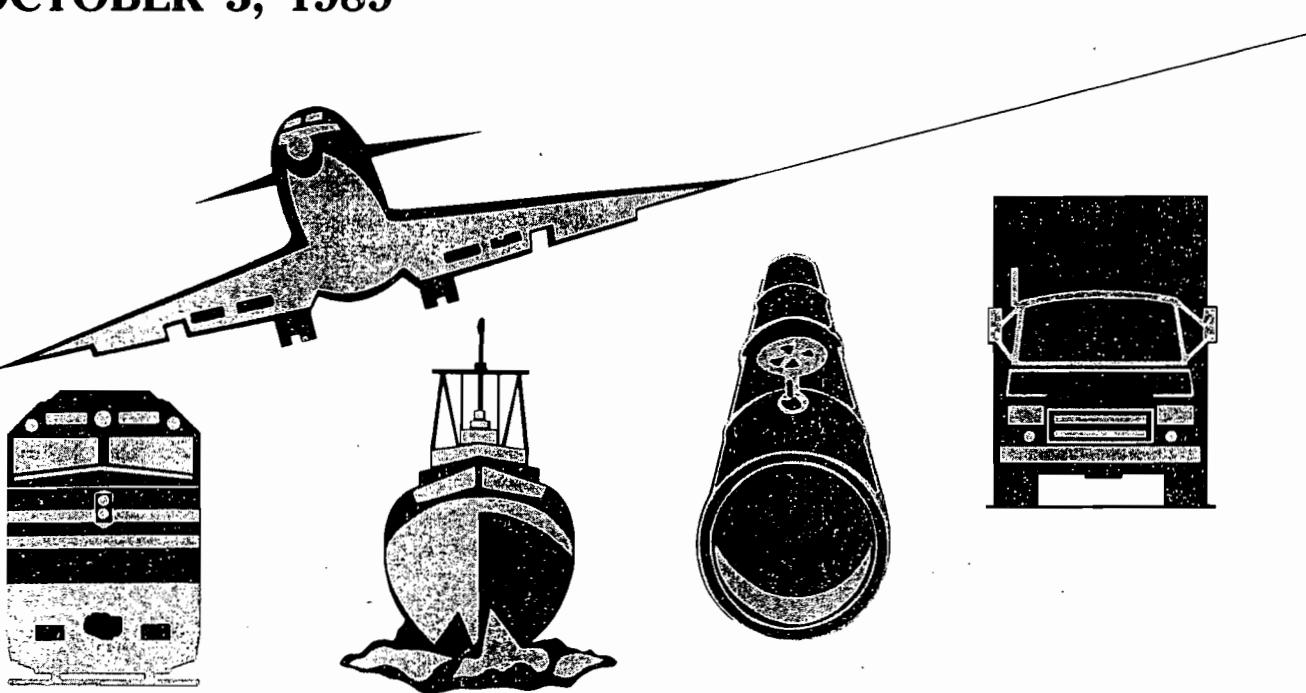


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NTSB/PAR-90/02

NATIONAL TRANSPORTATION SAFETY BOARD

PIPELINE ACCIDENT REPORT

FIRE ON BOARD
THE F/V NORTHUMBERLAND AND
RUPTURE OF A NATURAL GAS
TRANSMISSION PIPELINE
IN THE GULF OF MEXICO
NEAR SABINE PASS, TEXAS,
OCTOBER 3, 1989



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16. Abstract <p>This report explains the fire on board the U.S. fishing vessel NORTHUMBERLAND and rupture of a natural gas transmission pipeline in the Gulf of Mexico offshore from Sabine Pass, Texas, on October 3, 1989. The safety issues discussed in the report are (a) the adequacy and enforcement of Federal and State regulations pertaining to submerged pipelines; (b) the potential hazard of submerged pipelines to fishing operations; (c) the marking of submerged pipelines on navigation charts; (d) the need to determine the number and location of submerged pipelines; and (e) emergency preparedness planning of offshore pipeline operators and producers, and emergency response agencies. Safety Recommendations were issued to the Zapata Haynie Corporation, Natural Gas Pipeline Company of America, U.S. Department of Transportation, Research and Special Programs Administration, U.S. Coast Guard, U.S. Department of the Interior, Minerals Management Service, U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration, Interstate Natural Gas Association of America, American Gas Association, American Public Gas Association, American Petroleum Institute, National Fish Meal and Oil Association, the Louisiana Shrimp Association, and the National Council of Fishing Vessel Safety and Insurance.</p>			
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EXECUTIVE SUMMARY

On October 3, 1989, the United States fishing vessel NORTHUMBERLAND struck and ruptured a 16-inch-diameter natural gas transmission pipeline about 1/2 nautical mile offshore in the Gulf of Mexico, and about 5 1/3 nautical miles west of the jetties at the entrance to Sabine Pass, Texas. Natural gas under a pressure of 835 psig was released. An undetermined source on board the vessel ignited the gas, and within seconds, the entire vessel was engulfed in flames. The fire on the vessel burned itself out on October 4. Leaking gas from the pipeline also continued to burn until October 4. Of the 14 crewmembers, 11 died as a result of the accident.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of Natural Gas Pipeline Company of America to maintain the pipeline at the burial depth required by the permit issued by the U.S. Army Corps of Engineers. Contributing to the accident was the failure of the Office of Pipeline Safety of the Research and Special Programs Administration, after its 1977 study, to require pipeline operators to inspect and maintain submerged pipelines in a protected condition.

The following safety issues are discussed in this report:

1. the adequacy and enforcement of Federal and State regulations for the maintenance, inspection, surveillance, and protection of submerged pipelines;
2. the need for commercial fishing vessel operators to recognize submerged pipelines as a potential hazard to fishing operations;
3. the marking of submerged pipelines on large scale navigation charts;
4. the knowledge of U.S. Coast Guard Captains of the Port of the number, type, location, and operator of all submerged pipelines within their particular zones; and
5. emergency preparedness planning of offshore pipeline operators with emergency response agencies and with offshore producers.

Recommendations concerning these issues were made to the Zapata Haynie Corporation, the Natural Gas Pipeline Company of America, the U.S. Department of Transportation, the Research and Special Programs Administration, the U.S. Coast Guard, the Minerals Management Service, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration, the Interstate Natural Gas Association of America, the American Gas Association, the American Public Gas Association, the American Petroleum Institute, the National Fish Meal and Oil Association, the Louisiana Shrimp Association, and the National Council of Fishing Vessel Safety and Insurance. Interim recommendations were also issued to the Department of Transportation and the Department of the Interior.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

PIPELINE ACCIDENT REPORT

FIRE ON BOARD THE F/V NORTHUMBERLAND
AND RUPTURE OF A NATURAL GAS TRANSMISSION PIPELINE
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OCTOBER 3, 1989

INVESTIGATION

The Accident

On October 2, 1989, about 4 a.m.,¹ the fishing vessel NORTHUMBERLAND departed Cameron, Louisiana, to begin a 5-day fishing trip in the Gulf of Mexico. The vessel was owned and operated by the Zapata Haynie Corporation (Zapata) and was registered in the United States. After departing Zapata's fish processing plant at Cameron, the vessel conducted purse seine fishing² operations for menhaden³ between High Island (HI) and Sabine Pass, located in Texas State waters between 3/4 mile and 1 mile offshore. The master anchored the vessel for the night in a position about 2 1/2 to 3 miles west of the Sabine jetties and about 1 mile offshore.

The vessel had a crew of 14: 1 master, 1 mate, 1 pilot, 1 chief engineer, 1 second engineer, 1 cook, and 8 fishermen. The master was responsible for the vessel at all times. The master was also in charge of one of the purse boats during fishing operations. The mate did not stand a navigation watch, but was in charge of the second purse boat during fishing operations and the other activities on deck. The pilot remained on board the vessel during fishing operations and maneuvered the vessel while the purse boats were deployed. The pilot was a watchstander and a helmsman who shared navigation responsibilities with the master. The pilot was also responsible for keeping the fishing log that detailed the quantity, location, and other information about each catch. The engineers were responsible for the operation and maintenance of all the machinery on board the vessel and were on call at all times when the vessel was underway.

¹ All times are central daylight savings time.

² Purse seine fishing is conducted using two self-propelled purse boats that are deployed from a mother vessel. The purse boats carry and set a large net in the water to encircle and trap a school of fish. When the fish are entrapped, the net is hauled in from the purse boats, concentrating the fish into a smaller and smaller area. After the mother vessel maneuvers alongside the net, the fish are pumped aboard and directed into refrigerated holds. This cycle is known as a "set."

³ Menhaden is a herring-like fish about 8 inches long and is found in shallow waters in the Gulf of Mexico and the Atlantic Ocean. It is used in the production of animal feed and fish oil.

On October 3, between 6:30 and 6:45 a.m., the vessel weighed anchor and fished between Sabine Pass and HI with two other Zapata fishing vessels, the TIGER SHOALS and the SMITH ISLAND. The three vessels were working with the pilot of a spotter plane (also owned by Zapata) who directed the vessels to the schools of fish.

The crew made five sets that day, then took the purse boats up into the davits and secured them. The last set, completed about 5:45 p.m., was conducted slightly more than 1/2 mile offshore and about 5 1/3 miles west of the Sabine jetties (figure 1).

Once the last set was completed, the master radioed the pilot of the spotter plane to ask where the vessel should proceed next and was told to head offshore. The master later estimated that the vessel was in 9 to 11 feet of water. The master began backing the NORTHUMBERLAND from a northerly heading to bring the bow around to a southeasterly heading. With the bow pointing northeasterly, the vessel, as it was moving backward at 2 to 3 knots, struck and ruptured the 16-inch natural gas transmission pipeline owned by Natural Gas Pipeline Company of America (NGPL). The master felt the vessel come to a jarring stop that rattled the windows of the pilot house. He heard an immediate explosion and, when looking aft, observed the entire stern, including the afterhouse, engulfed in flames with the flames moving forward rapidly.

According to the master, most of the crew was in or near the afterdeck house when the explosion occurred. The only fisherman to survive stated that he and two other fishermen were washing at the faucet located on the port side of the forward deckhouse. The master and the pilot, who both survived the accident, were in the pilothouse. The pilot and the only surviving fisherman later stated they felt an impact followed immediately by a single explosion.

According to the master, he told the pilot, who was on the starboard side of the pilothouse, "to get out" as the master proceeded out the port doorway of the pilothouse. The master moved forward and down the ladder to the foredeck, where he found the mate and one or two other crewmembers jumping overboard. The master then climbed over the port side of the bow and entered the water. He had no flotation device with him because he kept his personal life preserver in the chart room aft of the pilot house and did not have enough time to retrieve it. The master later stated he did not notice if any of the crewmembers who entered the water from the foredeck were wearing flotation devices.

The pilot attempted to leave the pilothouse through the starboard doorway, but was driven back by flames. He ran across the pilothouse to the port doorway and jumped into the water from the bridge. The fisherman who survived and another fisherman also jumped overboard on the port side of the vessel. The surviving fisherman was wearing rubberized bib overalls, rubber boots, and a water skiing flotation belt worn around the waist. Once in the water, he kicked off his boots, took off the overalls, and pulled the flotation belt up under his arms. He later stated these actions aided him somewhat in staying afloat. He also stated that one of the two fishermen

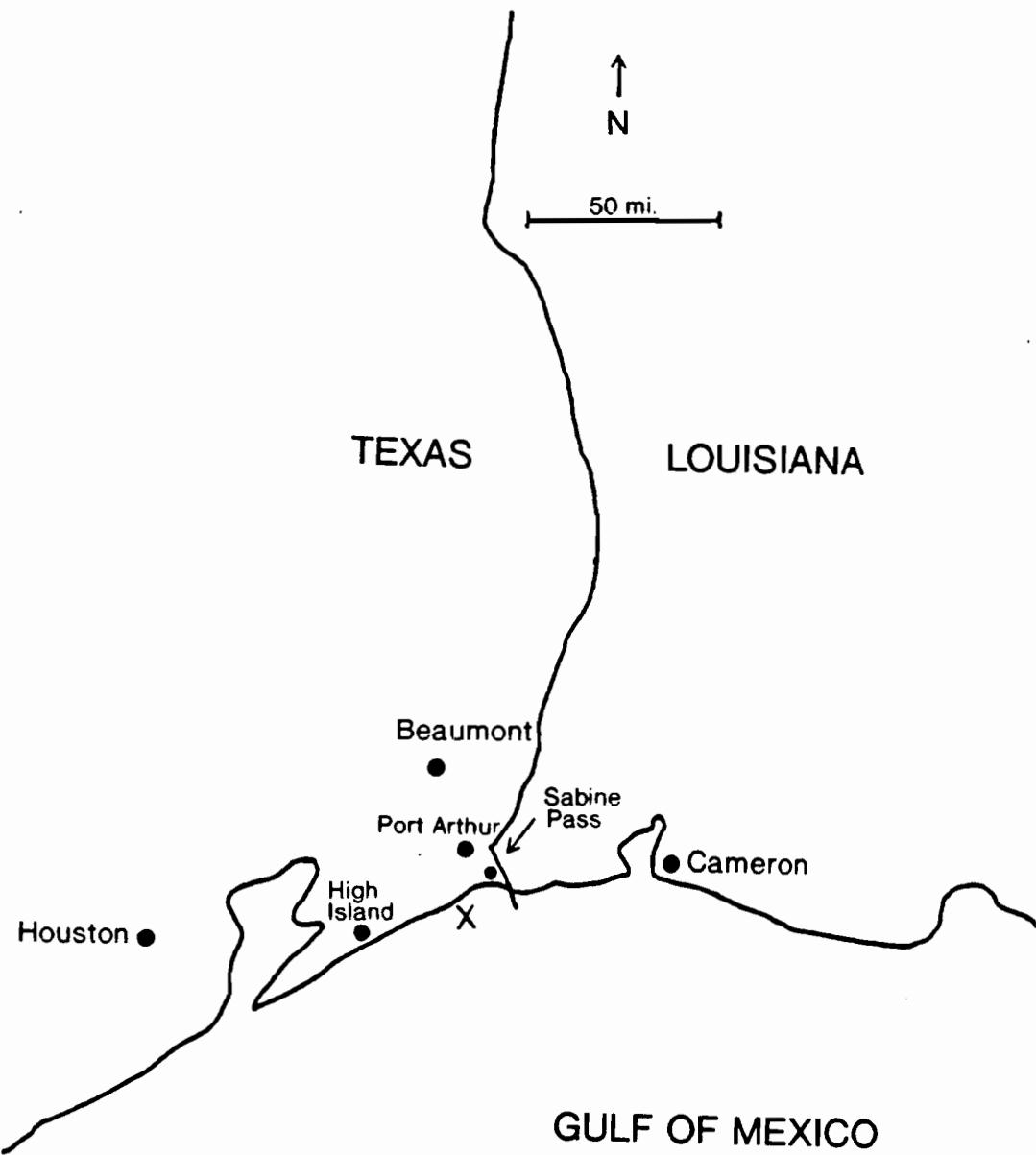


Figure 1.--Accident location (marked by "X").

who had been with him at the faucet entered the water and was "swimming real good." According to the surviving fisherman, this other fisherman was not wearing a flotation device.

From his position in the water, the master saw the pilot and a crewmember in the water with him. The master later stated that the crewmember appeared to be struggling to keep afloat. The master unsuccessfully attempted to assist the crewmember; however, the crewmember was displaying signs of panic and kept dragging the two of them underwater. The pilot later stated that he saw "several" crewmembers struggling in the water, including the cook and the second engineer. The fisherman who survived saw the master, pilot, mate, cook, and three other fishermen in the water after the explosion. He also stated that all were alive when he first sighted them. According to the surviving fisherman, the mate was burned but was wearing a life preserver. The surviving fisherman saw the mate swimming away from the vessel when the mate appeared to "give up" and drown. The surviving fisherman stated that the cook appeared to be afraid, but did not appear to be burned or otherwise injured. While the surviving fisherman was attempting to reach him, the cook also drowned.

Emergency Response

Notification and Initial Response.--The fire was noticed almost immediately by the pilot of Zapata's spotter plane, operating about 1 1/2 miles south of the NORTHUMBERLAND. The spotter pilot first notified the masters of the TIGER SHOALS and the SMITH ISLAND and the Zapata dispatcher in Cameron. The spotter pilot then flew toward the NORTHUMBERLAND. The SMITH ISLAND got underway immediately and its purse boats, which had not been taken up, followed under their own power. The TIGER SHOALS, because of its distance from the NORTHUMBERLAND, did not respond.

When the spotter plane arrived on scene, the pilot circled the NORTHUMBERLAND looking for survivors in the water. On his second pass, the pilot saw one survivor off the port stern of the vessel. He called Sabine tower⁴ and Petroleum Helicopters, Inc. (PHI), in Sabine Pass for additional help. PHI advised the spotter pilot that a helicopter was on the way.

About 6:00 p.m. a pilot for Evergreen Helicopter Service heard an explosion and also saw a white smoke cloud as he stood near his helicopter at the Evergreen landing site in Sabine Pass. He subsequently saw flames that reached about 100 feet in height. He decided to investigate the source of the fire by taking off in his helicopter; four other Evergreen employees accompanied him.

When the Evergreen helicopter arrived on scene about 6:05 p.m., the pilot noted the bow of the NORTHUMBERLAND extending from the fire ball that

⁴ Sabine tower is the call sign of a VHF UNICOM radio facility operated by Petroleum Helicopters, Inc. at its Sabine Pass base. The facility provides information on known airborne traffic within a 10-nautical-mile radius to participating aircraft entering the area.

was engulfing the after half of the vessel. He began to look for survivors and saw four persons in the water. The pilot immediately contacted PHI by radio, briefed them on the situation and requested that they notify the Coast Guard. He later stated that none of the four persons was wearing a life preserver.

Coast Guard Station Sabine, the operational unit having search and rescue responsibilities for the area, was notified at 6:00 p.m. by telephone and by an FM radio call from the master of the SMITH ISLAND about an explosion of a vessel west of the Sabine jetty. Two search and rescue vessels from Station Sabine, CG 41374 (a 41-foot patrol boat) and CG 213504 (a rigid hull, inflatable boat), were underway at 6:19 p.m. and 6:24 p.m. A helicopter from the Coast Guard air station in Houston, Texas, was also airborne at 6:30 p.m.

At 6:05 p.m. the Zapata dispatcher notified the watchstander at the Coast Guard Marine Safety Office (MSO) in Port Arthur, Texas, of the accident. The MSO watchstander contacted Station Sabine about 6:10 p.m. and was informed that Station Sabine was aware of the accident, and that search and rescue units were being dispatched. Between 7:05 and 7:30 p.m. various officers at the MSO were notified, including the Commanding Officer who was also the Captain of the Port and the Officer in Charge, Marine Inspection, for the Port Arthur zone.

Rescue of the Crewmembers.--After sighting the four survivors, the Evergreen helicopter pilot decided to assist the NORTHUMBERLAND's pilot, the survivor who appeared to be in the most distress. The Evergreen helicopter hovered about 10 feet above the water so that an inflatable liferaft could be dropped to the pilot. The raft landed about 10 to 20 yards from the pilot who was unable to swim to it. One of the Evergreen employees on the helicopter jumped into the water and helped the pilot into the raft.

By this time the PHI helicopter arrived on scene; however, only two survivors remained. Because the Evergreen helicopter had only one liferaft left, the Evergreen pilot asked the PHI pilot to throw liferafts to the two survivors, the master of the NORTHUMBERLAND and a fisherman. The PHI helicopter dropped a liferaft to each man, and the master and the fisherman were able to enter the liferafts without assistance. After the master, pilot, and surviving fisherman were all in liferafts, the Evergreen pilot began to search for additional survivors but found none.

The SMITH ISLAND had stopped about 1 mile from the NORTHUMBERLAND where the master of the SMITH ISLAND boarded one of the purse boats. The two purse boats from the SMITH ISLAND proceeded toward the three rafts. At 6:34 p.m. CG 41374 arrived on scene and overtook the two purse boats. CG 41374 proceeded to the liferaft with the NORTHUMBERLAND pilot and the Evergreen employee, and took them on board. The purse boats proceeded to the two other liferafts and picked up the master and fisherman from the NORTHUMBERLAND. CG 213502 arrived on scene at 6:49 p.m. and began a search for additional survivors. At 6:52 p.m. Coast Guard helicopter 6590 was onscene. The pilot from the NORTHUMBERLAND was transferred from CG 41374 to the Coast Guard

helicopter about 7:05 p.m. CG 41374 then joined the search for additional survivors.

Meanwhile, an air ambulance helicopter from the Baptist Memorial Hospital in Beaumont, Texas, was dispatched (about 6:30 p.m.) and landed on the beach about 1/2 mile from the NORTHUMBERLAND. The purse boats brought the master and the surviving fisherman from the NORTHUMBERLAND to the beach where the air ambulance helicopter had landed. The Coast Guard helicopter also landed on the beach to pick up a flight nurse from the air ambulance helicopter, and immediately proceeded to the Baptist Memorial Hospital, arriving about 7:26 p.m. After the air ambulance pilot and a second flight nurse verified that no other survivors had been found, the air ambulance helicopter departed directly for the Baptist Memorial Hospital with the master and surviving fisherman.

Search efforts continued with additional sorties by Coast Guard helicopters and search and rescue vessels. A search by foot of the shoreline was also conducted by Coast Guard personnel and local volunteers. All the remaining victims were found over the next 4 days, including two who were found on the NORTHUMBERLAND.

After the accident, the MSO established a safety zone around the vessel and broadcast local notices to mariners about the safety zone.

Pipeline Company Notification.--The Port Arthur Fire Department notified NGPL's Gas Control monitoring center (Gas Control) at corporate headquarters in Lombard, Illinois, about 6:45 p.m. that a vessel possibly had struck NGPL's pipeline, and was on fire. Gas Control recommended that the fire department contact the superintendent of NGPL's Port Arthur district. NGPL later stated that the fire department did not have sufficient information for Gas Control to positively identify any company facilities involved.

About 6:50 p.m. the district superintendent of NGPL's Port Arthur district received a telephone call at home from an NGPL employee who, in turn, had been contacted by a pilot from a local helicopter company. The pilot had told the NGPL employee that a vessel was on fire south of NGPL's Sabine Pass station (also known as compressor station 344 or CS 344), and was curious if NGPL's pipeline was involved (figure 2). While the district superintendent was on the telephone with his employee, he received a call-waiting signal for a second incoming call. He answered the second telephone call, which was from the Port Arthur Fire Department advising the superintendent that there had been an explosion and fire in the area where NGPL's pipeline is offshore from Sabine Pass.

The district superintendent then contacted Gas Control for a check of the system pressure and flow rates at CS 344, the monitoring point closest to the reported accident location. Gas Control advised the superintendent that the pipeline pressure was 485 psig (pounds per square inch gage) with zero flow. The superintendent responded to Gas Control that those readings were not normal and that he was going to check into the situation immediately.

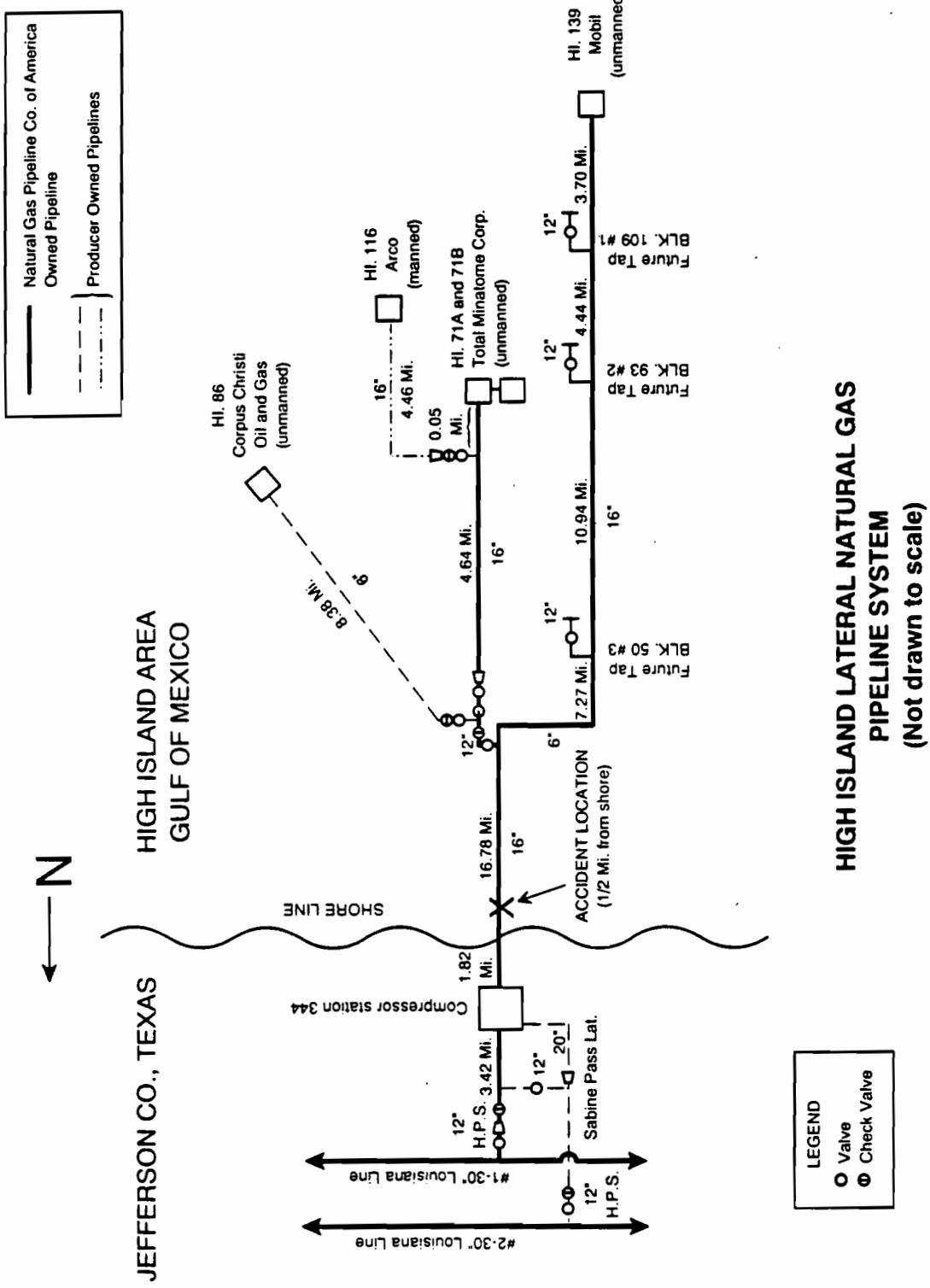


Figure 2.--Schematic of the pipeline system.

The superintendent departed his home about 6:55 p.m., picked up a second employee and proceeded to CS 344, which was about 2 1/4 miles north of the accident site. While en route to CS 344, he received a radio call from a third employee. The superintendent directed this employee to contact the crew of the HI 116 offshore platform, the only manned platform for the HI lateral pipeline. The employee called back and reported that he had been unable to contact the HI 116 platform because the telephone line was busy.

When arriving at CS 344 about 7:35 p.m., the superintendent checked the metering charts, which indicated there had been a sudden loss of pressure and flow in the pipeline at 5:50 p.m. He then closed a manual valve at CS 344 to isolate the pipeline on the shoreside downstream from the accident.

Verification of Pipeline Ownership.--The superintendent notified Coast Guard Station Sabine about 7:40 p.m. that NGPL "had indications that we had a sudden loss of flow and pressure in the pipe." He also advised Station Sabine that the pipeline had been isolated onshore and that NGPL was attempting to verify that the offshore platforms had shut down. The superintendent later stated that the purpose of his telephone call was to advise the Coast Guard that NGPL was attempting to isolate the pipeline.

According to a Coast Guard official from the MSO in Port Arthur, the watchstander at Station Sabine was left with the impression that the district superintendent was going to verify this information and call back. At that time, the Station Sabine was aware that the pipeline belonged to either NGPL or a second pipeline company. The MSO contacted Station Sabine at 7:50 p.m. and again at 8:22 p.m. to inquire if Station Sabine had established who owned the pipeline. Both times personnel at Station Sabine indicated they were still awaiting confirmation of ownership.

Between 8 p.m. and 10 p.m., MSO personnel attempted to contact the Minerals Management Service (MMS)⁵ by telephone to learn the identity of the pipeline owner. However, there was no response at any of the telephone numbers listed for the MMS in the MSO's local contingency plan for emergency pollution response. The Captain of the Port stated that MSO personnel assumed the telephone numbers to be 24-hour numbers, but subsequently determined they were regular business numbers.

After initially contacting Station Sabine, the superintendent advised Gas Control that NGPL's pipeline appeared to be involved and that there had been a complete loss of pressure in the pipeline. He gave Gas Control a second update about 8:20 p.m. NGPL's corporate office subsequently notified the National Response Center (NRC)⁶ of the pipeline rupture about 9 p.m. The

⁵ Minerals Management Service is an agency in the Department of the Interior and issues right-of-way permits for pipelines on the Outer Continental Shelf.

⁶ The National Response Center, located in U.S. Coast Guard Headquarters in Washington, D.C., is a continuously staffed communications center that receives telephonic notification of major pollution incidents and

MSO also notified the NRC at 9:15 p.m., and received confirmation at 10:10 p.m. from the NRC that NGPL owned the pipeline involved in the fire.

Isolation of the Pipeline.--After his initial call to Station Sabine, the district superintendent began making telephone calls to the owners of the offshore platforms to determine if the emergency shutdown systems on each of the four platforms had activated to isolate and stop the flow of natural gas into the NGPL pipeline. By 7:45 p.m. the district superintendent had confirmation from Atlantic Richfield Corporation (ARCO) and Mobil, owners of the manned HI 116 and unmanned HI 139 platforms, respectively, that the flow of natural gas from these two platforms had been stopped. About 7:45 p.m. the superintendent contacted a representative of Total Minatome Corporation, owner and operator of the unmanned HI 71A platform. The representative indicated he needed to check and call the superintendent back. About 8 p.m. the representative advised the superintendent that Total Minatome was not certain that the natural gas flow from the HI 71A platform had been stopped. The superintendent later stated that he did not contact the owner of the fourth platform, Corpus Christi Oil and Gas, about the status of the unmanned HI 86 platform because the NGPL's district emergency plan did not list a telephone number. The superintendent did not use other means to find a telephone number for Corpus Christi Oil and Gas.

Because the superintendent had not received confirmation that the flow of gas from all of the platforms had been stopped, he arranged for a helicopter to fly NGPL personnel to each of the four platforms. The helicopter departed Sabine about 8:50 p.m., arrived at the HI 86 platform about 9:10 p.m., but could not land because the platform was too small. The helicopter proceeded to the HI 71A platform, arriving about 9:15 p.m. After landing on the platform, the NGPL employees determined from the metering charts that gas was still flowing from the platform into the pipeline; consequently, they manually closed two valves on either side of NGPL's gas flow meter located on the platform.

About 9:45 p.m. the representative from Total Minatome notified the superintendent that the flow of gas from the HI 71A platform had been stopped. An official from Total Minatome later stated there were problems with the microwave communications to the platform that prevented the company from verifying that the gas flow into the pipeline had been stopped.

From the HI 71A platform, the helicopter proceeded to a manned drilling platform nearby, from which one of the NGPL employees disembarked and took a crew boat to HI 86. The helicopter took the second employee to the HI 139 platform, arriving about 10 p.m. The flow of gas from the HI 139 platform had been stopped. The helicopter, with the NGPL employee, then returned to its base in Sabine, and the employee returned to CS 344.

By 10:40 p.m. the crew boat arrived at the HI 86 platform; according to the metering charts, the NGPL employee determined that the flow of gas had

been stopped about 6:20 p.m. The employee returned by crew boat to the drilling platform, arriving about 11:30 p.m.

In the meantime, a second helicopter had arrived at the drilling platform with the superintendent, who learned at that time that the flow of gas from all four platforms had been stopped. Because he did not have direct communications with NGPL employees onshore, the superintendent did not notify or instruct an employee to notify the Coast Guard that the pipeline was isolated upstream of the rupture. The logs from Coast Guard Station Sabine had an entry for 11:37 p.m. that NGPL had stopped the gas flow from the offshore platforms. When the superintendent was later asked if the Coast Guard would have been interested in knowing that the pipeline had been isolated, he stated that he did not know. After arriving back at the helicopter base in Sabine after midnight, the superintendent returned briefly to CS 344. He then proceeded to Coast Guard Station Sabine where he spoke with officers from the MSO about sending divers to the accident site on the morning of October 4.

At 9 a.m. on October 4, an NGPL engineer flew to each of the four production platforms to again verify that the flow of gas from each had been secured. According to the NGPL engineer, the HI 86, 116, and 139 platforms were secure. However, he observed on the HI 71A platform that gas was venting from an unidentified piece of processing equipment on the platform even though the valves on either side of NGPL's meter were closed. The engineer closed an emergency shutdown valve for the platform, and the gas flow stopped.

Injuries

<u>Injuries</u>	<u>NORTHUMBERLAND</u>	<u>Other</u>	<u>Total</u>
Fatal	11	0	11
Serious	2	0	2
Minor	1	0	1
None	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	14	0	14

Damage

Vessel Damage.--The vessel was a total loss. External fire damage extended from the stern of the vessel to the front of the pilothouse (figure 3). The foredeck area was the only part of the vessel where the paint was not scorched or discolored. Internally, all compartments and accommodation spaces on the main deck level and above were completely incinerated. All furnishings, bulkhead linings, paneling, and engine controls in the pilot house were consumed in the fire. Steel decks, bulkheads, and internal joiner bulkhead frames in both the forward and after deckhouses were bent and buckled. The engineroom, which had flooded, did not suffer extensive fire damage; however, all electrical equipment and other equipment was severely damaged by the flooding water.

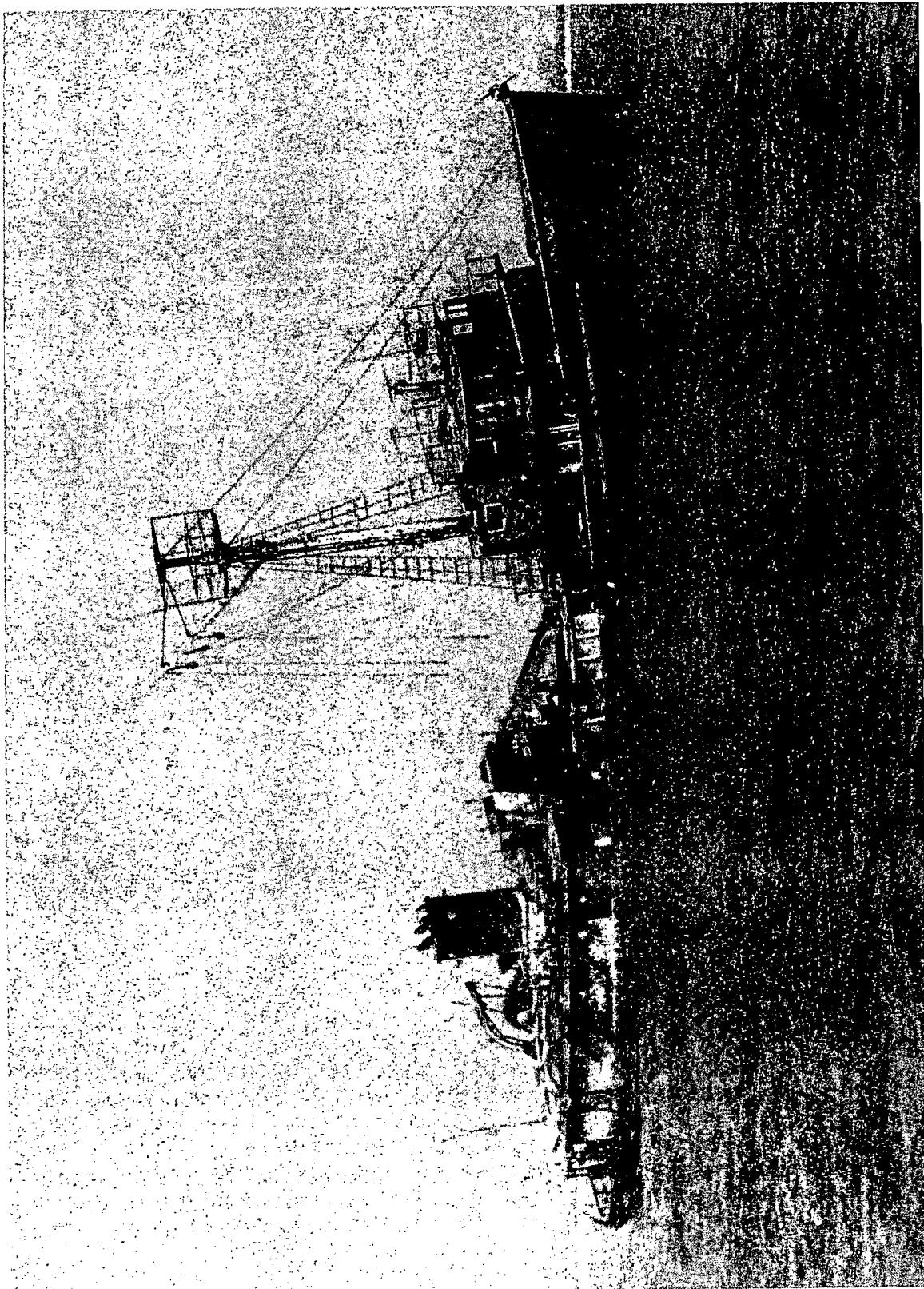


Figure 3.--NORTHUMBERLAND at the accident site.

Pipeline Damage and Repairs.--NGPL removed about 315 feet of pipeline, including the damaged pipeline at the accident site, and replaced it with new pipeline having a slightly greater wall thickness. Divers inspected 33,000 feet of pipeline, including the repaired segment, from the shoreline out to a water depth of 22 feet. Of the pipeline inspected, NGPL reported that 1,280 feet had less than 6 inches of cover, 9,440 feet had 1 1/2 feet to 2 1/2 feet of cover, and the remainder had a minimum of 3 feet of cover. All pipeline that was found to have less than 3 feet of cover was reburied to a minimum depth of 3 feet and was anchored. The pipeline was returned to service on April 3, 1990.

NGPL's superintendent for the Port Arthur district stated that 25 million cubic feet of gas were released following the accident, including 150,000 cubic feet attributed to flow from the HI 71A platform. Total Minatome, however, estimated the postaccident volume from HI 71A to be 87,000 cubic feet.

Monetary Estimates of Damage.--Estimates by Zapata and NGPL of the damages incurred were as follows:

NORTHUMBERLAND	\$ 900,000
NGPL pipeline and loss of gas	800,000
Lost revenues from downtime of the pipeline	<u>583,000</u>
TOTAL	\$2,283,000

Meteorological Information

Weather observations from the Coastal Marine Automated Network station located at Sabine Pass were recorded at 5:25 p.m. and 6:25 p.m. on October 3. The temperature was about 79 °F, and winds were southeasterly at 7 to 9 knots. Satellite photographs taken at 5:31 p.m. and 6:01 p.m. showed no significant cloudiness in the immediate vicinity of Sabine Pass. Marine forecasts issued by the National Weather Service for October 3 called for east and southeast winds between 5 and 10 knots, seas 1 to 3 feet, and a light chop in protected waters. Climatological maps of the Defense Mapping Agency indicate that water temperatures in the accident area average 78-80 °F during October.

Crew Information

The master held a valid merchant mariner's license issued by the Coast Guard, which permitted him to serve as a master of uninspected fishing vessels of not more than 800 gross tons on the Atlantic Ocean and the Gulf of Mexico, and not to exceed 200 miles offshore between Eastport, Maine, and Port Isabel, Texas. The master received his original license in 1981 after completing a Zapata-sponsored training program of 2 1/2 to 3 weeks duration that prepared him to pass the Coast Guard's examination for the license. Coast Guard licensing records indicated that the license was last renewed on March 19, 1987, in Baltimore, Maryland. All Coast Guard licenses are issued for a period of 5 years.

The master had been employed as a commercial fisherman by Zapata for 13 years, the last 8 of the 13 as a master. Although this was his first season as a master of the NORTHUMBERLAND, he had been master of a sister ship to the NORTHUMBERLAND for the two previous seasons. Between October 1982 and October 1986, he also had served as master of two other Zapata vessels. Prior to serving as a master, he had served as a mate for 2 years, a pilot for 1 year, and a crewman for 2 years. All of his seagoing experience with Zapata had been gained in the Gulf of Mexico, primarily along the coasts of Louisiana and Texas.

The master was 31 years old at the time of the accident, and is a high school graduate and unmarried. He characterized his general health as good. He stated that he was not taking any medication, had no health, vision, or hearing problems, and had not consulted a private doctor in the year previous to the accident. The results of his company medical examination on February 14, 1989, did not indicate any medical problems. A drug screen conducted on that same date was negative.

The master was off duty at home on September 30 and October 1. He went out with friends on the evening of September 30. He returned home about 12:30 a.m. on October 1 and slept for 7 hours. He departed for the NORTHUMBERLAND about 10 or 10:30 p.m. on October 1 and slept about 4 1/2 hours on board before the vessel got underway at 4 a.m. on October 2.

The master stated that he smokes about one carton of cigarettes per week, is an occasional beer drinker, and has never used illicit drugs.

The National Driver Register, a 50-State driver's license check, and the criminal records files at the Federal Bureau of Investigation contained no information that was applicable to this accident. Also, there were no records of any action ever being taken by the Coast Guard against the master's license.

Vessel Information

General Description.--The NORTHUMBERLAND was of all welded construction and had an overall length of 176.5 feet, a beam of 32 feet, and a depth of 11.8 feet. The master stated that the NORTHUMBERLAND had a draft of 4 feet forward and 9 feet aft when the vessel had no fish in the holds, and a maximum draft of 11 to 12 feet when the fish holds were full. He estimated that the vessel's draft was 9 to 10 feet at the time of the accident.

The vessel was built as a freight vessel in 1944 for the U.S. Army, and was later sold to commercial interests and converted to fishery service. As originally constructed, the vessel had a single deckhouse located aft, over the engine room. After its sale to commercial interests, a deckhouse containing living quarters for the crew was constructed in the forward part of the vessel. The pilot house was moved forward and placed on top of the new forward house. The single-level deckhouse aft contained the galley, crew's mess, officer's mess, engineers' quarters, and a compressor room.

Two fish holds that had the combined capacity of 450 tons of fish were located between the two deckhouses. The two holds were forward of the engine room and separated by a single bulkhead. At the time of the accident, the vessel had about 220 tons of fish stowed in the forward fish hold.

The vessel's main diesel engines were started and stopped in the engine room. However, once the main engines were started, full pilothouse control was available. Two throttle/clutch controls were in the pilothouse, one each on the port and starboard side. Two fixed steering levers were mounted on the bulkhead of the pilothouse, one each on the port and starboard side. A third steering station, identical to the other two, was mounted on the centerline of the vessel where the helmsman could see the magnetic steering compass.

The NORTHUMBERLAND had two propellers and a single rudder. The solid, four-bladed bronze propellers were 76 inches in diameter.

Navigation and Communication Equipment.--The NORTHUMBERLAND was equipped with an Apelco 6000 loran receiver, a Rathenon Pathfinder navigation radar, a magnetic steering compass, and a Wood Freeman model 500B autopilot. The vessel was not equipped with a fathometer. Communication equipment included an FM radio and two citizen band radios.

Lifesaving and Water Survival Equipment.--According to Zapata's vice president of operations, each crewmember was issued a life preserver equipped with reflective material and a locator light; crewmembers normally stowed their life preservers in their quarters near their bunks or personal belongings. A hardhat and a work vest or a water skiing flotation belt were also issued to those crewmembers working in the purse boats during fishing operations. Crewmembers were required by company policy to wear a work vest or a ski flotation belt when working in the purse boats. Four extra life preservers were stowed on deck in a watertight box. Two extra work vests, ski belts, and hardhats were also kept in the pilothouse.

According to Zapata's Vessel Operations Manual, each vessel had two eight-man life floats that were stowed on top of the pilothouse. Four life ring buoys with lights were mounted along the deck. Three day/night distress flares and a man-overboard light were kept in the pilothouse. Each vessel was also equipped with an emergency position indicating radio beacon (EPIRB) that was designed to float free if the vessel sank. A Zapata representative also stated that the two purse boats could serve as life boats. Each purse boat was also equipped with a life ring buoy with an attached 90-foot line.

Responsibility for Maintenance and Inspections.--During the fishing season, the master and the chief engineer are responsible for the maintenance and repair of all equipment and machinery on board the vessel. Shore-based superintendents, vessel managers, and port engineers are also responsible for the maintenance and repair of vessels under their charge. Zapata's written maintenance policy prescribed daily, weekly, and monthly checks of all equipment and machinery.

The master also had the responsibility for conducting a vessel safety inspection once every 4 weeks. In addition to inspections by the master, Zapata's general manager was required to have an "appropriate" person inspect each vessel once every 4 weeks. When possible, the inspections were to be staggered so that each vessel was inspected at 2-week intervals. The scope of these inspections included deck equipment and lighting, steering and engine controls, lifesaving equipment, firefighting equipment, navigation equipment, engineroom machinery, and safety equipment. Records indicate that no deficiencies were noted for inspections conducted by the master on July 24 and September 1. The master also testified that the vessel's steering gear, main engines, and other equipment were working properly at the time of the accident.

Safety Training.--The vice president of operations testified that at the beginning of each fishing season in mid-April, the personnel manager at Zapata's plant at Cameron provides training about the "emergency action drills" or procedures for the master and crew of each fishing vessel. Masters are then expected to conduct safety training of their crews by holding periodic emergency drills and monthly safety meetings.

The purpose of the emergency action drills is to ensure that all crewmembers are familiar with their duties in emergency situations and that all emergency equipment is in place and in working order. The drill procedure consists of (1) sounding the general alarm; (2) assembling all crewmembers wearing life preservers; (3) a review of the emergency action drills for fire, man overboard, heavy weather, and abandon ship; (4) securing and checking all watertight doors, hatches, and ports for proper operation; (5) identification and demonstration of emergency equipment; (6) discussion or demonstration of lowering the purse boats without electrical power; and (7) a check of the life floats. According to records provided by Zapata, emergency action drills were conducted on the NORTHUMBERLAND on May 12, July 24, and September 1, 1989.

Zapata also encourages the master to hold 5-minute safety meetings each month. The content of these meetings is left to the discretion of the master. Zapata provided records indicating that the master of the NORTHUMBERLAND conducted 5-minute safety meetings on May 10, July 25, and September 1, 1989, about the use of life preservers, flotation devices, liferafts, and man-overboard procedures. Two additional meetings were held on July 26 about the use of fire extinguishers and emergency signals.

Waterway Information

Conditions in the Accident Area.--The accident occurred in open water. There were no offshore markers, buoys, or other navigational aids in the area to indicate the presence of the pipeline.

Charts for the Accident Area.--Navigation charts provide the mariner with a graphical representation of the waterway and other specific information that is necessary for safe navigation. For example, water depths, land marks, navigational aids, demarcation of channels, and hazards to navigation are routinely indicated on navigation charts. Charts for the

coastal waters of the United States are produced and published by the National Ocean Service of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce.

Four different NOAA charts (Nos. 11332, 11340, 11341, and 11342) depict the accident site. The HI lateral pipeline was charted on all the charts except No. 11340. A NOAA representative indicated that the pipeline was not charted on No. 11340 because the small scale of that chart precluded such details. A second offshore natural gas pipeline located slightly east of the NGPL pipeline was not shown on any of the four charts.

The charts depicting the accident area indicate that the depth of water at the accident site was about 6 feet. Depth measurements taken by divers after the accident indicate that the actual water depth was about 10 feet. A NOAA representative stated that the range of tides in the Gulf of Mexico is about 1 foot and could not account for the difference between the charted and the actual depths. He could not reconcile the difference in the depths and was not aware of any plans by NOAA to perform a new hydrographic survey of the area. He further stated that the depth soundings printed on the charts of the accident area were the result of a hydrographic survey conducted in 1964. Normally hydrographic surveys are conducted every 15 to 20 years or when NOAA receives reports from various maritime interests that information on a particular chart is no longer accurate. Before ordering a new survey, NOAA will first verify any reports of inaccuracies.

Practices in Charting Submerged Pipelines.--A NOAA representative stated that NOAA is not required by law or regulation to mark submerged pipelines on navigation charts. NOAA, however, recognized that submerged pipelines may constitute a hazard to navigation. In its Cartographic Order No. 00379 dated June 28, 1979, NOAA stated that certain underwater pipelines "convey hazardous materials under high pressure, such as mineral products or gas, presenting not only pollution potential but the danger of explosion or fire." The order cited a third hazard: the movement of unburied or unanchored pipelines caused by natural forces. Because of the danger from pollution, explosion and fire, and movement, NOAA directed in Order No. 00379 that submerged pipelines were to be charted in purple or magenta on navigation charts.

NOAA has received information about the location of submerged pipelines through the U.S. Army Corps of Engineers (the Corps), the MMS and its predecessor, the Offshore Office of the Bureau of Land Management.⁷ Secondary sources of information about pipeline locations are State government agencies and private companies. A NOAA representative indicated that most of the information received is unsolicited. He also stated that the Corps is required to submit information to NOAA concerning submerged pipelines in the navigable waters of the United States; NOAA also receives similar information from the MMS. The NOAA representative indicated that the

⁷ The Offshore Office of the Bureau of Land Management and the Conservation Division of the U.S. Geological Survey were consolidated as the Minerals Management Service in the early 1980s.

MMS selects "the large flow pipelines" and sends the information to NOAA. Although NOAA reserves the right to print or not to print the information, the NOAA representative stated that all of the pipelines reported to NOAA have been charted. NOAA, however, does not attempt to locate and mark all submerged pipelines on all navigation charts. The NOAA representative stated he thought it would be impossible to chart all of the pipelines in the Gulf of Mexico without obliterating other, equally important information.

Precautionary Information About Pipelines.--In addition to charting the location of certain submerged pipelines, NOAA prints a cautionary note on some navigation charts about submarine pipelines and cables. The cautionary note indicates the symbol used to mark the location of pipelines and cables, and warns the mariner to use caution when anchoring, dragging, or trawling (figure 4).

NOAA also publishes precautionary information concerning submerged pipelines in the "United States Coast Pilot." Volume 5⁸ provides the following cautions to the mariner:

- Submarine cables and pipelines cross many waterways... but all of them may not be charted. For inshore areas, they are usually buried beneath the seabed....
- They [submarine cables and pipelines] are shown on charts when the necessary information is reported to NOS [National Ocean Service] and they have been recommended for charting by the cognizant agency.
- In view of the serious consequences resulting from damage to submarine cables and pipelines, vessel operators should take special care when anchoring, fishing, or engaging in underwater operations near areas where these cables or pipelines may exist or have been reported to exist.
- ...Many pipelines carry natural gas under high pressure or petroleum products....Fire, or explosion with injury, loss of life, or a serious pollution incident could occur if they are broached.

Marine Operations Information

Menhaden Fishing Practices.--The menhaden fishery is the largest fishing industry by volume in the Gulf of Mexico, and second only to the shrimping industry in terms of value. In 1988, menhaden accounted for 29 percent of

⁸ U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 1987. 20th ed. Atlantic Coast: Gulf of Mexico, Puerto Rico, and Virgin Islands. Washington, DC. 322 p. plus supplemental material. (United States Coast Pilot, vol. 5).

CAUTION
SUBMARINE PIPELINES AND CABLES

A selection of large submarine pipelines are shown thus: — — — — — — — —

Additional uncharted submarine oil and gas pipelines and submarine cables may exist within the area of this chart. Mariners should use caution when anchoring, dragging or trawling.

Covered wells may be marked by lighted or unlighted buoys.

Figure 4.--Precautionary note on a navigation chart (enlarged 2 X). (Source: Chart No. 11342, "Sabine Pass and Lake," National Oceanic and Atmospheric Administration, U.S. Department of Commerce.)

all fish caught off the gulf and Atlantic coasts. According to Zapata, five menhaden fishing companies operate in the Gulf of Mexico and four off the Atlantic coast. The companies in the Gulf of Mexico have 73 vessels actively engaged in menhaden fishing.

Menhaden fishing season in the Gulf of Mexico extends from mid-April to late October. During the season, Zapata's vessels work on a 5-day-per-week basis, from Monday through Friday. Because fishing is a daylight operation, the crew may work as many as 14 hours per day to make 10 to 12 sets per day. The vessels return to their home ports for the weekend and the crews are allowed to go home.

According to Zapata's vice president of operations, the company's vessels operate anywhere from the shallow waters close to the beach to as far as 20 miles offshore. He estimated, however, that 80 to 90 percent of the total catch is made within 3 miles of shore, and 40 to 50 percent of the total catch is made within 1 mile of shore. He further stated that it was typical for Zapata vessels to operate in shallow waters less than 1 mile from shore. The president of Wallace Menhaden Products, Inc., a competing menhaden fishing company that operates a fleet of 14 purse seine fishing vessels similar to the NORTHUMBERLAND, also stated that it was typical for his vessels to operate within 1 mile of shore.

Fishing Vessel Owner.--Zapata owns and operates a fleet of 50 vessels that fish solely for menhaden. The vessels are operated from fish processing plants located in Louisiana, Mississippi, and Virginia. Zapata also owns and operates a fleet of 35 airplanes, 10 of which are used to support the operation out of Cameron, Louisiana. These airplanes are used to locate schools of fish from the air and then to direct a vessel to the fish. One airplane can work with four to six vessels concurrently.

Navigation in Shallow Waters and Near Submerged Pipelines.--Zapata did not specify a minimum water depth in which a master could operate and navigate the vessel. A master is permitted to go wherever necessary to catch fish. Zapata's vice president of operations stated, however, that a master is "not advised" to run a vessel aground. He further stated that "running close to the bottom, scraping bottom, moving through the bottom is not the same [as grounding]." The vice president indicated that grounding occurs when the vessel becomes mired and cannot proceed. Grounding, as described by Zapata's vice president, was an unusual occurrence during fishing operations. Zapata has not experienced much bottom damage to its vessels from their operation in shallow waters of the Gulf. The master of the NORTHUMBERLAND also indicated that he maneuvered the vessel slowly whenever the vessel was in a shoal area or within a mile of the shore.

The president of Wallace Menhaden also stated that it was common for his vessels to come into contact with the bottom during fishing operations. According to company policy, a master may operate a vessel wherever "he's legal to navigate." The master is required to use his judgment as to what is prudent operation of the vessel.

Zapata's vice president of operations stated that Zapata did not perceive submerged pipelines to be a serious safety hazard to its vessels before the accident. He further stated that Zapata's perception was based on the belief that all submerged pipelines were to be buried and were to remain safely buried below the subsea surface. Therefore, Zapata issued no verbal or written precautions to vessel masters about operating near submerged pipelines. The master of the NORTHUMBERLAND stated that the company never provided him with information or cautioned him about operating around submerged pipelines. Although the master was aware of offshore pipelines in the gulf, he also stated that he believed they were to be buried.

The president of Wallace Menhaden also stated that it was his understanding that all submerged pipelines are required to be buried. The company has cautioned its masters about fishing around wells where the nets could snag the appurtenances on the well, but has not cautioned the masters about submerged pipelines.

Use of Navigation Charts.--Zapata and Wallace Menhaden have no specific policies requiring the vessel masters to use navigation charts. Both companies indicated that the decision to use or not use a navigation chart is left to the discretion and judgment of the individual master. The NORTHUMBERLAND was not required by Federal regulation to have a chart on board.

The master of the NORTHUMBERLAND stated that he was not referring to a navigation chart while he was maneuvering the vessel immediately before the accident. He testified that he had a navigation chart on board that covered the geographical area from High Island, Texas, to Freshwater Bayou, Louisiana, but it was stowed in the chart room at the time of the accident. Such a chart would have included the accident site. The master did not recall which specific chart he had on board the vessel.

The master also explained that it was not his normal practice to use a navigation chart while fishing in familiar waters. The master stated that he had never seen pipelines indicated on a navigation chart; the HI lateral pipeline and at least one other offshore pipeline, however, were indicated on some navigation charts for the accident area. The master also was not aware of any printed warnings on the charts about submerged pipelines.

Shrimping Operations.--Shrimping is the major fishing industry in the Gulf of Mexico in terms of value. The executive director of the Louisiana Shrimp Association estimated there are 18,000 shrimp vessels operating full-time in the gulf, and another 17,000 operating part-time.

Shrimp fishing involves the dragging of heavy gear over the sea bottom. According to the executive director, larger vessels (greater than 50 feet long) generally fish in deeper waters offshore, and the smaller vessels operate in the shallower waters close to the shore. The executive director stated that the fishing gear often becomes entangled on submerged objects, including pipelines and well appurtenances, sometimes so badly that the gear must be cut loose from the vessel. Shrimp fishermen consider submerged pipelines to be the "number one problem in the shrimp industry in the Gulf of Mexico" because of the economic losses incurred from lost fishing gear rather than from any danger of striking and rupturing a pipeline. The executive director did not recall any instances when a shrimp vessel had ruptured a submerged pipeline. He also stated that the shrimping industry held the perception that submerged pipelines were required to be buried.

Right of Navigation.--Zapata and Wallace Menhaden maintain that the right to unimpeded navigation is a well-established tradition and that it has been supported by law and the courts. To support its position, Zapata cited Title 33, United States Code (U.S.C.), Section 403 (Section 10 of the Rivers and Harbors Act of 1899), which prohibits the creation of any obstruction to navigation of any waters of the United States that is not "affirmatively authorized by Congress." Zapata also cited many cases, including several involving vessels striking submerged pipelines, in which the courts have upheld the right of navigation. Zapata and Wallace Menhaden also maintain that navigable waters include muds through which vessels are capable of running; Zapata cited case histories as support. Because Zapata and Wallace Menhaden consider unimpeded navigation to be a right upheld by the courts and the law, they believe that operators of offshore pipelines should be required to bury the pipelines and maintain them in a buried state.

NGPL and the Interstate Natural Gas Association of America (INGAA) advocate restrictions on navigation in shallow waters where a vessel's draft

presents a potential for striking a submerged pipeline. Both have stated that the soft silt and mud covering a pipeline cannot offer any protection from vessels routinely running through the mud. NGPL and INGAA also maintain that vessels routinely running along or through the sea bottom accelerate the erosion of sediment covering a pipeline and lead to exposure of the pipelines.

Pipeline Information

High Island Pipeline System.--The HI lateral pipeline is an interstate natural gas transmission pipeline. The pipeline extends south from the shore near Sabine Pass into the Gulf of Mexico; it transports natural gas from four producer-owned production platforms located 25 to 40 miles offshore to two 30-inch transmission pipelines on shore. (See figure 2.) Three of the four platforms (HI 71A, HI 86, and HI 139) are unmanned and fully automated. The fourth platform, HI 116, is continuously manned. All four platforms and the processing equipment on them are owned, maintained, and operated by the individual producers. NGPL owns the pipelines to the HI 71A and HI 139 platforms. However, ARCO and Corpus Christi Oil and Gas own the branch pipelines connecting their respective platforms (HI 86 and HI 116) to the HI lateral pipeline.

The HI 71A platform also has a satellite platform, HI 71B, that serves three active wells and is located about 2,500 feet from the HI 71A platform. Natural gas flows from the HI 71B platform through two 4-inch flow or gathering lines to the HI 71A platform. Total Minatome Corporation indicated that the two gathering lines were buried to a depth of 3 feet at the time of their construction in accordance with Department of the Interior regulations in 30 CFR Part 250. After processing on the HI 71A platform, the gas enters the HI lateral pipeline.

Northward from shore, the HI lateral pipeline extends about 1.8 miles to CS 344, an inactive compressor station used as a metering site.

Pipeline Specifications.--The HI lateral pipeline was constructed of 16-inch outer diameter, 0.312-inch wall thickness, American Petroleum Institute (API) specification 5LX52 seamless/cold expanded steel pipe. The pipeline had a design pressure of 1,200 psig. According to metering charts at CS 344, the operating pressure of the pipeline was about 835 psig at the time of the accident. The pipeline had a somastic⁹ coating for corrosion protection, and a 2-inch-thick concrete coating for negative buoyancy. Engineering blueprints indicate that the pipeline, with the concrete and somastic coatings, had a specific gravity of 1.25.¹⁰

⁹ Somastic is a tar-like coating substance.

¹⁰ Specific gravity is the ratio of the density of a material with that of a reference material, usually water. A specific gravity greater than 1.0 indicates the material is denser than water, and will sink rather than float.

Construction and Burial.--The pipeline was constructed in 1973. As-built construction plans show that the pipeline in the vicinity of the accident had about 8 to 8 1/2 feet of cover over the pipeline in a depth of water of 8 feet at mean low water.

NGPL has indicated that four construction techniques were used for the pipeline. From the tap on the 30-inch pipelines to within 350 feet of the original beach, the pipeline was constructed using a trenching machine and a backhoe. A barge equipped with dredging equipment excavated a channel from an offshore water depth of 15 feet to the onshore connection point. After the channel was completed, the dredging barge proceeded seaward through the channel and excavated a trench for the pipeline. The spoil that was deposited on either side of the trench was carried away by the currents and the surf. After the trench was completed, the pipeline was placed in the water from a construction barge offshore, and pushed into the channel toward the beach. When floats on the pipeline were removed, the pipeline settled into the trench.

A diver then surveyed the pipeline from the shore to the end of the section constructed with the dredging barge. The diver measured the depth of water from the top of the pipeline and from the natural bottom alongside the trench for the pipeline. The difference of the readings was the burial depth of the pipeline. NGPL indicated that "near the shoreline," spoil that accumulated was pushed in the trench and spread by a barge. "Further seaward," however, the spoil was spread by the surf and the current. NGPL stated that natural sedimentation filled in the trench and returned the sea bottom to its natural elevation after a period of time. NGPL did not inspect the cover over the pipeline after the postconstruction inspection.

The remainder of the offshore construction used a jet sled for digging a trench for the pipeline. The jetting process disperses the soil so that no soil is left to cover the pipeline. A diver inspects the trench to determine that the correct depth has been attained. Natural sedimentation that occurs after construction is expected to return the sea bottom to its naturally occurring elevation. NGPL also stated that the pipeline industry relies on natural sedimentation to cover offshore pipelines.

The pipeline was constructed by Brown and Root International of Houston, Texas. According to an NGPL representative, the as-built construction drawings were certified by NGPL's vice president of engineering.

Features for Emergency Isolation.--Emergency isolation from the upstream side of a leak or break offshore required that the flow of gas from each production platform be stopped. Downstream from an offshore break, the backflow of gas is prevented by a check valve located between CS 344 and the tie-in to the 30-inch transmission pipeline. Manually operated valves at CS 344 can also be closed to isolate an offshore break on the downstream side. However, there are no automatic isolation valves in the pipeline between the offshore production platforms and CS 344.

To shut-in a platform (to stop the flow of gas from each unmanned production platform into the pipeline), NGPL relies on automatic emergency

shutdown systems that are producer owned, controlled, and maintained. On the HI 71A platform, high and low pressure sensors monitor the gas pressure in the departing HI lateral pipeline. If the threshold values for either sensor are reached, emergency shutdown valves at the wells and in the pipelines connecting the B platform to the A platform are designed to close and stop the flow of gas. Total Minatome stated that the emergency shutdown system has redundant design features to attain platform shut-in if the primary sensor fails. Total Minatome can also shut-in the HI 71 platforms remotely from a shore station or another platform through microwave communications. However, according to a Total Minatome representative, the microwave communication can be disrupted by atmospheric conditions.

Pipeline System Monitoring.--Controllers at NGPL's Gas Control center in Lombard, Illinois, monitor the operational parameters at some 120 locations within NGPL's entire pipeline network to control the flow and pressure within the network. The system polls each monitoring point about every 3 minutes and generates an automatic printout at Gas Control every 8 hours. The most current operating data from any monitoring point can be obtained at any time by the on-duty controllers.

The only automatic alarms to warn controllers of abnormal operating conditions in the pipeline network are for designated major compressor stations. For non-major monitoring points, including CS 344, an automatic alarm would not be given. An abnormal operating condition for a non-major monitoring point can be detected only if a controller checks the input for the specific monitoring point or happens to note an abnormal condition on the most current printout for the system. The district superintendent indicated that problems at non-major points would likely be noticed first by the local district and then verified through Gas Control.

At the district level in Port Arthur, NGPL has a flow computer and chart recorders for the gas meters at CS 344. The chart recorders are checked two or three times each week. The flow computer, which transmits the input data to Gas Control, can be downloaded locally for the operating pressures and flow rates recorded over the previous month. The only automatic alarm at CS 344 is to indicate a high percentage of liquid hydrocarbons in the pipeline.

Pipeline Operations Information

Pipeline Owner.--NGPL operates about 12,600 miles of pipeline between Texas, New Mexico, and Colorado to northern Illinois. Of this total, 12,000 miles are classified as transmission pipelines and the balance as gathering lines. Only 650 miles of its pipeline network is offshore. All of NGPL's pipelines transport natural gas and condensate. NGPL's system delivers about 1.6 trillion cubic feet of gas per year from the gulf coast to northern Illinois.

Inspection and Surveillance of Submerged Pipelines.--NGPL has no regular reinspection program to verify that the burial depths of its submerged pipelines are maintained because NGPL believes there is no regulatory requirement to do so. Because current U.S. Department of Transportation (DOT) regulations for the burial and protection of submerged pipelines are

designated as construction requirements, NGPL contends that the burial requirements apply only at the time of construction. NGPL further contends that because the specific provisions for the burial and protection of offshore gas pipelines became effective in 1977, they are not retroactive for the HI lateral pipeline and other offshore pipelines constructed before 1977.

According to NGPL, it monitors its offshore pipelines by conducting an aerial overflight over each pipeline once every 6 months. NGPL has indicated that overflights over sections of the offshore pipelines are made on an ad hoc basis when employees are flown to the different offshore platforms to replace meter charts or to conduct maintenance on meters. During the overflights, employees will look for unusual situations, such as bubbling in the water, that indicate a leak in the pipeline. NGPL will also note if there is heavy vessel activity in the vicinity of its pipelines. NGPL acknowledged that aerial surveys do not provide a determination of the burial depth of an offshore pipeline; NGPL believes, however, that aerial surveys do reflect if there is some erosion problem on the shoreline. NGPL has no program to physically inspect its offshore pipelines and employs no additional measures to inspect and survey these pipelines in shallow waters. The last scheduled aerial survey over the HI lateral pipeline before the accident was conducted in August 1989.

Although NGPL stated it had no program to maintain the cover over an offshore pipeline, the company indicated that it would respond and "take care of the problem" if the company were made aware of an exposed or unburied pipeline and if the company thought the condition presented a hazard. NGPL did not indicate, however, it would rebury a pipeline to its construction depth in this situation, but would attempt to maintain the cover.

In addition to the aerial surveys, NGPL conducts cathodic protection tests, gas analyses to detect internal corrosion, and operations to flush liquids from the pipeline. The district superintendent stated that the HI lateral pipeline has not had any internal or corrosion problems.

NGPL Emergency Plans.--NGPL's written corporate plan for handling emergencies in effect at the time of the accident contained procedures for the notification of company employees and public officials about incidents. The plan also categorized various emergency situations, specified the responsibilities and actions to be taken by corporate-level and local-level employees, and listed the telephone numbers and criteria for the notification of Federal and State agencies. The Port Arthur district's local emergency plan consisted of the corporate plan and additional appendixes that listed addresses and telephone numbers of the district employees, emergency response agencies, customers, and producers.

According to the corporate plan, each employee was expected to be familiar with the plan and to review it annually. Each district superintendent was responsible for determining what additional or alternate plans were necessary based on local parameters.

Under the corporate plan, an employee receiving notification of an emergency was to notify the local superintendent or supervisor. This

guidance, however, was included under a section entitled "Field Responsibilities," which applied to local or district employees. The responsibilities of Gas Control during an emergency were listed in a different section of the emergency plan and did not include procedures for the controllers if they were the first employees to receive information about a possible emergency situation. The emergency plan only specified that controllers were to notify designated corporate officials and those customers whose service was affected. NGPL has not revised its procedures for the controllers since the accident.

The emergency plan also designated the district superintendent or supervisor as the company's emergency coordinator for emergency situations. The emergency plan specified that the district superintendent "shall coordinate an effort to investigate and control the emergency." Although the emergency plan included actions to be taken in response to different emergency situations such as increases or decreases in pressure, explosion, fire, and natural disasters, the emergency plan did not specifically address responses for emergencies that involved offshore pipelines. The local emergency plan also included a section entitled "Offshore Emergency Procedures Manual," which applied to all company pipelines, platform facilities, and metering facilities located offshore of Texas and Louisiana. Under these procedures, a rupture or leak in a pipeline "would result in the need to blowdown [purge] the lateral [pipeline]." The procedures, however, did not elaborate about how the blowdown should be accomplished, or identify other actions to be taken during an offshore emergency.

According to the emergency plan, the district superintendent was also responsible for the notification of appropriate fire, police, and other public officials and the coordination of any joint response. The telephone number given for the Coast Guard in the local emergency plan was that of the search and rescue coordinator at Coast Guard Station Sabine. The emergency plan did not include a telephone number for the local Coast Guard MSO. The district superintendent, who had held that position for 3 1/2 years, stated that he was not familiar with the responsibilities of the MSO before the accident, and that he considered the Coast Guard's station at Sabine to be an initial point of contact. A corporate representative stated at the Safety Board's public hearing after the accident that NGPL considered it appropriate to contact the MSO in an emergency situation with an offshore pipeline now that the company had an understanding of the internal structure of the Coast Guard.

The local plan also did not list the telephone number of the owner of the HI 86 platform, Corpus Christi Oil and Gas. The district superintendent stated that the failure to list the telephone number was an oversight. The superintendent thought, but was not certain, that the telephone numbers for the producers were 24-hour emergency numbers. He stated, however, that telephone numbers are normally verified when the local plan is updated.

Since the accident, NGPL has revised the local emergency plan to include the telephone numbers for the local Coast Guard MSO and Corpus Christi Oil and Gas. NGPL has also revised the local plan's procedures for offshore emergencies. The revised procedures require the notification of the platform

owners and the Coast Guard MSO. The procedures also identify specific offshore emergencies and the response actions to isolate the offshore pipelines. The revised emergency plan, however, does not provide any additional guidance about the duties and responsibilities of the emergency coordinator or about coordination with the offshore producers.

Emergency Planning and Coordination.--The DOT regulations in 49 CFR Part 192 for natural gas pipelines include requirements for emergency planning. Under 49 CFR 192.615(c), a natural gas pipeline operator is required to establish and maintain communication with appropriate fire, police, and other public officials. An operator is also required to establish and maintain liaison with these officials, in part, to learn the responsibility of each government organization that may respond to a gas pipeline emergency, and to plan how the operator and the public officials can mutually assist each other to minimize hazards to life and property.

According to the district superintendent, NGPL contacts local fire, police, and sheriff departments annually. The Port Arthur district, however, did not communicate or coordinate its emergency planning activities with local Coast Guard officials before the accident. The district superintendent indicated that the regulations do not specifically require an operator to contact the Coast Guard; however, he acknowledged in light of the accident, communication with the Coast Guard would be beneficial. Corporate officials also acknowledged the need for further coordination with local Coast Guard officials, and indicated that NGPL will facilitate that coordination.

Similarly, there was no formal coordination between NGPL and the four platform producers before the accident. Because of the various design pressures of the processing equipment on each platform and the danger of overpressurization, the district superintendent believes that each producer is best able to shut-in the platform. Yet the superintendent indicated that in an emergency, NGPL would send employees to the platform and activate the emergency shutdown equipment without the permission of the producer, and take the action necessary to stop the flow of gas to the pipeline.

Since the accident, NGPL has initiated contacts with Coast Guard MSO in Port Arthur and the offshore producers. NGPL employees from the Port Arthur district have met with MSO personnel and provided copies of NGPL's offshore system maps and other information about NGPL facilities. NGPL's district office also provided NGPL's emergency telephone numbers to all offshore producers. NGPL also requested that each producer provide an emergency telephone number, indicate the pressure limits that would actuate emergency shut-in valves on the platform, and specify the procedures NGPL should follow in the event of a pipeline emergency that affected the operation of the platform.

Medical and Pathological Information

Results of the autopsies indicated that the two victims found on board the vessel died from suffocation caused by the fire. No additional injuries other than fire-induced injuries were observed on these two victims. The

remaining nine victims died from drowning. Four of the victims exhibited flash burns of the head, upper torso, and extremities.

Postaccident medical examinations indicated that the pilot received second- and third-degree burns over 68 percent of his body. The surviving fisherman received second-degree burns of the face and a third-degree burn of the upper right arm. The master received multiple contusions, salt water ingestion, and inhalation of gas fumes.

Blood specimens were obtained from the master, pilot, and surviving fisherman at the Beaumont Baptist Hospital and were submitted to the Center for Human Toxicology in Salt Lake City, Utah, for analysis. The specimens were screened for alcohol, stimulants, opiates, sedatives/tranquilizers, hallucinogens, antihistamines, and cannabinoids. No drugs of abuse were found in any of the specimens. The specimen of the pilot contained lidocaine, a drug consistent with hospital administered medications.

Blood specimens were also obtained from 9 of the 11 fatalities. Specimens from the remaining two fatalities could not be obtained because of the condition of the remains. Alcohol levels of 0.03, 0.04, and 0.09 percent were found in six of the fatalities; these levels are consistent with the decomposed condition of the blood samples when they were obtained at autopsy because of prolonged immersion of the bodies in salt water. No other drugs of abuse were found in any of the specimens.

Tests and Research

Diving Surveys of the Accident Site.--By October 7, NGPL and Zapata both contracted divers to survey the accident site and the pipeline in both directions from the accident site. The two groups of divers found unburied sections of the pipeline to the north and south of the accident location and also noted barnacle and other marine growth on the unburied sections of the pipeline.

In the immediate accident area, Zapata's and NGPL's divers both reported that the pipeline had been completely broken apart, with the broken ends about 10 feet apart. A crater also extended under and between the broken pipe ends. The pipeline's concrete coating was missing at the broken pipe ends and in the vicinity of the crater. NGPL's divers estimated the depth of water to be about 10 feet adjacent to the crater, and the bottom of the crater to be about 15 feet below the water surface. Both groups of divers also reported that the NORTHUMBERLAND was resting on the pipeline an estimated 17 to 22 feet north of the north break in the pipeline.

Zapata's divers reported that 30 feet north of the accident location as much as 3/4 of the pipeline was unburied above the seabed; the area of the pipeline above the seabed gradually decreased until the pipeline was slightly below the mud line 60 feet north of the accident location. Zapata's divers also reported damage to the pipeline's concrete coating 40 feet north of the accident location. The depth profile submitted by NGPL's divers also indicated that the pipeline was unburied for a distance of 80 to 100 feet north of the accident location. Neither group of divers reported any

unburied pipeline north of this location, although Zapata did provide a photograph of an unburied section of pipeline at the shoreline during low tide.

Proceeding south of the accident location, Zapata's divers reported that the pipeline was unburied for about 330 feet until the top of the pipeline was even with the mud line. Over this distance, Zapata's divers reported areas with barnacle growth, damage to the concrete coating, and two locations where the pipeline was suspended as much as 6 inches above the bottom. NGPL's divers estimated that the pipeline was unburied for 200 feet before it started to go into the natural bottom. They only noted "small amounts of hard marine growth and patches of soft growth" on exposed areas of the pipeline.

Examination on Biofouling of the Pipeline.--On October 27 and 28, 1989, sections of the ruptured pipeline were recovered. The Safety Board had a marine biologist examine the marine growth and sediment samples found on and in the recovered sections. Marine organisms such as barnacles, oysters, and coral were found on the recovered sections of the pipeline. The marine biologist noted that cracks and areas of damage to the concrete coating contained large organisms, "suggesting damage to the coating at an earlier time." Based on an evaluation of the number of organisms found, their size, density, and the remains in the sediment, the marine biologist concluded that the top half of the pipeline was unburied at the time of the accident and had been exposed for more than a year but less than 5 years.

Metallurgical Examination of the Pipeline.--The recovered sections of the pipeline were examined at Battelle laboratories in Columbus, Ohio (figure 5). Reconstruction of the recovered pipe sections indicated that one or more sections were missing near the south break in the pipeline. The pipeline fractures near the broken pipe ends (which would have been adjacent to any missing sections) were consistent with a pressurized rupture but did not exhibit the characteristics that would be indicative of the initial fracture. The fractures observed in other areas of the recovered pieces had characteristics typical of mechanical loading after the initial fracture.

Mechanical and chemical tests of the recovered pipeline demonstrated that it met the API specifications for grade 5LX52 pipe for strength and composition. The pipe sections also showed no indications of significant corrosion.

Tests of Emergency Shutdown Valves on the High Island 71A Platform.--The emergency shutdown system for the 71A platform was tested by contractors for Total Minatome on September 21, 1989, with no deficiencies noted. To determine why a small volume of gas continued to flow from the HI 71A platform into the HI lateral pipeline after the platform's emergency shutdown system had activated, Total Minatome had contractors test the system. On October 20, 1989, the low pressure sensor for the NGPL pipeline and the emergency shutdown valves on the incoming pipelines from the HI 71B satellite platform to the HI 71A platform were operationally tested at the platforms. According to the contractor's report, when the simulated pressure

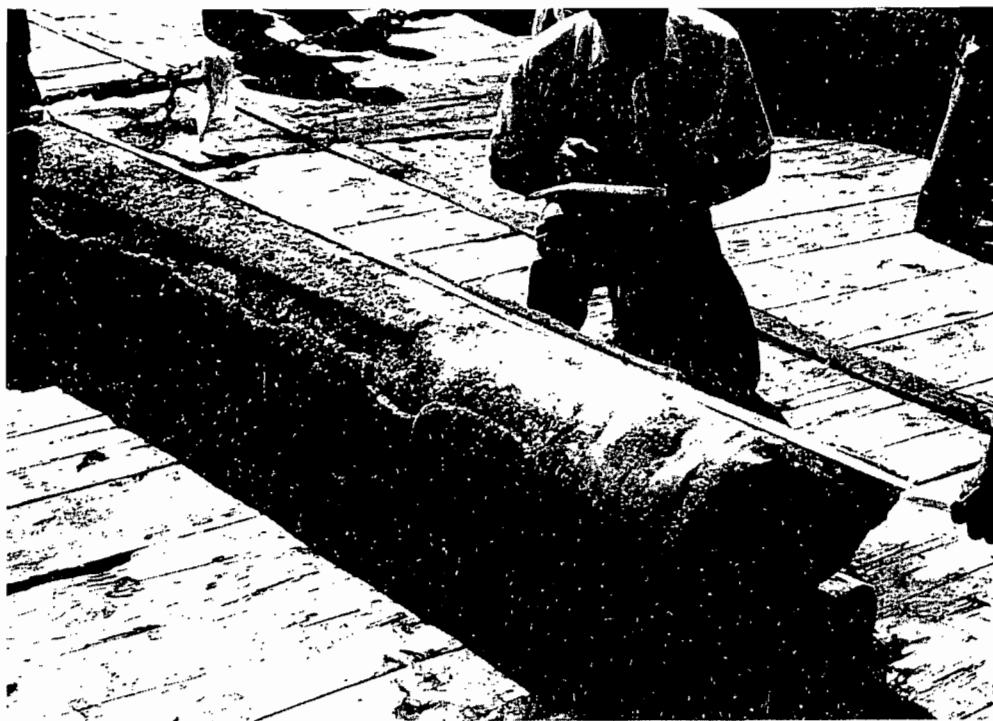
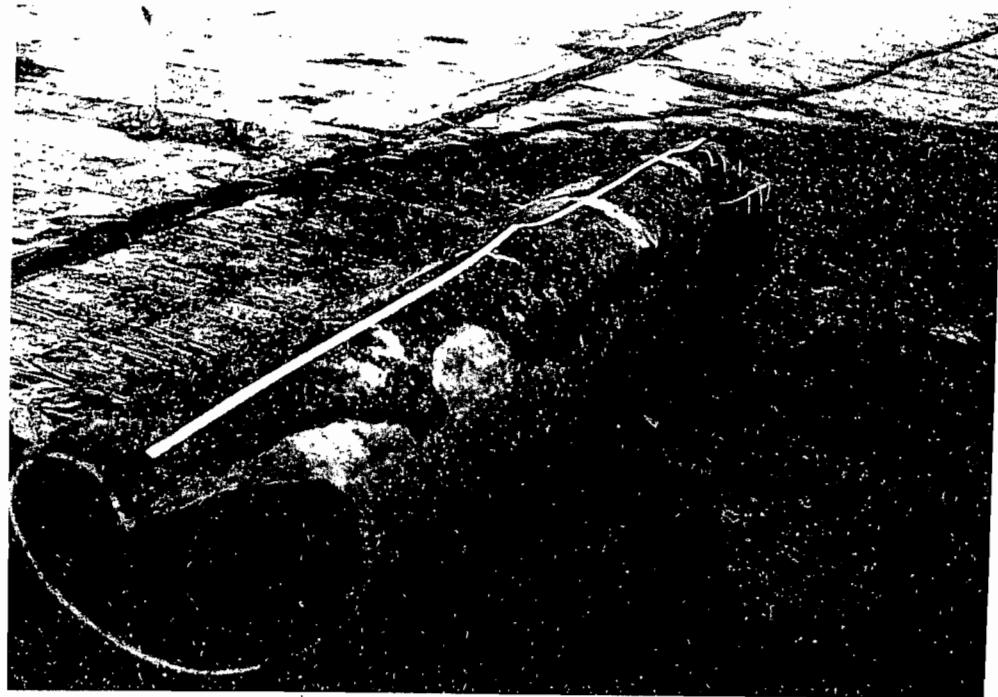


Figure 5.--Sections of the recovered pipeline.

in the HI lateral pipeline fell to 690 psi, the two shutdown valves on the incoming pipelines from the HI 71B satellite platform automatically and fully closed within 36 seconds. The contractor further stated that the two shutdown valves operated properly.

Total Minatome subsequently removed the two shutdown valves for independent testing and analysis. According to the testing report, the seat faces and sealing surfaces for both valves were damaged and corroded, and had weld slag imbedded in them. Sealant had also been injected in one of the valves. The testing report concluded that the continued flow of gas after emergency shutdown was caused by the leaking valves that had damaged seat and sealing surfaces.

Total Minatome believes that most of the gas flow into the pipeline after the accident can be attributed to the residual gas that was in the platform's gas processing system, rather than to leakage through the two valves.

Dry Dock Inspection of the Vessel.--After being towed from the accident site to Morgan City, Louisiana, the vessel was dry-docked. A Safety Board investigator inspected the NORTHUMBERLAND's underwater hull, rudder, and propellers on October 27, 1989. The steel plating of the underwater hull, from the keel to the waterline and from the bow to the stern, appeared undamaged on both the port and starboard sides. A keel cooler¹¹ that was located on the exterior hull plating on the starboard side and below the engine room was damaged; however, there was no indication of how or when the damage occurred.

The port and starboard propellers had minor indentations at the blade tips, but were otherwise in good condition. The rudder was undamaged. The original flat keel was undamaged from the bow to a modified skeg. A triangular section of steel had been added at some unknown date to the after end of the original skeg. A flanged steel plate measuring 10 inches wide, 3/4 inch thick and 6 feet long was welded to the bottom of the new skeg's triangular section of steel in line with the keel (figure 6). The flanges on both the port and starboard sides at the extreme aft end of the plate were bent upward and into the steel plate. There was no marine growth on the bent flanges.

Regulatory Jurisdiction Over Submerged Pipelines

An offshore pipeline can be and often is subject to the jurisdiction of several Federal and State regulatory agencies. Within the Gulf of Mexico, Louisiana and Texas are of particular importance because many offshore pipelines come ashore in these two States. The authority and jurisdiction of these agencies permit them to address such issues as pipeline safety, obstructions to navigation, conservation of natural resources, and protection of the offshore environment.

¹¹ A series of tubes exposed to the sea water and used as a heat exchanger for shipboard machinery.

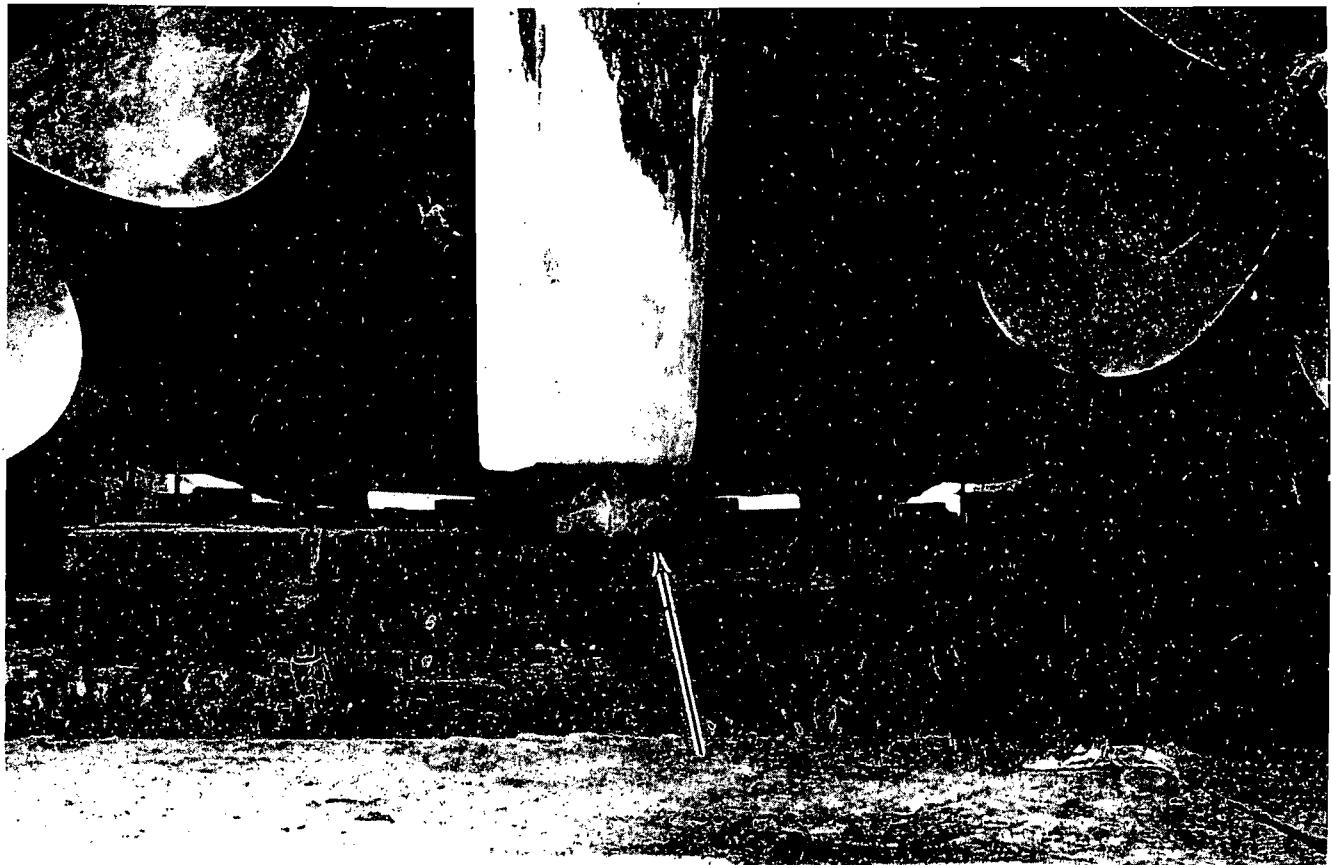


Figure 6.--Damaged skeg (marked by the arrow).

To illustrate, the HI lateral pipeline, as an interstate natural gas transmission pipeline, is subject to the DOT gas pipeline safety standards of 49 CFR Part 192. Because the pipeline extended across the Outer Continental Shelf,¹² and under designated shipping lanes in the Gulf of Mexico and through Texas State waters, separate right-of-way permits were required and issued by U.S. Department of the Interior (DOI), the U.S. Army Corps of Engineers (the Corps), and the General Land Office of Texas before the pipeline was constructed.

Department of Transportation.--The transportation of gas and hazardous liquids by pipeline is regulated by the Office of Pipeline Safety (OPS) of the Research and Special Programs Administration (RSPA) within the DOT. The regulations, found in 49 CFR Parts 192 and 195, prescribe minimum safety standards for the design, construction, maintenance, inspection, and operation of gas and liquid pipelines. According to the OPS, both Parts 192 and 195 apply to offshore¹³ pipelines; however, Parts 192 and 195 have different criteria for excluding certain offshore pipelines from the regulations.

Part 192 applies to offshore gas pipelines and facilities within the limits of the Outer Continental Shelf but does not apply to offshore gathering¹⁴ pipelines upstream from the outlet flange of each facility on the Outer Continental Shelf where hydrocarbons are produced, separated, or processed. Part 192 does not specifically exclude offshore gathering lines that are not within the Outer Continental Shelf.

Part 195 applies to liquid pipelines associated with facilities in or affecting interstate commerce, including those on the Outer Continental Shelf. Part 195 also does not apply to those pipelines that are upstream of the outlet flange of each production facility on the Outer Continental Shelf. Part 195 excludes only onshore gathering lines in rural areas, and does not specifically exclude offshore gathering lines that are not within the limits of the Outer Continental Shelf. All liquid pipelines that operate at a stress level of 20 percent or less of the specified minimum yield strength¹⁵ of the pipe are also excluded from the regulations under Part 195.

12 Outer Continental Shelf means all submerged lands lying seaward and outside the offshore boundary line of each State. See 43 U.S.C. 1301 and 1331.

13 Offshore as defined in 49 CFR 192.3 and 195.2.

14 Under gas pipeline regulations, a gathering line is a pipeline that transports gas from a current production facility to a transmission line or main. Under liquid pipeline regulations, a gathering line is a pipeline 8 inches or less in diameter that transports petroleum from a production facility. See 49 CFR 192.3 and 195.2.

15 A measure of the strength of the pipe, and therefore a limiting factor on the operating pressure of the pipe.

Department of the Interior--Under the Outer Continental Shelf Lands Act (43 U.S.C. 1331), the DOI is responsible for regulating drilling and production operations, handling, measurement, transportation of production, and other operations and activities on the Outer Continental Shelf, including the construction of pipelines. Within the DOI, these responsibilities have been delegated to the Minerals Management Service (MMS).

The MMS has issued regulations under 30 CFR Part 250, Subpart J, for pipelines and associated equipment and fittings to provide "safe and pollution-free transportation of fluids in a manner which does not unduly interfere with other uses in the Outer Continental Shelf." According to 30 CFR 250.150, the DOI has exclusive jurisdiction for those pipeline activities that extend upstream from the outlet flange at each facility where hydrocarbons are first produced, separated, or processed. The MMS regulations for offshore pipelines include standards for design, construction, maintenance, and inspection.

The MMS also issues right-of-way permits for offshore pipelines that cross the Outer Continental Shelf seaward of the State boundary lines. Installation of such pipelines is prohibited under 30 CFR 250.150 until the right-of-way has been requested and approved. According to the MMS regional supervisor for the Gulf of Mexico, gathering lines between production platforms do not generally require right-of-way permits because they cross leases owned by the producers.

Joint Jurisdiction Between the Department of Transportation and the Department of the Interior--In June 1976, the DOT and the DOI issued a memorandum of understanding¹⁶ to avoid duplication of regulatory efforts regarding offshore pipelines and to maximize the exchange of relevant information. The DOT and the DOI established in the memorandum that the jurisdictional demarcation for offshore pipelines would be the outlet flange at each facility where hydrocarbons are produced or at each facility where produced hydrocarbons are first separated, dehydrated, or otherwise processed. The DOT would regulate offshore pipelines from the outlet flange to shore, and the DOI would regulate those pipelines upstream of the outlet flange. Additionally, the DOI, in issuing right-of-way permits and easements on the Outer Continental Shelf for pipelines subject to the DOT regulations, would make those rights and easements conditional on the pipelines being in compliance with applicable DOT regulations.

U.S. Army Corps of Engineers--Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) prohibits the unauthorized obstruction or alteration of navigable waters of the United States, unless recommended by the Corps and authorized by the Secretary of the Army. The authority of the Secretary was broadened under the Outer Continental Shelf Lands Act of 1953 (43 U.S.C. 1333(e)) to include artificial islands, installations, and "other devices located on the seabed" to the seaward limit of the Outer Continental Shelf. The Corps authorizes the placement of these offshore installations in navigable waters through permits issued to the owner of the installation.

¹⁶ Federal Register Vol. 41, No. 114, dated June 11, 1976, page 23746.

The Corps has typically issued nationwide or regional permits for offshore pipelines. Nationwide general permits are for activities that are similar in nature and considered to have minimal affect on the environment. Nationwide permits were issued to reduce the overlap in responsibilities between the Corps and the MMS in leasing areas on the Outer Continental Shelf. Regional permits are used to authorize a specific activity within a limited geographical area, and also to avoid duplication of the regulatory control of another agency or State. Regional permits have normally been used for pipelines in the Gulf of Mexico; a regional permit was used for the HI lateral pipeline.

States.--Texas and Louisiana have established and exercise jurisdiction of offshore waters in the Gulf of Mexico. Texas State waters extend from shore to the "3-league line," a distance of about 9 nautical miles offshore, while Louisiana State waters extend only 3 nautical miles offshore.

The Pipeline Safety Group of the Railroad Commission of Texas and the Department of Natural Resources of the Office of Conservation for Louisiana both have adopted and enforce Federal pipeline safety standards in 49 CFR Parts 192 and 195 for intrastate pipeline systems. Texas also requires that all offshore pipelines extending through State waters must have a permit issued by the State's General Land Office.

In 1979, the Louisiana legislature enacted the Underwater Obstructions Act. This statute empowered the State's Office of Conservation to implement additional regulations to prevent obstructions to fishing, shrimping, and other navigation resulting from oil and gas production and transportation activities in State waters. Under these regulations, permits are required for the construction of new offshore pipelines, with the exception of gathering lines. The regulations also address the abandonment of facilities and corrective action when obstructions are discovered.

Nonregulated Pipeline Systems.--A representative from the Railroad Commission of Texas indicated that there are an unspecified number of pipelines offshore of Texas that are not under State or Federal jurisdiction. As examples, he cited liquid pipelines that operate below the level of 20 percent of the specified minimum yield strength and that are not regulated under 49 CFR Part 195. He also mentioned natural gas gathering lines extending between offshore wells and the separation and processing facilities on shore. (Such pipelines are not regulated under 49 CFR 192.1(b)(1).) He also stated that many pipelines had been installed before Texas began keeping records of the locations and owners.

A representative of the Department of Natural Resources for Louisiana stated there are no comprehensive maps of offshore pipelines in the Gulf of Mexico. He further stated that the construction standards for and the number, location, and current condition of many of these pipelines are unknown. Many of the pipelines in the near-shore areas of Louisiana date back to the 1920s and 1930s, whereas pipelines in the offshore areas date back to the 1940s.

Regulations and Standards on the Burial and Protection of Submerged Pipelines

Department of Transportation Standards.--Under 49 CFR 192.327(e), offshore gas pipelines installed under water less than 12 feet deep must have a minimum cover of 36 inches in soil or 18 inches in consolidated rock between the top of the pipe and the natural bottom. Submerged pipelines installed in a navigable river, stream, or harbor must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock. Offshore gas pipelines in at least 12 feet but not more than 200 feet of water are required by 49 CFR 192.319(c) to be installed so that the top of the pipe is below the natural bottom unless the pipeline is supported, anchored, or protected "by an equivalent means." According to an OPS representative, the demarcation of 12 feet of water was based on accepted practice of the pipeline industry. Comparable burial requirements for submerged liquid pipelines are found in 49 CFR 195.246 and 195.248. Beyond a water depth of 200 feet, there are no requirements that an offshore gas or liquid pipeline be buried.

The regulations do not define what constitutes the natural bottom, soil, or cover over the pipeline. OPS officials have indicated that the mud line is the natural bottom in areas with soft, muddy bottoms and silt. In an interpretation of cover as used in 49 CFR 192.327(a), the OPS stated the following:

The "cover" required for buried transmission lines refers to the depth of backfill that is placed on top of a pipeline that has been installed in a ditch. It is that minimum vertical distance measured between the topmost part of the pipe after installation in the ditch and the restored grade level directly over the pipe after burial is completed.

To satisfy the burial requirements for offshore pipelines in less than 12 feet of water, the OPS requires backfilling of a trench containing the pipeline. For pipelines in depths from 12 to 200 feet, the OPS accepts the placement of the pipeline in a trench without backfilling if the top of the pipeline is below the natural ocean bottom. Under 49 CFR 192.319 and 192.327, backfilling of the trench is not explicitly required. In amending section 192.319 in 1976, the DOT acknowledged that many offshore pipelines are installed below the seabed by a water jetting process, and cover for the pipeline results from a natural action of the water currents rather than from backfilling.

Construction requirements contained in 49 CFR 192.317(a) specify that offshore gas pipelines must be protected from various hazards, including ship anchors and fishing operations. Paragraph 192.317(a), however, does not specify the nature of the protection from these hazards or the actions an operator should take to provide protection. In an interpretation of this paragraph dated August 31, 1989, the OPS stated that operators must provide a "reasonable" level of protection against the anticipated effects of each listed hazard. The OPS explained that depending on the nature and the level of risk perceived, protection might include any one or combination of

measures such as deeper burial, anchorage of the pipeline, greater wall thickness for the pipe, added flexibility, heavy concrete coating, or other measures "considered necessary to protect the pipeline against foreseeable damage." In an additional clarification dated September 27, 1989, the OPS stated that the requirements of paragraph 192.317(a) for protection from certain hazards apply to conditions that are known or can be foreseen at the time of construction. There are no requirements in paragraph 192.317(a) that an operator continue to provide protection against hazards from changed or new conditions. However, the OPS stated that it can and will require an operator to take remedial action under the general maintenance requirements found in section 192.703 if a gas pipeline becomes unsafe because of any changes in conditions that occur after construction. There is no comparable requirement to paragraph 192.317(a) for liquid pipelines in 49 CFR Part 195.

According to the OPS, with the exception of section 192.703, these standards for the burial and protection of offshore gas and liquid pipelines are construction requirements; they do not apply throughout the service life of the pipeline, but only at the time of construction. The current standards for the burial and protection of offshore gas pipelines in sections 192.319 and 192.327 were published as amendments to Part 192 in August 1976¹⁷ "to more clearly delineate the applicability of Part 192 to offshore pipelines." The amendments to sections 192.319 and 192.327 became effective on August 1, 1977, and applied to those pipelines installed after July 31, 1977.

The versions of sections 192.317, 192.319, and 192.327 in effect when the HI lateral pipeline was constructed in 1973 did not differentiate between offshore and submerged pipelines and other types of pipelines, nor did they identify hazards associated with the offshore environment. The OPS representatives stated that these sections, in their pre-amended versions, applied to submerged pipelines.

In its notice of proposed rulemaking to amend Part 192, the OPS had specifically acknowledged the need to protect offshore gas pipelines from damage by fishing vessels. In the notice, published in October 1975,¹⁸ the OPS stated that pipelines installed under water less than 200 feet deep are placed below the natural bottom to avoid interference by trawlers. The OPS also indicated in the notice that the proposed requirement for 36 inches of cover for pipelines in less than 12 feet of water "appears necessary to protect persons using these relatively near-shore areas and to protect the pipeline from possible external damage." According to the notice, the proposed cover requirements were consistent with requirements of the U.S. Army Corps of Engineers. In a response to the notice, however, the Corps stated that the proposed burial standards were less than those imposed under regulatory permit programs administered by the Corps' New Orleans district engineer. For example, the Corps required burial 3 feet below the seabed or 12 feet below mean sea level, whichever was deeper, and out to a water depth

¹⁷ Federal Register, Vol. 41, No. 159, dated August 16, 1976, page 34598.

¹⁸ Federal Register, Vol. 40, No. 191, dated October 1, 1975, page 45192.

of 200 feet. Also, pipelines under anchorage areas or fairways [designated shipping lanes] were to be buried 10 feet below the seabed.

Department of the Interior Standards.--Under 30 CFR 250.153, all pipelines that are greater than 8 5/8 inches in diameter and installed in water depths less than 200 feet must be buried to a minimum depth of 3 feet. The MMS regional supervisor may also require the burial of any pipeline if the supervisor determines that the burial will reduce the potential of environmental damage or the hazard to trawling operations or other uses. The supervisor may also require surveys to determine that a pipeline has been properly buried. The requirements in 30 CFR 250.153 are designated as "installation" standards.

According to the MMS regional supervisor for the Gulf of Mexico, the standards of Title 30 CFR were implemented in May 1988 and incorporated the standards of longstanding DOI orders. The regional supervisor and an official from the MMS headquarters did not know the basis for the burial standards found in 30 CFR Part 250.

The MMS requirements for issuing right-of-way permits for offshore pipelines are found in 30 CFR 250.157. Although the regulations require an applicant to describe the design features for withstanding certain environmental factors such as soft bottoms, storms, and water currents, the regulations do not require an applicant to bury the pipeline and maintain its buried condition.

U.S. Army Corps of Engineers.--The Corps' regulations in 33 CFR Parts 320, 322, 325, 326, and 330 do not specify burial depths for offshore pipelines. However, the district engineer for the New Orleans district, in testimony before the House Subcommittee on the Coast Guard and Navigation on February 26, 1990, stated that the regional permits issued for the Gulf of Mexico require a minimum burial depth of 3 feet in depths of water less than 200 feet. He did not indicate the basis for this burial depth. Also, the Corps requires a burial depth of 10 feet below the seabed under anchorage areas and shipping lanes. The regional permits also impose certain limits and conditions on an operator. For example, the permit issued for the HI lateral pipeline contains a condition requiring NGPL to maintain the pipeline in good condition in accordance with approved plans showing the burial depth.

States.--Because the Railroad Commission of Texas enforces the DOT pipeline safety standards in 49 CFR Parts 192 and 195 for intrastate pipeline systems, a representative of the Commission acknowledged that any problems interpreting Federal regulations for the burial and protection of submerged pipelines would also affect the State's application of the regulations. For example, the Commission, as does the OPS, also considers burial requirements as applicable to construction.

Louisiana regulations require permits for the construction of new pipelines and associated structures, except for gathering pipelines. The State determined the number of gathering pipelines was too large for the State to efficiently administer the issuance of permits. Under the State regulations, pipelines located in less than 20 feet of water must be buried

to a depth of 3 feet. The cutoff of 20 feet is based on data indicating that 90 percent of incidents of interference from obstructions occur in water less than 20 feet. The permits include conditions that require the facility "be constructed and maintained so as to prevent obstructions to the maximum extent possible."

Louisiana regulations also emphasize the removal of abandoned facilities other than flow or gathering lines. All facilities--including platforms, well heads, and pipelines--that are located above the mud line and in less than 20 feet of water and that constitute an obstruction must be removed within 90 days after abandonment.

Requirements on Inspection and Surveillance of Pipelines

Department of Transportation--Neither the gas nor the liquid pipeline safety standards require an operator to conduct periodic inspections of offshore or submerged pipelines to verify that the pipelines remain buried. An OPS representative indicated that he believed that any benefits from maintaining the buried state of submerged pipelines are not sufficient to justify the expense of monitoring the buried condition of submerged pipelines, and then reburying the pipelines.

Under 49 CFR 192.613, each operator of a gas pipeline "shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in...other unusual operating and maintenance conditions." Although the OPS has not officially interpreted this provision, the OPS representatives from headquarters and the Southwest regional office, which covers the accident area, stated that an operator cannot be expected to take corrective action if the operator is unaware of a hazardous condition such as an unburied or unsupported submerged pipeline. Both representatives indicated that an operator, in complying with this provision, must learn of the hazardous condition, determine if the pipeline is in danger of failing or is subject to damage, and take the appropriate remedial action. They also acknowledged that an unburied pipeline in shallow waters can be an unusual operating condition subject to this provision. The representative from the OPS headquarters indicated that an operator would normally become aware that a pipeline was unburied and subject to damage when the pipeline had been "snagged by a trawler," or otherwise involved in an accident.

Gas pipeline operators, including those operating submerged systems, are required by 49 CFR 192.705 to conduct patrols to observe the surface conditions along the pipeline right-of-way for indications of leaks, construction activity, or other factors affecting safety and operation. The OPS accepts aerial surveillance and overflights along the track of the pipeline as means of compliance with these requirements.

For liquid pipelines, section 49 CFR 195.401(b) requires an operator to correct any condition that adversely affects the safe operation of the pipeline whenever the operator discovers the condition. Surface inspections along the pipeline right-of-way are required by 49 CFR 195.412.

Other Federal Agencies.--The MMS requires under 30 CFR 250.152 that all pipelines must be designed and maintained to "mitigate any reasonably anticipated detrimental effects of water currents, storm or ice scouring, soft bottoms, mud slides,...and other environmental factors." The MMS also requires under 30 CFR 250.155 that pipeline operators inspect pipeline routes for indications of leakage at intervals and by methods prescribed by the regional supervisor. Monthly aerial overflights or boat surveys are accepted by the MMS regional office as acceptable means of compliance with these requirements for pipelines in the Gulf of Mexico. Also, the regulations in 30 CFR Part 250 do not require operators to inspect submerged pipelines to verify burial depths, or to verify that pipelines remain buried. However, the regional supervisor for the gulf stated that in his opinion, a pipeline required to be buried at construction should be maintained in the buried condition throughout its service life.

The Corps does not explicitly require operators to conduct inspections of submerged pipelines, but does expect operators to conduct periodic inspections in order to maintain the pipelines in accordance with the permits.

States.--The Railroad Commission of Texas and the Department of Natural Resources for Louisiana have adopted the DOT pipeline safety regulations for the regulation of intrastate pipeline systems. Louisiana also requires operators to notify the State within 30 days after an operator has knowledge that a pipeline has become unburied. The State, however, does not require operators to conduct regular inspections of submerged pipelines, but can require operators to conduct inspections if considered to be in the public interest.

Enforcement and Oversight for Pipelines

Department of Transportation.--The Southwest Region of the OPS encompasses the States of Texas, Louisiana, Arkansas, Arizona, and New Mexico, and offshore in the Gulf of Mexico from the western border of Mississippi to the Mexican border. The regional office comprises a chief, assistant chief, and two engineers. The assistant chief estimated there are 130 offshore pipeline operators within the region. Based on right-of-way permits issued by the MMS, there are about 13,450 miles of pipelines under the DOT jurisdiction in the Gulf of Mexico.

According to the chief of the regional office of the OPS, the interval between inspections of offshore operators is determined by risk priority. An interval of 3 years has been established for operators of pipelines transporting hazardous liquids or natural gas with a high content of hydrogen sulfide. Inspection of other natural gas pipeline operators is on a 5-year basis. However, according to the regional chief, current staffing is insufficient to meet this schedule. The assistant chief indicated that the regional office had conducted 15 inspections of NGPL's on-shore operations in the last 2 years; no inspections were conducted in the off-shore area.

According to the assistant chief, compliance inspections generally are not conducted at offshore sites, but at company offices. The OPS inspectors

will review an operator's maintenance and inspection records, plans, and procedures for the offshore facilities. When the OPS inspectors do visit the offshore platforms, they inspect the valves and equipment on a platform that are owned by the operator. The inspectors also examine the cathodic protection on the pipeline risers to the platform, and the testing records of the pressure sensors that are part of the platform's emergency shutdown system. The assistant chief estimated that the OPS inspectors had made 21 offshore inspection trips in the 2 years prior to the accident. Since January 1990, the regional office has assigned a senior engineer full-time to inspect offshore operators. The OPS has indicated that as of June 29, 1990, 12 compliance inspections had been conducted.

Department of the Interior--The MMS regional office for the Gulf of Mexico approves and regulates all leasing activities for oil, gas, and sulfur on the Outer Continental Shelf within the gulf. These activities include about 3,700 production platforms, and about 18,000 miles of active oil and gas pipelines. Of the 18,000 miles of pipeline, the MMS has exclusive jurisdiction over 4,550 miles. The balance are pipelines that are subject to the DOT safety standards. The MMS regional office had 55 inspectors assigned to 4 district offices within the region at the time of the accident.

The MMS does not have an inspection program for verifying the burial of offshore pipelines. Inspections of the production platforms and the emergency shutdown systems on the platforms are conducted annually. The MMS will physically test some components of the emergency shutdown equipment on the platform, including the high and low pressure sensors for the pipelines, as part of each annual inspection. The MMS also reviews the records of monthly tests on the emergency system that are conducted by the producer. The MMS inspectors will apply the MMS regulations when examining measuring equipment belonging to the pipeline company, such as meters.

U.S. Army Corps of Engineers--The Corps representative stated that its enforcement and inspection authority is discretionary. The Corps inspects those activities requiring permits commensurate with the resources available, and the potential impact of the activity. Consequently, not all activities are inspected. Because pipelines have not presented a statistically significant portion of those activities requiring oversight, the Corps considers inspections of the pipeline to be the operator's responsibility. To determine that an operator has complied with the permit, the Corps requires pipeline operators to provide as-built drawings that are compared with the permit.

The Corps has also indicated that the permit may be revoked, modified, or suspended in cases where an activity does not meet the minimum requirements and conditions included in a permit. One such condition is that the pipeline not cause an "unacceptable interference" with navigation.

States--A representative of the Railroad Commission of Texas estimated there are 70 offshore pipeline systems, totaling 600 miles of pipeline, within Texas State waters and under State jurisdiction. He indicated the Commission does not require periodic inspections to verify burial other than the surface patrols an operator must conduct over the pipeline.

The Department of Natural Resources for Louisiana estimates there are 20 miles of intrastate pipelines and 5,000 miles of interstate pipelines in Louisiana State waters. The Department has placed its inspection priorities on land pipelines in populated areas rather than on offshore systems; the Department has 11 inspectors.

The Louisiana Commissioner of Conservation testified before a Congressional subcommittee in February 1990 that the State did not have the financial resources to "police and enforce" offshore pipeline activities within State waters. The Commissioner stated that the costs of permit insurance, data acquisition, mapping, inspection, monitoring and other tasks essential to effective enforcement are beyond the means of any single State.

Coordination Between Regulatory Agencies.--In the 1976 memorandum of understanding between the DOT and the DOI, both Departments agreed to "coordinate all of their respective research and development projects concerning offshore pipelines," and to "coordinate and perform inspection activities" for those pipelines originating on the Outer Continental Shelf and subject to the DOT regulations. According to the agreement, at least once each calendar year, the DOT and the DOI were to review all existing standards, regulations, orders, and operating practices concerning pipelines on the Outer Continental Shelf.

Representatives from the OPS Southwest regional office and the MMS regional office for the Gulf of Mexico do not regularly meet to discuss offshore pipeline responsibilities, conduct joint inspections, or exchange inspection records or information. The two offices communicate and exchange information on an "as needed basis." The MMS regional supervisor was not aware of past discrepancies that required coordination with the OPS, although joint inspections have been conducted on occasion in the past. The MMS regional supervisor believed that the memorandum of understanding adequately defined the respective responsibilities of the two agencies.

Although the OPS and the MMS headquarters personnel have had periodic discussions about revising the memorandum, the agencies have not had regular coordination with the Coast Guard and its Captains of the Ports about offshore pipeline operations. The OPS, the MMS, Army Corps of Engineers, and Coast Guard did meet following the July 1987 accident in which the fishing vessel SEA CHIEF struck and ruptured a submerged pipeline. The OPS regional office personnel have met with representatives of Texas and Louisiana about offshore pipelines. An engineer from the OPS regional office also conducted a joint inspection with Louisiana pipeline inspectors in February 1990. The OPS has also indicated that Texas and Louisiana do contact the OPS as needed with questions about the regulations.

Coast Guard Captain of the Port

Authority and Responsibility.--The Coast Guard Captain of the Port (COTP) is responsible for the safety and security of the port, its facilities, and ships within the port. The COTP can control the movement of vessels when such action is deemed necessary for the protection of the port

and the safety of life and property at sea. Each COTP has an assigned geographical zone of responsibility. Typically, the Commanding Officer of a Marine Safety Office (MSO) serves as the COTP and is also designated as the Officer in Charge, Marine Inspection.

Submerged Pipelines as Hazards to Navigation.--The COTP is also responsible for the safety of navigation within his zone. The COTP can mark a hazard to navigation or require it to be marked. The COTP can also issue a Notice to Mariners that warns vessel operators of the hazard. The COTP can also establish a safety zone around a hazard to navigation. Once the safety zone is established, however, it must be patrolled to be enforced. According to the Chief of the Port Safety and Security Division in Coast Guard headquarters, the Coast Guard has no responsibility to search for hazards to navigation. If a hazard is brought to the Coast Guard's attention, however, the Coast Guard has the responsibility to followup such reports and to take appropriate actions to mitigate the hazard.

According to the Chief of the Port Safety and Security Division, the Coast Guard has not generally considered submerged pipelines to present a hazard to navigation. A Coast Guard representative stated, however, that with the occurrence of "several accidents within the past several years," district and local offices in the gulf region are concerned that submerged pipelines are presenting a hazard to navigation that needs attention. The Coast Guard has indicated that knowledge of submerged pipelines traversing areas of coastal erosion or heavy vessel activity does not constitute knowledge of a possible hazard to navigation. The Coast Guard requires knowledge of a specific hazard before it can be considered a hazard to navigation. Since the accident, the Coast Guard has stated in Notices to Mariners that exposed pipelines are hazards to navigation and should be reported.

Knowledge About Operators of Submerged Pipelines.--Pursuant to a COTP's responsibilities for environmental protection, the COTP is required to have a local contingency plan that provides a coordinated and integrated response by Federal, State, and local agencies to pollution discharges in the marine environment. The local contingency plan is to address oil pollution or the release of hazardous materials into the navigable waters, including those that result from a pipeline leak or rupture. Under a local contingency plan, the COTP can require a pipeline operator to take appropriate action to mitigate or stop the flow of a pollutant, and to clean up spills.

A COTP is not specifically required to maintain a listing of the owners and operators of submerged pipelines within the COTP's zone. The specific information to be included in the local contingency plan is left to the judgment of the local COTP. A Coast Guard representative stated it would be acceptable for a local COTP to identify a source in the local contingency plan that can provide the necessary information about offshore pipelines and operators.

The COTP in Port Arthur did not consider natural gas as a polluting material under his jurisdiction because a release of natural gas would be expected to pollute the air rather than the water. The local contingency

plan for Port Arthur did not list addresses or telephone numbers for operators of natural gas pipelines in the COTP's zone of responsibility. The COTP for Port Arthur stated that the plan is updated annually and that verification of the telephone numbers listed in the plan (which includes numbers for the MMS) is part of the updating process.

Other Information

Previous Incidents Involving Menhaden Vessels.--In 1981, a Zapata-owned vessel, the MISSISSIPPI SOUND, struck and ruptured a submerged natural gas pipeline in Breton's Sound, Louisiana. The gas that was released did not ignite, and no one was injured. Zapata's vice president of operations stated that the pipeline was supposed to have been buried but was above the subsea surface. He also indicated that the pipeline was not marked on a navigation chart. He further stated that other than the MISSISSIPPI SOUND accident, Zapata has not received any complaints from any pipeline company about operations near or damage to submerged pipelines by Zapata vessels.

In July 1987, the vessel SEA CHIEF, owned by Wallace Menhaden Products, Inc., struck a submerged pipeline transporting natural gas liquids in Louisiana waters. Product from the ruptured pipeline ignited and enveloped the vessel, resulting in the deaths of two crewmembers. The accident occurred in 6 1/2 feet of water and about 3/8 mile offshore. The draft of the vessel at the time of the accident was also about 6 1/2 feet. The pipeline had been installed in 1968 and originally was buried near the water's edge. At the time of the accident, the pipeline was unburied. The president of Wallace Menhaden stated that he did not know whether the pipeline had been marked on a navigation chart.

The Safety Board, the OPS, and the Coast Guard each investigated the accident involving SEA CHIEF. The Safety Board determined the probable cause of the accident to have been an unmarked, uncovered pipeline ruptured by a fishing vessel in shallow water.¹⁹ The Coast Guard determined the proximate cause to have been a hazard to navigation imposed by the unmarked pipeline. The Southwest regional office of the OPS determined that the release of natural gas was the result of the pipeline being ruptured when struck by a vessel.

The Southwest regional office of the OPS concluded that the operation of the vessel was not prudent because the draft of the vessel was about the same as the depth of water. The regional office also recommended amending the DOT regulations to require pipeline operators to inspect, at 3-year intervals, offshore pipelines that are in waters less than 10 feet deep and in areas where erosion has occurred, and then to require operators to rebury those pipelines found to have insufficient cover. The assistant director for regulation at the OPS headquarters evaluated the recommendation and determined that the recommendation was incorrectly addressing a navigational problem; however, he did not discuss the recommendation with the Coast Guard. The assistant director cited the difficulty and cost of lowering the

¹⁹ NTSB Brief of Accident DCA-87-FP-13.

pipelines with little benefit to the public to "protect imprudent operators." He consequently determined that a less costly solution would be the use of buoy markers and the charting of pipelines. He also noted that existing regulations in 49 CFR Parts 192 and 195 require an operator to take appropriate remedial action if pipelines without sufficient cover in shallow waters were considered unsafe.

Other Fishing Vessel Claims.--In 1979, Louisiana created the Fisherman's Gear Compensation Fund as a means to compensate fishermen who sustained damage to their vessels or equipment by striking a man-made underwater structure. The fund is generated from fees assessed on all State mineral leases and pipeline rights-of-way located within the State's coastal zone. Each year since 1979, Louisiana has received an average of 364 reports of damage to fishing vessels or gear caused by striking underwater obstructions. According to a representative of the State's Department of Natural Resources, this average number of reports does not reflect (1) the number of vessels that have hit an underwater structure without sustaining damage, (2) the number of incidents in which fishing vessels have sustained damage but were not reported, or (3) the number of nonfishing vessels that have hit underwater obstructions.

Reported Pipeline Incidents.--Since 1981, NGPL has reported five incidents of third-party damage to its offshore pipelines. Three of the incidents occurred when subsea valves were broken or damaged by shrimp trawling nets. In the fourth incident, a pipeline was buckled and cracked from a dragging barge anchor. All four of these incidents resulted in the release of gas. The fifth incident occurred when a contractor damaged the riser pipe to a platform with no release of gas.

The Safety Board's review of the OPS incident reports found that since 1985, 21 incidents have been reported in which marine vessels have damaged offshore pipelines, including the SEA CHIEF and NORTHUMBERLAND accidents. Other than the latter two accidents, none of the reported incidents resulted in death or injury.

Communication Between Pipeline and Vessel Operators.--NGPL's district superintendent stated that although he was aware of shrimping and sport fishing within shallow waters of the gulf, he was not familiar with other types of fishing operations. He was aware that shrimp fishermen drag nets, and expected them to contact either the pipeline company or the Coast Guard if their nets were caught on a pipeline. According to a corporate representative, NGPL had not thought there were safety problems with fishing vessel operators. Since the accident, however, NGPL officials have stated that pipelines buried in a soft mud are endangered by fishing vessels navigating through the soft mud bottom. There is no indication that before the NORTHUMBERLAND accident NGPL directly communicated with fishing companies or their associations about the potential dangers to and from offshore pipelines.

Other than the accidents with the MISSISSIPPI SOUND and the SEA CHIEF, Zapata and Wallace Menhaden have not received any complaints from any pipeline operators about their vessels operating near or damaging any

submerged pipelines. The Louisiana Shrimp Association also has not received any complaints from pipeline operators about damages caused by shrimpers.

The president of Wallace Menhaden stated that offshore pipeline operators at one time attended meetings of the Gulf States Marine Fisheries Commission to discuss problems with debris, obstructions, and abandoned wellheads. However, he could not recall if offshore operators had attended in recent years.

Coastal Erosion and Subsidence.--The U.S. Geological Survey, State agencies, and universities in Texas and Louisiana have been and are conducting studies of coastal erosion and subsidence²⁰ along the gulf coasts of Louisiana and Texas. The thrust of the effort generally has been to identify areas highly prone to erosion, to predict erosion rates, and to mitigate the loss of coastal wetlands.

According to a representative of the U.S. Geological Survey, the rate of erosion of coastal lands in the Gulf of Mexico is the highest in the United States, and can be as much as 10 times greater than the rate along the Atlantic coast. Between 1974 and 1982, the rate of erosion of the shoreline west of Sabine Pass has averaged 15 feet per year. Erosion will typically extend offshore where the water depth is 10 to 12 feet. A reduction of sediment supply, frequent storms, and subsidence of the sea bottom can increase the rate of erosion. Subsidence can occur from the compaction of bottom sediments or the depletion of fluids from the subsurface. Tidal data between 1958 and 1983 indicate that the average rate of subsidence in the Sabine Pass area was equivalent to 3 feet per century.

The sea bottom in the Sabine Pass area is soft mud deposited from the Mississippi River and carried by currents and wave action to the Sabine Pass region. A Geological Survey representative acknowledged that 3 feet below the mud line such a bottom can be very soft and unstable.

A scientist with the Bureau of Economic Geology at the University of Texas-Austin reported that muddy beaches and shorefaces are more vulnerable to erosion after a pipeline is buried than are sandy beaches. The excavated mud from a pipeline trench becomes saturated with water and consequently loses its cohesiveness. This excavated mud, if used as backfill over the pipeline trench, is more likely to be removed by the natural action of the water than is the adjacent undisturbed mud.

The scientist also indicated that dragging towed objects along the sea floor and movement of ships would have "a minor local influence on [the] disturbance of the sea floor." He acknowledged, however, that the removal of the pipeline overburden (the sediment covering a pipeline) can occur if propeller wash or dragging of the same area was frequently repeated, if the area had been previously disturbed, and if the rate of sedimentation was too low to replace the sediment removed. After comparing the reported burial

²⁰ Erosion is the lateral retreat of coastal lands and subsidence is a settling or lowering of the land or sea bottom.

depth of the HI lateral pipeline, the depth of water shown on the as-built construction plan, and the depth of water recorded at the time of the accident, the scientist estimated that the maximum erosion of the overburden for the HI lateral pipeline was 2 to 4 feet. He concluded that erosion of the shoreline since 1973 would not lower the sea floor 8 to 10 feet, the approximate distance the pipeline was shown to have been buried on the as-built plan. He also concluded that subsidence of the sea floor did not adequately explain the loss of overburden because subsidence occurs at a lower rate than erosion, and also tends to increase water depth without the loss of overburden.

Technology to Inspect Submerged Pipelines.--NGPL, the Interstate Natural Gas Association of America (INGAA), and the American Gas Association maintain that cost-effective and practical technology does not currently exist for inspecting an offshore pipeline, particularly in shallow waters, to determine if the pipeline is buried and to what depth. During the Safety Board's public hearing, the effectiveness and limitations of side scan sonar and divers were discussed as means of surveying submerged pipelines. NGPL indicated the pipeline must be exposed sufficiently to be detected by side scan sonar. Further, NGPL and INGAA stated that with zero visibility in the murky waters of the near-shore areas along the gulf coast, divers must detect the exposure of a pipeline by their sense of touch, thereby making this process time consuming and costly.

Sources such as the United Kingdom's Department of Energy, British Gas, the Coast Guard, and a consortium of U.S. companies indicated that technology is available (such as remotely operated vehicles, acoustic techniques, electromagnetic tracking, and internal instruments) that can be used to inspect submerged pipelines. They also indicated that present operational costs are high, and that present applications are for deeper waters than those encountered in this accident. (See appendix E.)

Study of Offshore Pipeline Safety Practices.--In December 1977, 14 months after the OPS had amended its regulations to include specific requirements for offshore pipelines, the results of a DOT-sponsored study on offshore pipeline safety practices were published.²¹ The purpose of the study was to conduct research that would assist the DOT in evaluating the adequacy of the pipeline safety standards in 49 CFR Parts 192 and 195 as they apply to offshore pipelines. When the report was distributed to the pipeline industry in June 1978, the DOT indicated in the transmittal letter that the report was being evaluated to determine if additional regulatory or other action was appropriate. The regulations for offshore pipelines have not been amended since the report's release.

²¹ Funge, William; Chang, Kai S.; Juran, David I. 1977. Offshore pipeline facility safety practices. DOT/MTB/OPSO-77/13 and DOT/MTB/OPSO-77/14. Washington, DC: U.S. Department of Transportation, Materials Transportation Bureau, Office of Pipeline Safety Operations. 2 vol. Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

The report groups the causes of offshore pipeline failures into five categories: severe weather, equipment malfunction, corrosion, external impact, and unknown. Of these categories, the most frequent cause of failure was external impact damage from third parties. The report further noted that impact damage to offshore pipelines is generally caused by parties unaware of the pipeline's existence and may result from anchor dragging, impact by boat propellers, fishing and bottom trawling equipment, and dredging equipment. In addition to third-party damage, natural phenomena such as the undermining of pipeline support from scouring action, seabed sediment instability, and storm-induced current and wave effects were cited in the report as hazards for offshore pipelines.²²

Although the burial of the offshore pipelines was identified as a means of protection from potential hazards, the study concluded that burial alone should not be considered as the sole means of protection. The study also concluded that because anchors are capable of penetrating great depths, especially in soft sea bottoms, burial of pipelines does not generally protect pipelines from anchor damage. Implementation of a "sea traffic control" system was offered as a possible solution.²³

The report contained several recommendations to revise the pipeline regulations, including the need for (1) periodic surveys of the sea bottom; (2) design factors for the effects of hurricanes, waves, currents and other natural forces acting on a pipeline; and (3) the determination of the depth of cover in ship channels. The study also recommended several areas for further research and development. (See appendix F.)

Postaccident Actions

Coast Guard--The MSO in Port Arthur has revised its local contingency plan to include after-hours telephone numbers for the MMS. The MSO is also obtaining telephone numbers and points of contact for pipeline companies operating in the MSO's zone. This information will be included in the annual update of the local contingency plan. Charts depicting pipeline locations have also been obtained through the MMS, the Jefferson County Emergency Office, NGPL and its affiliate (Stingray Pipeline Company), and are now available in the MSO's operations center.

The MSO has also requested that pipeline companies within its zone provide information about pipelines that may be exposed on the seabed. The MSO will use any information gathered to issue Notices to Mariners about the potential hazards of exposed pipelines. The MSO will continue this effort as an ongoing project. The Eighth Coast Guard District in New Orleans also issued a Notice to Mariners in May 1990 for the coastal waters of the Gulf of Mexico that warns mariners involved in shallow water fishing operations of the possible hazards of submerged pipelines.

22 Funge, Vol. 1, p. 22-27.

23 Funge, Vol. 1, p. 28-30.

Pipeline Company.--In addition to revising its emergency plan and establishing liaison with the Coast Guard MSO in Port Arthur, NGPL has prepared a public safety bulletin and mailed it to commercial fishermen registered in the area. The bulletin urges fishermen to note the location of offshore pipelines on navigation charts, and contains a reproduction of the caution about submarine pipelines and cables that appears on the navigation charts. The bulletin also describes procedures for identifying and reporting a gas pipeline emergency.

Fishing Vessel Owner.--Zapata has cautioned its vessel masters of the necessity to avoid taking the vessels into areas where the vessel may contact the sea bottom. Zapata has also distributed the notices issued by the Coast Guard, the OPS, and NGPL to the masters of all company vessels.

No new equipment has been installed on company vessels. Zapata stated it unsuccessfully searched for equipment that would enable crews to detect uncovered, exposed pipelines in shallow waters. The Coast Guard's Research and Development Center has also confirmed that affordable and reliable equipment to detect exposed pipelines is not currently available for use on commercial fishing vessels.

Zapata has sought to have legislation drafted that would require burial of offshore pipelines and continual monitoring to assure that the pipelines remain buried. Legislation addressing this issue has recently been drafted and introduced in both Houses of the United States Congress. Zapata has also met with RSPA to request that RSPA take action to require the reburial of unburied pipelines. According to Zapata, RSPA cited the establishment of the Federal task force to develop solutions and also cited time and budget constraints.

Joint Meetings of the Pipeline and Fishing Industries.--Representatives of the pipeline and fishing industries have had several meetings since May 1990, to discuss actions needed to prevent recurrence of the NORTHUMBERLAND accident. Officials from INGAA, the American Petroleum Institute, and the Association of Oil Pipelines have represented the pipeline industry. The fishing industry has been represented by officials from Zapata, the National Fisheries Institute, and the Offshore Operators Association. Congressional staff have also attended.

The two industries have reached a consensus about the need to inspect natural gas pipelines in offshore waters, studies to determine the need for regulations for the inspection of offshore natural gas pipelines, and the availability of comprehensive charts indicating the location of submerged natural gas pipelines. (See appendix G.)

The pipeline and fishing industries still differ on the depth of water in which inspections should be required, a completion date for the initial inspections, and changes in the navigational practices. The pipeline industry advocates inspections out to a water depth of 15 feet and within 24 months after the enactment of legislation. The fishing industry supports inspections out to water depths of 22 feet to be completed by October 1,

1991. The pipeline industry believes that navigation practices in shallow waters should be reviewed, whereas the fishing industry does not.

ANALYSIS

General

According to the results of the mechanical and chemical tests conducted on samples of the recovered pipe, the pipeline met the API specifications for strength and chemical composition. The absence of any significant corrosion of the pipeline indicates that the pipeline was not in a weakened condition at the time of the accident. The weather and the sea state did not affect the operation of the vessel and were not factors in the accident. The lack of a fathometer on the vessel also was not a factor in the accident. Although a fathometer can indicate the distance between the vessel's bottom and the sea bottom, it cannot detect a pipeline. It can only alert a master to the potential of hitting the sea bottom, and the NORTHUMBERLAND's master knew the vessel was running close to the bottom.

Because of the complete destruction of the vessel by the fire, the condition of the steering and throttle controls before the accident could not be determined. Maintenance and inspection records, however, support the master's statements that all vessel equipment was working properly at the time of the accident. Therefore, there were no problems with the steering and throttle controls or other operating equipment on the vessel that adversely affected the operation of the vessel.

The Accident

When the accident occurred, the NORTHUMBERLAND was in shallow waters and close to shore, which was normal and usual for its trade. The major constraint to the vessel's operation in the area was its draft. The water depth and the estimated draft of the vessel at the time of the accident were both about 10 feet. Consequently, the bottom of the vessel was close to the sea bottom or slightly penetrating the bottom when it struck the pipeline.

The flanged plate welded to the modified skeg, which was on the deepest part of the vessel, was the most likely part of the vessel to strike the pipeline on the seabed while the vessel was backing. When the pipeline was struck and ruptured, the natural gas that was released instantaneously formed an explosive mixture with air that enveloped the vessel. Although the specific ignition source on the vessel was not identified because of the extent of damage, any piece of operating machinery or electrical fixture located toward the stern of the vessel may have been the ignition source.

The pipeline was not fully buried when it was struck by the NORTHUMBERLAND. The diving surveys established that the unburied segments of the pipeline were not confined to a limited length, but extended for as much as 400 feet in the immediate accident area. The quantity and type of marine growth found on the pipeline indicates that the pipeline had been unburied

for a prolonged period. Damage to the concrete coating also indicates that the pipeline had been previously struck by other vessels or equipment towed by vessels.

The Corps issues permits to operators placing man-made objects in navigable waters to prevent the obstruction of such waterways. Therefore, in issuing its permit to NGPL, the Corps required the pipeline to be buried and maintained to the buried depths shown on approved plans (about 9 feet below the seabed in the case of this pipeline). To satisfy the requirement that the pipelines be maintained in accordance with the permit, the Corps expects the operators to conduct periodic inspections. The NORTHUMBERLAND struck and ruptured the pipeline because the pipeline was not buried and maintained at the burial depth required by the Corps' permit. Therefore, the Safety Board believes that the failure of NGPL to keep the pipeline safely buried caused the accident.

Marine Operations and Practices

Right of Navigation.--Because the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction of the navigable waters of the United States, restricting the navigation of fishing vessels as advocated by NGPL and INGAA does not appear to be consistent with the statute. Further, such restrictions could not be effectively enforced to reduce the danger to the vessels and crews because of the large number of vessels operating and pipelines located in the Gulf of Mexico.

Awareness of Offshore Pipelines.--The master had sufficient experience as the master of a vessel operating in the offshore waters of Texas and Louisiana to have been very familiar with these waters. The master had a valid and proper Coast Guard license for a vessel of the NORTHUMBERLAND's size and service. There were no indications from Coast Guard licensing or other records that the master had operated a vessel imprudently, or had behavioral problems that might have affected his ability to perform his duties. The master was not maneuvering the NORTHUMBERLAND at an excessive speed when the accident occurred, nor was he operating the vessel in a manner that would lead to a hard grounding of the vessel.

The master apparently had no specific knowledge of the presence and location of submerged pipelines in the areas in which he had worked and was familiar. Although he was aware that submerged pipelines existed in the Gulf of Mexico, he believed that all submerged pipelines were buried beneath the seabed and were required to be maintained in that condition. The Safety Board concludes that the actions of the master did not contribute to the cause of the accident.

Zapata's management also believed that submerged pipelines were buried and maintained in that condition. As a result, the company did not train its vessel masters about the potential dangers of submerged pipelines and did not have any policies regarding the operation of its vessels near submerged pipelines. Based on his training and experience, the master consequently had no reason to be concerned about submerged pipelines. Because of the uncertainty about the actual condition of submerged pipelines in the Gulf of

Mexico, the Safety Board believes that marine operators should be made aware that submerged pipelines may be unburied and pose a hazard to their vessels and crews when the vessels are in depths of water comparable to their drafts. Therefore, the Safety Board urges Zapata to develop and implement a program to train its vessel masters about the potential dangers of exposed pipelines and the precautions masters can take when operating the vessels in shallow water.

Further, the Safety Board has been concerned that the perception held by Zapata's management may not be an isolated situation. Statements by officials from Wallace Menhaden and the Louisiana Shrimp Association indicate that the same perception may be held by most of the commercial fishing industry in the Gulf of Mexico. Except for accidents involving the MISSISSIPPI SOUND in 1981 and the SEA CHIEF in 1987, there were no known incidents or complaints from pipeline operators about menhaden vessels striking submerged pipelines. The occurrence of these two accidents in the 9 years preceding the NORTHUMBERLAND accident would not have given Zapata or other menhaden companies reason to believe that many submerged pipelines were unburied and posed a significant safety hazard to their vessels when running close to the sea bottom. Further, the equipment losses that shrimp fishermen have sustained from submerged pipelines and wells were viewed as economic losses rather than safety hazards.

To address the lack of knowledge about submerged pipelines within the fishing industry, the Safety Board recommended on February 22, 1990, that the DOT:

P-90-3

Issue an advisory notice or use other means to caution commercial fishing, shrimping, and other marine vessel operators in the Gulf of Mexico that submerged offshore pipelines may be unprotected on the ocean floor and that marine vessels can damage such pipelines and endanger their crews when operating in water depths comparable to a vessel's draft or when operating bottom dragging equipment.

In a response dated May 30, 1990, the DOT provided copies of warnings issued by the OPS and the Coast Guard. The OPS issued an "Alert Notice," dated April 9, 1990, to all natural gas and hazardous liquid pipeline operators, and to commercial fishing and shrimping associations. The notice urged pipeline operators to identify commercial fishing and vessel operators and to caution them that submerged pipelines may be unprotected. The notice also recommended that operators identify and correct any conditions that would violate the OPS and the MMS requirements, or the terms and conditions of an Army Corps of Engineers permit, especially those requirements or conditions regarding the burial of any pipeline in shallow water. The Coast Guard also issued a Local Notice to Mariners in May 1990 for the Gulf of Mexico region that warned mariners about the hazards of submerged pipelines. The advisory notices issued by the OPS and the Coast Guard were satisfactory responses to the recommendation, which has been classified as "Closed--Acceptable Action."

However, the Safety Board remains concerned that the efforts by the OPS and the Coast Guard to warn pipeline operators, commercial fishermen, and other mariners may have only a temporary effect. Therefore, a continuing program is needed to educate commercial fishermen and other marine operators about the potential danger to their vessels from exposed pipelines in shallow waters. The Safety Board believes that the Coast Guard, as the primary Federal agency responsible for navigation safety in U.S. waters, should develop and implement a program to educate fishermen and other marine operators about submerged pipelines. Moreover, the Coast Guard should also work with fishing and other marine industry representatives to develop practices in vessel operations that could be adopted to lessen the likelihood of vessels striking exposed submerged pipelines.

Pipeline Company Operations and Practices

Construction and Burial of the High Island Pipeline.--The HI pipeline was placed in the bottom of a trench. The cover, as indicated on the as-built construction plans, was the vertical distance from the level of the sea bottom down to the top of the pipeline; the cover, however, was not necessarily the same as the actual depth of the overburden (the sediment) that may have been over the pipeline.

The NGPL never inspected the pipeline after its construction to confirm that natural sedimentation had filled in the trench and had returned the sea bottom to its natural elevation, and thus it is not certain that the trench filled in and produced an overburden of the depth shown on the as-built construction plans and required by the right-of-way permit issued by the Corps. Because the pipeline was supposed to have been buried at the time of construction but was unburied at the time of the accident, the Safety Board is concerned that NGPL's other submerged pipelines may also be unburied and vulnerable to damage and rupture.

Inspection of Company Pipelines.--The NGPL acknowledged that it did not have a program of regular inspections of its offshore pipelines to determine if they were unburied or vulnerable to damage from surface vessels. Instead, the company adopted a reactive policy of waiting until the company was made aware of a hazardous condition before taking any remedial action, rather than an active policy of looking for hazardous conditions and correcting them before an accident occurred.

Under 49 CFR 192.613, each operator of a gas pipeline must have a procedure for continuing surveillance to determine unusual operating and maintenance conditions. In its investigation of five accidents involving natural gas pipeline systems operated by Kansas Power and Light Company,²⁵ the Safety Board concluded:

²⁵ National Transportation Safety Board. 1990. Kansas Power and Light Company, Natural Gas Pipeline Accidents, September 16, 1988, to March 29, 1989. Pipeline Accident Report NTSB/PAR-90/01. Washington, DC. 128 p.

Unlike many of the regulations, Section 192.613...contain[s] a statement of purpose and a general objective. However, in these and previous investigations, the Safety Board has found that gas operators either do not understand or choose to ignore the significance of these regulations and have often not established procedures to comply with their requirements....Although the Safety Board believes that it is clear that procedures are explicitly required...for continuing surveillance..., experience indicates that these requirements are not being met.

To have an effective procedure that will actually determine unusual operating and maintenance conditions, an operator must regularly and actively inspect for these unusual conditions. According to the OPS, NGPL's reliance on aerial overflights was consistent with the requirements of 49 CFR 192.705 for patrolling offshore pipelines. While aerial overflights or surface patrols are useful to detect leaks, they do not, in the Safety Board's view, satisfy the needs for continuing surveillance required under section 192.613--to detect that a pipeline has become unburied and vulnerable to damage from surface vessels. Also, because NGPL did not inspect the pipeline, NGPL did not maintain the pipeline as required by the permit issued by the Corps. The HI lateral pipeline was exposed and vulnerable to damage from surface vessels because NGPL did not have a program for continuing surveillance that incorporated regular inspections of the pipeline.

The presence of a submerged pipeline, whether it is offshore or passes under a river or other body of water, is not obvious to a vessel operator. Because submerged pipelines transport natural gas and hazardous liquids that can endanger life and property if released, pipeline operators have the primary responsibility to construct, maintain, and operate their pipelines in a manner that does not endanger the public. Therefore, the Safety Board urges NGPL to establish and implement a program to conduct regular and adequate inspections of its submerged pipelines and to maintain the pipelines in accordance with as-built construction plans and all right-of-way permits.

Industry Practices.--The Safety Board is concerned that NGPL's inspection and maintenance practices are typical of other operators of submerged pipelines because of testimony provided by industry associations before the House Subcommittee on the Coast Guard and Navigation. Consequently, many other submerged pipelines may not have been adequately buried and may be similarly vulnerable to damage. Also, pipelines that were never required to be buried because of regulatory exemptions or grandfathering provisions are also likely to be vulnerable to damage. The majority of all submerged pipelines very likely have not been regularly inspected.

The Safety Board believes that the only reasonable long-term solution to minimize the hazard posed to mariners and the environment by unprotected submerged pipelines is to bury them where the depth of water is comparable to the drafts of surface vessels. The Safety Board also believes that the operators of all submerged pipelines should be required to conduct regular

inspections that will ensure the pipelines remain buried and not become vulnerable to damage from surface vessels.

The Safety Board recognizes that the legislative and regulatory changes needed to achieve these goals are long-term actions. In the interim, all operators of submerged pipelines should proceed with programs to inspect their pipelines and to bury them where necessary. Therefore, the Safety Board urges INGAA, the American Gas Association, the American Public Gas Association, and API to recommend to their members to regularly inspect their submerged pipelines and to maintain them in accordance with as-built construction plans and all right-of-way permits.

Regulation of Offshore/Submerged Pipelines

Many deficiencies in the Federal regulations for submerged pipelines and the oversight and enforcement programs are discussed in the following sections. Actions that are needed by the OPS, the MMS, and the Corps to rectify these deficiencies are also identified.

Effects of Multiple Jurisdiction.--At the Federal level, the OPS, the MMS, and the Corps all exercise some jurisdiction over submerged pipelines. The regulations or standards of each agency, however, differ in their applicability and scope. Pipelines are exempted from regulation by one agency but not another because of seemingly arbitrary factors such as minimum stress level, diameter, or location of a pipeline. For example, the OPS does not regulate hazardous liquid pipelines that operate at a stress level of 20 percent or less, while the MMS and the Corps do not have a similar exclusion. The MMS requires the burial of pipelines greater than 8 5/8 inches in diameter, whereas the OPS requires the burial of hazardous liquid and natural gas transmission pipelines without consideration of diameter.

Further, the DOT regulations also have grandfathering provisions that exempt existing pipelines from many standards. As a result of the inconsistent standards, exemptions, and grandfathering provisions among the different regulatory agencies, submerged pipelines may not be required to be buried, protected, or even regulated. To ensure that all pipelines with comparable hazards will be consistently protected, RSPA (through the OPS), the MMS, and the Corps collectively need to evaluate the applicability of their respective regulations and to amend their regulations as necessary to provide uniform regulation of submerged pipelines. Because Texas and Louisiana have adopted the DOT regulations for intrastate systems, the Safety Board would expect amendments to the DOT standards to carry over to these States as well.

However, the Safety Board is also concerned about the possible number of submerged pipelines that have never been regulated, were never required to be buried and protected, and have never been regularly inspected. Although the number of reported incidents of submerged pipelines damaged by surface vessels is small according to the OPS, the large number of claims filed under Louisiana's Fisherman's Gear Compensation Fund suggests that the danger from underwater obstructions, including pipelines, is greater than the OPS records suggest. Because all submerged pipelines are not subject to the OPS or other

reporting requirements, and because the number, location, and owners of all submerged pipelines in the Gulf of Mexico are not known, the actual danger cannot be ascertained from the OPS incident reports alone. Consequently, the magnitude of the problem and the potential danger of submerged pipelines to surface vessels are unknown.

Therefore, in a safety recommendation issued on February 22, 1990, the Safety Board recommended that the DOT:

P-90-4

Identify, with the assistance of the Department of the Interior and other Gulf Coast States that may have jurisdiction, the type, number, location, and owner of all offshore pipelines in the Gulf of Mexico.

A similar recommendation, P-90-1, was issued on the same date to the Department of the Interior. In a response dated May 30, 1990, the DOT cited a recently completed study conducted as part of the MMS' ongoing environmental studies program. The study includes the information specified in the recommendation for those pipelines previously documented by the MMS. The DOT also cited the records maintained under the Corps' permit program. The DOT further stated it is considering proposals to require pipeline operators to maintain current maps and other information about their pipelines that can be used to identify and locate pipeline facilities. The DOI, in response to Recommendation P-90-1, stated that it was cooperating with the DOT through a DOT-sponsored task force that was organized as a result of this accident. (The task force is discussed in the section "Actions Needed.")

The responses of the DOI and the DOT, however, did not completely meet the intent of the recommendations. The study and records cited in the DOT's response identify known pipelines that were issued right-of-way permits. The Safety Board's primary concern, however, is for those pipelines that were--for whatever reason--never issued right-of-way permits or otherwise regulated. Until their number, location, and ownership are established, the potential danger to surface vessels remains unknown. The Safety Board urges both the DOI and the DOT to renew their efforts to collect these data, and to utilize the resources of the States in the gulf region. However, because of the positive efforts of the DOT and the DOI, Safety Recommendations P-90-1 and -4 are classified as "Open--Acceptable Response."

Regulations and Standards for the Protection of Pipelines.--The OPS, the MMS, and the Corps have acknowledged the need to bury submerged pipelines to protect them from vessel operations. Yet, the MMS and the Corps were unable to cite the basis of their respective standards, whereas an OPS representative indicated that the OPS standards were based on industry practices.

The Safety Board believes that the appropriate burial depth to protect a submerged pipeline from damage depends on several factors, including the design of the pipeline, the product transported, the operating pressures of

the pipeline, characteristics of the sea bottom, subsidence and sedimentation rates, the depth of water, and the type and extent of vessel activity in the area. Without proper consideration of these factors, burial depths become arbitrary and may not necessarily be effective in protecting the pipelines from damage. Because the OPS, the MMS, and the Corps cannot justify the basis for their standards, the Safety Board is concerned that each agency has adopted its standards without proper consideration of these factors.

Also, the burial standards of the OPS, the MMS, and the Corps establish the "natural bottom" or the "sea bottom" as the reference datum for burial depths. However, in areas of soft mud and silt, such as those found in much of the Gulf of Mexico, there may be several feet of mud and silt suspended in the water. Because the suspension of mud and silt does not provide effective support or cover for a pipeline, the reference datum must be located where the bottom sediment has sufficient consistency and compaction to support and cover a pipeline. The Safety Board believes that prescribed burial depths would provide a more consistent level of protection if the reference datum was based on a specified compaction of the bottom sediments.

Although current DOT regulations in 49 CFR 192.317 require that offshore gas pipelines must be protected from ship anchors and fishing operations, the OPS has not adequately defined the level of protection required. Interpretations that an operator must provide "reasonable" protection against "foreseeable damage" are vague and do not provide sufficient guidance to pipeline operators. The OPS should be able to identify those conditions that place unacceptable risks on the pipeline, and then determine the minimum level of protection required. For example, if the rupture of a gas pipeline under high pressure is an unacceptable risk, events that can cause a rupture should be identified and adequate protection of the pipeline from those events should be required. Additional protection can also be required for those sections of the pipeline perceived to be in the greatest danger, such as those sections in areas with heavy vessel activity. Hazardous liquid pipelines should also be afforded the same protection as natural gas pipelines because of the potential for loss of life, property damage, and pollution damage.

Both the OPS and the MMS have designated the requirements to bury and protect submerged pipelines as construction or installation standards that do not apply throughout the service life of the pipeline. The need to protect a pipeline from damage, however, does not diminish after the pipeline has been constructed. Consequently, the level of protection required throughout the service life of a pipeline should not be less than that required at the time of construction.

Because of these deficiencies, the DOT and the DOI regulations and the standards of the Corps do not provide a sufficient level of safety. Texas and Louisiana apply the DOT regulations to their intrastate pipelines, so the level of protection afforded these systems is also inadequate. Consequently, RSPA (through the OPS), the MMS, and the Corps should, collectively and under the leadership of RSPA, develop and implement new standards for the

burial and continued protection of submerged pipelines based on the potential risks to and from the pipeline.

Surveillance of Pipelines.--Requirements to bury and protect submerged pipelines from surface vessels will have little effect without proper inspection and surveillance programs. Over time, environmental effects and the activities of surface vessels in the near-shore or along embankment areas can lead to the loss of overburden over a submerged pipeline that is offshore or under a river. The pipeline therefore becomes more vulnerable to external damage and poses a greater danger to vessels that operate in the area.

Because the OPS, the MMS, and the Corps do not explicitly require operators to conduct regular inspections of submerged pipelines, operators have not given adequate attention to potential dangers from unburied pipelines. Further, OPS officials have stated that operators cannot be expected to take corrective action if the operators are not aware of hazardous conditions, and that the operators do not usually become aware of such conditions until an accident is reported. The OPS, therefore, adopted a reactive posture that permitted operators to take action after an accident occurred rather than a proactive posture that would have required operators to continuously search for and identify hazardous conditions. This reactive posture by the OPS has very likely led operators of submerged pipelines, such as NGPL, to also adopt reactive policies regarding continuing surveillance, to the detriment of public safety.

Although current methods such as divers' surveys or the use of various types of technology can be used for the inspection and monitoring of the burial condition of submerged pipelines, each is expensive and has limitations. Further, much of the available technology has not been developed specifically for use in shallow waters. However, because of the experience of the United Kingdom's Department of Energy and the development of various types of technology, the Safety Board believes that existing methods and technology can, with further refinements, be developed for use in shallow water.

Currently, inspections of pipelines in shallow waters can best be accomplished by divers using mechanical probes or equipment such as magnetic sensing devices. NGPL used divers to conduct a postaccident survey of the HI lateral pipeline to determine if additional segments of the pipeline were unburied. Divers' surveys could have been used for inspections before the accident, and can be used until more advanced technological methods are developed for use in shallow water.

Enforcement and Oversight for Pipelines.--The DOT-sponsored study published in 1977 identified many of the problems noted in this accident about deficiencies and inconsistencies in the regulations and also identified needed areas of research. However, the OPS took no action. As a result of the SEA CHIEF accident, the OPS's Southwest regional office recommended that the OPS regulations be amended to require operators to inspect all offshore pipelines on a regular cycle and to rebury those pipelines without sufficient cover. Personnel in the OPS headquarters did not act on the recommendation,

stating that the problem was a navigational one, yet did not discuss it with the Coast Guard.

The Safety Board believes that the OPS had enough information to recognize there were problems with submerged pipelines and that they posed danger to surface vessels. If the OPS had acted on the study and the recommendation from its Southwest regional office, effective regulations requiring operators such as NGPL to maintain their submerged pipelines in a safely buried condition might have been in force, and the HI lateral pipeline might have been protected from the NORTHUMBERLAND. Therefore, the Safety Board believes that the failure of the OPS to require operators of submerged pipelines to inspect and maintain their pipelines in a protected condition was a contributing factor to this accident.

The Safety Board recognizes that insufficient resources have also adversely affected Federal and State enforcement programs. The staffing of the OPS Southwest regional office is not sufficient to meet its enforcement and oversight responsibilities given the number of offshore pipeline operators, the miles of offshore pipelines, and the office's additional responsibilities for land-based pipelines and the evaluation of the DOT-certified State inspection programs. The inability of the regional office to comply with its internal policies of inspection intervals also suggests that staffing levels are insufficient. Because of the shortage of qualified inspectors, the Southwest regional office does not adequately fulfill its enforcement and oversight responsibilities.

The Safety Board has recognized in previous accident investigations the shortage of OPS personnel and its effect on programs intended to carry out the OPS responsibilities.²⁶ As a result of those investigations, the Safety Board issued Safety Recommendations P-87-28 to the DOT, and P-88-13 and P-90-13 to RSPA:

P-87-28

Increase, through use of State inspection personnel and by increasing the number of Office of Pipeline Safety (OPS) inspectors, the OPS pipeline inspectors, the OPS pipeline inspection capabilities sufficient to perform thorough, periodic safety reviews of all pipeline operations directly subject to OPS monitoring and to perform timely, effective, followup compliance

26 (a) National Transportation Safety Board. 1987. William Pipe Line Company, Liquid pipeline rupture and fire, Mounds View, Minnesota, July 8, 1986. Pipeline Accident Report NTSB/PAR-87/02. Washington, D.C. 58 p. (b) National Transportation Safety Board. 1988. Piedmont Natural Gas Company, natural gas explosion and fire, Winston-Salem, North Carolina, January 18, 1988. Pipeline Accident Report NTSB/PAR-88/01. Washington, D.C. 43 p. (c) National Transportation Safety Board. 1990. Kansas Power and Light Company, natural gas pipeline accidents, September 16, 1988 to March 29, 1989. Pipeline Accident Report NTSB/PAR-90/01. Washington, D.C. 53 p.

reviews of those operations in which compliance deficiencies are identified.

P-88-13

Monitor the staffing levels of the certified State pipeline inspection agencies, and require staffing level increases sufficient to respond to responsibilities beyond programmed inspection activities.

P-90-13

Assess the adequacy of and modify, as necessary, its program for monitoring and detecting inadequacies in State pipeline safety programs accepted by RSPA for determining compliance with Federal pipeline safety standards.

The RSPA Administrator has also recognized the OPS staffing problem and in August 1990 commented that the "...resource deficiency, when matched against the issues we face is of particular concern."²⁷ The Administrator pointed out that the OPS has overall responsibility for more than 2,000 pipeline operators of 1.6 million miles of gas pipelines and more than 200 operators of 155,000 miles of hazardous liquid pipelines. He further commented that to improve operations, the pipeline safety program:

- (1) is being placed on a risk-assessment basis to target inspections and to rank regulatory projects so that optimum utilization will be made of the program's limited resources;
- (2) is being upgraded to meet the challenges of an aging pipeline infrastructure;
- (3) is being examined to determine if additional rulemaking actions are needed to enhance public safety;
- (4) is being improved by enhancing cooperation among Federal agencies to more effectively meet the OPS responsibilities for pipeline safety;
- (5) is seeking to expand its staff from 51 to 60 personnel to increase its capabilities to determine compliance, carry out enforcement, and develop regulations (3 of the new personnel are to be added to the OPS Southwest regional office to meet the agency's goal of more frequent inspections of offshore pipelines, especially those of operators with a history of violations, poor accident record, or poor rating under the OPS computer-based risk assessment tool); and

²⁷ Dungan, Travis P. 1990. Current thinking and future activities at DOT and OPS. Pipe Line Industry. 73(2): 21-24.

- (6) is seeking to improve the current partnership between Federal and State agencies by increasing the amount of funds provided to the States.

The Safety Board commends these proposed actions, which, if implemented, could greatly enhance pipeline safety. However, the Safety Board recognizes that Federal and State agencies with responsibilities for pipeline safety have limited resources, and the likelihood of these agencies obtaining additional resources may be small unless RSPA's proposed actions are endorsed by the Secretary of the Department of Transportation as a priority need within the Department. The Safety Board believes that the Secretary should provide staffing and other resources adequate for the OPS to effectively fulfill its regulatory, inspection, enforcement, and State program oversight responsibilities.

The Safety Board also believes that the inadequacy of the OPS resources is the primary reason for the problems previously identified in RSPA's oversight of State pipeline safety programs, in its lack of frequent and thorough inspections of pipeline operators for which the OPS has sole responsibility, and in its previous reluctance to implement resource-consuming enforcement actions. Although accomplishment of the objectives of Safety Recommendations P-87-28, P-88-13, and P-90-13 is needed, the Safety Board does not believe it is reasonable to expect the OPS to accomplish those objectives without adequate resources to fulfill its responsibilities. Consequently, the Safety Board has reclassified Safety Recommendations P-87-28, P-88-13, and P-90-13 as "Closed--Superseded" by Safety Recommendation P-90-28 issued as part of this report.

Although the resources for meeting its pipeline safety responsibilities are limited, the OPS could improve the effectiveness of its existing resources by identifying mutual areas of cooperation and coordination with other Federal agencies and within the States. The OPS could also improve its effectiveness by gaining a better understanding of the operations of the fishing industry; such an understanding might have prompted the OPS to reassess the appropriateness of its regulations for offshore pipelines. Further, an understanding of the fishing industry also might have prompted the OPS to have coordinated an exchange of information with the Coast Guard, thereby making the OPS more aware of the hazards to navigation posed by offshore pipelines.

Actions Needed.--Because of concerns about deficiencies in the regulations and practices to protect and inspect submerged pipelines, the Safety Board, on February 22, 1990, recommended that the DOT:

P-90-5

Determine, with the assistance of the Department of the Interior, effective methods of inspection, maintenance, and protection for offshore pipelines located in the Gulf of Mexico to depths of water comparable to the maximum drafts of marine vessels that may operate outside of established sea lanes.

The Safety Board also issued a similar recommendation, P-90-2, to the Department of the Interior.

In response to Safety Recommendation P-90-5, DOT stated that a Federal task force, under the sponsorship of the OPS, had been established in February 1990 to develop solutions to the hazards that may exist between offshore pipelines and fishing vessels. Other participating agencies included the MMS, the Coast Guard, the Corps, NOAA, and the States of Texas and Louisiana. The OPS has indicated that by October 1, 1990, the task force will have completed a report on the long-term regulatory and administrative projects to be initiated by each agency. In response to Recommendation P-90-2, the DOI stated that it is cooperating with the DOT through the Federal task force.

The Safety Board is pleased that the DOT has established the Federal task force to develop near-term and long-term solutions that will adequately protect offshore pipelines in the Gulf of Mexico and that will also be compatible with operations of the fishing and pipeline industries. In issuing Recommendations P-90-2 and P-90-5, however, the Safety Board also cited the need to involve industry associations as well. The Safety Board believes that the insights and expertise of the pipeline and fishing industries will provide a more comprehensive evaluation because both industries have already established a consensus on some actions they believe are needed to prevent a recurrence of this type of accident.

Since these two recommendations were issued, however, the Safety Board has become concerned that the safety problems with submerged pipelines are not confined to the offshore areas of the Gulf of Mexico. A submerged pipeline under a river, shipping channel, or other body of water is also susceptible to being unburied and damaged or ruptured by a vessel. For example, on January 2, 1990, a submerged 12-inch pipeline transporting heating oil was ruptured in the Arthur Kill channel between Staten Island, New York, and Linden, New Jersey. Although the investigation of this accident is still continuing, evidence indicates that the pipeline was struck possibly by a passing ship or dredge.

Although the Federal task force is addressing safety issues involving commercial fishing vessels and offshore pipelines in the Gulf of Mexico, the Safety Board now believes that the scope of the initial recommendations needs to be expanded to evaluate the level of safety that exists for all submerged pipelines located under navigable waterways. Therefore, the Safety Board has classified Recommendations P-90-2 and P-90-5 as "Closed--Superseded" by Recommendations P-90-34 and P-90-29 issued as part of this report.

The Safety Board believes that RSPA should expand the scope of the current evaluation being conducted by the Federal task group to specifically address the issues and problems noted in this report concerning the practices of both the fishing and pipeline industries, the jurisdiction over submerged pipelines, the deficiencies in regulatory standards for submerged pipelines, the inadequacy of enforcement and oversight, and the need for improved communication and coordination. Because RSPA, through the OPS, is the primary Federal agency for pipeline safety, the Safety Board believes that

RSPA, with the assistance of the MMS, the Coast Guard, and the Corps, should build on the work of the current Federal task force and develop and implement effective methods and requirements to bury, protect, inspect the burial depth of, and maintain all submerged pipelines in areas subject to damage by surface vessels and their operations.

While the standards are being developed for the protection of submerged pipelines, measures are also needed to increase communication and coordination between and among government and industry groups. The Safety Board therefore believes that RSPA, with the assistance of the MMS, the Coast Guard, and the Corps, should also implement permanent measures to increase the coordination and communication between and among Federal and State regulatory agencies, and the pipeline, fishing, and marine industries.

Practices in Charting Offshore Pipelines

Usefulness of Navigation Charts.--Because the master of the NORTHUMBERLAND was not concerned about submerged pipelines and did not have reason to routinely use a navigation chart, he was unaware that some submerged pipelines are marked on navigation charts. Although navigation charts can help the mariner identify the location of submerged pipelines and do provide some precautionary warnings, the current criteria for marking submerged pipelines and the precautionary notes on the charts do not provide sufficient information to the mariner. Examples are given in the following sections.

Charting Criteria.--Although the HI lateral pipeline was marked on the larger scale navigation charts for the area (not on the smaller scale charts), the charts would not indicate whether or not the pipeline was buried. The charts also did not indicate that a second natural gas pipeline was in the immediate vicinity. Consequently, mariners cannot depend exclusively on navigation charts to locate and avoid submerged pipelines.

NOAA had recognized before the accident that submerged pipelines may constitute a hazard to navigation, and, as policy, had directed that submerged pipelines are to be marked on navigation charts. NOAA, however, had not established any criteria for charting submerged pipelines. In the absence of such criteria, NOAA accepted whatever information was provided to it by other agencies such as the Corps, the MMS, and some State agencies. As a result, agencies without the expertise in developing navigation charts have decided which pipelines should be marked on navigation charts, without consistent determination of the degree of hazard presented.

Because NOAA has the responsibility for producing navigation charts, NOAA should seek the advice of the OPS, the MMS, the Army Corps of Engineers, the Coast Guard, the States, and the pipeline and fishing industries, and then determine criteria for marking submerged pipelines on navigation charts. NOAA can chart those pipelines that potentially pose the greatest hazards to navigation without obscuring other navigation information by using criteria to determine the extent of hazard such as the product carried, the operating pressures of the pipeline, whether the pipeline was ever buried and to what depth, and the level of vessel activity where the pipeline is located. The

Safety Board believes that with proper application of such criteria, NOAA will be able to chart all pipelines of comparable hazard to the mariner.

Precautionary Warnings.--The current precautions on the navigation charts do not adequately warn the mariner of the hazards from submerged pipelines that may be unburied. Because it appears that much of the fishing and shrimping industry perceives that submerged pipelines generally are buried (or at least do not present a significant safety hazard to navigation), NOAA's warnings on navigation charts should state that not all pipelines were required to be buried, and those that were originally buried may have become exposed over time. The precautionary information published in the "Coast Pilot" also needs to be more explicit about the burial of submerged pipelines and the exercise of caution when vessels operate near them.

Accuracy of Charted Depths.--The large difference between the charted depth of water and the measured depth at the accident site raises doubt about the accuracy of the other soundings marked on the charts of the area. If the accuracy of the information on the chart is uncertain, the value of the chart to the mariner is severely lessened. Although it is possible that the discrepancy between the charted and measured soundings may be confined to the area in which the accident occurred, NOAA should take immediate steps to verify that the soundings throughout the areas covered by charts 11332, 11341, and 11342 are accurate, and if necessary, to conduct a new hydrographic survey of these areas.

Emergency Response

Search and Rescue.--Rescue efforts were initiated almost immediately because of the prompt notification of Coast Guard Station Sabine, Sabine tower, and Petroleum Helicopters, Inc. (PHI) by the pilot of Zapata's spotter plane and the master of the SMITH ISLAND, both of whom had been nearby when the accident occurred. The Zapata dispatcher in Cameron, who was notified by the spotter pilot, also notified the Coast Guard MSO in Port Arthur in a timely manner.

Although 20 minutes elapsed between the time that Coast Guard Station Sabine was initially notified and the first Coast Guard rescue boat was underway, the Safety Board does not consider this time to be excessive. Assembling the boat crew and checking out the boat before getting underway can easily take this amount of time. The added 15 minutes of underway time from Station Sabine to the accident scene was prompt given the distance traveled.

The arrival of the Evergreen and PHI helicopters on scene of the accident and the actions of their crews within 15 minutes of the accident resulted in the rescue of the three survivors in waters near the NORTHUMBERLAND. Without the liferafts dropped from the helicopters, the three survivors may not have been able to remain afloat until the first Coast Guard rescue boat and the purse boats from the SMITH ISLAND arrived on scene about 6:35 p.m. Also, without the assistance of the Evergreen employee who

jumped into the water to assist the NORTHUMBERLAND's pilot into the liferaft, the pilot may not have survived.

The medical evacuation of the three survivors to the Baptist Memorial Hospital in Beaumont was prompt and without incident. The search for additional survivors was also well executed and coordinated.

Isolation of the Pipeline From the Offshore Platforms.--The emergency shutoff valves and equipment on the HI 86, HI 116, and HI 139 platforms functioned properly. Postaccident testing demonstrated that the pressure sensors on the HI 71A platform for the HI lateral pipeline also functioned as designed.

Damage and corrosion to the shutoff valves in the flow lines between the HI 71B and the HI 71A platforms caused the valves to leak and permitted gas to flow into the pipeline following the accident. The presence of sealant and the weld slag in the valves suggest that faulty workmanship had occurred during installation or repair. Because there was no evidence of similar problems with the other platforms, the failure of these valves is likely an isolated event. The Safety Board does not believe that the failure of the shutdown valves to stop the flow of gas was the result of a design or operational problem with the emergency system on the platform. Further, the volume of gas that can be attributed to leakage through the faulty valves was between 0.3 and 0.6 percent of the total volume of gas released and did not affect the severity of the accident.

Emergency Management and Coordination by the Pipeline Company.--When NGPL's Gas Control was first notified about the accident at 6:45 p.m. by the Port Arthur Fire Department, the duty controllers at Gas Control should have contacted the district superintendent rather than directing the fire department to contact the superintendent. The notification procedures in the emergency plan, however, were based on the presumption that initial notification of an accident would be received by a field [district] employee rather than a controller at Gas Control. Because the emergency plan failed to address this second possibility, the controllers did not have adequate guidance that would have prompted them to contact the superintendent.

After the superintendent was notified at home about 6:50 p.m., he properly called Gas Control to verify the pressure and flow rates at CS 344. Once Gas Control had verified that the pressure and flow rates for CS 344 were abnormal, the district superintendent had sufficient reason to believe that the HI lateral pipeline was leaking or had ruptured. After arriving at CS 344, the district superintendent had additional information from the metering charts to indicate that the HI lateral pipeline was definitely involved in the accident. In his initial telephone call to Coast Guard Station Sabine, the superintendent's report that there had been a sudden loss of flow and pressure in the pipeline failed to convey that the pipeline belonged to NGPL and the superintendent's belief that the pipeline had ruptured. The superintendent obviously believed at that time that it was NGPL's pipeline that was involved because he made such a report to Gas Control shortly after calling Station Sabine. Had the superintendent made the same report to Station Sabine as he did to Gas Control, the confusion and

uncertainty of Coast Guard Station Sabine and the MSO about ownership of the pipeline could have been avoided.

Further, the superintendent failed to keep the Coast Guard informed about the status of the pipeline or about the actions taken by NGPL to isolate the pipeline. The superintendent also failed to maintain lines of communication with the employees sent to the offshore platforms; because he left his post to go to the offshore platform and was no longer in communication with his employees, he was not in a position to effectively serve as an emergency coordinator.

The Safety Board believes that the proper role of an emergency coordinator is to direct the actions of his employees and to be available at all times to the onscene commander or the public official directing the emergency response efforts. However, for an employee to fulfill these responsibilities, the employee must be given sufficient guidance to understand the duties and responsibilities of the emergency coordinator. Because of the superintendent's tenure in that position and his responsibility to review and modify the plan as needed, he was familiar with the plan and understood the guidance it provided. NGPL's emergency plan, however, did not provide sufficient guidance to the district superintendent about emergencies involving the rupture of an offshore transmission pipeline. For example, procedures regarding the communication with emergency responders, actions to be taken for various emergency situations, and the supervision and use of company employees must be explicitly addressed in a company's emergency plan. The Safety Board, therefore, concludes that the failure of the district superintendent to properly fulfill his duties as an emergency coordinator can be attributed to the lack of guidance in the company's emergency plan.

According to the DOT regulations in 49 CFR Parts 192 and 195, the pipeline operator is responsible for emergency planning and coordination with local emergency response officials. Under 49 CFR 192.615(c), an operator of a natural gas pipeline must establish liaison with police, fire, and other public officials to (1) learn the responsibilities of each government agency that may respond to a pipeline emergency, (2) acquaint the officials with the operator's ability in responding to an emergency, (3) identify the types of emergencies in which an operator notifies these officials, and (4) plan how the operator and officials can engage in mutual assistance to minimize hazards to life and property. As a result of its investigation of a natural gas fire and explosion in Winston-Salem, North Carolina, on January 18, 1988,²⁸ the Safety Board stated that with proper liaison, pipeline operators and public officials would better understand the expertise they can expect each other to provide in emergency situations.

Although the NGPL's emergency plan listed a telephone number for the Coast Guard, NGPL took no action to establish liaison with local Coast Guard

²⁸ National Transportation Safety Board. 1988. Piedmont Natural Gas Company natural gas explosion and fire, Winston-Salem, North Carolina, January 18, 1988. Pipeline Accident Report NTSB/PAR-88/01. Washington, DC.

officials as required by the regulations. Consequently, the district superintendent and a corporate representative were both unaware of the respective missions and responsibilities of Coast Guard Station Sabine and the MSO. NGPL's expectation that the Coast Guard would direct NGPL to the appropriate officials in an emergency does not, in the Safety Board's view, satisfy the obligation of an operator to establish and maintain liaison with the Coast Guard representatives, as public officials, and to be knowledgeable of the role of the Coast Guard in an offshore emergency.

NGPL also had to rely on the proper operation of the automatic shutdown systems on the four offshore platforms to isolate the pipeline from offshore; therefore, it was imperative for the district superintendent to be able to contact each producer for confirmation that each platform had shut-in. While the Safety Board is concerned that the district emergency plan did not include a telephone number for the owner of the HI 86 platform, the Board is equally concerned that there was no indication that the superintendent attempted to find an emergency telephone number or otherwise attempted to contact the owner of HI 86. Because of the inability to contact the owner of HI 86 and the communications problems with the HI 71A platform, the superintendent correctly dispatched two employees by helicopter to confirm that all four platforms had shut-in.

The failure of the district superintendent to have an emergency telephone number for the owner of the HI 86 platform can be attributed to an absence of emergency planning and coordination between the pipeline operators and the offshore producers. Because the operations of an offshore pipeline and platform are directly integrated, an emergency condition on one will necessarily affect the operation of the other. As shown in this accident, to isolate the pipeline from offshore, NGPL had to rely on the operation of emergency shutdown systems on platforms that were under the control of the producers. The failure to have a telephone contact for the owner of the HI 86 platform and the communications problems with the HI 71A platform may have been mitigated if NGPL and the producers had previously planned and coordinated for emergency situations. Effective coordination requires that the pipeline operator and the producer have current emergency contacts and agreement on their respective procedures in the event of an offshore emergency.

Although NGPL has improved its emergency plan for offshore emergencies since the accident, the plan still does not provide adequate guidance about (1) notification procedures for controllers at Gas Control, (2) the duties and responsibilities of the emergency coordinator, and (3) liaison and coordination with public officials and the offshore producers. Consequently, the Safety Board believes that the emergency plan should be further revised to provide explicit guidance in these areas, and that when the revisions have been made, the appropriate employees should be trained and educated about their responsibilities.

The Safety Board is also concerned about the effectiveness of the emergency planning and coordination between pipeline operators and offshore producers on an industry-wide basis. Because such emergency planning is not required under the DOT or the DOI regulations, the Safety Board believes that

RSPA, through the OPS, and the MMS should evaluate the need for greater emergency planning between offshore pipeline operators and producers, and then should implement, if necessary, appropriate safety regulations.

Response of the Coast Guard Marine Safety Office.--Because MSO personnel incorrectly assumed that telephone numbers for the MMS listed in its local contingency plan were 24-hour emergency numbers, MSO personnel were unable to obtain information about the pipeline involved in the accident, and thereby were unable to confirm if NGPL owned the pipeline. The MSO in Port Arthur, as the Coast Guard office responsible for mitigating water pollution incidents and for ensuring navigation safety in the area, had a need to know the identity of the owner of the pipeline as soon as possible after the accident occurred. Because accidents involving offshore pipelines may result in catastrophic spills, explosions, or fires, an MSO must be able to identify the pipeline and the product involved to make necessary decisions concerning the safety of the port area. An MSO must therefore have readily accessible information to make the proper identification and to make contact with the pipeline owner.

Although the MSO in Port Arthur has since revised its local contingency plan to include after-hours numbers for the MMS and is also collecting telephone numbers and points of contact for pipeline companies within its zone, comparable efforts are needed wherever submerged pipelines traverse navigable waters. The Safety Board is concerned that other Captains of the Port or MSOs do not have information about all submerged natural gas and hazardous liquid pipelines that traverse their zones. Therefore, the Safety Board believes that the Coast Guard should require all Captains of the Port and MSOs to have this information.

The exchange of information between the MSO and Station Sabine was prompt and accurate. The establishment of the safety zone and the broadcasting of a local notice to mariners were consistent with the MSO's responsibilities and were instituted in a timely manner.

Survivability

Although the NORTHUMBERLAND was appropriately outfitted for a vessel of its type and service with lifesaving and emergency equipment, nine crewmembers (without serious injuries from burns) drowned. Despite the rapid ignition and spread of the fireball, the nine crewmembers apparently either had a chance to jump overboard or were blown overboard.

Individual life preservers had been issued to everyone on board. Because the crewmembers typically stowed their life preservers near their bunks and personal possessions, the life preservers were not immediately accessible from the deck area. Even if life preservers had been accessible, the immediacy of the emergency did not offer the crewmembers an opportunity to retrieve personal flotation equipment before they were forced to abandon the vessel. The Safety Board concludes that the inability of crewmembers to retrieve personal flotation equipment and to keep themselves afloat without such equipment contributed to the high loss of life.

The master and surviving fisherman had observed several of the crewmembers trying to swim. A person knowledgeable about water survival techniques, if not incapacitated from being blown overboard, should have been able to survive in the water for the 15 to 30 minutes that it took for rescue personnel to arrive onscene. For those who were not incapacitated, water survival training may have enabled some who drowned to remain afloat until rescued. The Safety Board is concerned that commercial menhaden and shrimp fishermen in the Gulf of Mexico may not be knowledgeable about water survival techniques.

There are several water survival training courses offered nationwide by commercial training schools and by universities operating under the sea grant program administered by the National Marine Fisheries Service of the U.S. Department of Commerce. Historically, commercial fishermen in the Gulf of Mexico have not taken advantage of the water survival training courses. Apparently, these fishermen have not recognized the need for this training. The Safety Board believes that water survival training is important for commercial fishermen and that associations for the gulf coast commercial fishing industries should encourage their members to provide water survival training to the commercial fishermen in their employ.

Medical Factors

The master's activities during the 72 hours before the accident were not unusual and would not have led to fatigue. Further, the results of the master's latest company medical examination indicated no medical problems, and drug tests that were performed with that medical examination and within 2 hours after the accident were both negative for all screened substances. Also, there was no evidence of drug or alcohol abuse by other members of the crew. Fatigue, the health of the master, and the abuse of drugs and alcohol therefore were not factors in the accident.

CONCLUSIONS

Findings

1. The pipeline met applicable material specifications and had not been weakened by corrosion.
2. Because the master of the NORTHUMBERLAND was operating the vessel in an area that was normal and usual to its trade and at a reasonable speed, his actions were not a factor in the accident.
3. The bottom of the NORTHUMBERLAND was either very close to, or slightly penetrating, the sea bottom at the time of the accident, when the skeg on the bottom of the NORTHUMBERLAND struck and ruptured the 16-inch natural gas transmission pipeline.
4. The accident would not have occurred if the Natural Gas Pipeline Company of America had maintained the pipeline at the depth required by the permit issued by the U.S. Army Corps of Engineers.

5. The level of protection required throughout the service life of a pipeline should not be less than that required at the time of construction.
6. The requirements of the Research and Special Programs Administration, the Minerals Management Service, and the U.S. Army Corps of Engineers do not provide a sufficient level of safety for the burial and protection of submerged pipelines; further, the standards are not adequately enforced.
7. Because the Office of Pipeline Safety, the Minerals Management Service, and the U.S. Army Corps of Engineers do not explicitly require operators to conduct regular inspections of submerged pipelines, operators have not given adequate attention to the potential dangers from unburied and exposed pipelines.
8. The Office of Pipeline Safety (OPS) failed to exercise proper oversight of submerged pipelines when it did not act on the findings of the 1977 Department of Transportation-sponsored study and the 1987 recommendation of the OPS Southwest regional office.
9. Federal and State enforcement and oversight efforts have been adversely affected by insufficient staffing levels and a lack of resources.
10. Those submerged pipelines that are marked on navigation charts are marked without consistent determination of the hazard they present and printed warnings do not indicate whether or not the pipelines are buried and thus navigation charts do not adequately warn mariners about potential risks.
11. The rescue efforts of the Coast Guard and the commercial helicopters were timely and well executed.
12. Some natural gas leaked into the pipeline from the HI 71A platform because the shutdown valves were damaged, probably during installation or repair; however, the volume of gas that continued to flow into the HI lateral pipeline from the HI 71A platform did not increase the severity of the accident.
13. The emergency plan of the Natural Gas Pipeline Company of America did not provide sufficient guidance to the district superintendent about his responsibilities as the emergency coordinator or to the system controllers about emergency notification procedures.
14. Prior emergency planning and coordination between the Natural Gas Pipeline Company of America (NGPL) and the offshore producers would have facilitated NGPL's efforts to verify that the pipeline was properly isolated at the offshore platforms.
15. The actions of the Coast Guard Marine Safety Office to establish a safety zone and to broadcast local notices to mariners were consistent

with the responsibilities of the MSO and were instituted in a timely manner.

16. The inability of crewmembers to retrieve personal flotation equipment before they were forced to abandon the vessel and to keep themselves afloat without personal flotation equipment contributed to the high loss of life.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of Natural Gas Pipeline Company of America to maintain the pipeline at the burial depth required by the permit issued by the U.S. Army Corps of Engineers. Contributing to the accident was the failure of the Office of Pipeline Safety of the Research and Special Programs Administration, after its 1977 study, to require pipeline operators to inspect and maintain submerged pipelines in a protected condition.

RECOMMENDATIONS

During its investigation, the National Transportation Safety Board issued the following recommendations on February 22, 1990:

--to the U.S. Department of the Interior:

P-90-1

Assist the Department of Transportation and other Gulf Coast States that may have jurisdiction with the identification of the type, number, location, and owner of all offshore pipelines in the Gulf of Mexico.

Status: "Open--Acceptable Response."

P-90-2

Assist the Department of Transportation, to determine effective methods of inspection, maintenance, and protection for offshore pipelines located in the Gulf of Mexico to depths of water comparable to the maximum drafts of marine vessels that may operate outside of established sea lanes.

Status: "Closed--Superseded" by Safety Recommendation P-90-34.

--to the U.S. Department of Transportation:

P-90-3

Issue an advisory notice or use other means to caution commercial fishing, shrimping, and other marine vessel operators in the Gulf of Mexico that submerged offshore pipelines may be unprotected on the ocean floor and that marine vessels can damage such pipelines and endanger their crews when operating in water depths comparable to a vessel's draft or when operating bottom dragging equipment.

Status: "Closed--Acceptable Action."

P-90-4

Identify, with the assistance of the Department of the Interior and other Gulf Coast States that may have jurisdiction, the type, number, location, and owner of all offshore pipelines in the Gulf of Mexico.

Status: "Open--Acceptable Response."

P-90-5

Determine, with the assistance of the Department of the Interior, effective methods of inspection, maintenance, and protection for offshore pipelines located in the Gulf of Mexico to depths of water comparable to the maximum drafts of marine vessels that may operate outside of established sea lanes.

Status: "Closed--Superseded" by Safety Recommendation P-90-29.

As a result of its completed investigation, the National Transportation Safety Board issued the following recommendations:

--to the Zapata Haynie Corporation:

Develop and implement a program to train the company's masters about the danger from exposed pipelines in shallow waters, and the precautions a master can take when operating vessels in shallow waters. (Class II, Priority Action) (M-90-60)

--to the Natural Gas Pipeline Company of America:

Establish and implement a program to conduct regular and adequate inspections of the company's submerged pipelines and to maintain them in accordance with as-built construction plans and all right-of-way permits. (Class II, Priority Action) (P-90-26)

Revise the corporate and district emergency plans to include detailed guidelines about (1) the responsibilities and duties of emergency coordinators, (2) emergency planning and coordination with all public officials and offshore producers that may be involved in offshore accidents, and (3) accident notification procedures for system controllers and other non-district employees who may receive initial reports of an incident; and ensure that all employees understand their duties and responsibilities. (Class II, Priority Action) (P-90-27)

--to the U.S. Department of Transportation:

Provide adequate staffing and other resources to the Office of Pipeline Safety so that it can effectively fulfill its regulatory, inspection, enforcement, and State program oversight responsibilities. (Class II, Priority Action) (P-90-28)

--to the Research and Special Programs Administration, U.S. Department of Transportation:

Develop and implement, with the assistance of the Minerals Management Service, the U.S. Coast Guard, and the U.S. Army Corps of Engineers, effective methods and requirements to bury, protect, inspect the burial depth of, and maintain all submerged pipelines in areas subject to damage by surface vessels and their operations. (Class II, Priority Action) (P-90-29)

Implement permanent measures, with the assistance of the Minerals Management Service, the U.S. Coast Guard, and the U.S. Army Corps of Engineers, to increase the coordination and communication between and among Federal and State regulatory agencies, and the pipeline, fishing, and marine industries. (Class II, Priority Action) (P-90-30)

Evaluate, with the assistance of the Minerals Management Service, the need for emergency planning and coordination between offshore pipeline operators and producers, and then implement, if necessary, appropriate safety regulations. (Class III, Longer Term Action) (P-90-31)

--to the U.S. Coast Guard, U.S. Department of Transportation:

With the assistance of fishing and marine industry representatives, (1) establish and implement an ongoing program to educate fishing vessel operators about the potential dangers to their vessels from submerged pipelines, and (2) develop practices that can be adopted in vessel operations to lessen the likelihood of vessels striking submerged pipelines. (Class II, Priority Action) (M-90-61)

Assist the Research and Special Programs Administration with the development and implementation of effective methods and requirements to bury, protect, inspect the burial depth of, and maintain all submerged pipelines in areas subject to damage by surface vessels and their operations. (Class II, Priority Action) (P-90-32)

Assist the Research and Special Programs Administration with the implementation of permanent measures to increase the coordination and communication between and among Federal and State regulatory agencies, and the pipeline, fishing, and marine industries. (Class II, Priority Action) (P-90-33)

Require all Captains of the Port to have access to information about the number, location, and owners of all submerged hazardous liquid and natural gas pipelines that traverse their zones. (Class II, Priority Action) (M-90-62)

--to the Minerals Management Service, U.S. Department of the Interior:

Assist the Research and Special Programs Administration with the development and implementation of effective methods and requirements to bury, protect, inspect the burial depth of, and maintain all submerged pipelines in areas subject to damage by surface vessels and their operations. (Class II, Priority Action) (P-90-34)

Assist the Research and Special Programs Administration with the implementation of permanent measures to increase the coordination and communication between and among Federal and State regulatory agencies, and the pipeline, fishing, and marine industries. (Class II, Priority Action) (P-90-35)

Assist the Research and Special Programs Administration with the evaluation of the need for emergency planning and coordination between offshore pipeline operators and producers, and the implementation of appropriate safety regulations. (Class III, Longer Term Action) (P-90-36)

--to the U.S. Army Corps of Engineers, Department of the Army:

Assist the Research and Special Programs Administration with the development and implementation of effective methods and requirements to bury, protect, inspect the burial depth of, and maintain all submerged pipelines in areas subject to damage by surface vessels and their operations. (Class II, Priority Action) (P-90-37)

Assist the Research and Special Programs Administration with the implementation of permanent measures to increase the coordination and communication between and among Federal and State regulatory agencies, and the pipeline, fishing, and marine industries. (Class II, Priority Action) (P-90-38)

--to the National Oceanic and Atmospheric Administration, U.S. Department of Commerce:

Seek the advice of the Research and Special Programs Administration, the Minerals Management Service, the U.S. Army Corps of Engineers, the U.S. Coast Guard, States, and representatives of the pipeline and fishing industries about the marking of submerged pipelines on navigation charts, and then implement charting criteria based on the potential hazards to marine operators. (Class II, Priority Action) (M-90-63)

Revise the warnings on navigation charts and in the "Coast Pilot" to caution mariners that submerged pipelines may not be safely buried and that the operation of a vessel in depths of water comparable to its draft can endanger the vessel and its crew. (Class II, Priority Action) (M-90-64)

Verify that the soundings indicated on navigation charts numbered 11332, 11341, and 11342 are accurate, and, if necessary, conduct a new hydrographic survey of these areas. (Class III, Longer Term Action) (M-90-65)

--to the Interstate Natural Gas Association of America, the American Gas Association, the American Public Gas Association, and the American Petroleum Institute:

Notify member companies of the circumstances of the accident involving the rupture of the natural gas pipeline in the Gulf of Mexico and the fire on board the F/V NORTHUMBERLAND on October 3, 1989, and recommend that members who operate submerged pipelines establish and implement a program to conduct regular and adequate inspections of their submerged pipelines and maintain them in accordance with as-built construction plans and all right-of-way permits. (Class II, Priority Action) (P-90-39)

--to the National Fish Meal and Oil Association, the Louisiana Shrimp Association, and the National Council of Fishing Vessel Safety and Insurance:

Notify member companies of the circumstances of the accident involving the rupture of the natural gas pipeline in the Gulf of Mexico and the fire on board the F/V NORTHUMBERLAND on October 3, 1989, and encourage member companies to provide water survival training to all commercial fishermen in their employ. (Class II, Priority Action) (M-90-66)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES L. KOLSTAD
Chairman

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Vice Chairman

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Member

JIM BURNETT
Member

CHRISTOPHER A. HART
Member

Adopted: September 11, 1990

APPENDIXES**APPENDIX A****INVESTIGATION AND HEARING****Investigation**

The National Transportation Safety Board was notified of the accident at 9:50 p.m. eastern daylight time on October 3, 1989, and dispatched an investigative team from Washington, D.C., to the scene. Individual groups were established for pipeline operations, marine operations, and human performance/survival factors.

Hearing

As part of its investigation, the Safety Board conducted a public hearing of the accident on December 11-12, 1989, in Houston, Texas. Parties to the hearing were the Zapata Haynie Corporation, the Natural Gas Pipeline Company of America, the Research and Special Programs Administration, the U.S. Coast Guard, and the Minerals Management Service.

APPENDIX B

PERSONNEL INFORMATION

Master of the NORTHUMBERLAND

Darryl Wayne Gough, age 31, had been master of the NORTHUMBERLAND since April of 1989. He held a master's license issued by the U.S. Coast Guard which qualified him to serve as the master of uninspected fishing vessels up to 800 gross tons, not more than 200 miles offshore between Port Isabelle, Texas, and Eastport, Maine. Mr. Gough had 13 years' experience with Zapata Haynie Corporation, including 8 years as a master, 1 year as a pilot, 2 years as a mate, and 2 years as a fisherman. All of his seagoing experience with Zapata had been gained in the Gulf of Mexico, primarily along the coasts of Texas and Louisiana.

NGPL District Superintendent

James N. Pitts had been the district superintendent for the Port Arthur district for 3 1/2 years at the time of the accident. He previously served as NGPL's district superintendent in Evanston, Wyoming, for 4 years. Mr. Pitts has a Bachelor of Science degree in electrical engineering and is a registered professional engineer in the State of Illinois.

APPENDIX C

DEPARTMENT OF TRANSPORTATION SAFETY STANDARDS
FOR SUBMERGED GAS AND LIQUID PIPELINES

Excerpts from 49 CFR Parts 192 and 195.

§ 192.1 Scope of part.

(a) This part prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipeline facilities and the transportation of gas within the limits of the outer continental shelf as that term is defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

(b) This part does not apply to:

(1) Offshore gathering of gas upstream from the outlet flange of each facility on the outer continental shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed, whichever facility is farther downstream; and

(2) Onshore gathering of gas outside of the following areas:

(i) An area within the limits of any incorporated or unincorporated city, town, or village.

(ii) Any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.3 Definitions.

As used in this part:

"Distribution Line" means a pipeline other than a gathering or transmission line.

"Gas" means natural gas, flammable gas, or gas which is toxic or corrosive.

"Gathering Line" means a pipeline that transports gas from a current production facility to a transmission line or main.

"High pressure distribution system" means a distribution system in which the gas pressure in the main is higher than the pressure provided to the customer.

"Listed specification" means a specification listed in section I of Appendix B of this part.

"Low-pressure distribution system" means a distribution system in which the gas pressure in the main is substantially the same as the pressure provided to the customer.

"Main" means a distribution line that serves as a common source of supply for more than one service line.

"Maximum actual operating pressure" means the maximum pressure that occurs during normal operations over a period of 1 year.

"Maximum allowable operating pressure (MAOP)" means the maximum pressure at which a pipeline or segment of a pipeline may be operated under this part.

"Municipality" means a city, county, or any other political subdivision of a State.

"Offshore" means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

"Operator" means a person who engages in the transportation of gas.

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and including any trustee, receiver, assignee, or personal representative thereof.

"Pipe" means any pipe or tubing used in the transportation of gas, including pipe-type holders.

"Pipeline" means all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenance attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

APPENDIX C

"Pipeline facility" means new and existing pipelines, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned.

"Service line" means a distribution line that transports gas from a common source of supply to (a) a customer meter or the connection to a customer's piping, whichever is farther downstream, or (b) the connection to a customer's piping if there is no customer meter. A customer meter is the meter that measures the transfer of gas from an operator to a consumer.

"SMYS" means specified minimum yield strength is:

(a) For steel pipe manufactured in accordance with a listed specification, the yield strength specified as a minimum in that specification; or

(b) For steel pipe manufactured in accordance with an unknown or unlisted specification, the yield strength determined in accordance with § 192.107(b).

"State" means each of the several States, the District of Columbia, and the Commonwealth of Puerto Rico.

"Transmission line" means a pipeline, other than a gathering line, that:

(a) Transports gas from a gathering line or storage facility to a distribution center or storage facility;

(b) Operates at a hoop stress of 20 percent or more of SMYS; or

(c) Transports gas within a storage field.

"Transportation of gas" means the gathering, transmission, or distribution of gas by pipeline or the storage of gas, in or affecting interstate or foreign commerce.

[Amdt. 192-13, 38 FR 9084, Apr. 10, 1973, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976; Amdt. 192-58, 53 FR 1635, Jan. 21, 1988]

§ 192.301 Scope.

This subpart prescribes minimum requirements for constructing transmission lines and mains.

§ 192.317 Protection from hazards.

(a) Each transmission line or main must be protected from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads. In addition, offshore pipelines must be protected from damage by mud slides, water currents, hurricanes, ship anchors, and fishing operations.

(b) Each aboveground transmission line or main, not located offshore or in inland navigable water areas, must be protected from accidental damage by vehicular traffic or other similar causes, either by being placed at a safe distance from the traffic or by installing barricades.

(c) Pipelines, including pipe risers, on each platform located offshore or in inland navigable waters must be protected from accidental damage by vessels.

[Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.319 Installation of pipe in a ditch.

(a) When installed in a ditch, each transmission line that is to be operated at a pressure producing a hoop stress of 20 percent or more of SMYS must be installed so that the pipe fits the ditch so as to minimize stresses and protect the pipe coating from damage.

(b) When a ditch for a transmission line or main is backfilled, it must be backfilled in a manner that:

(1) Provides firm support under the pipe; and

(2) Prevents damage to the pipe and pipe coating from equipment or from the backfill material.

(c) All offshore pipe in water at least 12 feet deep but not more than 200 feet deep, as measured from the mean low tide, must be installed so that top of the pipe is below the natural bottom unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by an equivalent means.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

APPENDIX C

§ 192.327 Cover.

(a) Except as provided in paragraphs (c) and (e) of this section, each buried transmission line must be installed with a minimum cover as follows:

Location	Normal soil	Consolidated rock
inches		
Class 1 locations.....	30	18
Class 2, 3, and 4 locations.....	36	24
Drainage ditches of public roads and railroad crossings	36	24

(b) Except as provided in paragraphs (c) and (d) of this section, each buried main must be installed with at least 24 inches of cover.

(c) Where an underground structure prevents the installation of a transmission line or main with the minimum cover, the transmission line or main may be installed with less cover if it is provided with additional protection to withstand anticipated external loads.

(d) A main may be installed with less than 24 inches of cover if the law of the State or municipality:

(1) Establishes a minimum cover of less than 24 inches;

(2) Requires that mains be installed in a common trench with other utility lines; and

(3) Provides adequately for prevention of damage to the pipe by external forces.

(e) All pipe which is installed in a navigable river, stream, or harbor must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock, and all pipe installed in any offshore location under water less than 12 feet deep, as measured from mean low tide, must have a minimum cover of 36 inches in soil or 18 inches in consolidated rock, between the top of the pipe and the natural bottom. However, less than the minimum cover is permitted in accordance with paragraph (c) of this section.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.613 Continuing surveillance.

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with § 192.619 (a) and (b).

§ 192.615 Emergency plans.

(a) Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following:

(1) Receiving, identifying, and classifying notices of events which require immediate response by the operator.

(2) Establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials.

(3) Prompt and effective response to a notice of each type of emergency, including the following:

(i) Gas detected inside or near a building.

(ii) Fire located near or directly involving a pipeline facility.

(iii) Explosion occurring near or directly involving a pipeline facility.

(iv) Natural disaster.

(4) The availability of personnel, equipment, tools, and materials, as needed at the scene of an emergency.

(5) Actions directed toward protecting people first and then property.

(6) Emergency shutdown and pressure reduction in any section of the operator's pipeline system necessary to minimize hazards to life or property.

(7) Making safe any actual or potential hazard to life or property.

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(8) Notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency.

(9) Safely restoring any service outage.

(10) Beginning action under § 192.617, if applicable, as soon after the end of the emergency as possible.

(b) Each operator shall:

(1) Furnish its supervisors who are responsible for emergency action a copy of that portion of the latest edition of the emergency procedures established under paragraph (a) of this section as necessary for compliance with those procedures.

(2) Train the appropriate operating personnel to assure that they are knowledgeable of the emergency procedures and verify that the training is effective.

(3) Review employee activities to determine whether the procedures were effectively followed in each emergency.

(c) Each operator shall establish and maintain liaison with appropriate fire, police, and other public officials to:

(1) Learn the responsibility and resources of each government organization that may respond to a gas pipeline emergency;

(2) Acquaint the officials with the operator's ability in responding to a gas pipeline emergency;

(3) Identify the types of gas pipeline emergencies of which the operator notifies the officials; and

(4) Plan how the operator and officials can engage in mutual assistance to minimize hazards to life or property.

(d) Each operator shall establish a continuing educational program to enable customers, the public, appropriate government organizations, and persons engaged in excavation related activities to recognize a gas pipeline emergency for the purpose of reporting it to the operator or the appropriate public officials. The program and the media used must be as comprehensive as necessary to reach all areas in which the operator transports gas. The program must be conducted in English and in other languages commonly understood by a significant

number and concentration of the non-English speaking population in the operator's area.

[Amdt. 192-24, 41 FR 13587, Mar. 31, 1976]

§ 192.701 Scope.

This subpart prescribes minimum requirements for maintenance of pipeline facilities.

§ 192.703 General.

(a) No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.

(b) Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.

(c) Hazardous leaks must be repaired promptly.

§ 192.705 Transmission lines: Patrolling.

(a) Each operator shall have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation.

(b) The frequency of patrols is determined by the size of the line, the operating pressures, the class location, terrain, weather, and other relevant factors, but intervals between patrols may not be longer than prescribed in the following table:

Class location of line	Maximum interval between patrols	
	At highway and railroad crossings	At all other places
1, 2.....	7½ months; but at least twice each calendar year.	15 months; but at least once each calendar year.
3.....	4½ months; but at least four times each calendar year.	7½ months; but at least twice each calendar year.
4.....	4½ months; but at least four times each calendar year.	4½ months; but at least four times each calendar year.

[Amdt. 192-21, 40 FR 20283, May 9, 1975, as amended by Amdt. 192-43, 47 FR 46851, Oct. 21, 1982]

APPENDIX C

§ 195.0 Scope.

This part prescribes safety standards and accident reporting requirements for pipeline facilities used in the transportation of hazardous liquids.

§ 195.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this part applies to pipeline facilities and the transportation of hazardous liquids associated with those facilities in or affecting interstate or foreign commerce, including pipeline facilities on the Outer Continental Shelf.

(b) This part does not apply to—

(1) Transportation of a hazardous liquid that is transported in a gaseous state;

(2) Transportation of a hazardous liquid through a pipeline by gravity;

(3) Transportation of a hazardous liquid through pipelines that operate at a stress level of 20 percent or less of the specified minimum yield strength of the line pipe;

(4) Transportation of petroleum in onshore gathering lines in rural areas;

(5) Transportation of a hazardous liquid in offshore pipelines which are located upstream from the outlet flange of each facility on the Outer Continental Shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed whichever facility is farther downstream;

(6) Transportation of a hazardous liquid through onshore production (including flow lines), refining, or manufacturing facilities or storage or in-plant piping systems associated with such facilities;

(7) Transportation of a hazardous liquid by vessel, aircraft, tank truck, tank car, or other vehicle or terminal facilities used exclusively to transfer hazardous liquids between such modes of transportation.

[Amdt. 195-22, 46 FR 38360, July 27, 1981, as amended by Amdt. 195-33, 50 FR 15898, Apr. 23, 1985; Amdt. 195-36, 51 FR 20976, June 10, 1986]

§ 195.2 Definitions.

As used in this part—

"Barrel" means a unit of measurement equal to 42 U.S. standard gallons.

"Breakout tank" means a tank used to (a) relieve surges in a hazardous liquid pipeline system or (b) receive and store hazardous liquid transported by a pipeline for reinjection and continued transportation by pipeline.

"Component" means any part of a pipeline which may be subjected to pump pressure including, but not limited to, pipe, valves, elbows, tees, flanges, and closures.

"Gathering line" means a pipeline 8 inches or less in nominal diameter that transports petroleum from a production facility.

"Hazardous liquid" means petroleum, petroleum products, or anhydrous ammonia.

"Highly volatile liquid" or **"HVL"** means a hazardous liquid which will form a vapor cloud when released to the atmosphere and which has a vapor pressure exceeding 276 kPa (40 psia) at 37.8° C (100° F).

"Interstate pipeline" means a pipeline or that part of a pipeline that is used in the transportation of hazardous liquids in interstate or foreign commerce.

"Intrastate pipeline" means a pipeline or that part of a pipeline to which this part applies that is not an interstate pipeline.

"Line section" means a continuous run of pipe between adjacent pressure pump stations, between a pressure pump station and terminal or breakout tanks, between a pressure pump station and a block valve, or between adjacent block valves.

"Nominal wall thickness" means the wall thickness listed in the pipe specifications.

"Offshore" means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

"Operator" means a person who owns or operates pipeline facilities.

APPENDIX C

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof.

"Pipe" or **"line pipe"** means a tube, usually cylindrical, through which a hazardous liquid flows from one point to another.

"Pipeline" or **"pipeline system"** means all parts of a pipeline facility through which a hazardous liquid moves in transportation, including, but not limited to, line pipe, valves and other appurtenances connected to line pipe, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations and fabricated assemblies therein, and breakout tanks.

"Pipeline facility" means new and existing pipe, rights-of-way, and any equipment, facility, or building used in the transportation of hazardous liquids.

"Production facility" means piping or equipment used in the production, extraction, recovery, lifting, stabilization, separation or treating of petroleum or associated storage or measurement. (To be a production facility under this definition, piping or equipment must be used in the process of extracting petroleum from the ground and preparing it for transportation by pipeline).

"Rural area" means outside the limits of any incorporated or unincorporated city, town, village, or any other designated residential or commercial area such as a subdivision, a business or shopping center, or community development.

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned.

"Specified minimum yield strength" means the minimum yield strength, expressed in pounds per square inch, prescribed by the specification under which the material is purchased from the manufacturer.

"Stress level" means the level of tangential or hoop stress, usually expressed as a percentage of specified minimum yield strength.

"Surge pressure" means pressure produced by a change in velocity of the moving stream that results from shutting down a pump station or pumping unit, closure of a valve, or any other blockage of the moving stream.

[Amdt. 195-22, 46 FR 38360, July 27, 1981; 47 FR 32721, July 29, 1982, as amended by Amdt. 195-33, 50 FR 15898, Apr. 23, 1985; 50 FR 38660, Sept. 24, 1985; Amdt. 195-36, 51 FR 15007, Apr. 22, 1986]

§ 195.200 Scope.

This subpart prescribes minimum requirements for constructing new pipeline systems with steel pipe, and for relocating, replacing, or otherwise changing existing pipeline systems that are constructed with steel pipe. However, this subpart does not apply to the movement of pipe covered by § 195.424.

§ 195.246 Installation of pipe in a ditch.

(a) All pipe installed in a ditch must be installed in a manner that minimizes the introduction of secondary stresses and the possibility of damage to the pipe.

(b) All offshore pipe in water at least 12 feet deep but not more than 200 feet deep, as measured from the mean low tide, must be installed so that the top of the pipe is below the natural bottom unless the pipeline is supported by stanchions, held in place by anchors or heavy concrete coating, or an equivalent level of protection is provided.

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§ 195.248 Cover over buried pipeline.

(a) Unless specifically exempted in this subpart, all pipe must be buried so that it is below the level of cultivation. Except as provided in paragraph (b) of this section, the pipe must be installed so that the cover between the top of the pipe and the ground level, road bed, river bottom, or sea bottom, as applicable, complies with the following table:

Location	Cover (inches)	
	For normal excavation	For rock excavation ¹
Industrial, commercial, and residential areas.....	36	30
Crossings of inland bodies of water with a width of at least 100 ft from high water mark to high water mark.....	48	18
Drainage ditches at public roads and railroads.....	36	36
Deepwater port safety zone.....	48	24
Other offshore areas under water less than 12 ft-deep as measured from the mean low tide.....	36	18
Any other area	30	18

¹ Rock excavation is any excavation that requires blasting or removal by equivalent means.

(b) Less cover than the minimum required by paragraph (a) of this section and § 195.210 may be used if—

(1) It is impracticable to comply with the minimum cover requirements; and

(2) Additional protection is provided that is equivalent to the minimum required cover.

[Amdt. 195-22, 46 FR 38380, July 27, 1981; 47 FR 32721, July 29, 1982]

§ 195.400 Scope.

This subpart prescribes minimum requirements for operating and maintaining pipeline systems constructed with steel pipe.

§ 195.401 General requirements.

(a) No operator may operate or maintain its pipeline systems at a level of safety lower than that required by this subpart and the procedures it is required to establish under § 195.402(a) of this subpart.

(b) Whenever an operator discovers any condition that could adversely affect the safe operation of its pipeline system, it shall correct it within a reasonable time. However, if the condition is of such a nature that it presents an immediate hazard to persons or property, the operator may not operate the affected part of the system until it has corrected the unsafe condition.

(c) Except as provided by § 195.5, no operator may operate any part of any of the following pipelines unless it was designed and constructed as required by this part:

(1) An interstate pipeline on which construction was begun after March 31, 1970.

(2) An interstate offshore gathering line on which construction was begun after July 31, 1977.

(3) An intrastate pipeline on which construction was begun after October 20, 1985.

[Amdt. 195-22, 46 FR 38380, July 27, 1981, as amended by Amdt. 195-33, 50 FR 15899, Apr. 23, 1985; Amdt. 195-33A, 50 FR 39008, Sept. 26, 1985; Amdt. 195-36, 51 FR 15008, Apr. 22, 1986]

APPENDIX C**§ 195.412 Inspection of rights-of-way and crossings under navigable waters.**

(a) Each operator shall, at intervals not exceeding 3 weeks, but at least 26 times each calendar year, inspect the surface conditions on or adjacent to each pipeline right-of-way.

(b) Except for offshore pipelines, each operator shall, at intervals not exceeding 5 years, inspect each crossing under a navigable waterway to determine the condition of the crossing.

[Amdt. 195-22, 46 FR 38360, July 27, 1981,
as amended by Amdt. 195-24, 47 FR 46852,
Oct. 21, 1982]

APPENDIX D

DEPARTMENT OF THE INTERIOR
SAFETY STANDARDS FOR SUBMERGED PIPELINES

Excerpts from 30 CFR Part 250.

Subpart J—Pipelines and Pipeline Rights-of-Way

§ 250.150 General requirements.

(a) Pipelines and associated valves, flanges, and fittings shall be designed, installed, operated, maintained, and abandoned to provide safe and pollution-free transportation of fluids in a manner which does not unduly interfere with other uses in the Outer Continental Shelf (OCS).

(b) An application shall be submitted to the Regional Supervisor and approval obtained prior to the installation, modification, or abandonment of a pipeline which qualifies as a lease term pipeline (see § 250.151, Definitions) and prior to the installation of a right-of-way pipeline or the modification or relinquishment of a pipeline right-of-way.

(c) A pipeline which qualifies under the Department of the Interior's (DOI) jurisdiction (DOI pipeline) shall meet the requirements of § 250.150 through 250.158 of this subpart. The DOI's exclusive jurisdiction with respect to pipeline activities extends upstream from the outlet flange at each facility where produced hydrocarbons are first separated, dehydrated, or otherwise processed to each production well in the OCS. In addition, those pipelines necessary for the development of a lease, e.g., gas-lift gas or supply pipelines, are under DOI's exclusive jurisdiction.

(d) A pipeline which qualifies as a right-of-way pipeline (see § 250.151, Definitions) shall not be installed until a right-of-way has been requested and granted in accordance with this subpart.

(e)(1) The Regional Supervisor may suspend any pipeline operation upon a determination by the Regional Supervisor that continued activity would threaten or result in serious, irreparable, or immediate harm or damage to life (including fish and other aquatic life), property, mineral deposits, or the marine, coastal, or human environment.

(2) The Regional Supervisor may also suspend pipeline operations or a right-of-way grant if the Regional Supervisor determines that the lessee or right-of-way holder has failed to comply with a provision of the Act or any other applicable law, a provision of these or other applicable regulations, or a condition of a permit or right-of-way grant.

(3) The Secretary of the Interior (Secretary) may cancel a pipeline permit or right-of-way grant in accordance with 43 U.S.C. 1334(a)(2). A right-of-way grant may be forfeited in accordance with 43 U.S.C. 1334(e).

§ 250.152 Design requirements for DOI pipelines.

(a) The internal design pressure for steel pipe shall be determined in accordance with the following formula:

$$P = \frac{2(S)(t)}{D} X(F)(E)(T)$$

For limitations see section 841.121 of American National Standards Institute (ANSI) B31.8 Where—

P=Internal design pressure in pounds per square inch (psi).

S=Specified minimum yield strength, in psi, stipulated in the specification under which the pipe was purchased from the manufacturer or determined in accordance with section 811.253(h) of ANSI B31.8.

D=Nominal outside diameter of pipe, in inches.

t=Nominal wall thickness, in inches.

F=Construction design factor of 0.72 for the submerged component and 0.60 for the riser component.

E=Longitudinal joint factor obtained from Table 841.1B of ANSI B31.8. (See also section 811.253(d)).

T=Temperature derating factor obtained from Table 841.1C of ANSI B31.8.

(b)(1) Pipeline valves shall meet the minimum design requirements of American Petroleum Institute (API) Spec 6A, API Spec 6D, or the equivalent. A valve may not be used under operating conditions that exceed the applicable pressure-temperature ratings contained in those standards.

(2) Pipeline flanges and flange accessories shall meet the minimum design requirements of ANSI B16.5, API Spec 6A, or the equivalent. Each flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated and to maintain its physical and chemical properties at any temperature to which it is anticipated that it might be subjected in service.

(3) Pipeline fittings shall have pressure-temperature ratings based on stresses for pipe of the same or equivalent material. The actual bursting strength of the fitting shall at least be equal to the computed bursting strength of the pipe.

(c) The maximum allowable operating pressure (MAOP) shall not exceed the least of the following:

(1) Internal design pressure of the pipeline, valves, flanges, and fittings;

(2) Eighty percent of the hydrostatic pressure test (HPT) of the pipeline; or

(3) If applicable, the MAOP of the receiving pipeline when the proposed pipeline and the receiving pipeline are connected at a subsea tie-in.

(d) If the maximum source pressure (MSP), exceeds the pipeline's MAOP, redundant safety devices meeting the requirements of section A9 of API RP 14C shall be installed and maintained. Pressure safety valves (PSV) may be used only after a determination by the Regional Supervisor that the pressure will be relieved in a safe and pollution-free manner. The setting level at which the primary and redundant safety equipment actuates shall not exceed the pipeline's MAOP.

(e) Pipelines shall be provided with an external protective coating capable of minimizing underfilm corrosion and a cathodic protection system designed to mitigate corrosion for at least 20 years.

(f) Pipelines shall be designed and maintained to mitigate any reasonably anticipated detrimental effects of water currents, storm or ice scouring, soft bottoms, mud slides, earthquakes, subfreezing temperatures, and other environmental factors.

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§ 250.153 Installation, testing, and repair requirements for DOI pipelines.

(a)(1) Pipelines greater than 8-5/8 inches in diameter and installed in water depths of less than 200 feet shall be buried to a depth of at least 3 feet unless they are located in pipeline congested areas or seismically active areas as determined by the Regional Supervisor. Nevertheless, the Regional Supervisor may require burial of any pipeline if the Regional Supervisor determines that such burial will reduce the likelihood of environmental degradation or that the pipeline may constitute a hazard to trawling operations or other uses. A trawl test or diver survey may be required to determine whether or not pipeline burial is necessary or to determine whether a pipeline has been properly buried.

(2) Pipeline valves, taps, tie-ins, capped lines, and repaired sections that could be obstructive shall be provided with at least 3 feet of cover unless the Regional Supervisor determines that such items present no hazard to trawling or other operations. A protective device may be used to cover an obstruction in lieu of burial if it is approved by the Regional Supervisor prior to installation.

(3) Pipelines shall be installed with a minimum separation of 18 inches at pipeline crossings and from obstructions.

(4) Pipeline risers installed after April 1, 1988 shall be protected from physical damage that could result from contact with floating vessels. Riser protection on pipelines installed on or before April 1, 1988 may be required when the Regional Supervisor determines that significant damage potential exists.

(b)(1) Pipelines shall be hydrostatically tested with water at a stabilized pressure of at least 1.25 times the MAOP for at least 8 hours when installed, relocated, uprated, or reactivated after being out-of-service for more than 1 year.

(2) Prior to returning a pipeline to service after a repair, the pipeline shall be pressure tested with water or processed natural gas at a minimum stabilized pressure of at least 1.25 times the MAOP for at least 2 hours.

(3) Pipelines shall not be pressure tested at a pressure which produces a stress in the pipeline in excess of 95 percent of the specified minimum-yield strength of the pipeline. A temperature recorder measuring test fluid temperature synchronized with a pressure recorder along with deadweight test readings shall be employed for all pressure testing. When a pipeline is pressure tested, no observable leakage shall be allowed. Pressure gauges and recorders shall be of sufficient accuracy to verify that leakage is not occurring.

(c) When a pipeline is repaired utilizing a clamp, the clamp shall be a full encirclement clamp able to withstand the anticipated pipeline pressure.

(4) The Regional Supervisor may require pressure testing of pipelines to verify the integrity of the system when the Regional Supervisor determines that there is a reasonable likelihood that the line has been damaged or weakened by external or internal conditions.

§ 250.154 Safety equipment requirements for DOI pipelines.

(a) The lessee shall ensure the proper installation, operation, and maintenance of safety devices required by this section on all incoming, departing, and crossing pipelines on platforms.

(b)(1) Incoming pipelines to a platform shall be equipped with a flow safety valve (FSV).

(2) Incoming pipelines delivering to a production platform shall be equipped with an automatic shutdown valve (SDV) immediately upon boarding the platform. The SDV shall be connected to the automatic- and remote-emergency shut-in systems.

(3) Departing pipelines receiving production from production facilities shall be protected by high- and low-pressure sensors (PSHL) to directly or indirectly shut in all production facilities. The PSHL shall be set at 15 percent above and below the normal operating pressure range. However, high pilots shall not be set above the pipeline's MAOP.

(4) Crossing pipelines on production or manned nonproduction platforms which do not receive production from the platform shall be equipped with an SDV immediately upon boarding the platform. The SDV shall be operated by a PSHL on the departing pipelines and connected to the platform automatic- and remote-emergency shut-in systems.

(5) The Regional Supervisor may require that oil pipelines be equipped with a metering system to provide a continuous volumetric comparison between the input to the line at the structure(s) and the deliveries onshore. The system shall include an alarm system and shall be of adequate sensitivity to detect variations between input and discharge volumes. In lieu of the foregoing, a system capable of detecting leaks in the pipeline may be substituted with the approval of the Regional Supervisor.

(6) Pipelines incoming to a subsea tie-in shall be equipped with a block valve and an FSV. Bidirectional pipelines connected to a subsea tie-in shall be equipped with only a block valve.

(7) Gas-lift or water-injection pipelines on unmanned platforms need only be equipped with an FSV installed immediately upstream of each casing annulus or the first inlet valve on the christmas tree.

(8) Bidirectional pipelines shall be equipped with a PSHL and an SDV immediately upon boarding each platform.

(9) Pipeline pumps shall comply with Section A7 of API RP 14C. The setting levels for the PSHL devices are specified in paragraph (b)(3) of this section.

(c) If the required safety equipment is rendered ineffective or removed from service on pipelines which are continued in operation, an equivalent degree of safety shall be provided. The safety equipment shall be identified by the placement of a sign on the equipment stating that the equipment is rendered ineffective or removed from service.

§ 250.155 Inspection requirements for DOI pipelines.

(a) Pipeline routes shall be inspected at time intervals and methods prescribed by the Regional Supervisor for indication of pipeline leakage. The results of these inspections shall be retained for at least 2 years and be made available to the Regional Supervisor upon request.

(b) When pipelines are protected by rectifiers or anodes for which the initial life expectancy of the cathodic protection system either cannot be calculated or calculations indicate a life expectancy of less than 20 years, such pipelines shall be inspected annually by taking measurements of pipe-to-electrolyte potential measurements.

§ 250.157 Applications.

(a) Applications for the approval of the installation of a lease term pipeline or for the granting of a right-of-way shall be submitted in quadruplicate to the Regional Supervisor and shall include the following:

(1) Plat(s) drawn to a scale specified by the Regional Supervisor showing major features and other pertinent data including area, lease, and block designations; water depths; route; length in Federal waters; width of right-of-way, if applicable; connecting facilities; size; product(s) to be transported with anticipated gravity or density; burial depth; direction of flow; X-Y coordinates of key points; and the location of other pipelines that will be connected to or crossed by the proposed pipeline(s). The initial and terminal points of the pipeline and any continuation into State jurisdiction shall be accurately located even if the pipeline is to have an onshore terminal point. A plat(s) submitted for a pipeline right-of-way shall bear a signed certificate upon its face by the engineer who made the map that certifies that the right-of-way is accurately represented upon the map and that the design characteristics of the associated pipeline are in accordance with applicable regulations.

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(2) A schematic drawing showing the size, weight, grade, wall thickness, and type of line pipe and risers; pressure-regulating devices (including back-pressure regulators); sensing devices with associated pressure-control lines; PSV's and settings; SDV's, FSV's, and block valves; and manifolds. This schematic drawing shall also show input source(s), e.g., wells, pumps, compressors, and vessels; maximum input pressure(s); the rated working pressure, as specified by ANSI or API, of all valves, flanges, and fittings; the initial receiving equipment and its rated working pressure; and associated safety equipment and pig launchers and receivers.

(3) General information as follows:

- (i) Description of cathodic protection system. If pipeline anodes are to be used, specify the type, size, weight, number, spacing, and anticipated life;
- (ii) Description of external pipeline coating system;
- (iii) Description of internal protective measures;
- (iv) Specific gravity of the empty pipe;
- (v) MSP;
- (vi) MAOP and calculations used in its determination;
- (vii) Hydrostatic test pressure, medium, and period of time that the line will be tested;
- (viii) MAOP of the receiving pipeline or facility;
- (ix) Proposed date for commencing installation and estimated time for construction; and
- (x) Type of protection to be afforded crossing pipelines, subsea valves, taps, and manifold assemblies, if applicable.

(4) The application shall include a description of any additional design precautions which were taken to enable the pipeline to withstand the effects of water currents, storm or ice scouring, soft bottoms, mudslides, earthquakes, permafrost, and other environmental factors.

(5) The application shall include a shallow hazards survey report and, if applicable, an archaeological resource report which covers the entire length of the pipeline. However, with approval of the Regional Supervisor, a shallow hazards analysis may be included in a lease term pipeline application in lieu of the shallow hazards survey report. In addition, the Regional Supervisor may require the submission of the data upon which the report or analysis is based.

(b) Applications to modify an approved lease term pipeline or right-of-way grant shall be submitted in quadruplicate to the Regional Supervisor. These applications need only address those items in the original application affected by the proposed modification.

(c) Applications to abandon a lease term pipeline or relinquish a right-of-way grant shall be submitted in triplicate to the Regional Supervisor and shall include the following:

- (1) Reason for operation,
- (2) Proposed procedures,
- (3) "As-built" location plat,
- (4) Length in feet of segment to be abandoned or relinquished, and
- (5) Length in feet of segment remaining.

APPENDIX E

TECHNOLOGY TO INSPECT SUBMERGED PIPELINES

The United Kingdom's Petroleum Division of the Department of Energy is that country's regulatory agency for pipeline safety, and has been involved with offshore pipeline operations in the North Sea. Under the Department's regulations, offshore pipelines must be inspected each year, in part to determine loss of cover. The Department identified four methods of inspecting pipelines in water depths less than 25 to 30 feet: remotely operated vehicles, divers, acoustic techniques, and electromagnetic tracking.

In assessing the effectiveness of the different techniques, the United Kingdom's Department of Energy stated that remotely operated vehicles are difficult to operate in the high current, low visibility environment normally found in near-shore, shallow-water locations. Divers will provide the best results, although the cost is high. If a pipeline is buried, the diver can use equipment to detect the magnetic field of the pipeline. Although acoustic techniques such as side scan sonar, sub-bottom profiling, and echo sounding provide a cheaper method, acceptable results are more difficult to obtain and multiple passes over a pipeline may be required.

According to the Coast Guard, remotely operated vehicles, divers, and side scan sonar are technically feasible methods for surveying an offshore pipeline. Only side scan sonar, however, is economically feasible for an extensive survey. The side scan sonar consists of a towfish, a vehicle that contains sonar transducers and is towed above the sea bottom by a survey vessel. Control and display equipment on board the survey vessel presents a two-dimensional image of the sea floor that enables an operator to detect a pipeline on or above the sea floor. The towfish can be fitted with an additional transducer to provide a sub-bottom profile that can detect a buried pipeline. The technology has been available for 20 years and has been frequently used in the North Sea.

The side scan sonar has several limitations. Although side scan sonar can be used in as little as 6 feet of water, the towfish must be kept out of the wake of the survey vessel. Nominal tow speed during a survey is 4 to 6 knots (4 to 6 nautical miles per hour). Rough weather can cancel sonar operations. The Coast Guard indicated that a 4-foot "chop" in shallow water would be very difficult to work in. Also, the accuracy of the system is related to the experience of the operator. The Coast Guard estimated the rates for equipment and an operator to be as much as \$1,000 per day, and for a survey vessel to be \$3,000 per day.

The United Kingdom's Department of Energy believes that electromagnetic tracking provides the greatest potential for accurate surveys at a reasonable cost. Detectors mounted on a boat can map signals induced into the pipeline or the magnetic profile of the pipeline itself. A consortium of four U.S. companies that specializes in offshore surveys utilizes a magnetic tracking system. The tracking system, developed and manufactured by Innovatum, Inc., is portable and can be mounted on a cart for land use, on a

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remotely operated vehicle for use on the seabed, or on a towed sled for shallow waters.

Innovatum's tracking system has been commercially available since 1979, and has been used around the world, most recently in the Gulf of Mexico. Innovatum claims the tracking system can measure cover to within 8 inches for a 12-inch-diameter pipeline buried 6 feet.

The Innovatum system has several limitations. In shallow waters, the vehicle transporting the system must have sufficient power, maneuverability, and stability to overcome wave and current action. Innovatum has indicated that the surf zone between 3 and 10 feet of water has proven the most difficult to work in. The cost of leasing a survey vessel, a remotely operated vehicle or other device to mount the Innovatum tracking system, and the tracking system itself was estimated to be \$16,500 per 12-hour day. An average of 4 to 8 miles of pipe can be surveyed each day. Innovatum has suggested that the most cost-effective method of surveying in shallow waters is working seaward from the beach with a land-based control unit.

British Gas has developed a "pig" (an internal inspection instrument that travels through a pipeline) that can detect if a pipeline is exposed, has unsupported spans, or has damaged coating. The pig cannot detect, however, the amount of cover exceeding 1 foot. The prototype pig is for use in a 36-inch diameter pipeline, although British Gas is developing a pig for a 24-inch diameter pipeline. The prototype pig was operationally tested in the North Sea without difficulty. Although a pig-based system is not dependent on weather and cannot stray away from the pipeline, it does require a minimum bending radius and other criteria that prevent its use in some pipeline systems. British Gas estimates the cost to be lower than the use of divers, remotely operated vehicles, or sonar systems.

APPENDIX F

**RECOMMENDATIONS FROM 1977 DOT STUDY
FOR FURTHER RESEARCH AND DEVELOPMENT**

Ref: Funge, William; Chang, Kai S.; Juran, David I. 1977. Offshore pipeline facility safety practices. DOT/MTB/OPS0-77/13. Volume 1. Washington, DC: U.S. Department of Transportation, Materials Transportation Bureau, Office of Pipeline Safety Operations.

The 1977 DOT study recommended that further research and development be conducted in several areas, including the following:

- Investigate route selection based upon the impact of potential hazards such as sea bottom phenomena, fishing practices, and other activities to collect resources on the outer continental shelf.
- Define the phenomenon of submarine soil liquefaction.
- Investigate entrenchment [burial] requirements due to the wide range of variables which govern the depth of entrenchment required for stability. Some areas experience seasonal variations in bottom level due to sediment transport or scour. A comprehensive study would include consideration of fishing industry requirements, increasing water depths, geographic locations, and potential hazards. Determine critical aspects associated with entrenchment by investigating penetration by anchors of different types and sizes in different soils. These data could then be used in specifying minimum entrenchment depths (in various geographic areas) which would depend on such parameters such as nature of soil, ship traffic density, water depth, and environmental phenomena.
- Determine the feasibility of establishing a vessel traffic control system in pipeline areas that have a high level of ship traffic.
- Develop improved methods of inspecting in-place offshore pipelines, including verification of burial depth during construction.
- Investigate the effectiveness of markers and signs in preventing damage to pipelines and risers.
- Determine regulatory requirements for communication systems.
- Research methods for controlling and activating subsea valves.

APPENDIX G**COMPROMISE PIPELINE SAFETY LEGISLATION**

July 6, 1990

COMPROMISE PIPELINE SAFETY LEGISLATION

In response to legislation introduced by Congressman Billy Tauzin, H.R. 4888, intended to enhance navigational safety, the pipeline industry and the vessel operators group have been meeting to negotiate a compromise bill that would lead to swift action regarding the elimination of the potential hazard to navigation posed by exposed pipelines, while not unduly burdening pipeline operators. With a few exceptions noted below, the two groups have come to a consensus on the following principles.

- Operators or owners of natural gas pipelines are to inspect their pipelines in offshore waters, from the beach out to 15 feet of water depth as measured from the mean low tide, to determine if any part is exposed, and that parts found to be exposed shall be recovered as soon as reasonably possible. This initial inspection is to be completed within 24 months of enactment, unless a pipeline receives an extension from the Secretary of Transportation. This requirement would be satisfied upon verification by the owner or operator that the pipeline was inspected within 12 months prior to enactment or since October 3, 1989 (whichever date is earlier). Records of inspections would be maintained by the pipeline owner or operator for inspection by the appropriate agency and the public.
- The Secretary of Transportation would be directed to issue regulations regarding this initial inspection of pipelines and the Department of Transportation would serve as the agency for verifying that the inspections had been performed. These regulations would be issued after consultation with state agencies and the affected industries - the pipeline industry and the vessel operators.
- A natural gas pipeline owner or operator discovering exposed portions of a pipeline would be required to notify the Coast Guard and other appropriate federal and state safety officials immediately, with a follow-up notification when corrective action has been completed.
- Based upon the results of this initial inspection, and after consultation with state agencies and the affected industries, the Secretary of Transportation would issue a report addressing the need for re-inspections. Subsequent rulemaking, if any, by the DOT should incorporate an assessment of critical offshore areas where exposed pipelines would pose a hazard to navigation, criteria for re-inspections and the findings of a study on the technology currently available, and in development, to determine the burial depth of pipelines in offshore areas.
- The Secretary of Transportation would also be directed to study, in consultation with state agencies and the affected industries, existing marine safety requirements for operators of commercial vessels to determine if additional regulations are needed to promote safety with regard to offshore natural gas pipelines. In reviewing navigational practices in multiple-use offshore waters, the study should include, but not be limited to, determining the safety of navigation in waters too shallow to ensure adequate clearance of the bottom given a vessel's draft, and the need for fathometers, loran, and other technical equipment, and associated personnel training, necessary to determine a vessel's location with respect to that of underwater pipelines. This study would also require an evaluation of the current practices of the various state and federal agencies which chart pipelines in offshore

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waters to ensure that complete and comprehensive charts are available. This report, with a proposal for any indicated legislative action, would be submitted to the Congress by March 1, 1991.

- All commercial vessels operating in 15 feet of water or less would be required to report immediately to the Coast Guard any incident where a vessel strikes an underwater object that may be near a charted pipeline. All vessels should be equipped with the communications equipment needed to transmit and receive Coast Guard navigation advisory warnings.

[The vessel operators have taken the position that oil pipelines, abandoned pipelines or pipelines in inland waters should not be included in the inspection requirements since these do not constitute an immediate danger to life and limb. Gathering lines for natural gas pipelines would, however, be included in their proposal.]

The following points of difference between the two groups remain.

DEPTH OF INSPECTIONS: The pipeline industry has proposed to inspect pipeline in waters out to a depth of 15 feet for exposure posing a threat to navigation. Inspecting to 15 feet would ensure adequate safety for the commercial fishing vessels operating in the affected coastal areas which, according to the fisheries industry, have a draft of no more than 12 or 13 feet. The marine vessel operators want the pipelines to inspect pipe out to 22 feet of water depth ostensibly to safeguard navigation for the few commercial oil service vessels with drafts greater than those of the fishing vessels. The pipeline industry notes that inspecting to 22 feet depth could potentially double the mileage of pipe requiring inspections at a cost and utilization of limited diver crews significantly in excess of any threat or benefit to service vessels which generally travel in marked navigation channels until they reach open seas.

TIMING OF INSPECTIONS: Due to the amount of affected pipe, the shortage of available diving crews and the uncertainty posed by inclement weather in the coastal zone, the pipeline industry has proposed the completion of the initial inspections within a realistic time frame of 24 months of enactment of the legislation. The vessel operators want the pipelines to be required to complete the inspections by October 1, 1991.

MARINE SAFETY PROGRAM: The pipeline industry has proposed that the Secretary of Transportation study and submit to Congress legislation to establish a program of marine safety requirements for commercial vessels operating in offshore areas containing pipeline rights-of-way. The study would review navigation practices in shallow offshore waters and address the need for comprehensive navigation charts and other technical equipment. The vessel operators only want the Secretary of Transportation to be required to submit a study on marine safety to Congress limited to the need for charts and technical equipment, without mention of navigation practices.