be a casualty.

The main hazard from H_2S is that one breath can render a man unconscious. H_2S gas, as well as other gases evolved during loading, or in some cases, offloading, of crude oil is heavier than air and can be expected to fall. Someone standing near a cargo tank vent could be overcome if not protected.

Flammability Tests

The flammable properties of crude oil can range from almost nil to highly flammable. The specific tests which characterize the fire and explosion hazard of crude oil are flashpoint and Reid vapor pressure (RVP) tests.

Flashpoint indicates the lowest temperature at which a small sample of liquid will envolve sufficient flammable vapor to briefly sustain a flame at the liquid-air interface. The most realistic flashpoint tests are tests which confine the evolved vapor prior to ignition—so called "closed cup" testers. Open-cup testers permit evolved vapors to escape during the test. A closed cnp flashpoint is usually 10° to 15° lower than an open-cup flashpoint on the same material. Most crude oils have flashpoints in the range of temperatures commonly experienced in transportation.

The RVP test is a standardized test for measuring the volatility of vapors released from a given liquid sample. A chilled (32° F) liquid sample is placed in the liquid portion of the test apparatus, then connected to an air chamber, heated to 100° F, and finally the entire apparatus is sealed. The apparatus is then placed in a 100° F water bath. The container is shaken to rapidly bring about equilibrium between the liquid and gas phases. The increase in internal pressure from 32° to 100° F is observed and roughly indicates the absolute vapor pressure of the sample at 100° F. The ratio of liquid to vapor space in the test apparatus is established as one to four (1:4).

However . . .

Neither the flashpoint test nor the Reid vapor pressure test are absolute indices of the flammability characteristics of a liquid, especially when crude oil is concerned. In the case of such a complex mixture of petroleum hydrocarbons, the nature of the flashpoint test and RVP test dictate that the tests are made after initial vaporization has occurred. There are sometimes small traces of highly volatile materials such as dissolved low-molecular-weight hydrocarbon gasses which affect the initial vaporizing properties of the sample but whose presence is undetected because they are lost before the actual test.

As an example, the vapor spaces above some high-flash liquids have been ignited at temperatures well below the indicated flashpoints. These explosions appear to have been caused by minute quantities of light hydrocarbons not detected by the flash test.

Even more interesting, it has been determined that RVP tests for crude oils may differ significantly from true vapor pressure. In fact, it has been shown that *the true vapor pressure may be 1 to 9.75 times larger than the measure RVP.* This situation occurs again because of evaporation of

the light hydrocarbon gases from the sample before and during the Reid test.

One must also appreciate that the Reid vapor pressure test does not duplicate the conditions found in transportation. The temperature of the cargo may be other than 100° F and the liquid-to-gas volume ratio different from 1:4. Both of these factors could significantly alter the true vapor pressure of the liquid in a cargo tank.

"I didn't know about crude oil, but I sure know now!" These graphic words were spoken by Mr. William K. Sloan during the investigation of the accident aboard the ATC 3060. Mr. Sloan was the firewatch inside the cargo tank at the time it exploded and miraculously survived although he was seriously injured and badly burned.

Mr. Sloan is now well aware that crude oil is not inert, but a dangerous flammable—and possibly explosive—material. He knows that crude oil is unforgiving. Make a mistake and it will kill you. ⚓

About the Authors

Captain Adam Zabinski *is presently assigned as Chief of the Traveling Inspector Staff of the Office of Merchant Marine Safety at Coast Guard Headquarters. Captain Zabinski entered the Coast Guard in July 1950, after serving 11 years in the U.S. Merchant Marine in various capacities from Ordinary Seaman to Master. He presently holds the sixth issue of his Master's Ocean License.*

Captain Zabinski has served in many assignments in the marine inspection field, as well as Captain of the Port, Huntington, W. Va., and in two tours of sea duty. In August he will assume duty as Chief, Marine Safety Division, 13th Coast Guard District, Seattle.

Lieutenant Commander Fred Halvorsen *is presently Chief of the Hazard Evaluation Branch of the Cargo and Hazardous Materials Division at Coast Guard Headquarters. He has been a frequent contributor to the* Proceedings *with a number of articles on hazardous materials.*

Following graduation from the Coast Guard Academy in 1964, he served as assistant engineer on two Coast Guard vessels homeported in Seattle. Since 1968 he has been assigned at Headquarters, part of that time being spent in postgraduate study at the University of Maryland from which he holds M.S. and Ph. D. degrees in chemical engineering.

(*Continued from page 127.*)

That the new company safety instructions, particularly section 7, which dealt with the entry of personnel into tanks, and section 8, covering vessels and hot work to be performed on tank vessels, were not followed.

It is apparent from witnesses' testimony that many were unaware of the contents of the safety instructions although they had received a copy of the safety instructions with their paychecks or had seen the safety instructions either in preparation or posted in the repair yard.

That although the organizational structure of the Allied Towing Corp. was recently modified to delineate the chain of responsibility of the maintenance department and safety engineer, the procedures followed during the testing and repair of the ATC 3060 on 17 March 1975 were not coordinated by those in authority and the entire responsibility for the repair ultimately hinged on the welding shop supervisor. The request for a firewatch should have alerted supervisory personnel to the fact that hot work was contemplated and, therefore, the provisions of company safety instructions pertaining to hot work and the need for a gas chemist's certification prior to the start of hot work should have been followed. The dismissal of responsibility by the general foreman when the welding shop supervisor said "I'll take care of it"—referring to the "checking" or certifying of the barge—can only indicate either unfamiliarity with tank barges, or else that welding on tank barges which previously carried "black oil" without obtaining a certification was common practice by repair personnel at Allied Towing Corp. It is difficult to believe that the welding supervisor would have undertaken welding on the ATC 3060 on his own initiative.

The undertaking of the welding repair on the ATC 3060 without notifying the Officer in Charge, Marine Inspection, was contrary to the provisions of 46 CFR 30.01–10. Although the port engineer called the Marine

Safety Office, Hampton Roads, concerning the need for inspection and was advised, based on the facts contained in the Coast Guard pollution incident report, that there was no indication of a hull leak, it was incumbent upon the owner or his representative to advise the Officer in Charge, Marine Inspection, once the leak affecting seaworthiness was detected and before repairs were accomplished.

That the current Coast Guard regulations require the control of activity on tank vessels to be vested in the senior officer present, or tankerman, during transfer operations (46 CFR 35.35–1), and that a barge, when moored not transferring, be under the control of a watchman for keeping unauthorized persons off the barge (46 CFR 35.05–15). In the instant case, the repair employees of the owner cannot truly be considered unauthorized persons, yet their presence and activities, without adequate supervision, did pose a danger to themselves and to the vessel. Although the assistant port engineer was assigned to oversee the repairs and the yard maintenance personnel had the responsibility for the repairs and testing, no employee was tasked with the responsibility for the safety of the barge.

That there was inadequate documentary information for responsible persons to identify the grade of the last cargo aboard the ATC 3060 as required by 46 CFR 35.01–10. The barge loading and discharge document indicated loading ullages and total quantity of cargo and description of the cargo as "crude oil," but was insufficient as there was no information available in the documents aboard the ATC 3060 or the logbook of the tug *Carville* to indicate the grade of cargo.

That the ATC 3060 normally was engaged in the carriage of refined heavy fuel oil. Personnel at the repair yard assumed that the ATC 3060 contained a residue of a high-flash point refined fuel oil which they referred to as "black oil." The residue of the light Iranian crude oil had the appearance of black oil and, therefore, repair personnel were not alerted to any increased flammability risks. No efforts were made by any supervisory or repair personnel after the barge arrived at the Allied Towing Corp. yard to determine the true nature or grade of the last cargo carried. The welding supervisor and firewatch, although they were affected by the volatile nature of the vapors in No. 3 starboard cargo tank when they entered the tank, were not alerted to the possible explosive hazard.

That Allied Towing Corp. personnel who testified before the investigation were in the main unaware of any specific hazards of crude oil before the accident. However, most testified that they have subsequently learned of the volatile nature of crude oil. One important lesson to be learned from this casualty is the need for public education in the hazards of crude oil.

That the bill of lading of the SS *Amoco Yorktown,* although it contained the bulk of the elements required for shipping papers as included in 46 CFR 35.01–10, did not contain the grade of cargo as required.

That a portion of the Allied Towing Corp. facility is used for tank cleaning of barges which involves the transfer of tank washing and petroleum product residues to portable storage and bulk storage on the Allied Towing Corp. property. The dock and storage meet the criteria necessary for requiring a designation as a waterfront facility as defined under 33 CFR 126.05. The various repair activities involving welding and burning in close proximity to bulk storage or operations which involve the transfer of petroleum products are considered to pose a serious port hazard, and further, that any welding or hot work which takes place upon this facility should be controlled under the authority of 33 CFR 126.15(c) and the dock and bulk storage area should be designated as a waterfront facility by the Captain of the Port under 33 CFR 126.13.

That entering of the tanks aboard the ATC 3060 by personnel of Allied Towing Corp. before the atmosphere was tested by a competent person was in violation of 29 CFR 1915.11 and the hot work done on No. 3 starboard tank before the tank was certified safe for hot work constituted evidence of violation of 29 CFR 1915.13, Department of Labor Regulations for Ship Repairing.

That there is no evidence that any member of the Coast Guard or any other Government agency caused or contributed to the cause of this accident.

That the procedures used by Allied Towing Corp. and U.S. Coast Guard personnel in the inspection of the two suspected pollution incidents were ineffective in determining the true condition of the ATC 3060. The suspected leak at Chesterfield, Va., and the leak in Yorktown were discounted after superficial external examination of the vessel or review of the pollution incident report. The leak was discovered only after a positive air pressure test was applied by yard workmen.

That residue oil spilled from the damaged ATC 3060 and the quantity of oil spilled constituted evidence of violation of 33 USC 1321(b)3.

Commandant's Action

The Commandant concurred with the conclusions of the investigating officer with the exception of the conclusion that the bill of lading of the SS *Amoco Yorktown* did not contain the grade of cargo as required by 46 CFR 35.01–10. The regulation, 46 CFR 30.01–5(c)(1), exempts foreign-flag vessels from the provisions of 46 CFR 35.01–10. A Notice of Proposed Rulemaking will be initiated amending 46 CFR 30.01–5(e)(1) so that the requirements of 46 CFR 35.01–10 will be applicable to foreign-flag vessels. ⚓

Marine Safety Council Membership

This summer there will be several changes in the membership of the Marine Safety Council. This is the first in a series of articles which will introduce the new members to our readers.

George Herbert Patrick Bursley was born on April 5, 1925, in Istanbul, Turkey. He is the son of the late Herbert S. Bursley, a career Foreign Service officer and former U.S. Ambassador to Honduras, and Mrs. Robertina H. Bursley who presently resides in Washington, D.C.

He graduated from the U.S. Coast Guard Academy, New London, Conn., and was commissioned as Ensign on June 5, 1946. He then served aboard the cutters *Ironwood, Taney, Gresham,* and *Trillium.* In October 1949 he was assigned as Executive Officer of the cutter *Ewing* based at Alameda, Calif. From January to August 1951 he was a training officer at the Coast Guard Training Station at Alameda.

He was selected for postgraduate training at George Washington University Law School, from which he received the Degree of Juris Doctor in 1953. He was admitted to the District of Columbia Bar in 1954 and to the California Bar in 1964. He has also been admitted to practice before the U.S. Coort of Military Appeals and the Supreme Court of the United States. He has been designated a Military Judge of General Courts-Martial and is also certified as Trial and Defense Counsel of Courts-Martial.

From 1954 to 1958 he served as District Legal Officer of the 13th Coast Guard District. From August 1958 to July 1960 he was Commanding Officer of the cutter *Magnolia,* based at San Francisco. He then served as District Legal Officer of the 12th Coast Guard District until July 1961, when he was assigned as District Legal Officer of the 14th Coast Guard District.

In February 1964, Lieutenant Commander Bursley was assigned to the Program Analysis Division at Coast Guard Headquarters. On July 15, 1964, he was detailed to the Treasury Department as Coast Guard Liaison Officer and Aide to the Assistant Secretary of Treasury.

Commander Bursley was a member of the interagency task force which drafted the legislation to establish the Department of Transportation and coordinated activities of the executive agencies in support of its enactment by the Congress in 1966. For exceptionally meritorious performance in that assignment, he was awarded the Distinguished Service Medal, the Coast Guard's highest award for noncombatant service.

In September 1968 he joined the Department of Transportation Office of Policy Review which was responsible for the coordination of policy development in the department. In March 1969 he was given additional duties as Departmental Representative on a White House Interdepartmental Working Group on Maritime Policy. His services in these two capacities led to the award of the Coast Guard Commendation Medal.

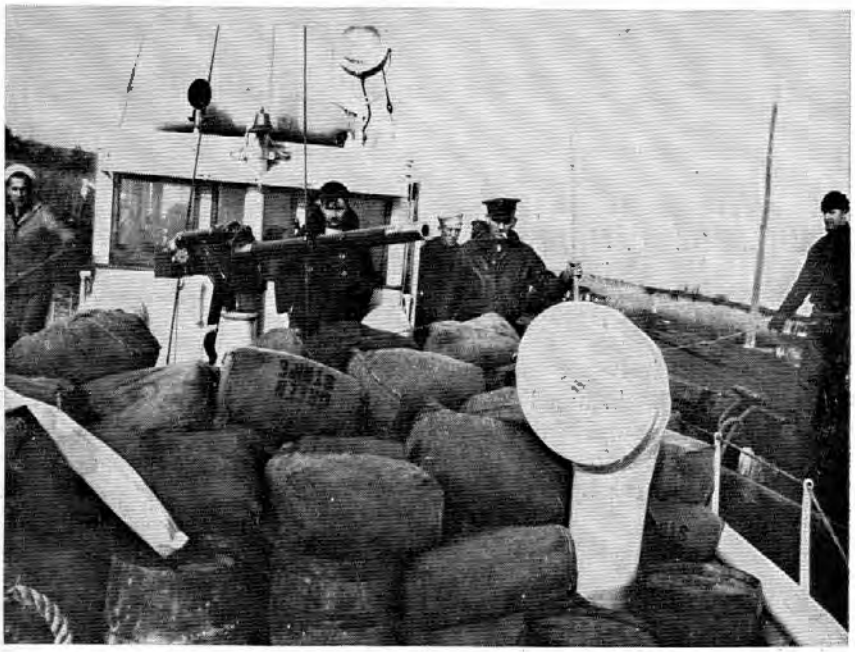
From July 1969 until June 1972 Captain Bursley served as Chief of the Maritime and International Law Division in the Office of the Chief Counsel. He served collaterally as a Judge of the Coast Guard Court of Military Review. On July 7, 1972, Captain Bursley assumed duties as Commander, Coast Guard Group, Baltimore and Commanding Officer, Coast Guard Port Safety Station, Baltimore.

Following nomination by the President in January 1974, and approval of the Senate, Bursley was promoted to Rear Admiral effective July 1, 1974. At that time he was assigned to the post of Commander, 2d Coast Guard District, St. Louis.

Rear Admiral Bursley will take over the post of Chief Counsel of the Coast Guard July 1, 1976. He will replace the retiring RADM R. A. Ratti as Chairman of the Marine Safety Council.

Rear Admiral Bursley is married to the former Claire Mulvany of Oakland, Calif. They have two children, Kathleen Anne and Kevin Herbert ⚓

Heritage



WITH the ratification of the 18th Amendment to the Constitution on January 16, 1919, the United States was launched into an era of bathtub gin, flappers, bootleggers, and smuggling on an unprecedented scale. Prohibition, "The Noble Experiment," was here! Members of the underworld were quick to realize that enormous profits could be made by smuggling contraband liquor into the country. By the early twenties rumrunning had reached epidemic proportions.

Off Sandy Hook, N.J., anchored just beyond the 3-mile limit was the notorious "rum row," a ragtag fleet of more than 30 ships of every size and description flying the flags of more than a dozen different nations. The members of this mongrel armada had one thing in common: their cargo was illicit alcohol destined for some deserted beach or estuary on the mainland. High powered "contact" boats would rendezvous with the vessels of rum row under cover of darkness and then dart back to the safety of some hidden cove to unload their illegal cargo.

The Coast Guard, with only a handful of vessels to patrol the entire eastern seaboard, was helpless to put an end to this blatant flouting of the law. In an address to Congress in 1923, President Calvin Coolidge requested a fleet of swift powerboats to combat the rum fleet. The Commandant of the Coast Guard, Rear Admiral F. C. Billard, estimated the cost of such a fleet at $28 million. Congress responded by transferring 20 Navy destroyers to the Coast Guard and appropriating $13 million for new construction, and by enacting a 12-mile enforcement limit.

With this increased enforcement capability, the Coast Guard struck the rum fleet quick and hard. By June 1924, the Commandant was able to report that the patrols had seized more than $10 million worth of contraband alcohol and had successfully scattered the occupants of rum row. The war against rumrunning was far from over, but the tide had turned. The smugglers were now forced to play a dangerous game of cat and mouse with patrol boats.

The patrol boat CG 808 (formerly the rumrunner *Black Duck*) was patrolling off Long Island one warm August evening in 1931 when she encountered the speedboat *Artemis,* a well known rumrunner. The *Artemis,* running totally darkened, was heading directly at the stern of the patrol boat at high speed with the apparent intention of ramming. As the collision of the two vessels became imminent the patrol boat fired a volley of machinegun fire into the onrushing *Artemis.* Seconds later the rumrunner slammed into the port quarter of the patrol boat carrying away strips of planking and part of the guard rail. As the speedboat sheared away she began laying down a heavy smoke screen in an attempt to obscure her escape. The CG 808 gave chase at top speed firing repeated volleys of machinegun fire into the *Artemis.* As the patrol boat began to close, the fleeing vessel made a sharp turn to port and engulfed the pursuing patrol boat in a dense cloud of black smoke which allowed the *Artemis* to make good her escape.

A quick message alerted the Chief of Staff, Destroyer Force, at New London of the incident. He secured permission to borrow a plane to patrol the Long Island coast and locate the rumrunner. Flying over Orient Point he spotted nearly a hundred persons carrying liquor up the beach from several beached skiffs, but the *Artemis* was nowhere in sight. Alerted by radio, patrol boats were able to converge on Orient Point and seize the contraband cargo.

The *Artemis* eventually was located undergoing repairs in a Port Jefferson shipyard and was seized. After a short retirement the notorious rumrunner found her way back into the rum trade.

On December 5, 1933, the Congress repealed prohibition, the noble experiment of the twenties died an ignoble death, and so closed another colorful chapter in the history of the Coast Guard's fight against smuggling. ⚓

Nautical Queries

The following items are examples of questions to be included in the new Chief Engineer and Master multiple choice examinations which are expected to be in use by September 1976.

Deck

1. You are running coastwise on a course of 275° T and you have a buoy bearing 9° on your starboard bow at 6 miles. You desire to leave the buoy to starboard at 2 miles off. What course should you steer?
   A. 256°.
   B. 265°.
   C. 275°.
   D. 286°.

2. On 18 June 1971, at 0800 zone time, you are in position 22°20′ north, 45°10′ west. You are en route to Southampton, England, and have determined that you have 1,895 miles remaining. At a speed of advance of 24 knots, what will be your E.T.A. local time and date?
   A. 1757 on 20 June 1971.
   B. 0617 on 21 June 1971.
   C. 1757 on 21 June 1971.
   D. 1817 on 21 June 1971.

3. You are in longitude 46° west. The GHA of Aries is 70° west. The SHA of a star is 32° west. The LHA of the star is
   A. 24°.
   B. 56°.
   C. 84°
   D. 148°.

4. You are in charge of cargo loading operations, and have been told by the chief mate to be sure that a certain lot of cargo classed as an "oxidizing material" be given deck stowage. What color label would you expect to see on this cargo?
   A. Green.
   B. Red.
   C. White.
   D. Yellow.

5. Your vessel is chartered under a time charter party. Under this type of charter party, your responsibility is
   A. solely to the owner, as under normal conditions.
   B. solely to the charterer for all matters pertaining to cargo and ship administration.
   C. to the owner for vessel administration and to the charterer for cargo operations and schedule.
   D. solely to the cargo shippers and consignees.

Engineers

1. If a radial piston hydraulic pump fails to deliver rated fluid volume, the
   A. pumping unit is worn.
   B. thrust rings are pitted.
   C. rotor bearings are worn.
   D. cylinder clearance is insufficient.

2. The peeling of boiler refractory associated with slagging is caused by the
   A. shrinkage of brickwork adjacent to slag coated refractory.
   B. chemical action of the slag on the firebrick surface.
   C. difference in the rate of expansion between the firebrick and slag coating.
   D. uneven heating of the brickwork during boiler warmup.

3. Pitting of reduction gear teeth is generally caused by
   A. breakdown of the lube oil antioxidation additives.
   B. loss of the oil film on gears that are otherwise mechanically perfect.
   C. fatigue failure of the gear metal under compressive stress.
   D. load concentrations in excess of the gear teeth design.

4. The basic control action of a magnetic amplifier depends upon
   A. variations in load inpedance.
   B. changes in inductance.
   C. type of core material.
   D. construction of the core.

5. The end joint formed by adjoining plates in a hull-plating strake is properly identified as a
   A. bracket.
   B. scarf.
   C. butt.
   D. seam.

Answers

Deck
1. B 2. C 3. B 4. D 5. C
Engineers
1. A 2. C 3. C 4. B 5. C.

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications of marine safety rules and regulations may be obtained from the nearest marine inspection office of the U.S. Coast Guard.* Because changes to the rules and regulations are made from time to time, these publications, between revisions, must be kept current by the individual consulting the latest applicable Federal Register. (Official changes to all Federal rules and regulations are published in the Federal Register, printed daily except Saturday, Sunday, and holidays.) The date of each Coast Guard publication in the table below is indicated in parentheses following its title. The dates of the Federal Registers affecting each publication are noted after the date of each edition.

The Federal Register will be furnished by mail to subscribers, free of postage, for $5.00 per month or $50 per year, payable in advance. The charge for individual copies is 75 cents for each issue, or 75 cents for each group of pages as actually bound. Remit check or money order, made payable to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

CG No.	TITLE OF PUBLICATION
101	Specimen Examinations for Merchant Marine Deck Officers (Chief Mate and Master) (1–1–74).
101–1	Specimen Examinations for Merchant Marine Deck Officers (2d and 3d mate) (10–1–73).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (4–1–72). F.R. 7–21–72, 12–1–72, 11–14–74, 6–18–75.
*115	Marine Engineering Regulations (6–1–73). F.R. 6–29–73, 3–8–74, 5–30–74, 6–25–74, 8–26–74, 6–30–75.
123	Rules and Regulations for Tank Vessels (1–1–73). F.R. 8–24–73, 10–3–73, 10–24–73, 2–28–74, 3–18–74, 5–30–74, 6–25–74, 1–15–75, 2–10–75, 4–16–75, 4–22–75, 5–20–75, 6–11–75, 8–20–75, 9–2–75, 10–14–75, 12–17–75, 1–21–76, 1–26–76, 2–2–76, 4–29–76.
169	Rules of the Road—International—Inland (8–1–72). F.R. 9–12–72, 3–29–74, 6–3–74, 11–27–74, 4–28–75, 10–22–75, 2–5–76, 3–1–76.
*172	Rules of the Road—Great Lakes (7–1–72). F.R. 10–6–72, 11–4–72, 1–16–73, 1–29–73, 5–8–73, 3–29–74, 6–3–74, 11–27–74, 4–16–75, 4–28–75, 10–22–75, 2–5–76.
174	A Manual for the Safe Handling of Inflammable and Combustible Liquids (6–1–75).
175	Manual for Lifeboatmen, Able Seamen, and Qualified Members of Engine Department (3–1–73).
176	Load Line Regulations (2–1–71). F.R. 10–1–71, 5–10–73, 7–10–74, 10–14–75, 12–8–75, 1–8–76.
182	Specimen Examinations for Merchant Marine Engineer Licenses (Chief Engineer and First Assistant.) (1–1–74).
182–1	Specimen Examinations for Merchant Marine Engineer Licenses (2d and 3d Assistant) (4–1–75).
184	Rules of the Road—Western Rivers (8–1–72). F.R. 9–12–72, 12–28–72, 3–8–74, 3–29–74, 6–3–74, 11–27–74, 4–16–75, 4–28–75, 10–22–75, 2–5–76, 3–1–76.
190	Equipment List (8–1–72). F.R. 8–9–72, 8–11–72, 8–31–72, 9–14–72, 10–19–72, 11–8–72, 12–5–72, 1–15–73, 2–6–73, 2–26–73, 3–27–73, 4–3–73, 4–12–73, 4–26–73, 6–1–73, 8–1–73, 9–18–73, 10–5–73, 11–26–73, 1–17–74, 2–28–74, 3–25–74, 4–17–74, 7–2–74, 7–17–74, 9–5–74, 10–22–74, 11–27–74, 12–3–74, 12–30–74, 1–15–75, 1–21–75, 2–13–75, 2–19–75, 3–18–75, 3–19–75, 4–9–75, 4–16–75, 5–1–75, 5–7–75, 6–2–75, 6–25–75, 7–22–75, 7–24–75, 8–1–75, 8–20–75, 9–23–75, 10–8–75, 11–21–75, 12–11–75, 12–15–75, 2–5–76, 2–23–76, 3–18–76, 4–5–76, 5–6–76.
*191	Rules and Regulations for Licensing and Certification of Merchant Marine Personnel (6–1–72). F.R. 12–21–72, 3–2–73, 3–5–73, 5–8–73, 5–11–73, 5–24–73, 8–24–73, 10–24–73, 5–22–74, 9–26–74, 3–27–75, 6–2–75, 7–24–75, 8–13–75, 12–11–75.
*200	Marine Investigation Regulations and Suspension and Revocation Proceedings (5–1–67). F.R. 3–30–68, 4–30–70, 10–20–70, 7–18–72, 4–24–73, 11–26–73, 12–17–73, 9–17–74, 3–27–75, 7–28–75, 8–20–75, 12–11–75, 5–6–76.
227	Laws Governing Marine Inspection (7–1–75).
239	Security of Vessels and Waterfront Facilities (5–1–74). F.R. 5–15–74, 5–24–74, 8–15–74, 9–5–74, 9–9–74, 12–3–74, 1–6–75, 1–29–75, 4–22–75, 7–2–75, 7–7–75, 7–24–75, 10–1–75, 10–8–75.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (4–1–73). F.R. 12–22–72, 6–28–73, 6–29–73, 8–1–73, 10–24–73, 12–5–73, 3–18–74, 5–30–74, 6–24–74, 1–15–75, 2–10–75, 8–20–75, 12–17–75, 4–29–76.
258	Rules and Regulations for Uninspected Vessels (5–1–70). F.R. 1–8–73, 3–2–73, 3–28–73, 1–25–74, 3–7–74.
*259	Electrical Engineering Regulations (6–1–71). F.R. 3–8–72, 3–9–72, 8–16–72, 8–24–73, 11–29–73, 4–22–75.
*266	Rules and Regulations for Bulk Grain Cargoes (5–1–68). F.R. 12–4–69, 8–20–75.
268	Rules and Regulations for Manning of Vessels (12–1–73).
293	Miscellaneous Electrical Equipment List (7–2–73.)
*320	Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (7–1–72). F.R. 7–8–72.
323	Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (9–1–73). F.R. 1–25–74, 3–18–74, 9–20–74, 2–10–75, 12–17–75.
329	Fire Fighting Manual for Tank Vessels (1–1–74).
439	Bridge-to-Bridge Radiotelephone Communications (12–1–72). F.R. 12–28–72, 3–8–74, 5–5–75.
467	Specimen Examinations for Uninspected Towing Vessel Operators (10–1–74).

CHANGES PUBLISHED DURING MAY 1976

CG–190 & 200, Federal Register of May 6.

*Due to budget constraints or major revision projects, publications marked with an asterisk are out of print. Most of these pamphlets reprint portions of Titles 33 and 46, Code of Federal Regulations, which are available from the Superintendent of Documents. Consult your local Marine Inspection Office for information on availability and prices.