

Gulf of Mexico OCS Region

Investigation of March 19, 1989, Fire South Pass Block 60 Platform B Lease OCS-G 1608

Gulf of Mexico OCS Region

Investigation of March 19, 1989, Fire South Pass Block 60 Platform B Lease OCS-G 1608

E. P. Danenberger
S. T. Dessauer
C. J. Schoennagel
W. D. Terrebonne
F. J. Torres

Contents

Investigation and Report

- Authority, 1
- Procedures, 1

Investigation

- Background, 4
- Description of Incident, 5

Findings

- Damage to Pipeline, 6
- Planning Repair, 6
- Preliminary Activities, 7
- Platform Activities, 7
- Activities at Main Pass Block 151, 8
- Commencement of Riser Cut, 9
- Completion of Riser Cut, 9
- Ignition and Emergency Evacuation, 10
- Fire, 11
- Rescue, 11
- Fire Extinguishment, 12
- Fatalities and Injuries, 12
- Subsequent Activities, 12
- Damages, 13

Conclusions

- Probable Cause of Incident, 14
- Probable Cause of Gas and Hydrocarbon Presence, 14
- Possible Causes of Ignition, 14
- Contributing Causes, 14
- Probable Cause of Fatalities, 15
- Contributing Causes of Fatalities, 15

Recommendations

- Safety Alerts, 17
- Regulatory Requirements, 17
- Additional Considerations, 17

Glossary, 19

Attachments

1. Photographs, Scene of accident and Platform B,
2. Location of Lease OCS-G 1608, South Pass Block 60,
3. Schematic of riser piping including valve identification,
4. Photographs, Plugged port and cold-cut machine,
5. Photographs, Area of cut and compressor on M/V *Bo-Truc 20*,
6. Photographs, Fire on Platform B and Rupture in pipeline,
7. Schematic of pipelines,

Investigation and Report

Authority

A serious fire occurred on ARCO Oil and Gas Company's (ARCO) Platform B, South Pass Block 60, Lease OCS-G 1608 in the Gulf of Mexico, offshore the State of Louisiana, at approximately 7:30 p.m. on March 19, 1989. Pursuant to Section 208, Subsections 22(d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act, as amended in 1978, and the Department of the Interior Regulation 30 CFR Part 250, the Minerals Management Service (MMS) is required to investigate and prepare a public report of this accident. By memorandum dated March 24, 1989, the following personnel were named to the Investigative Panel:

E. P. Danenberger	Herndon, Virginia
S. T. Dessauer	New Orleans, Louisiana
C. J. Schoennagel	New Orleans, Louisiana
W. D. Terrebonne	New Orleans, Louisiana
F. J. Torres	New Orleans, Louisiana

Also participating as Investigative Panel members were the following Department of Transportation personnel:

Lt. Comdr. D. Smith	United States Coast Guard (USCG)
W. C. Bertges	Office of Pipeline Safety (OPS)

Procedures

Minerals Management Service personnel flew to South Pass Block 60, Platform B, on March 20, 1989, and photographed the scene from a helicopter. They then proceeded to Venice, Louisiana, to obtain preliminary information from personnel familiar with the accident. (For photograph of scene, see attachment 1.)

Representatives of the MMS, USCG, and OPS met on March 21, 1989, to discuss jurisdictional authority of the Federal agencies involved in investigating the accident. At this meeting it was decided that MMS would lead the investigation.

Attorneys representing ARCO, Southern Natural Gas Company (SONAT), Pipelines Unlimited Services (PLUS), and L & M Boat Truck Rental (Bo-Truc), parties of interest, met with the Investigative Panel members on March 24, 1989. They discussed the transfer of information concerning the accident and the procedures that would be used in conducting the investigation.

Investigative Panel members flew to the accident location on March 28, 1989, and landed at South Pass Block 60 Platform A. They obtained additional preliminary information from personnel familiar with the accident. They then proceeded by workboat to Platform B to peruse and photograph the structure from the vessel. (For photograph of Platform B, see attachment 1.)

The Investigative Panel convened from April 10 to 13, 1989, at the Ramada Inn, Kenner, Louisiana. The following individuals were questioned about the accident, including prior and subsequent activities:

Monday — April 10, 1989

James Roland	- Bo-Truc
Landa Plaisance	- Bo-Truc
Steven Frith	- Bo-Truc
Norman Bruce	- Bo-Truc
Julian Drew	- John R. Graham and Sons
Joseph Anders	- ARCO

Tuesday — April 11, 1989

Ivan Garzotta	- PLUS
William Crosby	- SONAT
Albert Sinitere	- ARCO
Bob Alcorn	- ARCO
Ronald Oliver	- Cal Dive International
Terrence Ronquillo	- SONAT

Wednesday — April 12, 1989

Raymond Wickland	- Global Divers
Mark Mohawk	- Global Divers
Larry Bergmann	- Global Divers
Harold Lind	- SONAT
James Young	- ARCO
Neil Matthews	- ARCO

Thursday — April 13, 1989

James Alexander	- ARCO
Charles Cloud	- SONAT
George Gernon	- PLUS
Lawrence McClure	- PLUS
Eric Thomas	- SONAT
Philip Gobe	- ARCO

On May 11, 1989, Investigative Panel members landed on Platform E, South Pass Block 60, and obtained additional information about the accident. They also toured Platform B and noted the damage to the platform and associated equipment.

The panel conducted subsequent hearings on May 24, June 20, and August 15, 1989, to question the following individuals about the accident:

May 24, 1989 — MMS Office, Jefferson, Louisiana

Timothy Parish	- Pipeline Supply and Service Company
Thomas Rinehart	- PLUS
Charles Bonvillian	- PLUS
Ronald Pellegrin	- Venture Associates
Rogers Byers	- Venture Associates
Moise LeJeune	- ARCO

June 20, 1989 — Ramada Inn, Kenner, Louisiana

John Smeitana	- PLUS
---------------	--------

August 15, 1989 — MMS Office, Jefferson, Louisiana

Scott Bradshaw	- SONAT
----------------	---------

Investigation

Background

Lease OCS-G 1608 covers approximately 3,510 acres and is located in South Pass Block 60, Gulf of Mexico (GOM), off the Louisiana coast. (For lease location, see attachment 2.) The lease was issued to the Atlantic Richfield Company (100 percent), effective July 1, 1967, for a cash bonus of \$5,300,020.60, with a 1/6 fixed royalty rate. (On May 7, 1985, the name of the Atlantic Richfield Company was changed to the ARCO Oil and Gas Company.)

Two platforms in South Pass Block 60 are relevant to this investigation — B and E. On May 6, 1971, the Atlantic Richfield Company submitted for approval an application to install an eight-pile, 18-well-slot platform, Platform B, in South Pass Block 60. Subsequent to approval, Platform B was installed in September 1972, and 18 wells were drilled.

In August 1973, a right-of-way permit was approved for an 18-inch gas pipeline to be laid to South Pass Block 60, Platform B. In January 1974, the Conservation Division, Gulf of Mexico Region, of the United States Geological Survey (one of the predecessors of MMS) received notice from SONAT that the pipeline was installed and in operation.

By letter dated April 17, 1980, the ARCO Oil and Gas Company submitted for approval an application to install Platform E in South Pass Block 60. Platform E, which is connected to Platform B by walkways, was installed in 1981. To date, Platforms A, B, C, D, E, F, and G have been installed in South Pass Block 60.

On August 13, 1980, an Enhanced Oil Recovery (EOR) project was approved for ARCO's South Pass Block 60 field. The project was initiated in May 1981 with the injection of dry gas into certain reservoirs in the field. By September 1981, a cryogenic plant installed on Platform B in South Pass Block 60 was producing natural gas liquids (NGL's) for injection as part of the EOR project.

In 1983, ARCO ceased transporting gas to SONAT through the 18-inch line as all gas production was designated for either the EOR project or field use. During 1987, ARCO started reselling gas to SONAT and shipping it through the 18-inch pipeline.

On February 28, 1989, one of the anchor chains from the PLUS barge *Cherokee* hooked onto and pulled off a 2-inch segment of line located on the 18-inch SONAT gas pipeline. The incident occurred during work contracted by SONAT on a 10-inch gas pipeline laid from Main Pass Block 77, Platform A, to a subsea tie-in in Main Pass Block 151. The 2-inch segment was used as a bypass around a check valve located at Mile Post 12.2 (M.P. 12.2) of the 18-inch line. This incident required the shutting in of gas production transported

through this pipeline, including gas from ARCO's South Pass 60 Platform B, and necessitated the repair operation that was being conducted when the accident occurred.

Description of Incident

The motor vessel (M/V) *Bo-Truc 20*, a work vessel contracted by PLUS, arrived at ARCO's South Pass Block 60 Platform B on March 19, 1989, at approximately 8 a.m., to begin installing a pig trap. The pig trap was intended to receive a pig that was to be launched from the barge *Cherokee* at M.P. 12.2 for the purpose of dewatering the 18-inch pipeline. The pig trap was to be installed in the 18-inch riser of South Pass Block 60 Platform B by removing a 7-foot section of the 18-inch pipe at the 15+ foot level of the platform. The 18-inch riser was checked for pressure at approximately 11:30 a.m. on March 19, 1989, in preparation for making a cold cut to remove the 7-foot section of pipe.

At approximately 6:30 p.m., the cold-cutting operation began on the 18-inch riser pipe at South Pass Block 60 Platform B. By 7:20 p.m., the machine used to make the cold cut initially penetrated the pipe. Instantaneously, a fluid started to spray out of the penetrated pipe.

As fluids continued to escape from the pipe, personnel made a cursory evaluation of the situation as they moved away from the cut area. When the 18-inch riser pipe parted, flow increased, and personnel working on the cellar deck started to evacuate the area. At approximately 7:30 p.m., the fluid spraying from the parted pipe in the 18-inch riser ignited.

The flames coming from the cellar deck spread upward to the production and drill decks and ignited additional hydrocarbon sources and flammable material. Personnel located on the adjacent Platform E evacuated that facility via escape capsule, while personnel aboard the M/V *Betty G*, moored at Platform E, readied its fire monitor to spray water on the fire and initiated a search for survivors. The fire finally subsided at approximately 7:40 a.m. on March 20, 1989.

Seven fatalities resulted from this accident, and the ARCO Platform B was destroyed. The M/V *Bo-Truc 20* and associated equipment received extensive damage as a result of the accident.

Findings

Damage to Pipeline

After its owned-and-operated 10-inch pipeline in Main Pass Block 77 was damaged in September 1988 by a mudslide created by Hurricane Florence, SONAT contracted PLUS to repair the line. On February 28, 1989, during repairs on the 10-inch pipeline, an anchor cable from the barge *Cherokee* hooked onto and pulled off a 2-inch bypass around a check valve on a SONAT 18-inch pipeline.

Gas began spewing from the damaged section and bubbling to the surface of the Gulf of Mexico. Production into the pipeline was shut in, and the pressure began to bleed down. A pressure of approximately 100 pounds per square inch (psi) was temporarily maintained on the check valve located north of the break to prevent the flooding of the pipeline's northern section (downstream of the break). On March 3, 1989, divers were able to close an 18-inch ball valve isolating the northern section from the break. Underwater pictures of the damaged area showed the bypass completely sheared off, the anchor cable and several shrimp nets entangled in the exposed valve area, and sandbags scattered several feet from the pipeline.

Planning Repair

The damage to the pipeline caused water to enter the southern section (upstream of the break) of the pipeline. Southern Natural Gas Company (SONAT) anticipated that the southern section of the pipeline, which runs downhill from the damaged section (depth 190 feet) to Platform B (depth 210 feet), would be flooded by seawater. The company planned to replace the damaged section, then dewater the pipeline. However, subsequent bottom profiles show undulations along the pipeline's entire route where pockets of trapped gas and liquid hydrocarbons could accumulate.

On March 9, 1989, representatives from SONAT and PLUS met in Birmingham, Alabama, to discuss the technical aspects of repairs to the 18-inch pipeline. The procedure was to bleed down the pipeline. Then at M.P. 12.2 in Main Pass Block 151, PLUS would unbolt a 30-foot misalignment spool piece, lift it on deck, and redress the flanges. They would then lift the northern section, remove the damaged section, weld on a prefabricated replacement section, and replace the pipeline on the bottom. The redressed spool piece, with a pig inserted inside and an air line connected to a 4-inch valve on the spool, would be re-lowered and re-flanged. Air would then push the pig to South Pass Block 60 Platform B.

A temporary pig catcher would be installed on the riser at Platform B. During dewatering of the pipeline, disposal equipment would separate and dispose the water overboard, vent the gas, and store the liquid hydrocarbon in tanks. The representatives also discussed the need to meet with ARCO, operator of South Pass Block 60 Platform B.

On March 10, 1989, representatives from SONAT and PLUS met in Lafayette, Louisiana, to discuss repair procedures with ARCO. They informed ARCO that a 7-foot section of straight pipe on the riser was needed to install the pig catcher. The parties discussed platform piping and determined the need of field inspection to determine the location on the riser to install the pig catcher.

Preliminary Activities

On the afternoon of March 16, 1989, the venting of the 18-inch pipeline at South Pass Block 60 Platform B began. With Valve No. 1 (the 18-inch shutdown valve) closed, an ARCO operator bled down the approximately 1,000 pounds per square inch gauge (psig) of pressure above the 18-inch shutdown valve. (For schematic of riser piping, including valve identification, see attachment 3.) The 18-inch shutdown valve was then opened. A reading of approximately 80 psig of pressure was present with Valve Nos. 1 and 7 opened, and Valve Nos. 2, 3, 4, 5, 6, 8, 9, and 10 closed. Valve No. 8 was cracked open and, over the next several hours, the line was slowly bled to 0 psig. On the night of March 16, 1989, the M/V *Cal Dive II*, with a SONAT representative on board, arrived at South Pass Block 60 Platform B to open the check valve located approximately 350 feet from the base of the riser. The check valve was to be opened in order to vent and flood the pipeline and to conduct pigging operations. Radio communications were established between ARCO and SONAT regarding the venting of the pipeline and the opening of the check valve.

On the morning of March 17, 1989, M/V *Cal Dive II* divers were unable to open the check valve due to a pressure differential. A 4-inch bypass was operated to equalize the pressure around the check valve. On March 17, 1989, at approximately 9:30 p.m., a diver was able to lock open the check valve. A shutdown valve located adjacent to the check valve was left in the open position.

Representatives from PLUS, SONAT, and ARCO met on March 17, 1989, on South Pass Block 60 Platform B and decided to install the pig catcher below the 18-inch shutdown valve on the riser.

On March 18, 1989, the *Bo-Truc 20*, equipped with a cherry picker, two 210-barrel disposal tanks, two welding machines, an air compressor, and hoses, left a Houma, Louisiana, dock. The *Bo-Truc 20* had five crew members and eight passengers who were to perform work at South Pass Block 60 Platform B. The passengers consisted of three employees of PLUS and five employees of Venture, a company subcontractor of PLUS.

Platform Activities

The ARCO personnel began shutting down South Pass Block 60 Platforms B and E on March 18, 1989, at 4 a.m. to install a SONAT gas meter skid and to do various maintenance projects. A SONAT

representative was present to inspect the meter skid work. The platform remained off production until approximately 7 a.m. on March 19, 1989, when ARCO began bringing the platform back on line.

After unloading fuel to the barge *Cherokee*, the *Bo-Truc 20* arrived at South Pass Block 60 Platform B at 8 a.m. on March 19, 1989, and moored onto the structure adjacent to the 18-inch riser. Testimony and boat logs indicate workers began preparations to install the pig catcher by placing air tuggers on the platform and rigging up workbaskets. Welders cut out a section of riser guard to make room for the cold-cut operations. A hot-work permit was obtained from ARCO personnel before that work was performed.

The ARCO, PLUS, and SONAT representatives held a meeting on Platform B at 9 a.m. to discuss ARCO's double-block and bleed procedure for venting the 18-inch pipeline and safety procedures.

At approximately 11:30 a.m. on March 19, 1989, personnel from ARCO and SONAT closed Valve No. 8 and pumped open the 18-inch shutdown valve. The gauge read approximately 6 psig with Valves Nos. 1 and 7 opened and Valves Nos. 2, 3, 4, 5, 6, 8, 9, and 10 closed. Valve No. 8 was cracked open and, over the next 30 minutes, the line was bled to 0 psig. The 18-inch shutdown valve was then closed at 12 p.m. on March 19, 1989.

Subsequent investigation has revealed two important aspects about the bleed-down of the 18-inch riser. Liquid hydrocarbons have been found in the ball cavity of the 18-inch shutdown valve, indicating that this fluid was trapped there when the valve was closed around 12 p.m. on March 19, 1989. A plugged port on the bottom side of the 18-inch shutdown valve body was found to be in communication with the annulus of the 18-inch riser, thereby allowing access to determine the contents of the riser before cutting operations began. (For photograph of plugged port, see attachment 4.)

Testimony indicates that an unsuccessful attempt was made to unbolt the flange above the 18-inch valve and install a skillet. A decision was made not to flame-cut the bolts to install this skillet. The afternoon of March 19, 1989, was primarily spent waiting for the arrival of the cold-cut machine operator.

**Activities at
Main Pass Block 151**

Operations were also initiated on the 18-inch pipeline at M.P. 12.2 in Main Pass Block 151 on March 18, 1989, from the work barge *Cherokee*. Testimony and barge and diver logs indicate divers began to unbolt the 30-foot misalignment spool piece at 2 p.m. on March 18, 1989. At 5:10 p.m. on March 19, 1989, divers were working on removing the remaining bolts on the south flange. At 8:05 p.m. on March 19, 1989, the remaining bolts on the south flange were cut and the pipeline separated about 2 feet. The bolts on the north flange were then cut, and the spool piece was hoisted on deck

at 10:55 p.m. Testimony indicates radio communication was set up between the *Cherokee* and *Bo-Truc 20*; however, few or no discussions on the progress of their activities took place.

Commencement of Riser Cut

At approximately 5 p.m. on March 19, 1989, a Pipeline Supply and Service Company employee responsible for operating the cold-cut machine (machine operator) arrived via crew boat at the South Pass Block 60 Platform B. (For photograph of cold-cut machine, see attachment 4.) This machine has a cutting head that is driven by compressed air and makes a beveled cut around the pipe without producing sparks. The cutting head continues to make a deeper groove as it rotates until it eventually severs the pipe.

The machine was clamped onto the riser, and the initial cut of the 18-inch pipe began at approximately 6:30 p.m. at the 15+ foot level of the platform. A compressor located on the *M/V Bo-Truc 20* supplied the air to run the machine. The machine operator, who was in a workbasket located adjacent to the 18-inch riser, controlled the air with a valve on the machine. (For photograph of cut area, see attachment 5).

The machine operator stopped the cold-cutting operation at least once to make adjustments to the machine. At approximately 7:20 p.m., the cold-cut machine initially penetrated the 18-inch pipe. A fluid immediately started to flow from the penetrated area, and almost simultaneously the machine operator closed the air valve shutting down the machine.

Testimony indicates that some time after the cutting began, but prior to penetration, a minor welding operation was conducted on the deck of the *M/V Bo-Truc 20*. Testimony also indicates that the penetration was approximately one-eighth inch in width and one-third of the way around the pipe. Initial flow from this cut ranged in description as being from no more than an ooze to spraying several feet out under minimal pressure.

Completion of Riser Cut

Immediately after initial penetration of the pipe, the PLUS employee in charge of the operation (PLUS foreman) went to the 18-inch riser and checked the fluid coming out of the cut area. Testimony indicates that the fluid was determined by smell, not by gas detection equipment, to contain hydrocarbons.

At the same time, the machine operator got out of the workbasket and moved away from the cut area. As flow continued and increased slightly, the personnel working on the cellar deck also moved away from the cut area. These personnel consisted of three PLUS, one SONAT, two Venture, and one Pipeline Supply and Service Company employees.

A short time later, perhaps 3 to 10 minutes, the cold-cut machine was restarted. Testimony indicates that, after a hand signal was

given by the machine operator, a valve located at the compressor was used to restart the machine. (For photograph of compressor, see attachment 5.) After the initial flow, but prior to the restarting of the machine, there appears to have been little discussion among the PLUS foreman, machine operator, and SONAT representative as to what should be the next course of action.

After being restarted, the machine made several revolutions around the pipe, completely parting the 18-inch riser. At this point, the flow was increasing severely, and all personnel on the cellar deck started to run to the opposite side of the platform. The flow was coming from the bottom side of the cut and spraying upward toward the production and drilling decks of the platform.

Ignition and Emergency Evacuation

As the personnel on the cellar deck reached the opposite end of the platform, the fluid coming from the 18-inch riser ignited. These seven personnel either jumped or were blown into the water by the initial explosion. Testimony indicates all were wearing lifevests.

There were also three Venture and five Bo-Truc employees on the M/V *Bo-Truc 20* at the time of ignition. Three of these personnel were on the stern, two were on the afterdeck, and three were in the quarters area when the explosion occurred. Upon the initial ignition, the three personnel on the stern were blown into the water, and the vessel caught fire. The vessel could not depart from the riser area because it was connected by mooring lines to the platform. As the fire raged on the vessel and at the riser area, three additional personnel on the M/V *Bo-Truc 20* jumped into the water. Testimony indicates that none of the personnel on the stern had lifevests on at the time of the accident, and two of the three who jumped donned a lifevest before jumping.

There were six ARCO personnel located on the production and drilling decks of Platform B when the fire ignited. There were also 21 personnel on Platform E when the explosion occurred.

The majority of personnel on Platform E assembled at the emergency capsule located on the opposite corner from Platform B. They evacuated the platform via the capsule and in the process of departing picked up the remaining personnel from Platform E at the cellar deck.

Conflicting testimony was obtained as to the initial source of ignition. One witness has indicated that the fluid ignited at the air compressor skid on the deck of the M/V *Bo-Truc 20* due to the overspeeding of the diesel engine. Another witness has stated that hot exhaust pipes located above the riser area on the production deck caused the fluid to ignite.

Fire

As the fire raged upward from the 18-inch riser, the ESD system shut down both Platforms B and E, including all incoming and departing pipelines for Platform B.

Several of these pipelines ruptured between the shutdown valve and the water from the intense heat, creating subsequent explosions and fueling the fire with additional hydrocarbons. (For photographs of the fire and one of the ruptures, see attachment 6.) Subsequent investigation revealed that 6 out of the 10 other incoming and departing pipelines ruptured, including a 3,000-3,200-psi very high pressure gas line. (For schematic of pipelines, see attachment 7).

The activation of the ESD system initiated shutdown of all wells and production equipment on the platforms. Testimony indicates that the ESD system, which can be activated from either platform, was activated by personnel on Platform E, but it is unclear whether personnel or the fire loop activated the ESD system on Platform B.

Rescue

There were two personnel remaining aboard the *M/V Bo-Truc 20* when its mooring lines were burned, and the vessel was able to depart from the platform. These two remaining personnel fought the fire aboard the vessel in an attempt to prevent the fire from igniting the vessel's fuel tanks. While these fire fighting efforts were being conducted, testimony indicates that the vessel passed close to the seven personnel who had abandoned the platform from the cellar deck.

The *M/V Betty G*, an ARCO standby vessel moored at Platform E, was offloading potable water to Platform B when the fire occurred. Immediately after the fire ignited, the vessel departed the platform and readied its fire monitor to spray water on the flames.

The *M/V Betty G* proceeded to the south-southeast side of Platform B where it rescued 10 personnel, 7 of who were originally on the cellar deck and 3 of who jumped from the *M/V Bo-Truc 20*.

An ARCO employee in the cryogenic plant on the drilling deck of Platform B at the time of the explosion was able to make his way to the bridge and cross over to Platform E, where he obtained a lifevest, proceeded to the cellar deck, and jumped into the water. While attempting to swim to an anchor buoy, this survivor was spotted and picked up by the *M/V Betty G*.

One of the Venture employees who were blown off the stern was able to swim to Platform E. The *M/V Betty G* spotted that survivor and rescued him at the same time it was spraying water to prevent the vessel and Platform E from being ignited. Testimony has indicated that the deluge system on Platform E was dumping a significant amount of water in the wellbay area.

Fire Extinguishment

The M/V *Betty G* then continued to search for missing personnel for a short period. As other vessels arrived on the scene, the M/V *Betty G* proceeded to South Pass Block 60 Platform A to obtain medical treatment for the injured personnel.

The two remaining personnel on the M/V *Bo-Truc 20* extinguished the fire aboard the vessel and proceeded to tie off to an anchor buoy, where they awaited further orders.

Meanwhile, the M/V *Betty G* returned to Platform B to provide additional assistance where needed. By that time numerous vessels had responded to the emergency and were on the scene searching for missing personnel and spraying water on the fire. By approximately 7:40 a.m., March 20, 1989, the last of the fire, which appeared to be coming from a small area in the wellbay, was put out by the fire fighting equipment on the vessels at the scene.

Fatalities and Injuries

An attempt was then made to board Platform B but was aborted because there were indications that gas might be leaking from the facility. However, on March 21, 1989, Platform B was boarded via the bridge from Platform E, and a search was conducted for missing personnel.

The bodies of ARCO personnel Richard Freeman, Doyle Henson, and Barry Pritchard were located on the production deck of Platform B. The bodies of ARCO personnel James Gibbs and J. B. Suharto were located on the drilling deck of the facility.

The body of Mark Plaisance, a Bo-Truc employee blown off the back of the M/V *Bo-Truc 20*, was found washed ashore at Grand Isle, Louisiana. Jerry Gentry, a Venture employee also blown off the back of the vessel, has not been located and is presumed dead.

Ten of the personnel rescued from the scene were transported from Platform A via helicopter to West Jefferson General Hospital, where they were admitted and treated for their injuries.

Subsequent Activities

Cleanup equipment was activated, as minor pollution incidents were observed, including small amounts of oil leaking from damaged wellheads.

The check valve located approximately 350 feet from the base of Platform B for the 18-inch pipeline was unlocked, and the shutdown valve was closed, isolating the facility from the northern side of the pipeline. All wells on Platform B were killed with fluid, and the wellheads were replaced. The 18-inch riser below the cut has been blocked so that it is isolated from the platform.

Damages

The production and drilling decks of Platform B were completely destroyed. (However, only one production vessel appears to have ruptured during the fire.) These decks and associated equipment have been removed. The platform jacket and wellheads remain, and ARCO is evaluating plans for remedial action. The 18-inch pipeline has been temporarily abandoned, and SONAT is also evaluating future activities.

The M/V *Bo-Truc 20* received extensive fire damage to the afterdeck and the equipment located on it. The quarters and engine area of the vessel received minor damage as a result of the fire.

Conclusions

Probable Cause of Incident The probable cause of the incident was the cold-cutting of the 18-inch riser. After the pipeline was flooded, liquid hydrocarbons, which have a specific gravity less than water, migrated up the riser, above the water line. The penetration of the riser from the cold cut allowed a mixture of gas, liquid hydrocarbons, and water to escape to the atmosphere. This escape reduced the hydrostatic pressure, creating a pressure differential that allowed additional flow into the riser. The presence of gas, which would expand over six times its volume up the riser, provided the driving force to expel the liquids.

Probable Cause of Gas and Hydrocarbon Presence The 18-inch pipeline transported gas that was rich in liquid hydrocarbons. The undulations in the 18-inch pipeline prevented it from being completely flooded with water and thus allowed pockets of gas and liquid hydrocarbons to remain in the line.

Possible Causes of Ignition The following were possible causes of ignition:

1. Equipment running on the *M/V Bo-Truc 20*
2. Equipment running on the production deck of Platform B

Contributing Causes The following were contributing causes:

1. The locking open of the check valve some 350 feet from the platforms. If this valve had been left in operation, and the shutdown valve located adjacent to it had been closed prior to the bleed-down, it would have isolated the pipeline segment to be cut and limited the flow of gas and fluids into the riser prior to and after the cold cut was completed.
2. The failure to complete the operation of inserting the skillet into the riser. If the flange had been unbolted, the presence of gas and liquid hydrocarbons could have been detected, and the operation could have been halted.
3. The failure to determine the contents of the 18-inch riser at the location where the cut was made. If the plug on the bottom of the 18-inch shutdown valve would have been removed, the contents of the riser would have been determined, and the operation could have been halted.

4. The pulling of the 2-inch bypass off the 18-inch pipeline. Without this incident the 18-inch pipeline would not have needed to be pigged, and the cut of the riser would not have occurred. Also, if this 2-inch bypass and associated valving had been properly sandbagged or protected, the damage might not have occurred.
5. The ruptures of the incoming and departing pipelines between the shutdown valves and the water. These ruptures provided significant sources of additional fuel to the fire.
6. The absence of detailed and coordinated planning for the project. Little consideration was given to the possibility for flow, despite the pipeline undulations and the potential for trapping large volumes of hydrocarbons.
7. The absence of oversight over contractor activities.
8. The decision to install the pig trap below the 18-inch shutdown valve.
9. The restarting of the cold-cut machine after initial penetration was made.
10. The close proximity of the M/V *Bo-Truc 20* to the work site.

Probable Cause of Fatalities

The following were probable causes of the fatalities:

1. Injuries sustained in the initial and subsequent explosions and the resulting fire caused the fatalities of Messrs. Freeman, Henson, Pritchard, Gibbs, and Suharto.
2. Drowning or injuries sustained in the initial explosion and subsequent fire caused the fatalities of Messrs. Plaisance and Gentry.

Contributing Causes of Fatalities

The following were contributing causes of the fatalities:

1. Because flotation vests were not being worn, personnel on the afterdeck of the M/V *Bo-Truc 20* were not able to maintain water survival techniques.
2. The failure to alert operations personnel on the drilling and production decks of Platform B prior to the

initiation of the cutting operations was also a factor. Apparently, the conditions associated with the cutting operations were not considered hazardous.

Recommendations

Safety Alerts

The Gulf of Mexico OCS Region should issue Safety Alerts concerning the following:

1. Lessees, transmission companies, and contractors should attempt to determine the contents of risers and/or pipelines before cutting a line.
2. Lessees, transmission companies, and contractors should isolate as small a portion of line as possible before cutting a line.
3. Lessees, transmission companies, and contractors should consider the effects before working on both ends of a pipeline simultaneously.
4. Lessees, transmission companies, and contractors should plan, coordinate, and work together more closely when operations are to be conducted on risers.

Regulatory Requirements

The MMS should require the following when work is to be conducted on a riser:

1. A complete plan of action should be submitted for MMS approval.
2. When a vessel is moored adjacent to a platform, it should adhere to MMS welding and burning requirements for that platform.
3. The lessee/pipeline company should be required to maintain onsite supervision of the operation.
4. Riser segments should be isolated prior to repairs by closing adjacent upstream and downstream valves or by installing reliable flow restriction devices.
5. Platform personnel should be put on alert before riser repair activities begin. A manually controlled ESD station should be installed near the repair activities.

Additional Considerations

The MMS should proceed with the following:

1. Revise the Memorandum of Understanding between the Department of the Interior and the Department of Transportation (DOT) to provide for a regulatory review of pipeline projects that is consistent with the oversight of other OCS activities with comparable safety

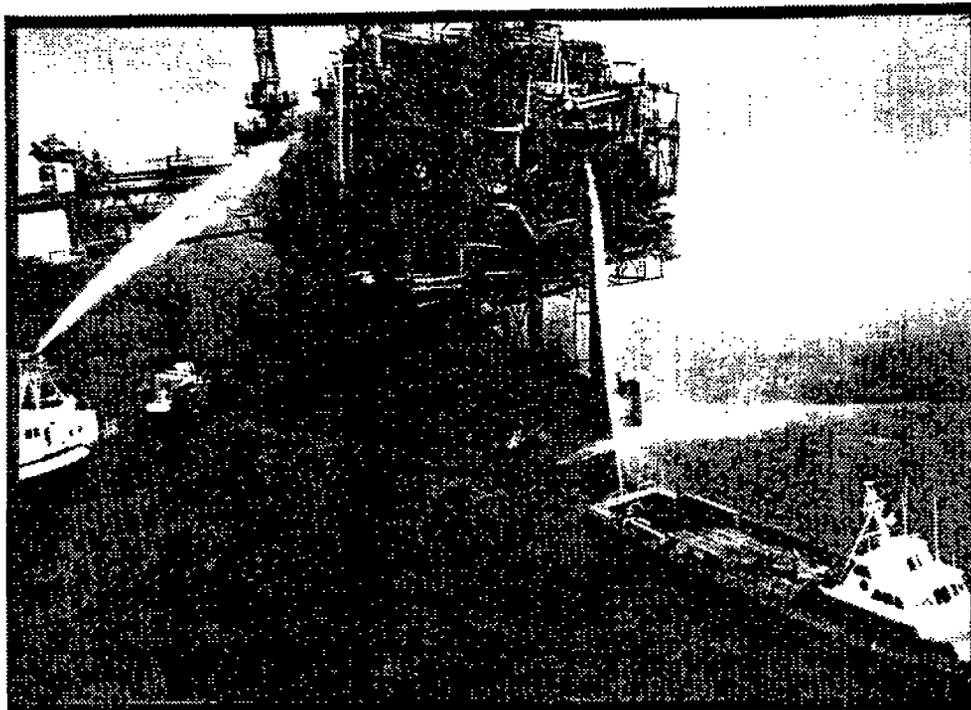
and environmental risks. In light of DOT's limited offshore presence, this responsibility should be assumed by MMS.

2. Conduct a study to determine the feasibility of requiring shutdown valves to be located near the water surface, subsea, or on the seafloor.

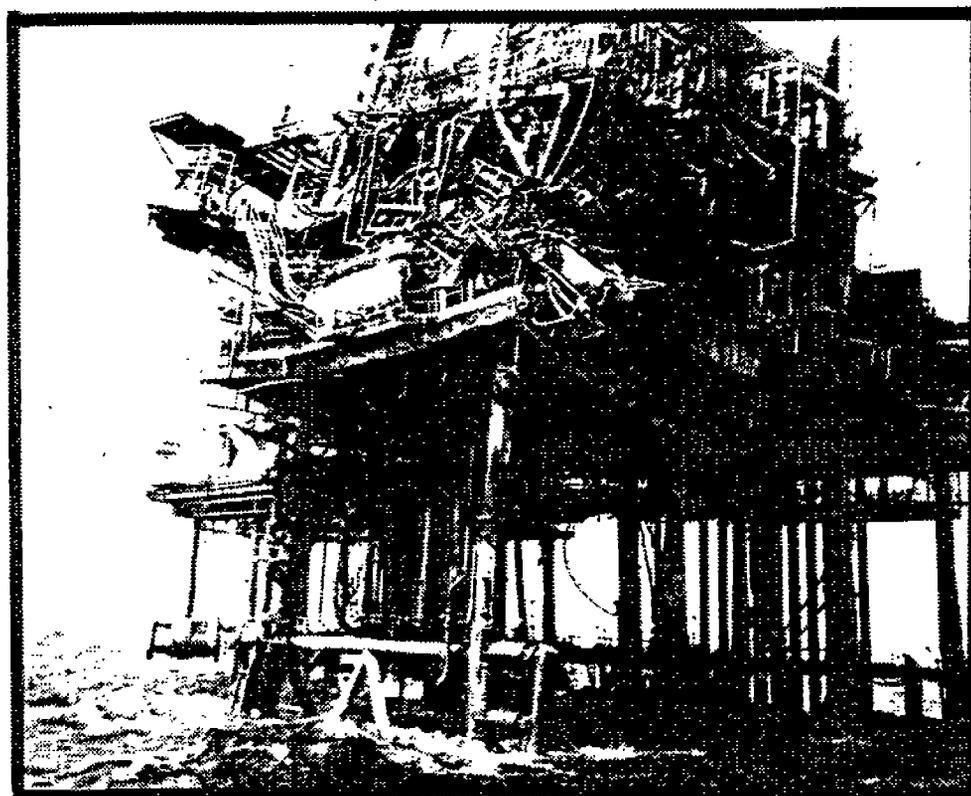
Glossary

Air tuggers	A mechanical device powered by compressed air and used for lifting and pulling equipment.
Annulus	The space around a pipe in a wellbore, the outer wall of which may be the wall of either the borehole or the casing, the space between two concentric cylinders. In the case of a well, it may be the space between tubing and casing, two strings of casing, drill pipe and the wellbore, etc.
Cellar deck	The lowest level deck on a platform.
Check valve	A valve that limits flow to one direction by closing automatically when the flow stops or reverses direction.
Cold-cutting operations	Procedures used to cut a pipe without using flame or generating extreme heat.
Communication	In regard to piping, including valves, two elements are said to be in communication if either has the ability to transfer flow to the other.
Cryogenic plant	A plant used to produce natural gas liquids by applying pressure to the gas and cooling the gas to very low temperatures.
Double-block and bleed procedure	The procedure followed in positioning pipeline valves to have the pipeline's annulus bled down to atmospheric pressure.
Emergency shutdown (ESD) system	A designed system of safety equipment that initiates shutdown of all wells and production-process equipment when a station is activated during an abnormal condition.
Fire loop	A system of heat sensitive plugs that, when subjected to extremely high temperatures, automatically activates the emergency shutdown system.
Gas meter skid	A unit containing equipment used to measure the volume of gas passing through a pipeline.
Hot-work permit	A notice issued by the operator approving the conduct of welding, burning, or hot-tapping operations in an area of a platform.
Misalignment spool	A short section of flanged pipe used to connect the ends of two pipelines together.
Pig	A spherical device pushed through a pipeline for the purpose of cleaning the pipe.
Pig trap	A device that catches the pig.

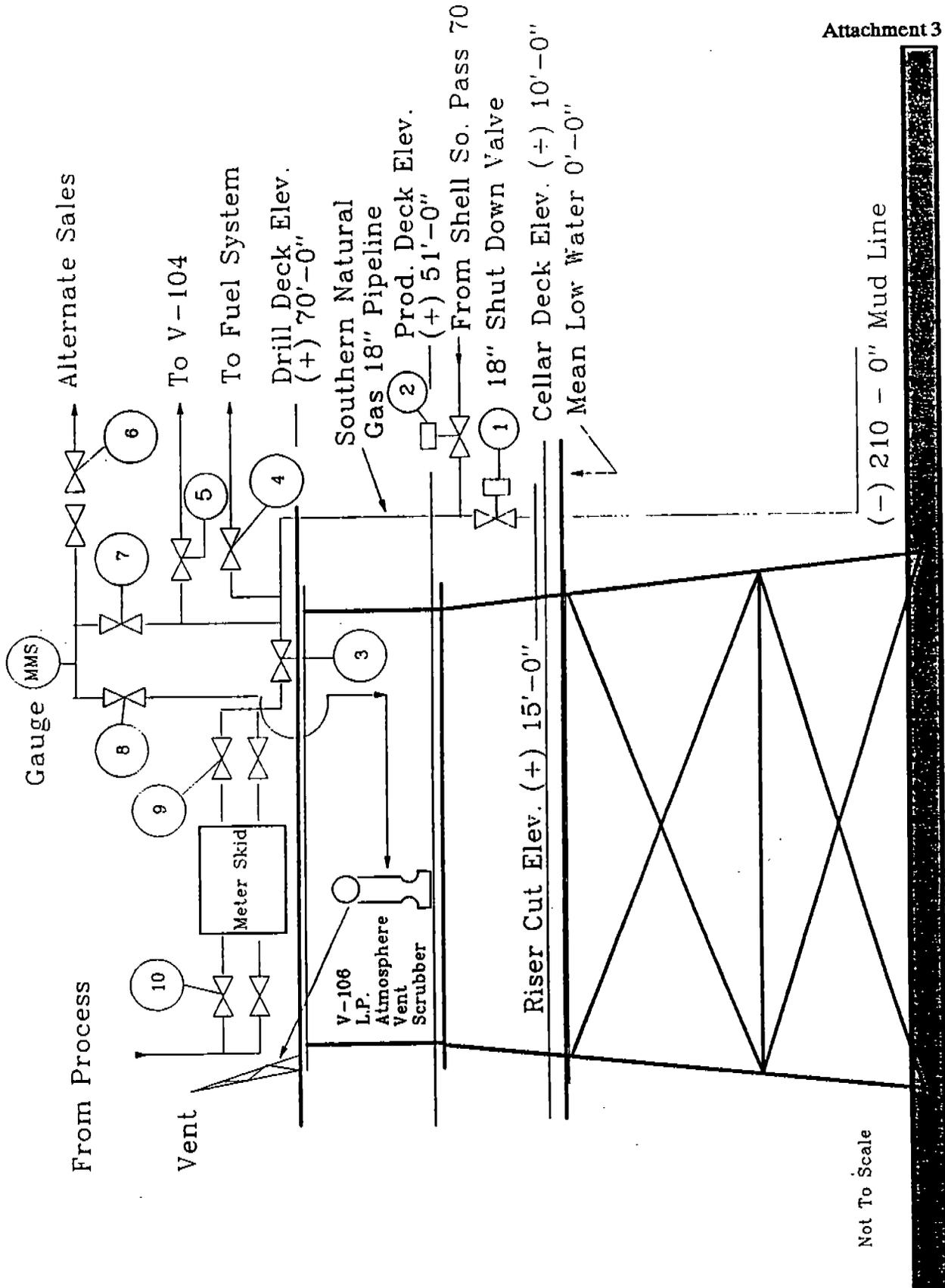
Riser	The pipe running from the top of a wellbore on the ocean bottom to the production equipment on the platform decks, or the pipe running from marine pipelines on the ocean floor to the production equipment atop the platform.
Shutdown valve	A valve that, when closed, stops the flow of gas or liquid in a pipeline.
Skillet	A solid metal plate inserted in a pipeline flange to block flow.



Scene of accident

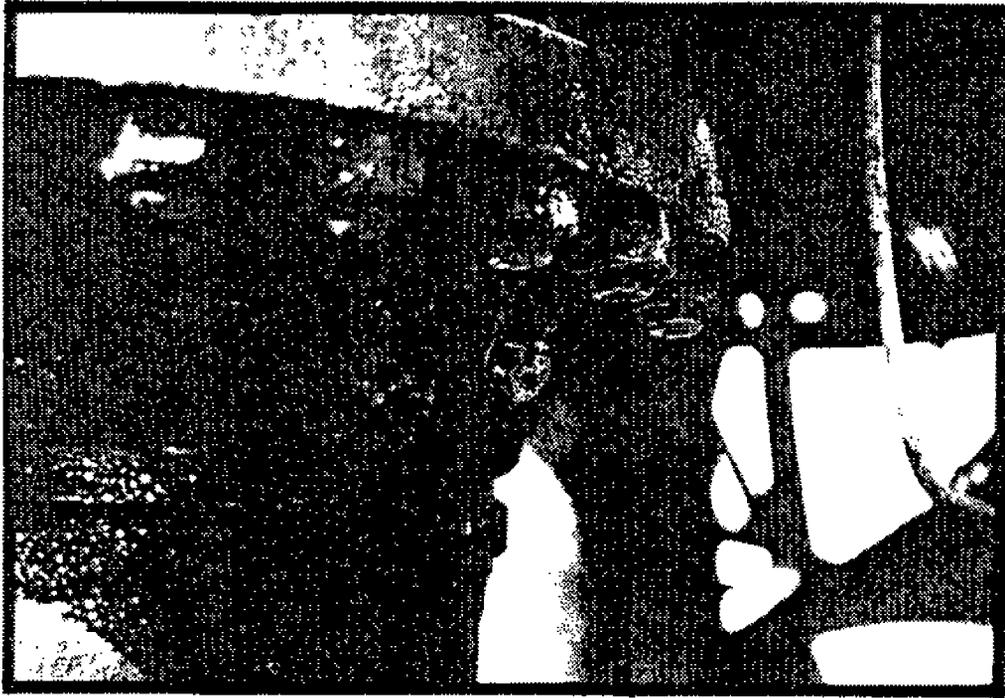


Platform B

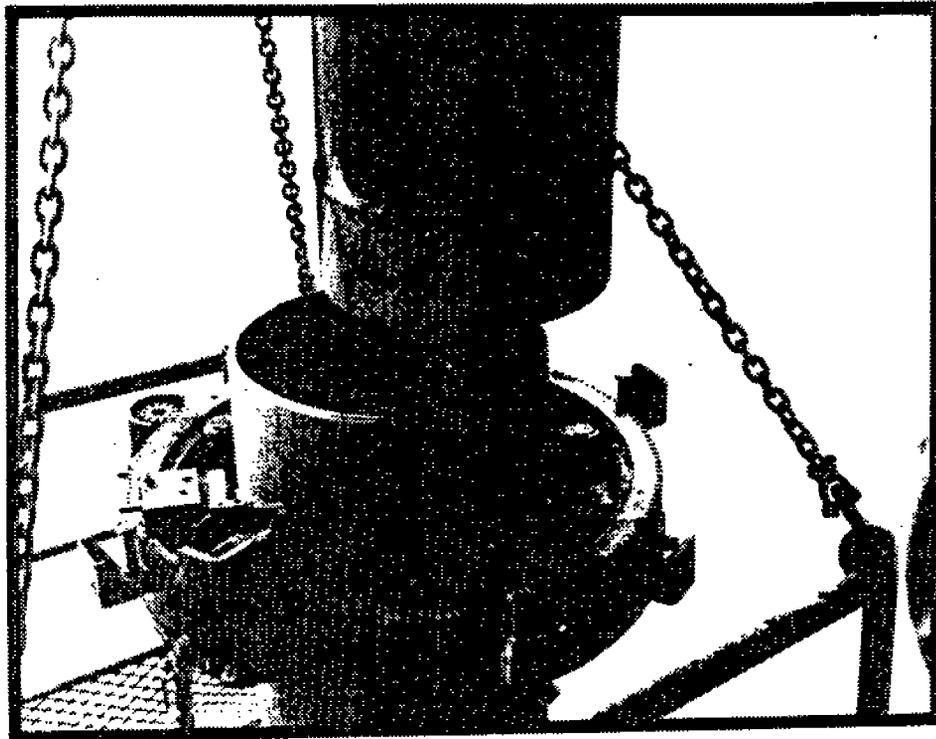


Not To Scale

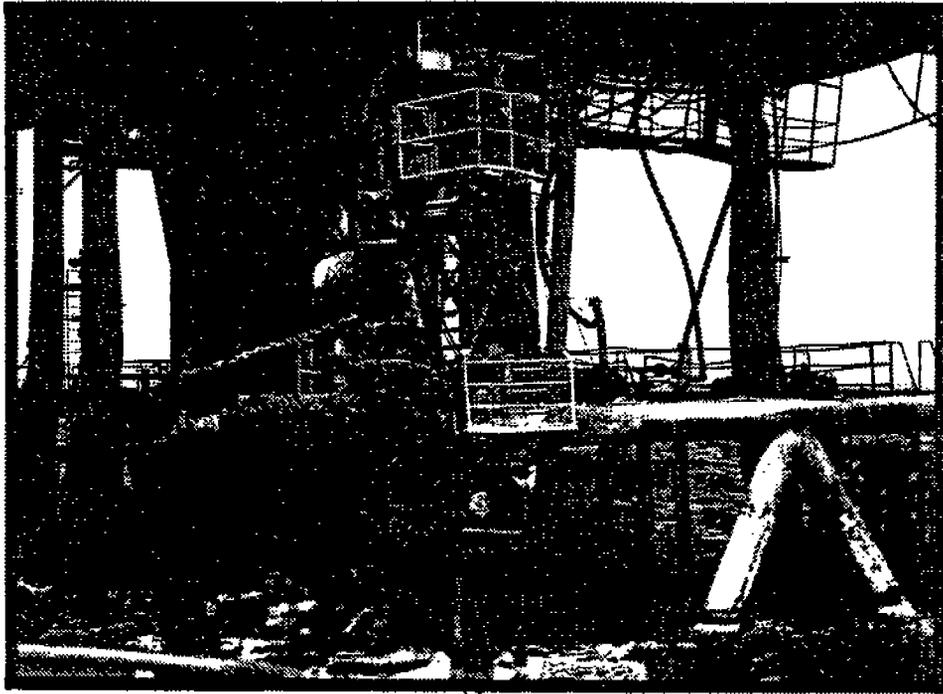
Schematic of riser piping including valve identification



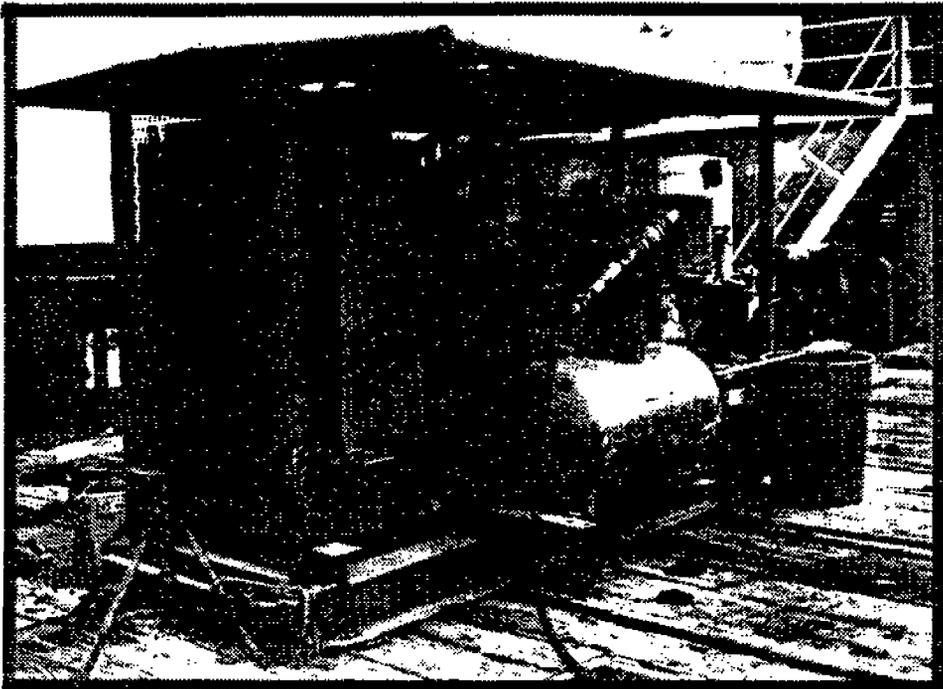
Plugged port



Cold-cut machine



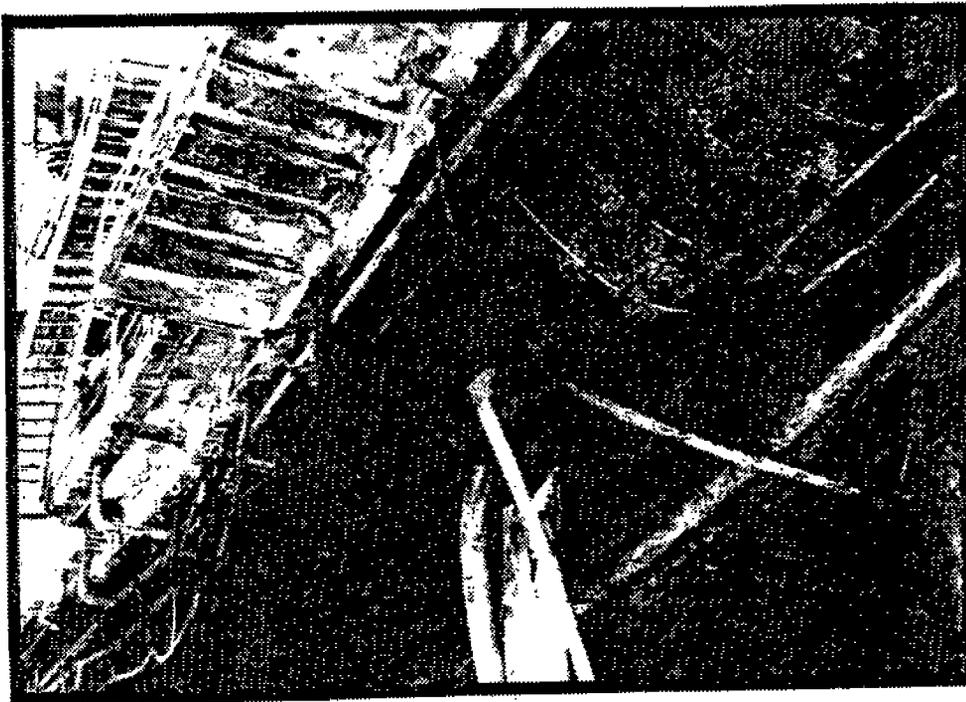
Area of cut



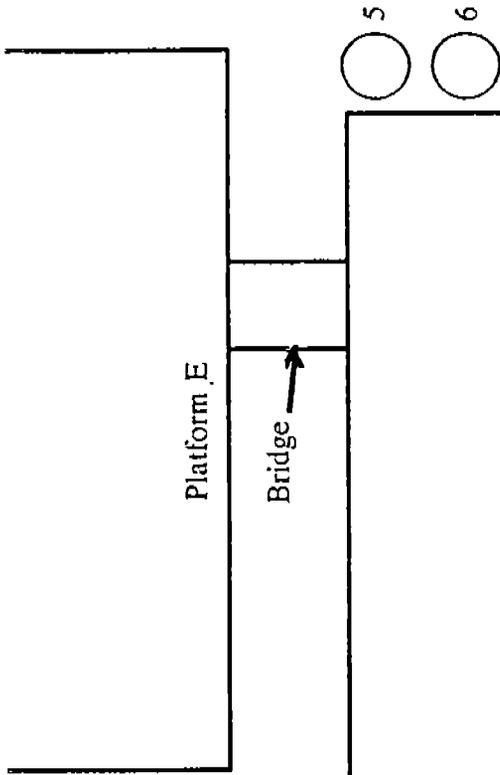
Compressor on M/V *Bo-Truc 20*



Fire on Platform B



Rupture in pipeline



Platform B

Pipeline No.	Size	Flow Direction	Contents	Operating Pressure (psig)	Rupture Point
1	18-inch	Departing	Gas	1,000	Riser Cut
2	8-inch	Incoming	Gas	1,000	No Rupture
3	6-inch	Departing	Gas	1,000	Under Production Deck
4	12-inch	Incoming	Gas	80-90	Under Production Deck
5	12-inch	Incoming	Gas	80-90	No Rupture
6	12-inch	Incoming	Gas	80-90	No Rupture
7	12-inch	Departing	Gas	1,000	Under Production Deck
8	4-inch	Bi-directional	Gas	3,000-3,200	Under Production Deck
9	6-inch	Bi-directional	Gas	1,000	Cellar Deck
10	6-inch	Departing	Oil	300-400	Cellar Deck
11	6-inch	Departing	NGL*	500-550	No Rupture

* NGL — Natural Gas Liquid



Not To Scale

Schematic of pipelines





The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission



As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The **MMS Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.