OCS Report
MMS 84-0040

Investigation of July 20, 1983, Blowout Matagorda Island Block 657, Lease OCS-G-4139 Gulf of Mexico

U.S. DEPARTMENT OF THE INTERIOR/MINERALS MANAGEMENT SERVICE

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by

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AUTHORITY AND PROCEDURES FOR THE INVESTIGATION AND PUBLIC REPORT

A. Authority

Pursuant to Section 208, Subsection 22 (d), (e), and (f) of the Outer Continental Shelf (OCS) Lands Act Amendments of 1978 and 30 CFR 250.70 and 250.71, an investigation and public report must be made of a serious blowout. A serious blowout occurred on July 20, 1983, in Matagorda Island (MI) Block 657, Lease OCS-G 4139, in the Gulf of Mexico. A panel was formed to investigate the blowout and to make a public report. The following individuals were named to the Investigative Panel:

William Martin	-	Minerals Management Service
Jack Sandridge	-	Minerals Management Service
Kenneth Blake	-	Minerals Management Service
Ulysses Cotton	-	Minerals Management Service
Robert Goodman	-	Minerals Management Service
Lt. Cmdr. Max Miller	-	U.S. Coast Guard

B. Procedures

An informal hearing was convened in Corpus Christi, Texas, on August 11, 1983. Exxon, the lease operator, and Penrod Drilling Company (Penrod), the drilling contractor, were represented by personnel who were on the drilling rig when the accident occurred and by supervisory and staff personnel who were onshore and were connected with the drilling operation. Exxon attorneys were present as was an attorney representing Hydril Company. (A list of individuals attending the hearing is attached on page 9.)

Exxon and Penrod personnel, who were on the drilling rig when the accident occurred, were asked to relate their activities before, during, and after the blowout. Onshore supervisory and staff personnel were also questioned.

The Investigative Panel held a meeting in the Minerals Management Service (MMS) office in Metairie, Louisiana, on October 24, 1983. Events of the drilling activity and blowout were discussed.

The Investigative Panel then came to its findings and conclusions and prepared this report for the public.

INTRODUCTION

A. Background

Lease OCS-G 4139, MI Block 657, Gulf of Mexico, was issued on October 1, 1979. (For the lease location, see Attachment No. 2.)

The lease contains approximately 5071 acres and is bounded on the northwest by the Texas Federal Boundary. Exxon purchased the tract for $7,562,000.

Exxon drilled and completed four wells from the B Platform under a Supplemental Plan of Development approved April 2, 1982. Well B-3, the nearest well to Well No. 1, where the blowout occurred, is perforated at a total vertical depth (TVD) of 1967′ and is located approximately 8100′ northeast of Well No. 1, which is some 11.8 miles off the Texas Coast.

Exxon drilled 10 development wells from platforms and five exploratory wells on MI Blocks 632, 656 and 657 before drilling Lease OCS-G 4139, Well No. 1. (For the exploratory well locations, numbers 1 and 2, and the platform well locations, numbers 2 and 3, see Attachment 3.) Exxon experienced some problems with lost returns from 4100′ to 4300′ TVD on four wells (657 A-3, 657 B-1, 632 No. 1, and 656 No. 1). However, there were no serious incidents associated with these lost return problems. All of the platform wells encountered gas at depths varying from 1800′ to 4300′ without any serious drilling incidents.

Exxon's Plan of Exploration for Lease OCS-G 4139, Well No. 1, was approved on June 28, 1983. (For the well location, see Attachment No. 4.)

B. Description of Incident

1. Positioning Rig On Location - The Penrod 52, a LeTourneaux type 82-SDC jackup rig, was moved onto Well No. 1 on July 11, 1983. The barge was jacked to a 50′ airgap and the legs preloaded to 7.8 million pounds. The final leg penetration was 47′ on all three cans. This agreed with the prelocation coring report that had indicated that leg penetration would be in the range of 44′ to 50′.

   The barge was jacked to a 50′ airgap and the drilling package was skidded out to the Well No. 1 drilling position.

2. Well Spudded - A string of 30″ drive pipe was driven to a depth of 332′ with 164′ of penetration below the mud line. The water depth was 68′ with the rotary kelly bushing 100′ above the water.

   The portion of the diverter system on top of the 30″ drive pipe was installed and connected to the rigs 6″ diverter system hose as shown in Attachment No. 5. The diverter system on the drive pipe was 21 1/4″, 2000 psi msp hydril and a diverter spool with an 8″ TK ball valve. The diverter system pressure tested to 150 psi.

   The 17½″ conductor hole was spudded on the morning of July 15 and was drilled to 1010′ with 9.4 pounds per gallon (ppg) mud. The hole was conditioned and logged. A string of 13-3/8″ 54.50 lb/ft. K-55 casing was run and cemented at this depth with full returns using 250 sacks Class H cement plus 12% gel cement and 400 sacks of Class H neat. The 30″ x 13 3/8″ annulus was washed out to 310′, and 300 sacks of Class H cement plus 2% $CaCl_2$ were placed up to 212′. The casing pressure was tested to 250 psi for 30 minutes and the annulus was tested to 150 psi.

The diverter system was reinstalled this time on top of the 13 3/8" 'A' section. It was then pressure-and-function-tested, and pumped through. The cement was drilled out of the 13 3/8" shoe, 10' of new hole was drilled to 1020', and a 12 ppg equivalent PIT test was performed.

Drilling reached 2880' on the morning of the 20th, and a 20-stand wiper trip was made as a precaution to check hole conditions. The wiper trip was made with no problems. Exxon was using a float in the drill string.

3. Loss Of Mud Return. Drilling proceeded to 3748' by Geolograph (3765' mud logger) when the driller noticed loss of mud returns on the flo-sho (drilling mud return monitor) at 1910 hours. (The well schematic is shown in Attachment No. 6.) The pumps were immediately shut down and the kelly picked up. Exxon supervisors were notified, and proceeded to the rig floor.

   The mud log data shows the penetration rate increased just prior to the blowout depth of 3748'. The last two intervals on the log (five feet each) were cut at 500' per hour and 140' per hour respectively. This was an increase from the average baseline of 120' per hour.

   Seawater from the trip tanks was pumped into the annulus, and a total of 32 bbls of seawater was added to raise the fluids in the annulus to the proper level. An additional 196 bbls were added over the next 20 minutes.

   During this time, 9.8 ppg mud was being pumped down the drill pipe at the rate of three barrels per minute (BPM) (approximately 80 bbls) in an attempt to fill the drill pipe. The drill pipe could not be kept full while pumping mud, so seawater was pumped to fill the drill pipe with fluid. Also during this time, the Penrod toolpusher was notified to be prepared to divert the well out through the port diverter line, which was downwind.

4. Annular Element Leak. At 1950 hours, the well started flowing through the annulus. The diverter system was opened, the annular preventer was closed, and the well was diverted on the port side (downwind). Flow through the diverter was observed by the workboat M/V Blue Crab. Almost immediately, the annular element started leaking, and gas, water, and sand started shooting 40' up into the derrick. Due to the large amount of gas on the rig floor, all personnel on the rig floor were evacuated and the power was shut down.

   During this period of flow, an inspection was made under the rig floor, and no leaks were noticed in the diverter system. The general alarm was sounded and all personnel donned life jackets and assembled on the main deck to standby. At approximately 1955 hours, a partial evacuation began of non-essential personnel, with four people being lowered, in the personnel basket via rig crane, to the M/V Blue Crab. At 2000 hours, the gas blowing up through the rotary subsided, power was restored, and three people re-entered the rig floor.

The rig pumps were activated and seawater was pumped down the drillpipe at 13 BPM. The annular element was still leaking, and an attempt was made to regulate the closing pressure from 1250 psi to 1500 psi. As the pressure was being regulated, the preventer suddenly started leaking severely necessitating reevacuating the rig floor. The valve to open the starboard diverter line was activated, but no flow was observed. (During this period, the diverter system apparently plugged.)

5. Rig Evacuated. At 2015 hours, the decision was made to evacuate the rig. By 2030 hours, all rig power was shut down and the other 34 people were loaded into the two 44-man lifeboats. The rig was evacuated without injury. The lifeboats motored to the M/V Blue Crab which was standing by 200-300 yards to the north. All personnel were accounted for and were transported to the MI 632-A platform.

6. Surveillance of Rig After Evacuation. At 2330 hours, the crew boat made a trip to the rig; the crew reported that the noise level was very high. The crew circled the rig and saw that gas and sand were blowing over the derrick with a lot of gas coming up underneath the floor.

   A surveillance flight made at daylight on the morning of July 21st showed that the well had broached outside the casing, the derrick had toppled, and the rig had turned completely around. The well was boiling the water 15′ to 20′ in the air. At 0805 hours, the flow died down for a short period, but it started up again and was flowing hard at 0945 hours. At 1045 hours, the well was raising the water 25′ to 50′, and the rig was sinking. (Photographs of these events are included in this report as Attachment 7.)

   On the morning of July 22, 1983, the well ceased flowing, and it has not flowed since.

II. FINDINGS

A. Preliminary Activities

While normal drilling operations were being conducted at 3748′ (3765′ mud logger), a loss of circulation was encountered. Attempts were made to regain circulation with no success. The subsequent loss of mud caused a lowering of the hydrostatic pressure in the well bore, which in turn allowed the well to flow. Any one of the several shallow zones could have fed the blowout. At this point the annular preventer was closed and the well flow was diverted to the port (downwind) side.

B. Loss of Well Control

Shortly after the well flow was diverted, the annular preventer started leaking. The closing pressure on the annular preventer was increased from 1250 psi to 1500 psi. A Hydril Company spokesman indicated that the annular element installed should have been able to withstand the full rated working pressure of 2000 psi. As the additional pressure was being applied, the preventer started leaking severely, allowing gas to accumulate on the rig floor. The valve activating the starboard diverter line was opened, but no flow was observed. (Also, during this time period, the diverter system apparently plugged.) There was no testimony indicating that Exxon drilled into gumbo sediments. At this time, the well was out of control. The rig was shut down and all personnel evacuated.

C. Attempts at Restoring Well Control

Seawater from the trip tanks was pumped into the annulus, and 32 bbls of seawater were added before the fluid in the annulus reached the proper level. An additional 196 bbls of seawater were added over the next 20 minutes.

Mud weighing 9.8 ppg was pumped down the drill pipe in an attempt to fill the drill pipe.

The flow from the well was diverted, and the annular preventer began leaking. Exxon began pumping seawater down the drill pipe.

D. Loss of the Rig

During the night of the 20th, the well apparently bridged and broached, resulting in a flow around the outside of the conductor casing. During the surveillance flights on the morning of the 21st, the well was observed to be flowing, causing a 15′ to 20′ boil in the water, and the rig was slowly sinking. By the morning of the 22nd the well flow ceased and the rig sank with only parts of two legs exposed. The photographs attached show this clearly.

Exxon mobilized a fast response skimmer from Corpus Christi to clean up minor pollution from the diesel fuel tanks on the rig.

E. Disturbed Area

A seismic survey of the rig site was conducted on July 24-25, 1983. The top portion of two legs and a crane boom were the only parts of the rig visible above the sea surface during the time of the survey. The third leg was twisted and bent; the top of it appeared to be 40′ below the sea surface.

The survey showed the disturbed area of the seabed to be oval in shape, with its long axis oriented northwest-southeast, with approximate dimensions of 900′ by 700′. The focus of disturbance appears to be an approximate 150′ diameter crater, asymmetric in shape. The greatest recorded depth for the crater was 120′ below the surrounding seafloor level. No debris from the rig was noted outside the crater.

Penrod requested permission from the Corps of Engineers, the Coast Guard, and MMS to remove all obstructions that were above the original surrounding sea floor (at a 68′ depth) and to leave the rest of the rig in the crater. The Corps of Engineers, with the final authority, granted Exxon (Penrod) permission. Penrod plans to blow off the legs and cranes and to let them fall on or beside the sunken rig.

F. Cost of Rig Loss

The total cost of the rig and the drilling of the well is estimated at $32,000,000.

G. Annular Preventer Failures

A Hydril Company representative indicated that they conduct studies on all failures of their equipment when it can be recovered. In this case the equipment is at the bottom of the Gulf.

IV. CONCLUSIONS

A. Causes of Incident and Rig Capsizing

1. Contributing Causes to the Incident

a. The lost circulation zone was encountered at a higher depth than anticipated.

b. The drilling penetration rate increased just prior to losing circulation, and apparently no immediate action was taken as a result of the increase in drilling rate.

c. The water pumped down the annulus was insufficient to hydrostatically control the pressure in the shallow gas sands previously encountered.

2. Proximate Causes of the Incident

a. Loss of circulation occurred.

b. The well kicked after loss of circulation occurred.

c. The diverter system apparently plugged after the well was diverted for approximately 25 minutes.

d. The primary cause of the blowout of the well; that is, loss of well control after the kick occurred, was the annular preventer failure. In this particular situation, the failure of the annular may have been good as it probably prevented broaching of the 13-3/8" conductor casing shoe from occurring sooner. If that had occurred, evacuation of personnel would have been more difficult.

3. Proximate Causes of Rig Capsizing

a. The occurrence of the blowout.

b. The well bridged.

c. The well flow broached around the casing shoe.

d. A cavity was created in the ocean floor.

B. Relationship of Incident to Conditions for Drilling

1. Exxon drilled the well in accordance with the approved Application for Permit to Drill.

2. The Penrod Drilling Company drill crew handled the situation properly.

C. Relationship of Incident to Regulations

1. A determination was made that Exxon did not violate a regulation.

2. The regulation that specifically applies (250 CFR 41) (Control of Wells) states that the lessee shall take all necessary precautions to keep its wells under control.

   Further steps might have been taken to control the lost circulation problems, but, under the circumstances, the panel concluded that Exxon's procedures were reasonable.

D. Relationship of Incident to Diverter System

1. The panel was unable to determine the cause of the diverter equipment failure. The diverter line apparently plugged but we do not know why. The Corps of Engineers allowed the drilling rig to remain on the bottom of the Gulf of Mexico.

2. The 6" diverter piping is probably too small but meets the current MMS regulatory requirements.

3. The diverter system was flow through tested as recommended by MMS and diversion through the system was successful for 25 minutes.

E. Relationship of Incident to Annular Preventer

1. The cause of the annular preventer failure cannot be determined as it is on the bottom of the Gulf.

2. Diverter annulars which are part of the diverter system can be exposed to maximum rated working pressure.

3. Testimony indicated that Penrod was not sure when the rubber element in the annular preventer on the rig had been changed.

V. RECOMMENDATIONS

A. The panel recommended to Exxon that they consider revising their subsequent casing programs to allow greater well control. Exxon's casing program to 4000′ for a well on the same lease included: drive pipe at the same depth as well No. 1; conductor casing 200′ deeper, at 1200′; surface pipe at 1800′; protective pipe at 3200′; and protective liner at 3850′. On the first well, where the blowout occurred, the conductor pipe was set at 1010′; the surface pipe was approved for 4000′ but was never set.

B. The panel recommends that lease operators use controlled drilling procedures when approaching a lost circulation zone. If a drilling break is encountered just prior to reaching the anticipated lost circulation zone, immediate remedial action should be taken. The remedial action should include circulating the well fluid to check mud properties and hole conditions.

C. The panel recommends, and the MMS is funding, research to develop technology for improving diverter systems. The problem of diverter plugging will be studied.

D. Many drilling contractors have programs for maintenance on annular preventers as the rubber elements are affected by heat and ozone. All companies should institute such programs. Operators should give special attention to inspecting annular preventers on rigs which have been stacked for a long period of time.

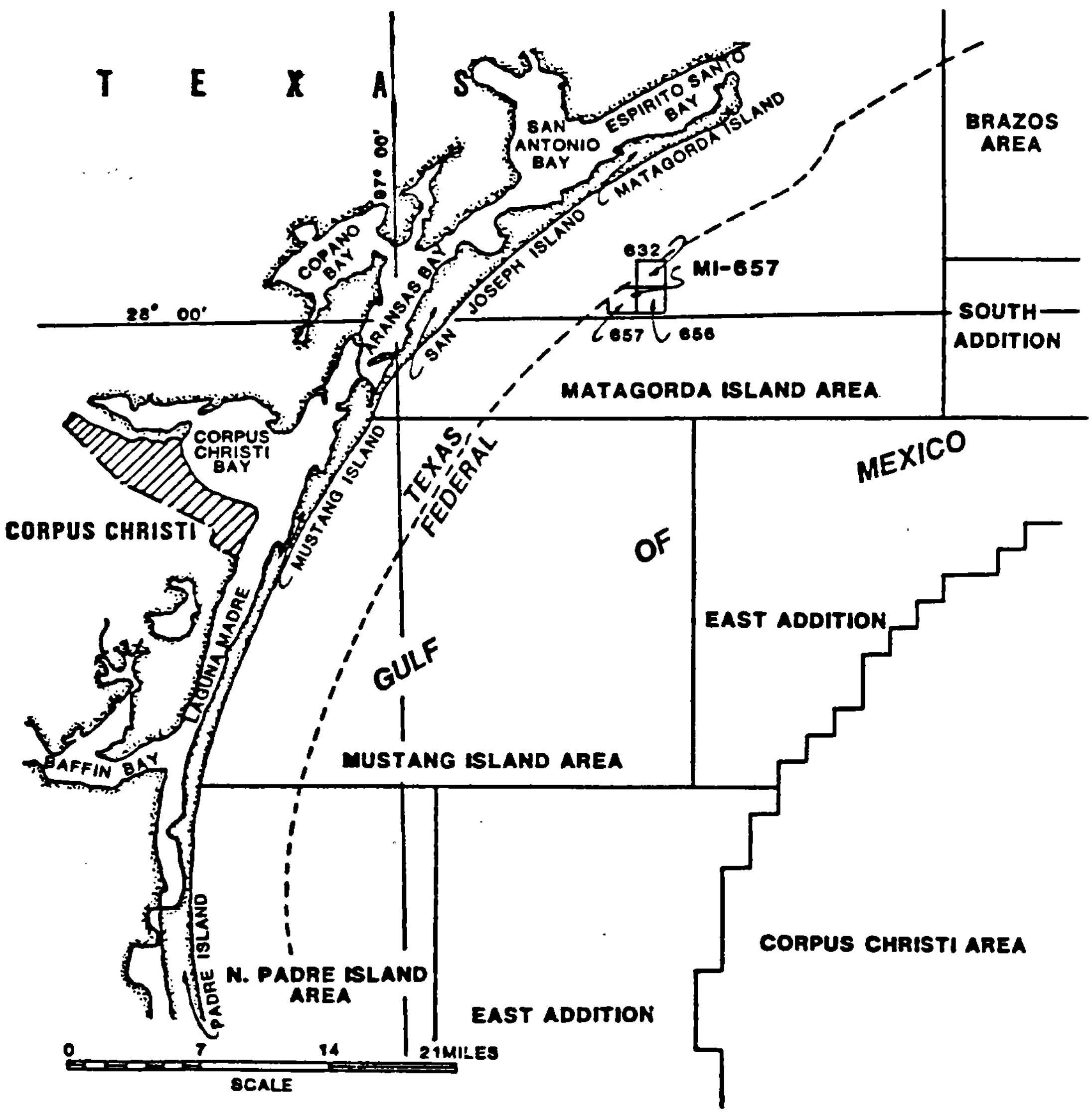
E. The panel recommends that larger diverter lines be required. This requirement has been proposed in the Regulatory Reform Document. Louisiana State University is conducting studies on the diverters for MMS.

F. The panel recommends that this case be closed with the submission of this report.

ATTACHMENT 2

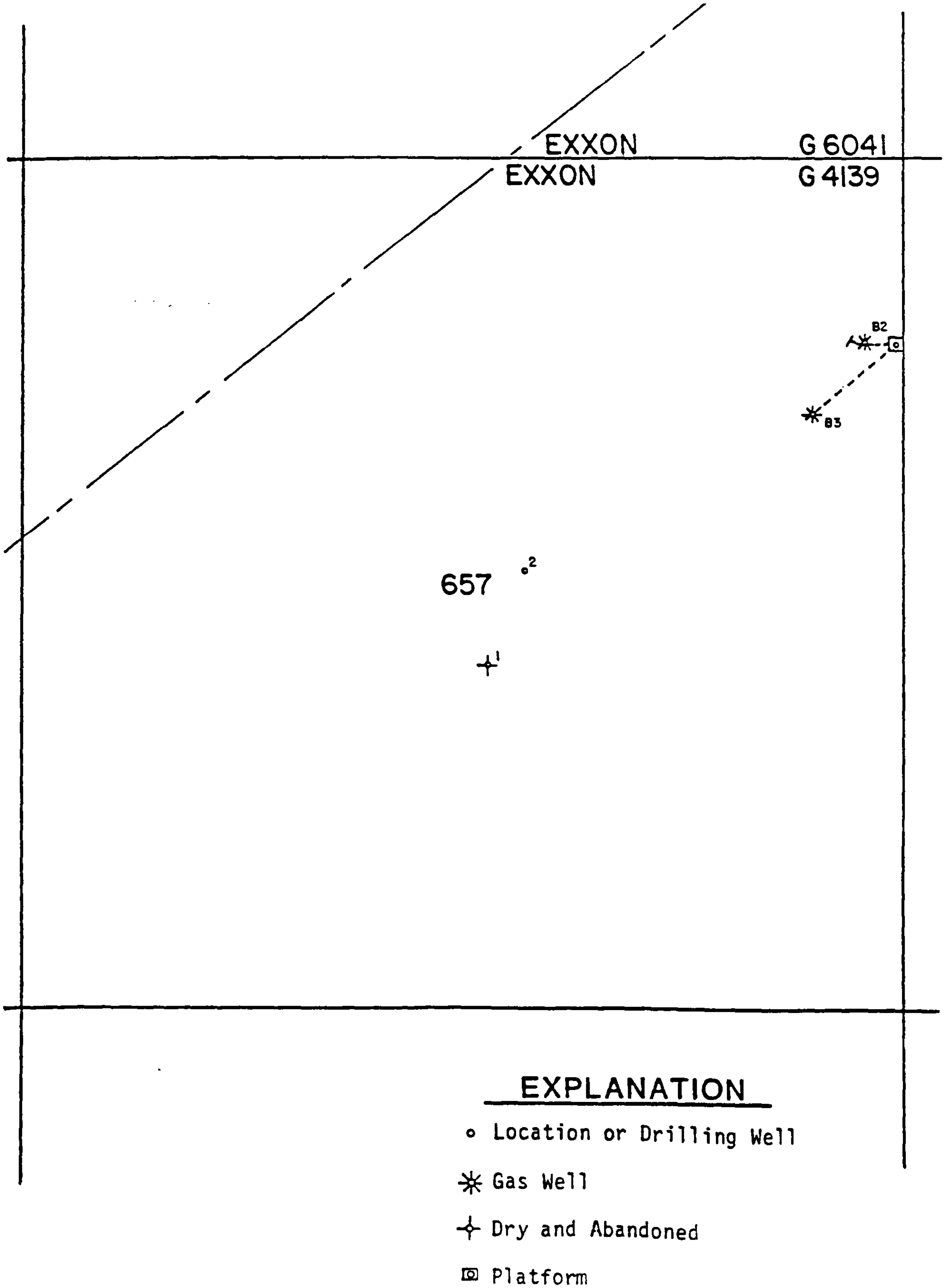
OCS-G 4139 WELL #1
MATAGORDA ISLAND BLOCK 657

VICINITY MAP



ATTACHMENT 3

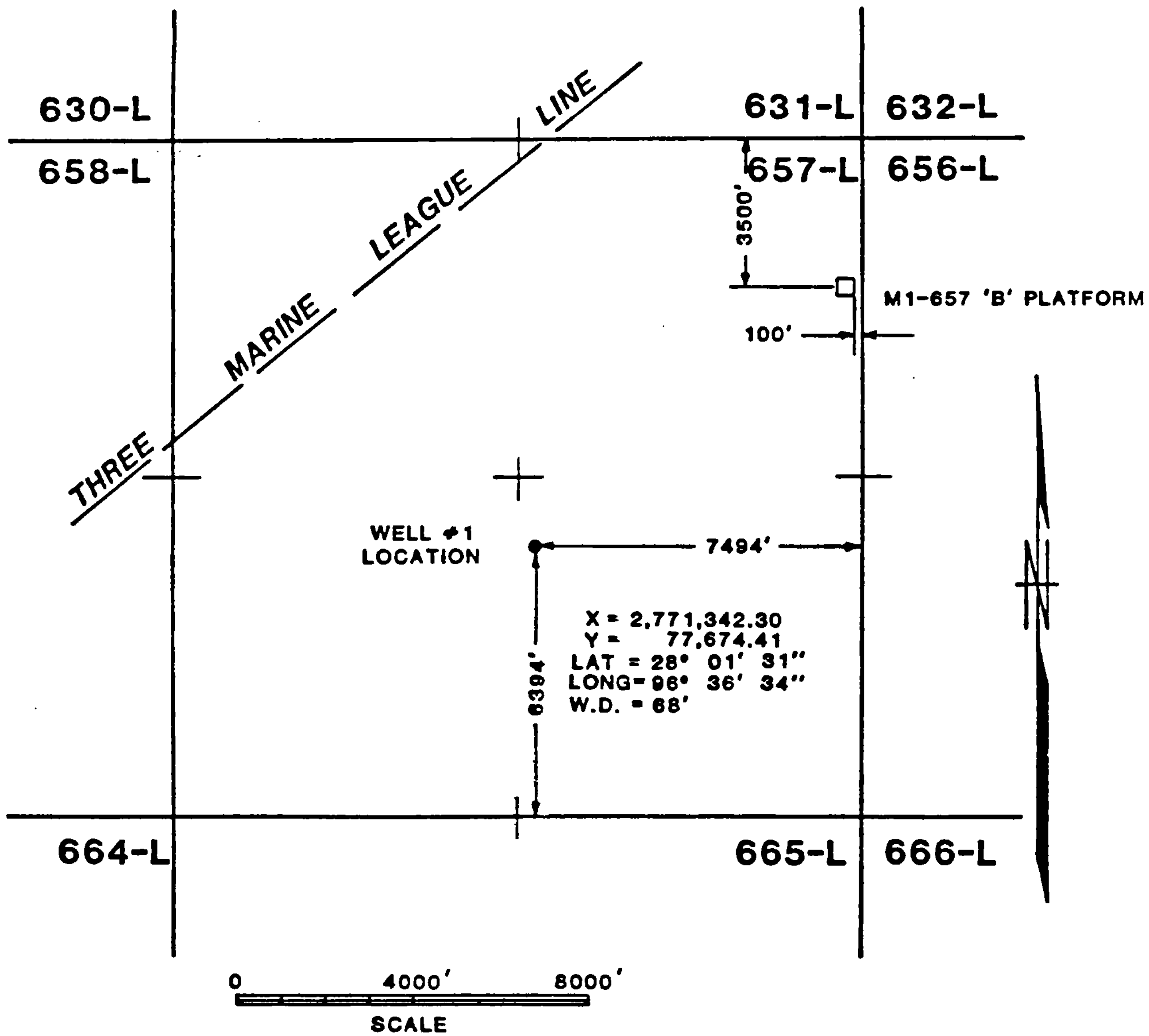
EXPLORATORY AND PLATFORM WELL LOCATIONS



ATTACHMENT 4

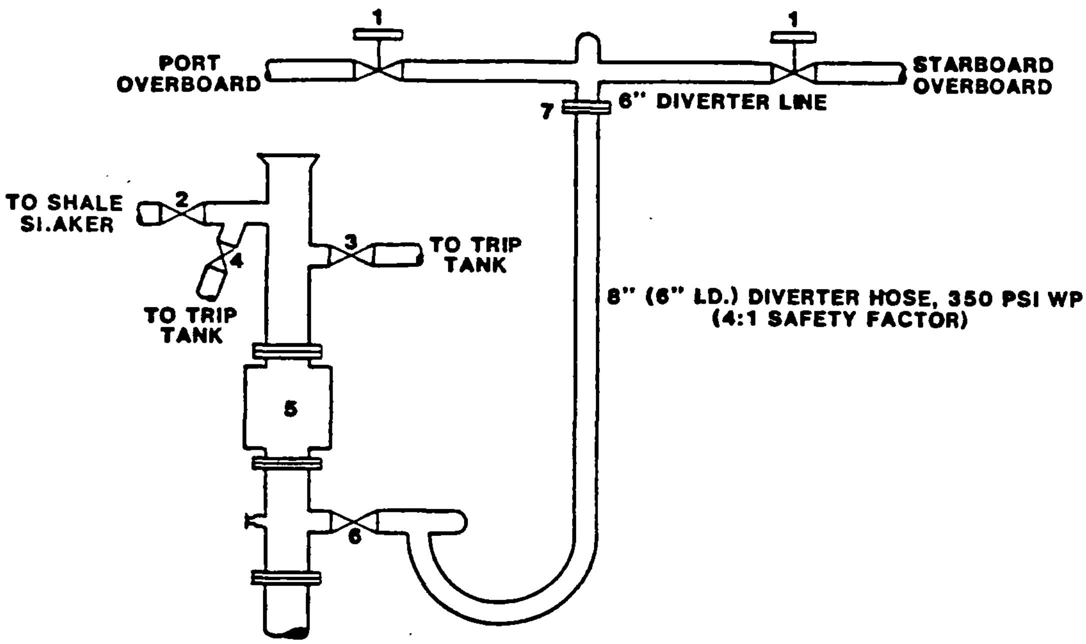
OCS-G 4139 WELL #1
MATAGORDA ISLAND BLOCK 657

LOCATION PLAT



OCS - G 4139 WELL #1
MATAGORDA ISLAND BLOCK 657

DIVERTER SYSTEM - PENROD 52 JACKUP RIG



OPERATING PROCEDURE

Diverter system has two 6" butterfly valves which are normally kept in the open position. One of the valves may be selected to close automatically when diverter BOP is closed. Each valve may also be remotely opened or closed.

LEGEND

1 - 6" air operated butterfly valves 150 psi W.P.

2, 3, 4 - manually operated valves.

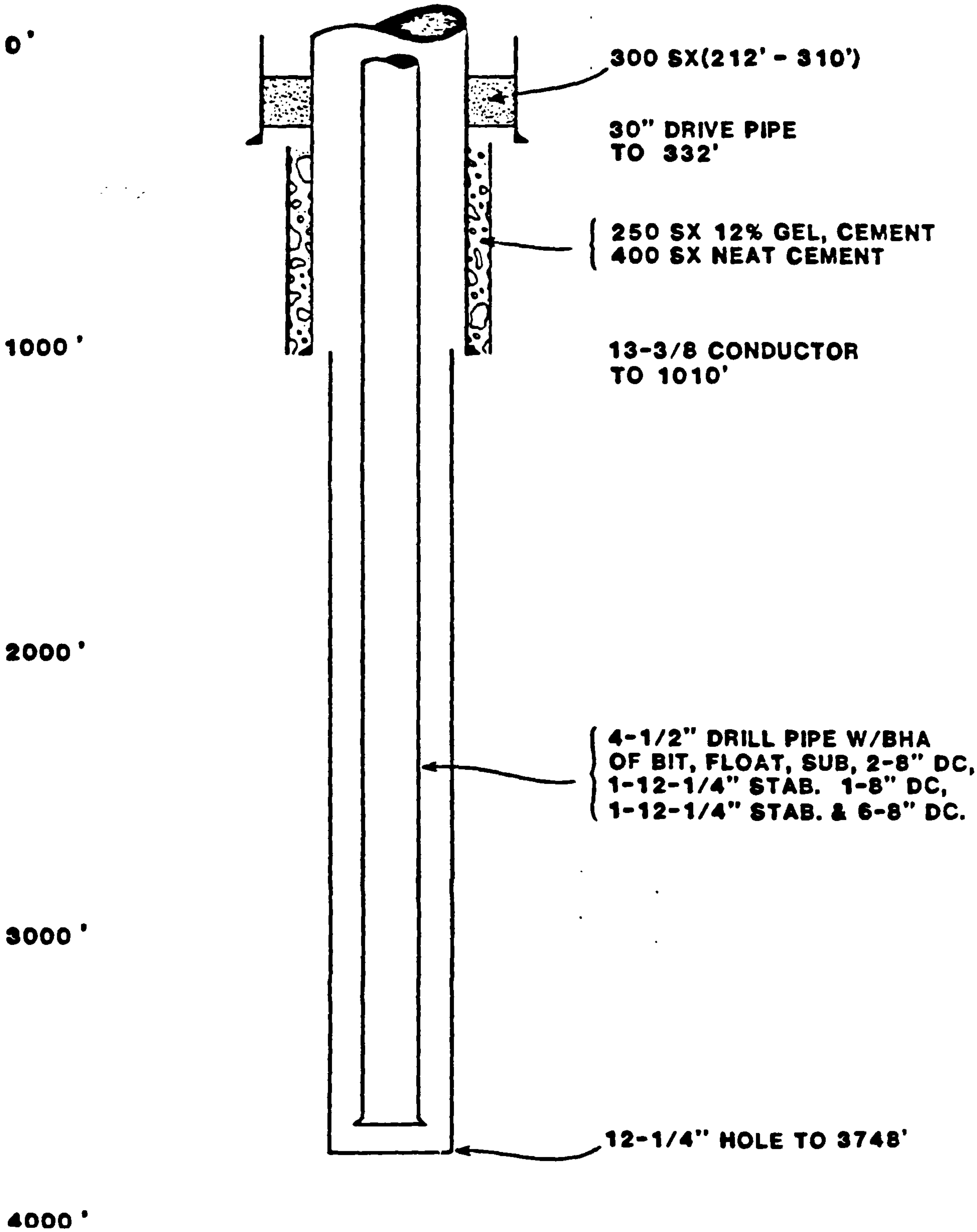
5 - annular BOP, 21 - 1/4", Hydril MSP, 2000 psi W.P.

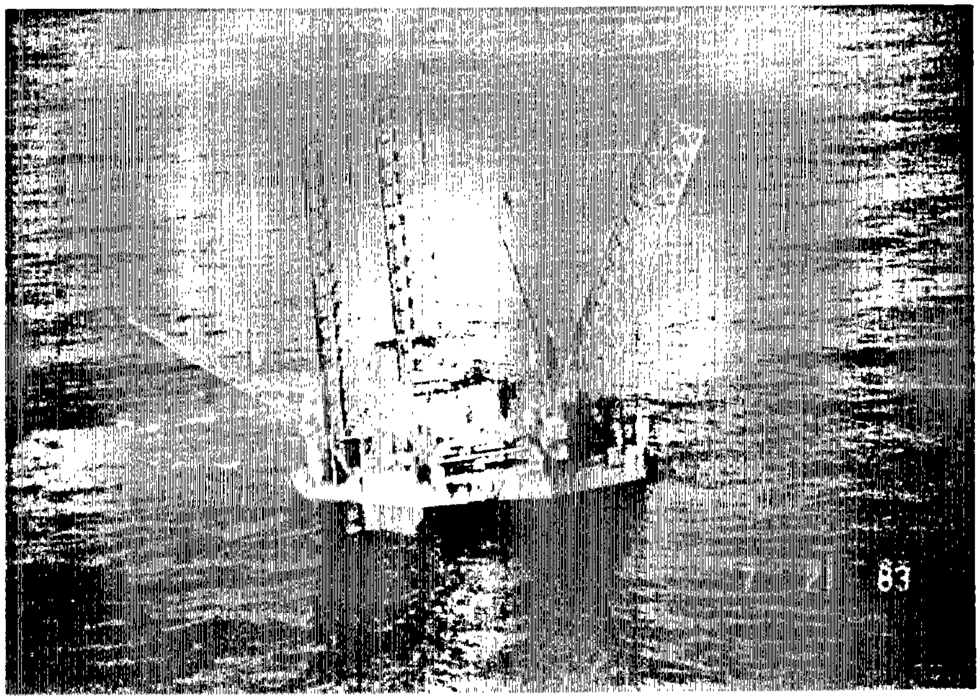
6 - 8" full opening ball valve, 275 psi W.P., air operated, will be kept closed during drilling operations requiring a diverter. This valve may be selected to open automatically when the diverter BOP is closed.

7 - 6" flange x 6" Hammer Union x - over.

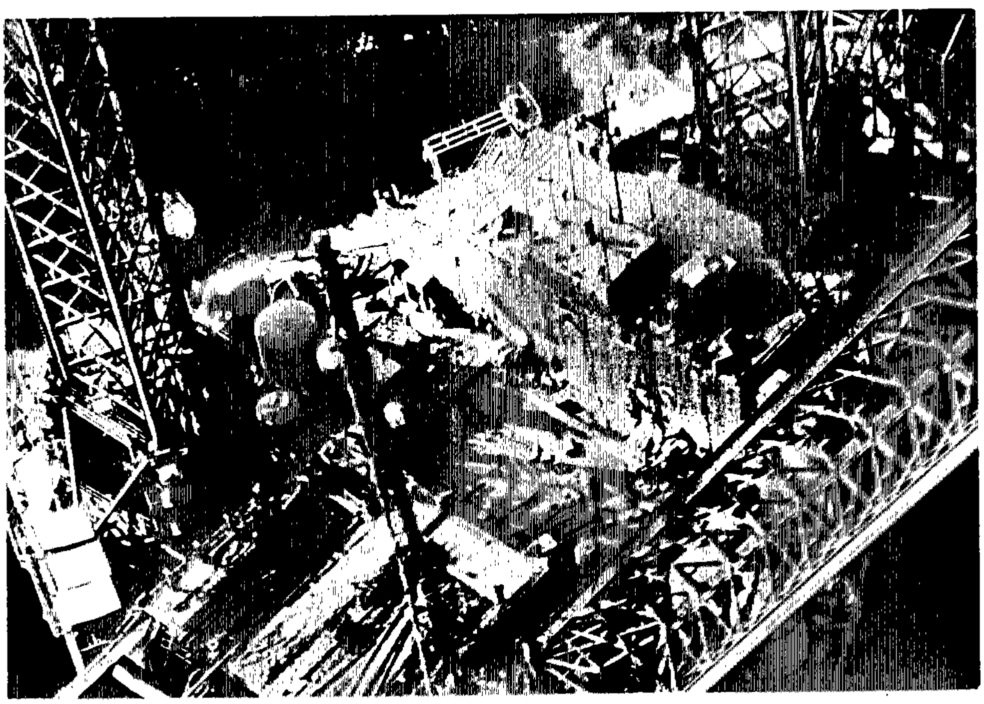
ATTACHMENT 6

OCS-G 4139 WELL # 1
MATAGORDA ISLAND BLOCK 657
WELLBORE SKETCH

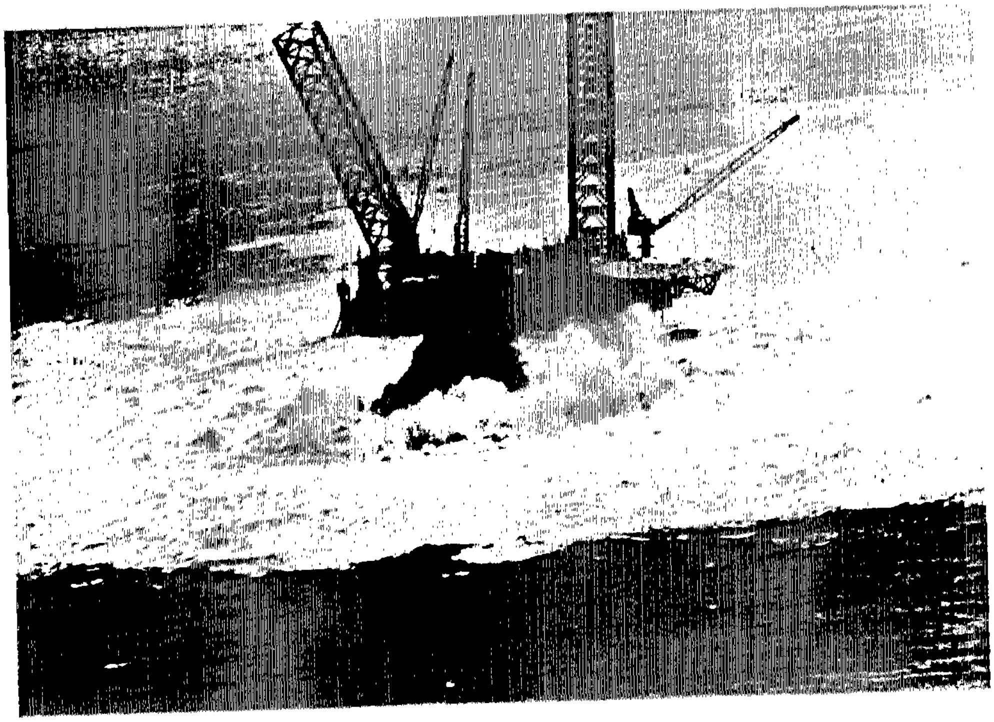




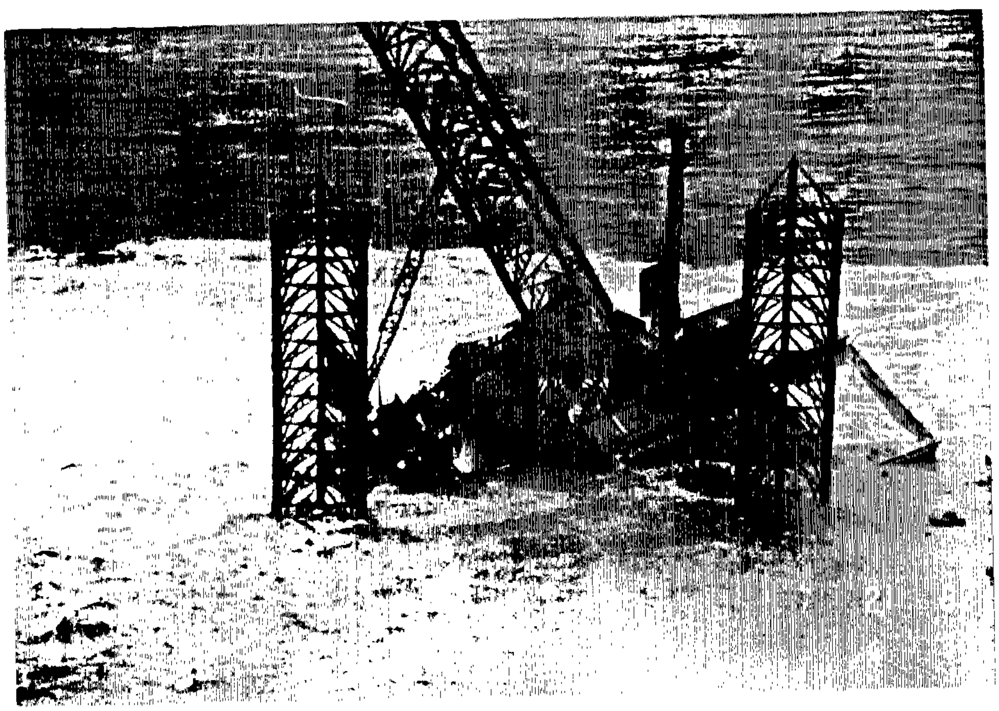
Rig began to sink, July 21, 1983



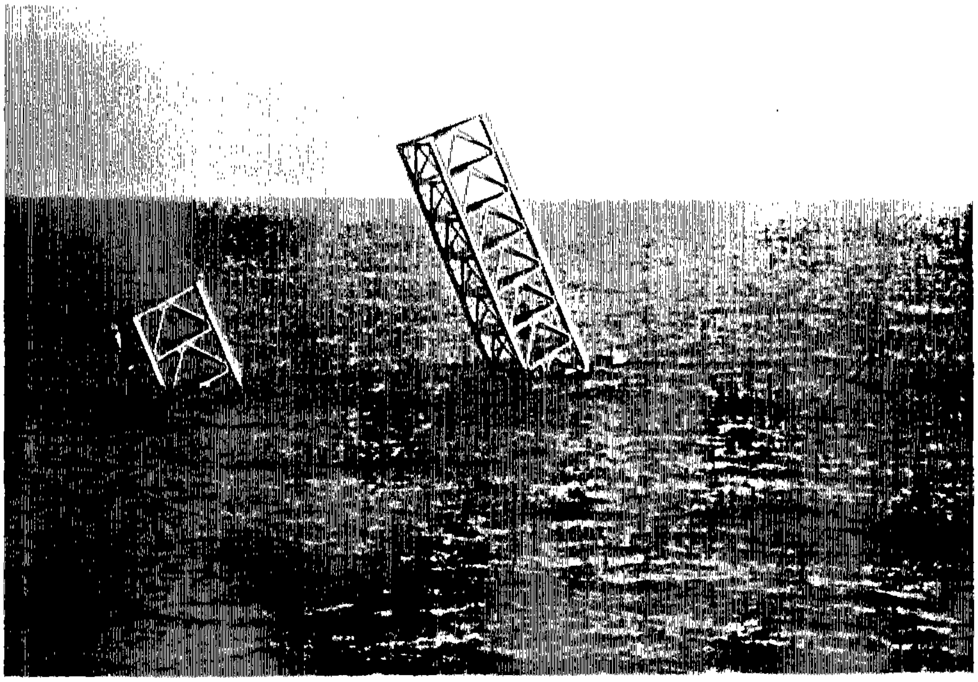
View of main deck and toppled leg, July 21, 1983



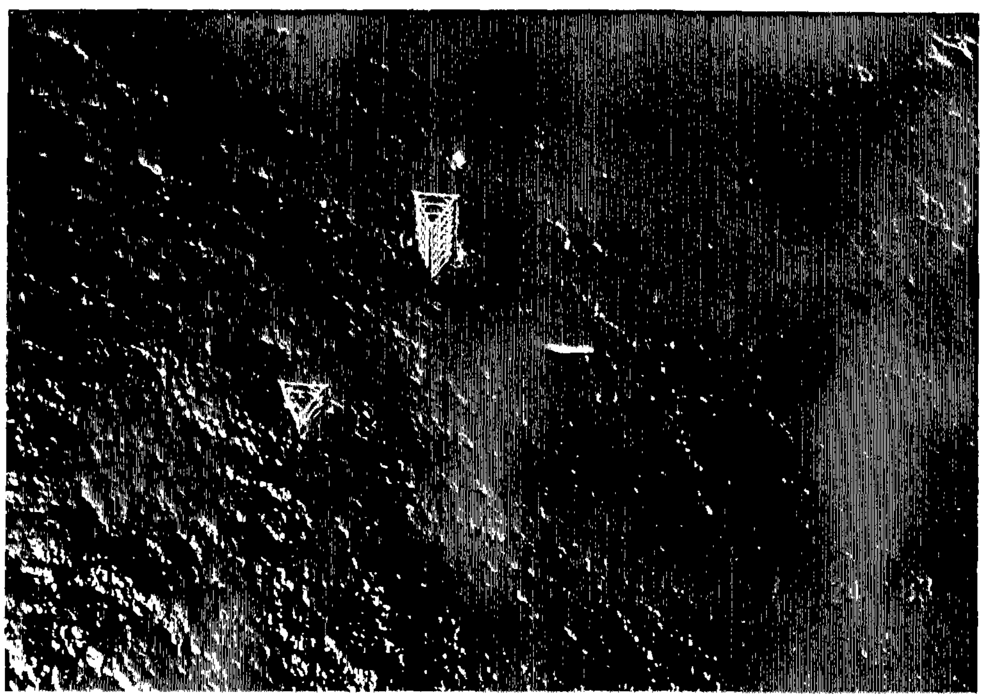
Boil in water caused by well flow, July 21, 1983



Rig tipped to side with view of boil
caused by well flow, July 21, 1983



Parts of two legs exposed, July 24, 1983



Parts of two legs exposed, July 24, 1983

GLOSSARY

Airgap - The distance from the waterline to the bottom of the main deck of the structure.

Annulus - The space between the surface casing and the producing or well bore casing.

Blowout - Out of control gas and/or oil pressure erupting from a well being drilled; a dangerous, uncontrolled eruption of gas and oil from a well; a wild well.

Bridging - The collapse of the walls of the borehole around the drill column.

Casing Shoe - A re-inforcing collar of steel screwed onto the bottom joint of casing to prevent abrasion or distortion of the casing as it forces its way past an obstruction on the wall of the borehole. Casing shoes are about an inch thick and 10 to 16 inches long and are an inch or so larger in diameter in order to clear a path for the casing.

Cement - To fix the casing firmly in the hole with cement, which is pumped through the drillpipe to the bottom of the casing and up into the annular space between the casing and the walls of the well bore. After the cement sets (hardens), it is drilled out of the casing. The casing is then perforated to allow oil and gas to enter the well.

Diverter System - An assembly of nipples and air-actuated valves welded to a well's surface or conductor casing for venting a gas kick (q.v.) encountered in relatively shallow offshore wells. In shallow wells there is often insufficient overburden pressure around the base of the conductor casing to prevent the gas from a substantial kick from blowing out around the casing. When a kick occurs, the blowout preventer is closed and the valves of the diverter system are opened to vent the gas harmlessly to the atmosphere.

Mud - A special mixture of clay, water, and chemical additives pumped down-hole through the drillpipe and drill bit. The mud cools the rapidly rotating bit; lubricates the drillpipe as it turns in the well bore; carries rock cuttings to the surface; and serves as a plaster to prevent the wall of the borehole from crumbling or collapsing. Drilling mud also provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to control downhole pressures that may be encountered.

Mud Logger - A progressive analysis of the well bore cuttings washed up from the borehole by the drilling mud. Rock chips are retrieved with the aid of the shale shaker (q.v.) and examined by the geologist.

Preventer - A stack or an assembly of heavy-duty valves attached to the top of the casing to control well pressure; a Christmas tree (q.v.)

Seismic Survey - Geophysical information on subsurface rock formations gathered by means of a seismograph (q.v.); the investigation of underground strata by recording and analyzing shock waves artifically produced and reflected from subsurface bodies of rock.

Spudding - To start the actual drilling of a well.

Tool Pusher - A supervisor of drilling operations in the field. A tool pusher may have one drilling well or several under his direct supervision. Drillers are directed in their work by the tool pusher.

Trip Tank - Tank used to measure drilling mud used to fill drillpipe while pulling the pipe out of the hole.

Well Bore - The hole in the earth made by the drill; the uncased drill hole from the surface to the bottom of the well.