



TREASURY DEPARTMENT
UNITED STATES COAST GUARD

Address reply to:
COMMANDANT (MVI-3)
U.S. COAST GUARD
WASHINGTON, D.C. 20226

5943/DANIEL PIERCE (Panamanian)
C-7 Bd
31 MAR 1967

Commandant's Action

on

The Marine Board of Investigation convened to inquire into the facts and circumstances surrounding the flooding and subsequent total loss of the SS DANIEL PIERCE (Panamanian) at Guanica, Puerto Rico on 13 July 1964

The record of the Marine Board of Investigation convened to investigate subject casualty has been reviewed and the record, including the Findings of Fact, Conclusions and Recommendations, is approved subject to the following comments.

REMARKS

1. Concurring with the Board it is concluded that the cause of the casualty was the loading of a cargo of sulfuric acid in a vessel designed and built for the carriage of petroleum products and therefore not equipped with cargo valves and fittings designed to resist the attack of the sulfuric acid that was being handled.
2. The generation of explosive hydrogen gas caused by the mixture of the acid and sea water was considered by the Civil Defense organization of the Port to be such a potential danger that for a period the civilian population in the vicinity of the loading berth was evacuated.
3. The Board in its Findings of Fact listed many of the regulations applicable to United States vessels carrying this cargo. A review of the circumstances of this casualty indicates that the regulations and safeguards applicable to a United States vessel carrying this dangerous cargo would not have allowed such a situation to develop.

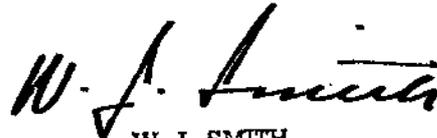


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4. The reference to Regulation 3 of Chapter VI of the International Convention for the Safety of Life at Sea, 1948 in Findings of Fact 19 is qualified to be applicable and limited to packaged cargoes. This interpretation is clarified by the regulation change implemented by the International Convention for the Safety of Life at Sea, 1960.

5. 46 CFR 98.10-45(f) mentioned in Findings of Fact 17 has been amended to require the prior authorization of Commandant (MMT) in lieu of Commandant (OPL) before a United States vessel is approved for the transportation of sulfuric acid in bulk.

6. A proposed regulation has been submitted to the Merchant Marine Council for their consideration. This would require any vessel carrying bulk cargoes having potential unusual risks, which include sulfuric acid, to advise the Coast Guard Captain of the Port or District Commander at least twenty-four (24) hours prior to arrival.



W. J. SMITH
Admiral, U. S. Coast Guard
Commandant

12 August 1966

From: Marine Board of Investigation
To: Commandant (MVI)

Subj: SS DANIEL PIERCE (Panamanian registry); flooding and subsequent total loss, without loss of life, at Guanica, Puerto Rico on 10 July 1964, while loading sulfuric acid; investigation of

FINDINGS OF FACT

1. On 10 July 1964 the SS DANIEL PIERCE, a tank vessel of Panamanian registry, moored at Ochoa Terminal, Guanica, Puerto Rico, to load a cargo of approximately two thousand tons of concentrated sulfuric acid. During the period 10 - 12 July, the vessel experienced difficulties. Her cargo became contaminated with salt water, in loading, and she began taking on water in all cargo tanks and started to sink. The vessel was moved from her berth to the flats in Guanica Harbor and grounded to prevent further sinking. She rests in that position at the present time.

2. The SS DANIEL PIERCE, a 391 foot steel tank vessel, riveted construction, of Panamanian registry of 4887 gross tons, was built at Wilmington, Delaware in 1921. The vessel is operated by the Thibodeaux Steamship Company, 60 E. 42 Street, New York, New York, and owned by Panama-Florida Shipping Line, Inc. of the Republic of Panama, and Nicholas Panas, 49 Rue des Olivettes, Nantes, France was her master. He holds a license as master, steam or motor vessel, any gross tons, issued by the Liberian Ministry of Mercantile Marine. The vessel is under classification 5¹ A1E (oil carrier) 1-64 for hull and classification 5² AMS 3-64 for machinery by the American Bureau of Shipping. She was last drydocked in December 1963 and had completed special survey no. 3 at Chicago, Illinois, in November 1963. The vessel is powered by a triple expansion reciprocating steam engine of 2400 H. P., with three single ended Scotch marine boilers of 200 psig designed working pressure. She had a provisional Safety Equipment Certificate issued 30 April 1964 by an ABS surveyor at Port-au-Spain, Trinidad. The vessel had a valid load line certificate issued by the ABS at New York on 28 November 1963, expiring 28 November 1967. The vessel's last Coast Guard Certificate of Inspection, issued at Chicago, Illinois, for a Great Lakes route, expired 6 April 1963 and the vessel was not operated during the 1963 season. On 27 November 1963 a Permit to Proceed to Montreal, Canada was issued and subsequently the vessel was transferred to Panamanian registry.

3. The SS DANIEL PIERCE had been a tank ship in the petroleum trade most of her long life. For about ten years prior to her acquisition by the present owners, she was owned and operated by Sinclair Oil Company in the petroleum trade, principally gasoline, on the Great Lakes. She was arranged with three tanks, port and starboard, forward of the forward pump room, then four tanks, port and starboard, aft of the pump room. In addition, she had "summer" tanks high in the wings outboard.

4. Her cargo loading and discharge piping system consisted of a typical loop suction main of approximately 10" diameter, flanged steel pipe running through both sides of the tanks and the pump room with isolating and suction valves at each tank and at the cargo pumps. The vessel was fitted with two steam reciprocating cargo pumps in the pump room so arranged as to be cross-connected for cargo discharge or ballasting from the sea as desired. The filling pipes on the upper deck were fitted with lines port and starboard, cross-connected in a loop system, with connections and isolation valves such that cargo could be loaded into drop lines port and starboard leading directly downward in the pump room and connecting with the suction lines, bypassing the cargo pumps, gravitating into the various cargo tanks. The cargo ends of the two cargo pumps were brass trimmed, that is, the cylinder liners, pump piston rods and suction and discharge valves were of brass composition or brass plated. The internal valves of the pumps were of a fiber composition and the valve seats of bronze. The various valves in the cargo piping system were of cast iron or steel with bronze gates, seats, and guides. The packings and gasket materials were of flax and plant fiber sheet.

5. For three trips prior to the ill-fated stop at Guanica, the DANIEL PIERCE had carried caustic soda from the U. S. Gulf Coast area to Caribbean ports. On her last voyage she had carried mixed petroleum products including gasoline and kerosene from Trinidad to Barbados, Martinique, and Guadeloupe. The vessel had then proceeded in ballast from Guadeloupe to Guanica, Puerto Rico. Enroute to Guanica, the prospective acid tanks 1-2-3, port and starboard, had been machine washed with sea water. The oily ballast was discharged on the day before arrival at Guanica, using the main cargo pumps on pairs of tanks in turn until all the forward tanks had been pumped as dry as possible. The pump suction was then maintained on the cargo lines for approximately ten minutes with all tank suction valves closed in an attempt to dry out the lines. After this, the Chief Mate entered all the tanks with a small portable air driven pump and pumped out all remaining pockets as dry as possible. No attempt was made to dry any water pockets that the portable air pump could not remove nor were the cargo lines drained after the tank cleaning operation that had been carried out in tanks 1-2-3, port and starboard.

6. The DANIEL PIERCE had arrived at Guanica on the morning of 10 July 1964. The forward tanks were inspected by Mr. Santos of Caribe Nitrogen Corporation, the shippers of the sulfuric acid, and found safe for loading, which commenced shortly after noon on 10 July. Mr. Santos had never been on a ship before and his inspection was made by looking through the manholes, from on deck, with the aid of a flashlight. Also, this was the first water-borne cargo that the chemical plant had ever loaded. Neither the Master nor any member of the crew had carried this type cargo before nor did the owners or operators offer any guidance. Loading was started using a four inch hose from the dock, reduced to suit the 10" cargo lines of the vessel. Pressure was estimated at 10 lb. psi. Several hours later, a smoky vapor was noticed emanating from the pump room and because of the strong acid fumes, no one was able to enter the pump room to check conditions. The vent fans were started and the shore people assured the ship's officers that it was likely just a little acid leaked into the bilge water and there was nothing to be concerned about. Loading was continued throughout 10 and 11 July. At 2000 on 11 July, loading was stopped due to liquids noted rising in the pump room. Analyses indicated 55%

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concentrated sulfuric acid. At 2200 the chief mate went into the pump room with an air mask and reported shutting all valves in the pump room. The water and acid continued to rise in the pump room and by midnight it covered the pumps and was about six feet deep. By this time the vessel had also developed a seven to eight degree starboard list which was corrected by ballasting No. 1 deep tank port.

7. At 0600 on 12 July the vessel was moved aft on the Ochoa Dock to permit loading No. 2 tank starboard through the expansion trunk. At this time there was acid in No. 1 port (527 barrels), No. 2 starboard (243 barrels) and No. 1 starboard (1070 barrels). The concentration of acid in the pump room had dropped to 35% and the high chloride content indicated probable contamination with salt water.

8. At noon on 12 July attempts to pump out the pump room began, utilizing a small air driven pump supplied by the ship. This pump was rapidly attacked by the dilute acid mixture and rendered inoperative. At about 1245 the cargo which was loaded into No. 1 starboard was discovered to be contaminated so that the concentration had dropped to 59% sulfuric acid.

9. There was a small loading hose leak at 1635 on 12 July and a sizeable rupture at 1935 which resulted in considerable noise and smoke and caused some of the crew to panic and run ashore. At 2000 that night a mixture of 32% sulfuric acid and water was discovered in No. 3 port tank and the master ordered loading stopped. Meanwhile, an electric driven pump furnished by Caribe Nitrogen was found unsatisfactory for pumping out the pump room due to the open motor on the pump and the high explosive test of pump room vapors. As the vessel now began to list to port due to the rising acid solution in No. 3 port tank, list was corrected by ballasting No. 4, summer tank, starboard. Meanwhile, the ship's crew began repairing a spare steam stripping pump with the intention of rigging same to pump out the pump room. About this time the vessel began to lose steam pressure on her boilers allegedly due to contamination of the bunkers with acid. The engineers cleaned the fuel oil strainers and shifted suction to another settler and were able to maintain sufficient pressure to keep the plant going. The allegation of fuel oil contamination by acid was unsubstantiated.

10. At 1000 on 13 July the master, fearing the vessel would settle to the bottom alongside the dock, ordered steam up and by 1155 had sufficient power to move the vessel to her present location. Once aground the after tanks were ballasted to hold the vessel in place.

11. Salvage efforts were undertaken by Puerto Rico Lighterage Company on 16 July 1964. Eventually as many as five pumps of up to 6" diameter suction were employed and failed to lower the water level in the pump room of the DANIEL PIERCE substantially. Salvage attempts were discontinued on 20 July 1964 at the request of the owners.

12. The underwriters employed their own surveyor and he has recommended that the DANIEL PIERCE be refloated and towed to drydock in San Juan in order that the cause of this casualty might be determined more exactly. Thus far, this has not been done.

13. 46 CFR 98.10-1(b) requires any U. S. vessel carrying sulfuric acid in bulk to be inspected and certificated in accordance with the provisions of Subchapter D (Tank Vessels) or Subchapter I (Cargo Vessels). The latter allows carriage of concentrated sulfuric acid in unlined gravity type tanks, based on corrosion properties of the acid mixture. 46 CFR 98.10-10 requires cargo tanks to be designed and tested to meet the rules of the ABS for a head of water at least eight feet above the tank top or the highest level the lading may rise, whichever is greater. It also requires gooseneck type vents closed with flame screens. Where pump suction is led from the bottom of a tank, the Commandant may permit same provided filling and discharge lines are fitted with shut off valves located above the main deck or operated therefrom. 98.10-45(b) requires cargo pumps, piping, valves, fittings, and flanges to be made of material resistive to attack by the sulfuric acid to be carried.

14. The exact extent of damages to the SS DANIEL PIERCE has not been determined. Divers have found rivets falling out, principally in the area of the former bilge keel attachments. These rivets, recovered from the bay bottom, show considerable corrosion as the inner head and rivet body have severely deteriorated. Some acid has been found as far aft as No. 8 tanks on 14 July.

15. The U. S. Regulations require, in 46 CFR 146.23-35, that sulfuric acid in bulk may be carried only in inspected and certificated cargo barges, tank barges, or cargo vessels and refers to Part 98 of Subchapter I. In addition, 46 CFR 146.02-13 requires the master of any ocean-going vessel about to enter a U. S. port with dangerous cargo on board, to inspect the vessel for fire or any other hazardous condition and report same to the appropriate Coast Guard authority.

16. 46 CFR 98.10-45(d) requires use of non-sparking tools for loading and unloading operations. 46(e) requires a water hose to be connected and ready for immediate use in the event of leakage or spillage.

17. 46 CFR 98.10-45(f) states that tanks in U. S. vessels approved for the transportation of sulfuric acid in bulk shall not be used for the transportation of any other commodity, except upon prior authorization by the Commandant (OPL).

18. 46 CFR 98.10-50(b) requires retesting of unlined gravity type tanks every four years, after a U. S. vessel is eight years old.

19. Regulation 3 of Chapter VI of the 1948 Convention for Safety of Life at Sea, of which Panama is a signatory, would classify sulfuric acid as, "dangerous goods" of category (iii) or (vi), and requires a written

statement by the shipper correctly describing the shipment by classification, requires the ship to list the dangerous goods on board, and requires each Contracting Government to issue, or cause to be issued, detailed rules for the packing and stowage of dangerous goods when carried with other commodities, and for the stowage of various categories of dangerous goods.

20. 33 CFR 126.15 outlines the conditions to be met in order to attain the general permit granted by 33 CFR 126.27, and the designation as a waterfront facility by 126.13.

21. 33 CFR 126.27 issues a general permit for handling, storing, loading, discharging, or transporting of dangerous articles and substances at designated waterfront facilities subject to certain conditions, the principal being that the standards required by 126.15 be met; 126.13 is a general designation as a waterfront facility for the handling, stowage, loading and discharge of dangerous cargo at those facilities which meet the standards of 126.15. Such permit is in force at all times unless and until the Captain of the Port terminates or suspends the general permit when he deems that the security or safety of the port or vessels or waterfront facilities therein so requires. The Ochoa Chemical Company dock at Guanica was a properly designated waterfront facility and was operating under the general permit granted by the regulations.

22. The following are some of the physical, chemical, and hazardous properties of sulfuric acid:

As a fire hazard, the acid itself is not flammable, but in its higher concentrations, may cause ignition by contact with combustible materials. A highly flammable gas (hydrogen) is generated by the action of the acid on most metals.

Concentrated sulfuric acid acts less rapidly upon metals to displace hydrogen than the dilute acid. This difference is caused by the smaller degree of ionization of the concentrated acid, and also by the slight solubilities of the sulfates of some of the metals in concentrated solutions of the acid; if the sulfate that first forms does not dissolve, it may cover the metal, thus preventing further action. It should be noted, however, that some metals---lead, for example---dissolve more readily in concentrated acid than in dilute, because their sulfates are more soluble in the solutions containing higher concentrations of acids.

It also removes the elements of water (hydrogen and oxygen) from certain compounds containing them. This effect is especially pronounced if the compounds contain the two elements in the same proportion in which they occur in water. Paper, cotton, and wood which consist essentially of cellulose $(C_6H_{10}O_5)_x$, are charred by sulfuric acid because they are dehydrated by it.

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Because of the vigorous affinity of H_2SO_4 for water, the concentrated acid is also a powerful dehydrating agent. In contact with wood, paper, cotton, or other cellulose, for example, it causes rapid charring by removal of the elements of water from the cellulose to leave behind free carbon.

When water is poured into concentrated sulfuric acid, the heat of reaction is so high that some of the water may boil before it mixes.

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List of Witnesses Interviewed:

1. Captain Nicholas Panas, 49 Olivettes Street, Nantes, France
2. Chief Engineer John Psaridis, Frankeadon 5, Pireaus, Greece
3. Pumpman Errol Nicholas, 74 Bombay Street, St. James, Trinidad
4. Chief Officer Emannual Raphaelakis, St. Nicholas Island of Crete, Greece
5. Mr. Pedro Juan Vargas, Director of Civil Defense, Guanica, Puerto Rico
6. Mr. Manuel Pedrigo Santos, Calle Viente Cinco Julio, 53, Yauco, Puerto Rico
7. Mr. P. Rhys, P. O. Box 32, Guanica, Puerto Rico
8. Mr. Daniel Walsh, P. O. Box 32, Guanica, Puerto Rico
9. Mr. Jose Ruiz Vasquez, 141 (unintelligible), Guanica, Puerto Rico
10. Mr. Oliverio Hinojosa, Plaza Guanica, Guanica, Puerto Rico
11. Mr. Lewis F. Colon, 30 Third Street, Yauco, Puerto Rico
12. Mr. Nelson Bassat, 20 South Rodriguez Street, Guanica, Puerto Rico

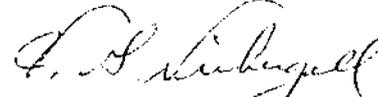
CONCLUSIONS

1. It is concluded that the concentrated sulfuric acid attacked the packings and gasket materials used in the cargo piping systems of the vessel, thus destroying the tightness and integrity of these systems. Further, it is likely that the concentrated sulfuric acid also acted very quickly against the brass trim of the valves, further destroying their ability to stop and hold the cargo intact. Additionally, the residues of previous cargoes of caustic soda and water washing would have removed any buildup of scale and rust in the cargo piping, thus creating thin spots or even small holes in the bottom side of the pipes which could not have been readily detected after the machine washing and pumping out prior to loading the acid cargo.
2. With the cargo initially being loaded through the deck piping and through the drops to the suction piping passing throughout the tanks and pump room, this provided ready means for the acid cargo to penetrate and contaminate all the tanks and the pump room. Any water remaining in the lines would have diluted the product and only hastened the eventual wastage and flooding.
3. It is believed that the flooding of the vessel probably occurred because the acid cargo penetrated through the valves, packings, and gaskets of the sea suctions and thus provided ready means for the ingress of sea water into the pump room and eventually throughout the entire cargo space of the vessel by progressive flooding through the cargo suction piping.
4. The above processes were accelerated by the heat of the reaction as flooding progressed and allowed further mixing of the acid cargo and the sea water.
5. As the cargo was contaminated and diluted by the flooding sea water, the rate of reaction and attack against the valve and piping materials and hull materials was rapidly increased, since the rate of attack against metals increases with heat and as the purity of sulfuric acid is reduced below 98% into the lesser ranges from 77.5% to 50% and lower. Evidence is available in the record from several sources that dilute acid attacks both cuprous and ferrous metals much more rapidly when in the middle ranges of concentration. From the condition of the rivets recovered by divers, it can be concluded that extensive damage has occurred throughout the midbody of the vessel. There are undoubtedly many acid eaten bottom and side plates, bulkheads, frames, internals, and fastenings. It is believed the vessel is a constructive total loss.
6. It is doubtful that the methods and means used by the ship's personnel to empty the tanks and cargo lines were completely effective and some ballast water undoubtedly remained in the piping system and in pockets in the tanks after machine washing and pumping out. This small amount of water provided the initial dilution of the cargo and probably accounted for the smoke and vapors first noticed shortly after loading commenced.

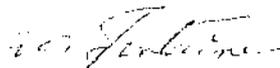
7. If loading had been stopped at the first indication of trouble when smoke and vapor emanated from the pump room and expert advice had been sought, it is probable that the vessel would not have flooded and could have been saved. In this respect, it appears that the shippers exhibited a rather casual attitude in notifying the ship's officers that there was nothing to be concerned about at that time and led them into a false sense of security regarding the handling and stowage of concentrated sulfuric acid.
8. There is evidence that the shipper was derelict in presuming that the ship was of a type and design fit for the transportation of concentrated sulfuric acid and not providing the ship's officers with the information regarding the hazardous characteristics of the cargo to be loaded whereby they might have determined that the vessel was not fit for the loading and transportation of the cargo for which she was chartered.
9. Since none of the ship's officers had ever carried a cargo of sulfuric acid before and had no knowledge of its characteristics, except that it was dangerous, it is reasonable to expect that when they learned that this was the first cargo of sulfuric acid to be shipped by this facility that they should have been more concerned and inquisitive about this new cargo they were to carry; yet this was not done.
10. There is no evidence of a deliberate intent to cause the loss of the vessel on the part of any of the parties concerned with this casualty. None of the personnel of the ship were serving under the authority of licenses or documents issued by the U. S. Coast Guard.
11. There is no evidence of any violation of law or regulation administered by the U. S. Coast Guard and pertaining to vessels or shore facilities having been committed.
12. There is no evidence that any personnel of the Coast Guard or other government agency or any other person contributed to the casualty.
13. Since this casualty occurred, action has been taken by the Commandant, U. S. Coast Guard, to disseminate information concerning the lessons learned from this casualty to the shipping industry.

RECOMMENDATIONS

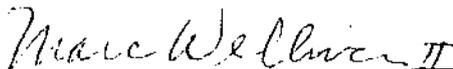
1. Inasmuch as no violation of law or regulation occurred; the information from lessons learned from the casualty has been published; and since nothing will be gained by further action, it is recommended that the case be closed.



V. G. NIEBERGALL
Captain, USCG
Chairman, Marine Board



A. A. FONTAINE
Commander, USCG
Member, Marine Board



MARC WELLIVER II
Commander, USCG
Member and Recorder, Marine Board

- Encls: (1) Commandant, USCG, ltr MVI-3, file 5943/DANIEL PIERCE, 24 July 1964; precept ordering Marine Board of Investigation
- (2) Report of Marine Casualty, CG-2692, DANIEL PIERCE, 14 July 1964 (original forwarded by OCMI Miami ltr 5941, 1 July 1965)
- (3) Transcript of testimony with exhibits, DANIEL PIERCE
- (4) General arrangement sketch, cargo tanks and piping, DANIEL PIERCE