

Investigation of November 10, 1986 Blowout and Fire OCS Lease 0244 West Cameron Block 71

Gulf of Mexico
off the Louisiana Coast

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J. L. Guidry
P. McDonald
S. J. Patkowski
C. J. Schoennagel
B. R. Stewart

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I. Investigation and Report

A. Authority

A serious blowout and fire occurred on the Mobil Oil Exploration and Producing Southeast, Inc., (Mobil) Platform No. 12, West Cameron Block 71, Lease OCS 0244, in the Gulf of Mexico (GOM), offshore the State of Louisiana, at approximately 8:40 a.m. on November 10, 1986. Pursuant to Section 208, Subsection 22 (d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act Amendments of 1978, and 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 November 14, 1986, the following MMS personnel were named to the investigative panel:

J. L. Guidry, Metairie, Louisiana
P. McDonald, Reston, Virginia
S. J. Patkowski, Lake Charles, Louisiana
C. J. Schoennagel, Metairie, Louisiana
B. R. Stewart, Lake Charles, Louisiana

B. Procedures

Inspection personnel from the MMS arrived at Platform No. 12, West Cameron Block 71, at approximately 11:30 a.m. on November 10, 1986. Preliminary interrogation of personnel familiar with the accident was conducted by the Inspectors.

After the investigative panel was appointed on November 14, 1986, and before the panel convened on December 15, 1986, panel members made several visits to the Otis Engineering Inc. (Otis) facilities in Lake Charles, Louisiana. The purpose of the visits was to examine the equipment in use when the accident occurred and to obtain additional information concerning the accident. (For photograph of damaged equipment, see appendix, attachment 1.)

The investigative panel convened on December 15 and 16, 1986, at the MMS Gulf of Mexico Regional Office in Jefferson, Louisiana. The following individuals were questioned about the blowout and fire:

William H. Olive, MMS
Eric L. Gambles, Otis
Walter Thibodeaux, Halliburton Services
Dudley J. Meaux, Otis
Rueben Roy, Mobil
Larry T. Simmons, Mobil
James I. Morris, Patterson Rental Tools, Inc.
(Representative)
Larry C. Babin, Otis
Lewis W. Powers, Otis
Nelson W. Burton, Mobil

II. Introduction

A. Background

Lease OCS 0244 covers approximately 5,000 acres and is located in West Cameron Block 71, GOM, off the western Louisiana coast. (For lease location, see appendix, attachment 2.) West Cameron Block 71 was initially leased by Superior Oil Company (100%) from the State of Louisiana as State Lease No. 786. By decision dated September 10, 1954, State Lease No. 786 was determined to meet the requirements of Section 6 of the Outer Continental Shelf Lands Act of August 7, 1953, and Federal Lease No. 0244 was assigned to the lease. The lease was issued with a 1/8 fixed royalty rate.

Superior Oil Company merged with and into Mobil Exploration and Producing North America, Inc., effective April 24, 1986. The present lessee (100%) is Mobil Exploration and Producing North America, Inc. The lease operator is Mobil Exploration and Producing Southeast, Inc.

On December 18, 1975, Superior submitted for approval a Plan of Development and an Application for Permit to Drill for Well No. 12, which was spudded on December 20, 1975, and was drilled as a straight hole to a total depth of 13,950 feet. It was tested through a 13/64-inch choke, and the well flowed gas at a

rate of 7,450 thousand cubic feet per day (MCF/day) with a flowing tubing pressure of 9,335 pounds per square inch (psi). It was completed in 1978 as a high-pressure gas well.

Wells Nos. 13, 14, 15, and 16 were subsequently approved and were drilled adjacent to Well No. 12. A design, plan of installation, and surface location for Platform No. 12 were approved on July 27, 1977. Wells Nos. 13 through 16 were also completed as gas wells. Platform No. 12 was placed on continuous production by October 1978. (For platform and well location, see appendix, attachment 3.)

In September 1984, Well No. 25 was drilled adjacent to Platform No. 12. Platform No. 25 was installed over the well with a walkway connecting both platforms. After completion in September 1985, Well No. 25 was shut in and left without further action.

Cumulative production from the No. 12 well amounted to 14.8 billion cubic feet of gas by July 1981. But the well was making water by this time, and several through-tubing workover efforts were completed by the end of 1985. In March 1986, after a snubbing unit cleanout operation was completed, the well flowed gas at the rate of 1,934 MCF/day on an 8/64-inch choke with a flowing tubing pressure of 7,770 psi and 120 barrels of water-per-day.

In June 1986, a tubing-casing communication was discovered in Well No. 12, and a workover proposal was submitted to MMS for approval. The well was to be killed with 15 pound-per-gallon (ppg) mud, cleaned out, and reperforated.

Before the Well No. 12 blowout and fire, the last complete inspection of Platforms Nos. 12 and 25 by an MMS representative was conducted on May 20, 1986. The inspection revealed a leaking surface safety valve on the wellhead of Well No. 12. The valve was repaired by May 22, 1986.

Before the accident, Well No. 14 was the only producing well at the site. Daily production rates averaged approximately 417 barrels of oil, 280 barrels of water, and 740 MCF of gas.

B. Description of Incident

On November 10, 1986, an Otis snubbing crew (consisting of a supervisor, an operator, and three helpers), a Halliburton pump operator, and a Mobil supervisor began work on Platform No. 12 in West Cameron Block 71. By 8:30 a.m., the Otis crew had begun snubbing into Well No. 12 with 1-inch Closed Seal (CS) Hydril P-110 pipe weighing 2.25 pounds-per-foot. At this time the Otis snubbing unit operator and two helpers were located in a workbasket about 40 feet above the heliport deck. (For photograph of workbasket, see appendix, attachment 1.)

At approximately 8:40 a.m., the snubbing crew had completed the makeup of the sixth joint of pipe and the operator had started snubbing in the hole when a blowout and fire occurred. The blowout started with a hissing noise and gas very quickly ignited, apparently from the abrasive action of the 1-inch pipe as it was blown out of the well. Ignition carried with it a tremendous explosion-like effect that rocked the platform and a jack-up barge located adjacent to the platform.

The three Otis personnel located in the workbasket were blown out, two landing near a pipe rack on the heliport deck. (For schematic of heliport deck, see appendix, attachment 4.) The other Otis employee was blown out in the opposite direction, breaking through the wire netting surrounding the heliport deck before landing in the water. (For schematic of elevation of platform decks, see appendix, attachment 5.)

With the 1-inch pipe out of the hole, the well blew wildly, and the resulting fire shot upwards towards the basket. The Otis helper not in the basket and the Halliburton pump operator were able to protect themselves from some of the intense heat by getting behind the Halliburton pump unit.

The Otis snubbing supervisor moved immediately towards the remote blowout preventer (BOP) control console to shut in the well. He found the heat too severe to reach the console. He then made his way down to the production deck where he shut in the No. 12 Well by closing the master valve on the christmas tree. At the same time, the Mobil representative in charge of the snubbing operation, who was on the jack-up barge at the time of the accident, boarded the platform and made his way to the production deck where he shut in Well No. 14. The Mobil representative then went to the cellar deck for a fire extinguisher when he noticed a person in the water, to whom he threw a life buoy. The Mobil representative and Otis supervisor both proceeded to the heliport deck where they worked together with fire extinguishers to control the fires on that deck. In a short time, personnel arrived from another platform with additional fire extinguishers and assisted in the final control action. All fires were out by 9:15 a.m.

The injured Otis employee in the water was assisted by some of the Mobil rescue personnel who had arrived from the nearby platform. The injured man was moved by boat to a nearby rig, was placed aboard a medical evacuation helicopter at 9:15 a.m. , and was transported to the John Sealy Burn Center in Galveston, Texas. The two Otis personnel who were blown out of the workbasket onto the heliport deck were presumed dead by personnel at the scene of the accident and were not removed pending the arrival of the coroner.

Damage to Mobil's Platform No. 12 was minimal but the Otis snubbing unit incurred severe damage from the accident.

III. Findings

A. Preliminary Activities

The MMS approved a Sundry Notice dated September 22, 1986, to conduct workover operations on Well No. 12, West Cameron Block 71. Mobil and Otis personnel met in Lake Charles, Louisiana, to discuss the workover operation. The 1-inch CS Hydril pipe, owned by Patterson Rental Tools, Inc., to be used in the workover

was pressure tested to 19,000 psi by Patterson in October 1986. The BOP stack and riser section, also owned by Patterson, to be used in the workover were pressure tested as stated above.

The workover began on November 4, 1986, with an unsuccessful wireline attempt to pull an Otis tubing plug from a landing nipple at 13,478 feet. MMS approved a modification of the work plan on November 6, 1986, when two christmas tree flanges were found leaking. The tree flanges were dismantled and repaired, and a wireline tubing plug was set at 5,000 feet. The shut-in tubing pressure was recorded as 7,700 psi.

The 2 7/8-inch production tubing was loaded with glycol to prevent freezing, and the christmas tree and upper 5,000 feet of tubing were pressure tested to 11,000 psi with the Halliburton pump. (For schematic of Well No. 12, see appendix, attachment 6.) The wireline tubing plug was pulled on November 8, 1986, and the Otis snubbing unit rig-up operations began. The snubbing unit was installed to kill the well and locate the point of the tubing-casing communication. The procedure was to snub approximately 1,000 feet of 1-inch tubing into the well, stop and circulate 15 ppg mud, and then repeat the process until the well was killed.

On November 9, 1986, installation of the Otis snubbing unit was completed. The unit was located on the heliport deck. From the christmas tree upward, the unit consisted of a riser to reach the heliport deck, a BOP stack with six BOP's, and the snubbing jack below the workbasket. (For schematic of the snubbing unit and BOP stack, see appendix, attachment 7.) The six BOP's, beginning from the top, were designated for use as follows:

- Stripper No. 1 (pipe rams)
- Stripper No. 2 (pipe rams)
- Safety (pipe rams)
- Blind (shut-in rams)
- Blind Shear (cut-the-pipe rams)
- Safety (pipe rams)

After the snubbing unit was installed, it was pressure tested to 10,000 psi between the top BOP and the master valve on the christmas tree. Before snubbing operations began, the shut-in tubing pressure was 6,200 psi, down from the previous reading due to the effects of the glycol overburden.

B. Operation of Snubbing Unit

In the workbasket, the snubbing operator controlled the hydraulic jack (10-foot stroke) and the stationary and traveling slips. The helpers controlled the upper three BOP's, the equalizing and bleed-off valves, and the pipe pickup winch. The snubbing unit supervisor controlled the lower three BOP's at the BOP remote console located on the heliport deck. Also located on the heliport deck were the power pack unit, pipe racks, and Halliburton pump. The power pack provided the hydraulics for the snubbing, all controls, pipe make-up, and winching. The power pack included a diesel engine and fuel, hydraulic pumps, and accumulators.

The snubbing procedure is to set the power pack so that the hydraulic jack exerts enough force on the 1-inch pipe to overcome well pressure and force the pipe into the well. With the well shut in at the christmas tree, the pipe is run until the lower end of the first joint is below Stripper No. 2. Stripper No. 2 is then closed, the well is opened, well pressure is observed, and snubbing operations are started. The pipe is then snubbed downward through the closed Stripper No. 2 until the next tool joint is located above Stripper No. 2 but below Stripper No. 1. The operator knows, from measurements taken from the traveling snubbers (when the jack is in the down position) to the middle of the spacer spool between the Nos. 1 and 2 strippers, the length of pipe that can be snubbed in to get the tool joint between the Nos. 1 and 2 strippers. As each piece of pipe is taken from the pipe rack it is measured and marked to indicate where the last bite of the travelling snubbers should be taken to allow the tool joint to be located between the Nos. 1 and 2 Strippers as the jack finishes its downward stroke.

When the tool joint is located between Strippers Nos. 1 and 2, the snubbing operator will conduct a crossover. He will close Stripper No. 1, equalize the pressure between Strippers Nos. 1 and 2, open Stripper No. 2, and proceed to snub downward until the tool joint is below Stripper No. 2. He will then close Stripper No. 2, bleed off the pressure between Strippers Nos. 1 and 2, open Stripper No. 1, and continue snubbing downward through a closed Stripper No. 2.

C. Loss of Well Control

At approximately 8:30 a.m., the snubbing crew had commenced operations with the running of the bottomhole assembly. The bottomhole assembly consisted of one mule shoe, one back-pressure valve, one joint of pipe, one back-pressure valve, and one N-nipple.

As the sixth joint of pipe was being snubbed downward, loss of well control occurred. Apparently, the tool joint connecting the fourth and fifth joints of pipe (1.6-inch diameter) was snubbed into the closed Stripper No. 2 (1.315-inch diameter). As the snubbing jack continued its downward stroke, the opposing forces caused the 1-inch pipe to weaken and buckle. As the 1-inch pipe buckled, the 6,200-psi well pressure became dominant and literally blew the pipe out of the well. The upward impact of the 1-inch pipe and tool joints significantly damaged the sealing inserts in Strippers Nos. 1 and 2.

The pipe exited the well through a window located just above the BOP stack. (For photograph of pipe remaining in the window, see appendix, attachment 8.) As the pipe exited, it blew a low-pressure (3,000 psi) wiper plug, located just below the window, out of its setting. The pipe also twisted and broke apart the high pressure pipe guides used to add stability to the pipe at the window. (For photograph of high pressure guides, see appendix, attachment 8.)

Subsequent investigation revealed the following information about the incident. The measurement taken as the length from the top of the traveling snubbers to the middle of the spacer spool between the Nos. 1 and 2 stripper rams was recorded as a distance of 31 feet where, in fact, subsequent measurement indicated the length was only 29-1/2 feet. The 31-foot measurement could imply that the jack was not completely down or the tape was wrongly positioned or misread. This erred measurement would put each tool joint 1-1/2 feet closer to Stripper No. 2 than the snubbing operator would anticipate as he snubbed downward.

The operator had probably passed the yellow mark by approximately 5 feet 8 inches on the downward stroke that was in progress when the incident occurred. This would place the No. 4-5 tool joint below

Stripper No. 2 upon completion of the stroke. The operator would have had to stop the snubbing jack in midstroke to locate the tool joint in between Stripper Nos. 1 and 2.

A spring was found broken in a valve located on the hydraulic power pack unit. The spring is necessary to self-center the valve and thereby neutralize the snubbing jack force (up or down). The valve is synchronized with another valve that the snubbing operator controls by a lever on his console in the workbasket. Normally centering the lever will center the valve on the hydraulic power pack unit; but, with a broken spring, centering (neutralizing) can only be accomplished by overcorrecting the lever in the opposite direction.

When the power pack unit was started up after the incident, the gauge showed 2,800 to 3,000 psi hydraulic pressure. This means the operator had four of the six pumps engaged. The hydraulic pressure reading equates to the following:

Pumps Engaged	Snubbing Jack Hydraulic Power Pressure (psi)	Force (pounds)
1	1,300	26,000
2	1,600	32,000
3	2,050	41,000
4	2,800	56,000
	(up to 3,000)	60,000

The snubbing force necessary to overcome well pressure, including friction, was calculated to be approximately 12,000 pounds.

The high-pressure guides are bolted together with six 1/2-inch diameter bolts and are used to stabilize the pipe as it is snubbed in the hole. If bolted together properly, the guides can withstand approximately 119,000 pounds of force. Indications are that some bolts were omitted and the others were of 3/8-inch diameter.

The wiper plug that was blown out of the hole can contain up to 3,000 psi of pressure, is used as a stripping element on low-pressure jobs, and is sometimes omitted in high-pressure jobs. If used in high-pressure

wells, a needle valve below it is left open to allow any accumulated pressure to bleed off. This needle valve was closed during this snubbing operation.

D. Blowout and Fire

Well control was lost about 8:40 a.m., followed immediately by a full-scale blowout. The flow was uncontrolled through the well production tubing (2.26-inch inside diameter). Ignition occurred almost instantaneously and, with little doubt, was caused by sparks created by the 1-inch pipe as it was blown out of the well at the window.

The three Otis personnel in the workbasket were blown out as the blowout and fire occurred. However, the No. 1 stripper ram control in the workbasket was found in the closed position. This suggests reaction time sufficient to activate a lever. Two of the personnel landed on the heliport deck and the other went through the netting surrounding the heliport deck and landed in the water.

The Otis supervisor and a helper and the Halliburton employee were on the heliport deck when the incident occurred. After the ignition, the Otis helper and the Halliburton employee sought relief from the fire and intense heat behind the Halliburton unit.

Upon ignition of the gas, the Otis supervisor attempted to reach the remote console to activate the BOP's. The heat was too intense around the remote console; therefore, he had to abandon this effort. The Mobil supervisor, who was on the jack-up boat at the time, immediately boarded the platform at the cellar deck and proceeded to the production deck.

E. Restoring Well Control

As the fire raged, the Otis supervisor realized that the only alternative to using the remote console for controlling the well was to reach the christmas tree on the production deck. The snubbing unit was located between himself and the only stairway leading from the heliport deck, thereby making the stairs inaccessible

because of the heat from the fire. Therefore, the Otis supervisor went to the edge of the heliport deck and dropped down some 20 feet to the catwalk connecting Platforms Nos. 12 and 25. He then went down a stairway from the cellar deck to the production deck and closed the master valve on the christmas tree of Well No. 12.

Seeing the fire still burning and thinking that the 1-inch pipe might be obstructing the closure of the master valve, the Otis supervisor went up the stairway to the heliport deck to close the blind shear rams. The heat had subsided, so he was able to make his way to the remote console where he found the controls ineffective due to loss of hydraulic oil through burned hoses. He then proceeded to the BOP stack to close the rams mechanically. The stack was uncomfortably hot when he started to close some of the rams. He stopped when he noticed that the blowout had ceased and the remaining fires were from hydraulic oil and other similar flammable substances. The master valve was effective in controlling the well, since the 1-inch pipe had been blown out during the initial loss of well control. However, the fire did not subside immediately after the master valve was closed, as gas in the riser had to burn before the fire could subside.

The Mobil representative in charge of the snubbing operation was on the jack up barge *Aries VII* jacked up at the cellar deck when the blowout and fire occurred. He boarded the platform, descended to the production deck, and went immediately to Well No. 14, the only well producing at the time of the accident, and shut it in.

After shutting in Well No. 14, the Mobil representative was going back up to the cellar deck to get a fire extinguisher when he noticed an Otis employee in the water. The Mobil representative threw a life buoy to the Otis employee who then put his arms through it and held on.

The intense fire from the well lasted two to three minutes. Essentially all the damage was done within a 5-minute period. Once the well fire had subsided, the Otis supervisor and the Mobil representative worked together with fire extinguishers to control the small fires remaining on the heliport deck. In a short time, additional

personnel and fire fighting equipment arrived from another platform. They assisted in the final control action, with all fires being out by 9:15 a.m.

F. Emergency Warning and Evacuation

The fact that no alarm sounded had no effect upon personnel safety, since the initial ignition of the gas was felt by all personnel, and the resulting fire was plainly visible. The jack-up barge operator began almost immediately to jack down and make ready for departure. However, because the danger was short-lived, the jack-up barge remained on location and supported the followup operation. There was no preliminary warning of the disaster.

Mobil's field foreman was in a helicopter headed for shore when he noticed the blowout had occurred. His helicopter began circling the platform and he noted that there was a man in the water. He called for a medical evacuation helicopter, assuming that there might be injured personnel; he also called for additional men to help with fire control and to assist the man in the water.

The man in the water was Otis employee David Romero, a helper in the workbasket when the blowout occurred. Moved by boat to a nearby rig, he was loaded onto a medical evacuation helicopter at approximately 9:15 a.m. and transported to the John Sealy Burn Center in Galveston, Texas. There, he was treated for third-degree burns.

G. Fatalities and Damages

The other two Otis personnel in the workbasket at the time of the accident, Otis snubbing operator Robert E. Banks and Otis snubbing helper Aubrey W. Swiney, were found on the heliport deck. The victims were examined by the Cameron Parish Coroner and pronounced dead before being removed from the facility.

The personnel in the workbasket were blown out by the force of the blowout and fire. If they had not been blown out, escape from the workbasket would have been difficult because the ladder leading from the workbasket passed the window where the fire was located.

The snubbing unit sustained fire damage to equipment located in the vicinity of the window. The six joints of 1-inch pipe, stripping rubber, and inserts of the Nos. 1 and 2 Stripper Rams were destroyed. Little damage occurred to the workbasket or the equipment located below the window.

H. Subsequent Activities

On November 18, 1986, Mobil began work again on Well No. 12. It showed 6,100 psi shut-in tubing pressure and 550 psi of casing pressure.

Efforts to kill the well by bullheading 15 ppg mud downhole failed. Circulation through the supposed leak could not be established. The casing pressure was bled down to 0 psi.

On November 19, 1986, another snubbing unit was rigged up to snub in with 1-inch pipe for kill purposes, but 0 psi was found on the casing. Mobil then decided to test the well. After three days of inconclusive testing, Mobil offloaded the well-testing equipment and shut-in the well.

IV. Conclusions

A. Probable Cause of Incident

The probable cause of the incident was the running of the tool joint between the Nos. 4 and 5 joints of 1-inch pipe into the closed Stripper No. 2, causing the pipe to buckle and fail. In turn, the well pressure acted on the pipe, the pipe seal was broken, and well control was lost.

B. Possible Causes of Running the Tool Joint Into the Rams

Possible causes of running the tool joint into the rams were the following:

1. The erred measurement caused the tool joint to be 1-1/2 feet closer to the ram than the operator thought it was.
2. The operator passed up his yellow mark, thereby allowing the tool joint to strike the closed ram if the downstroke of the snubbing jack were not stopped before that stroke was completed.
3. The spring in the valve located on the hydraulic power pack broke, hindering the control of the snubbing jack.

C. Probable Cause of Ignition

Sparks created by the 1-inch pipe exiting from the well through the window were the probable cause of the ignition of the escaping gas.

D. Contributing Causes of Incident

The following were contributing causes:

1. The operator had four of the six pumps engaged, giving the snubbing jack some 60,000 pounds of force. With this force the pipe was easily buckled as the tool joint struck the closed Stripper No. 2 and the jack continued its downward motion.
2. In the high-pressure guides, some bolts were omitted; further, those that were installed were the wrong size. The guides offered little stabilization to the 1-inch pipe, as they were easily separated by the exiting pipe.
3. The location of the remote BOP console was too close to the snubbing unit and therefore unreachable because of the intense heat from the fire. Also, the controls for the Nos. 4, 5, and 6 BOP's were not available to the men in the workbasket.

E. Probable Cause of Fatalities

Injuries sustained in the accident caused the fatalities of Messrs. Banks and Swiney.

V. Recommendations

A. Safety Alerts

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

1. Lessees and contractors should review snubbing units to determine if the window area can be redesigned such that a pipe-centering device can be installed to essentially cover the window and avoid the possibility of pipe buckling.
2. Lessees and contractors should review possible alternative means of escape from the workbasket in the event of a fire that renders the normal exit impassable.
3. Lessees and contractors should emphasize to their employees during training sessions the importance of taking accurate measurements for determining tool joint locations, of not passing up their marks, of not bumping the rams as a means of determining tool joint location, and of not excessively exceeding the hydraulic force needed to snub the pipe into the well.
4. Lessees and contractors should review equipment location, including any remote BOP consoles, before the installation of such equipment. Also, at that time, the means of evacuation from the platform should be considered.

B. Regulatory Requirements

The MMS should implement requirements for snubbing operations concerning the following:

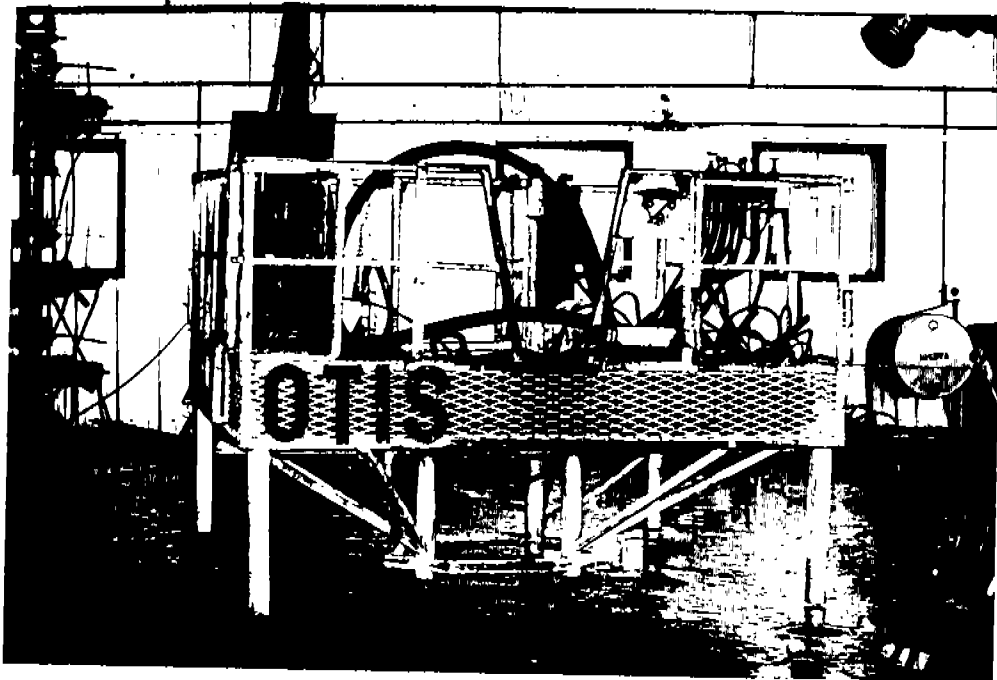
1. BOP stack requirements, including number and kinds of rams.
2. BOP console requirements, including the redundancy of workbasket and remote consoles and the location of the remote console.
3. Training requirements for the lessee representative in charge of operations and contractor personnel.

C. Research

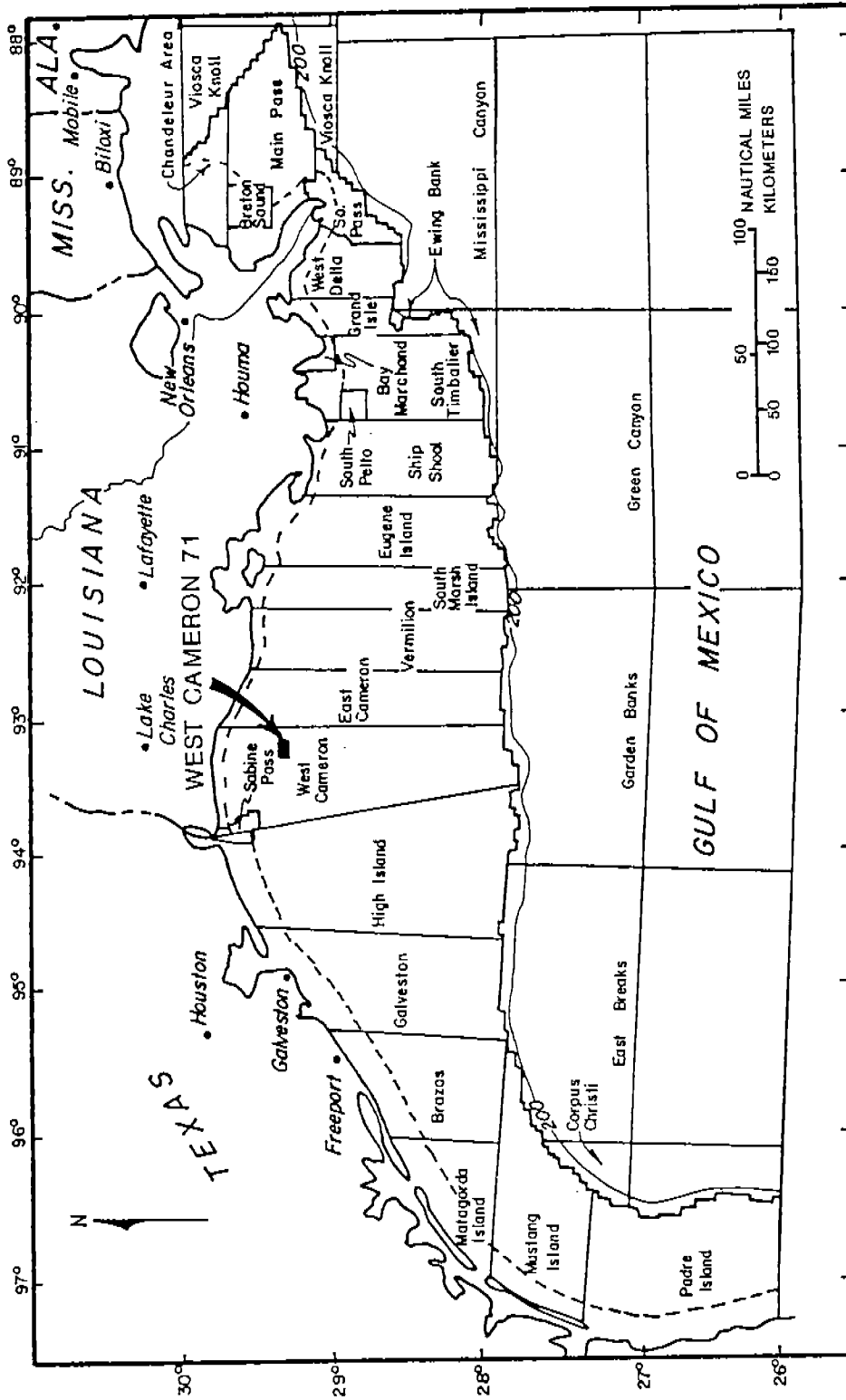
The MMS should fund a research project to evaluate the type and suitability of control lines used in the hydraulic system to connect the BOP stack with the remote BOP control console.



Damaged equipment

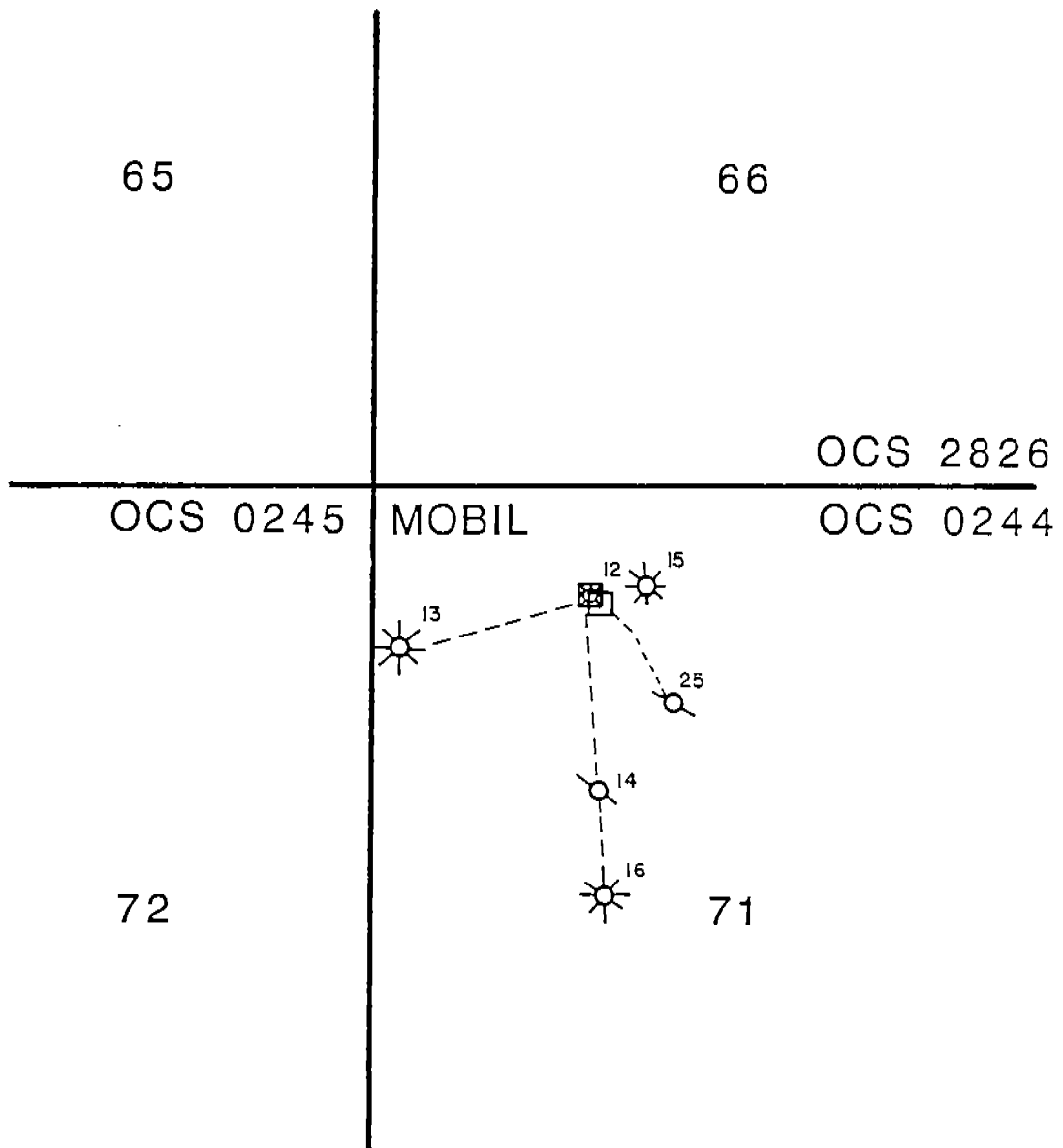


Workbasket

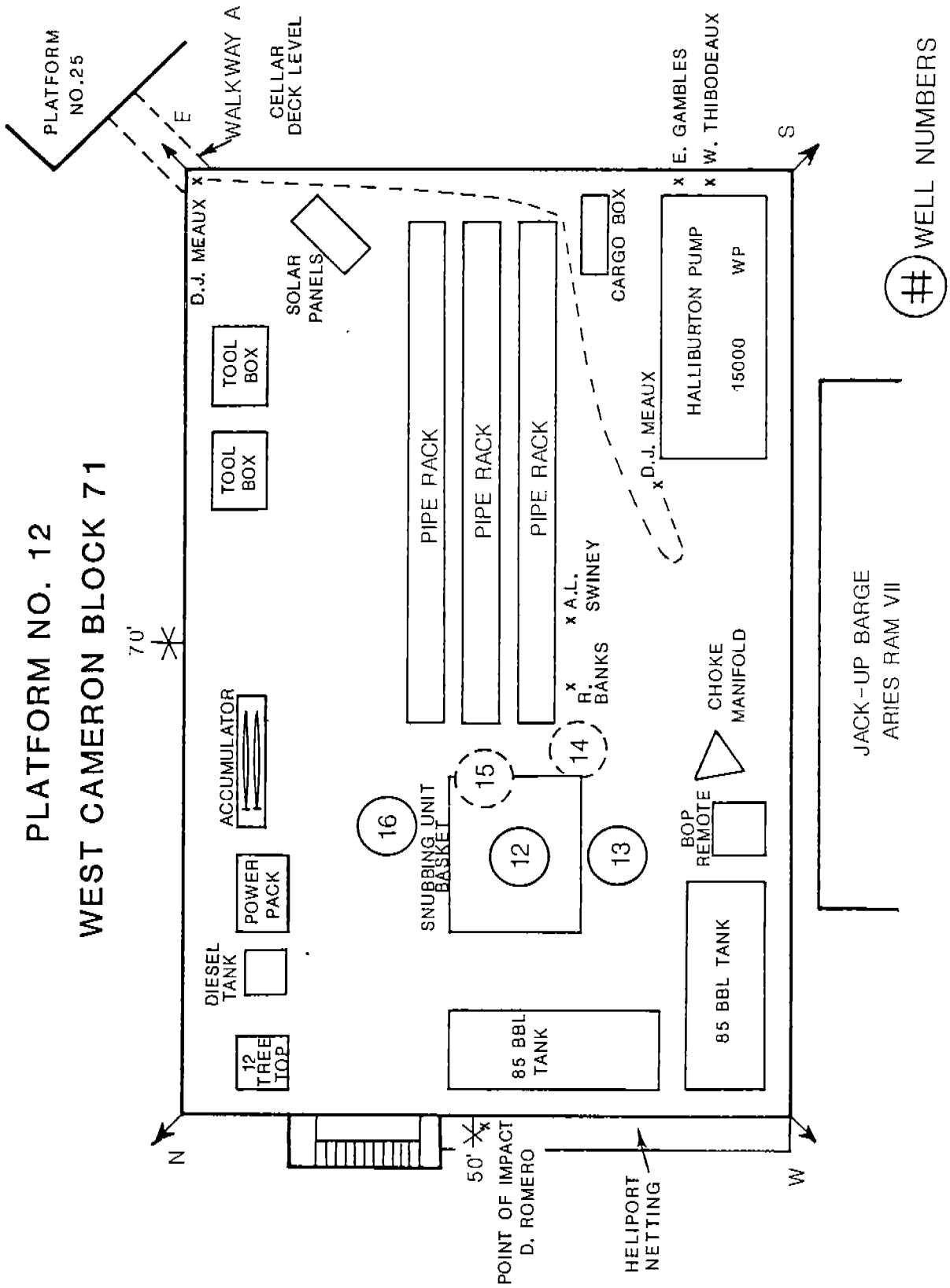


Location of Lease OCS 0244, Gulf of Mexico. Dashed lines indicate boundary between State and Federal waters, solid lines indicate 200-meter water depth.

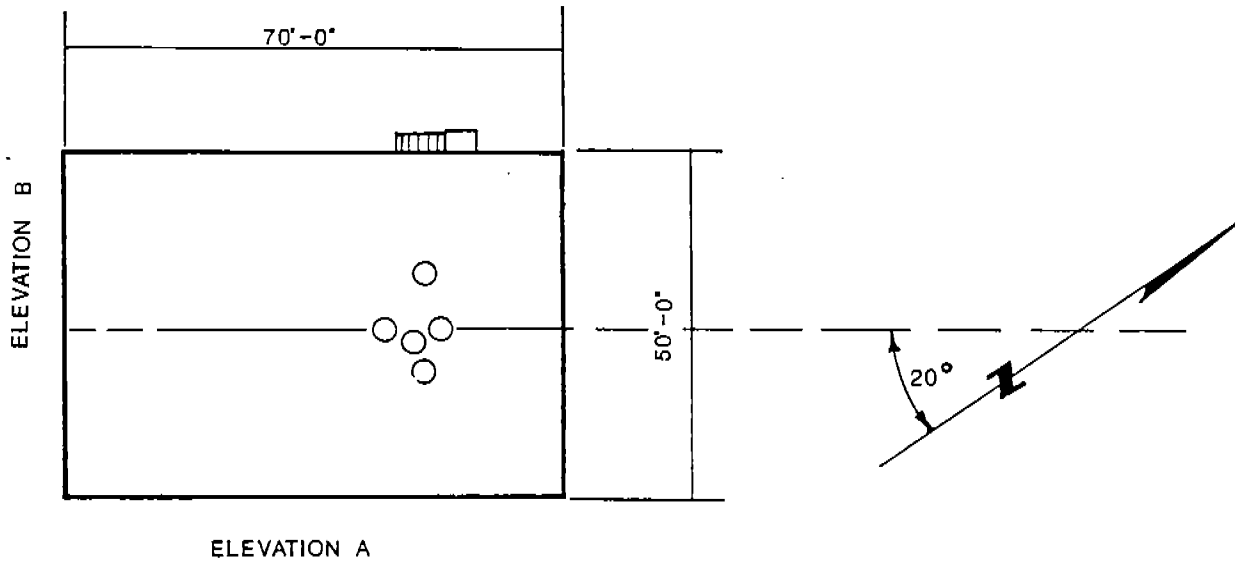
WEST CAMERON BLK. 71
PLATFORM AND WELL LOCATION NO. 12 AND NO. 25



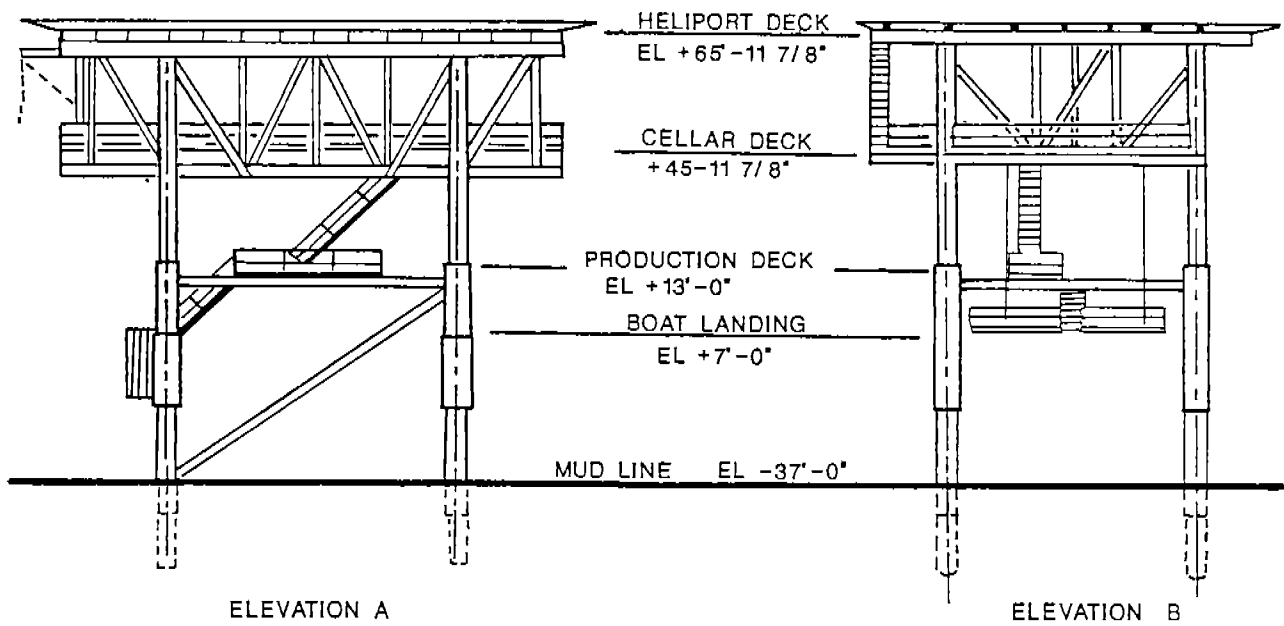
SCHEMATIC OF HELIPORT DECK
PLATFORM NO. 12
WEST CAMERON BLOCK 71



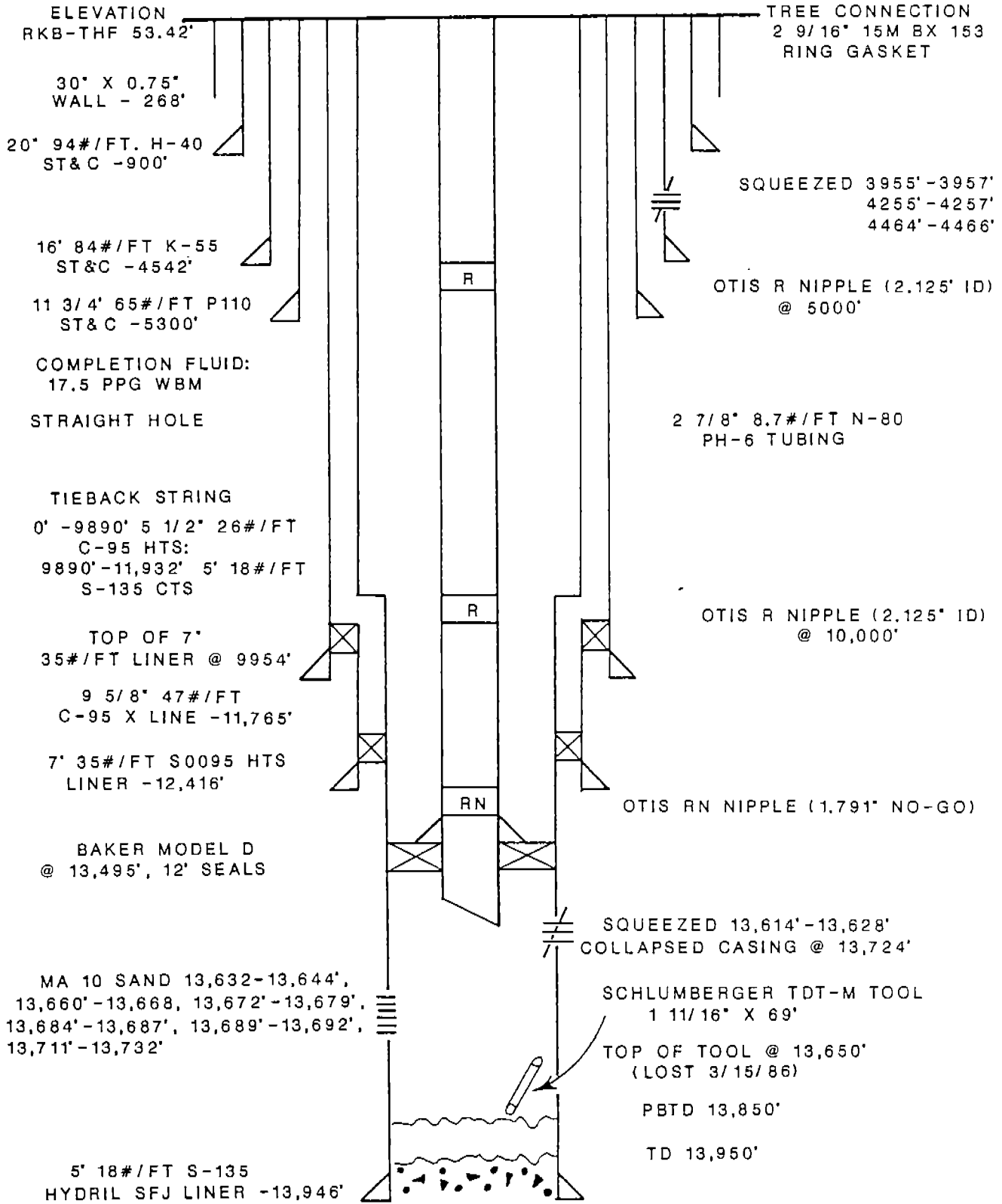
SCHEMATIC OF ELEVATION OF PLATFORM DECKS



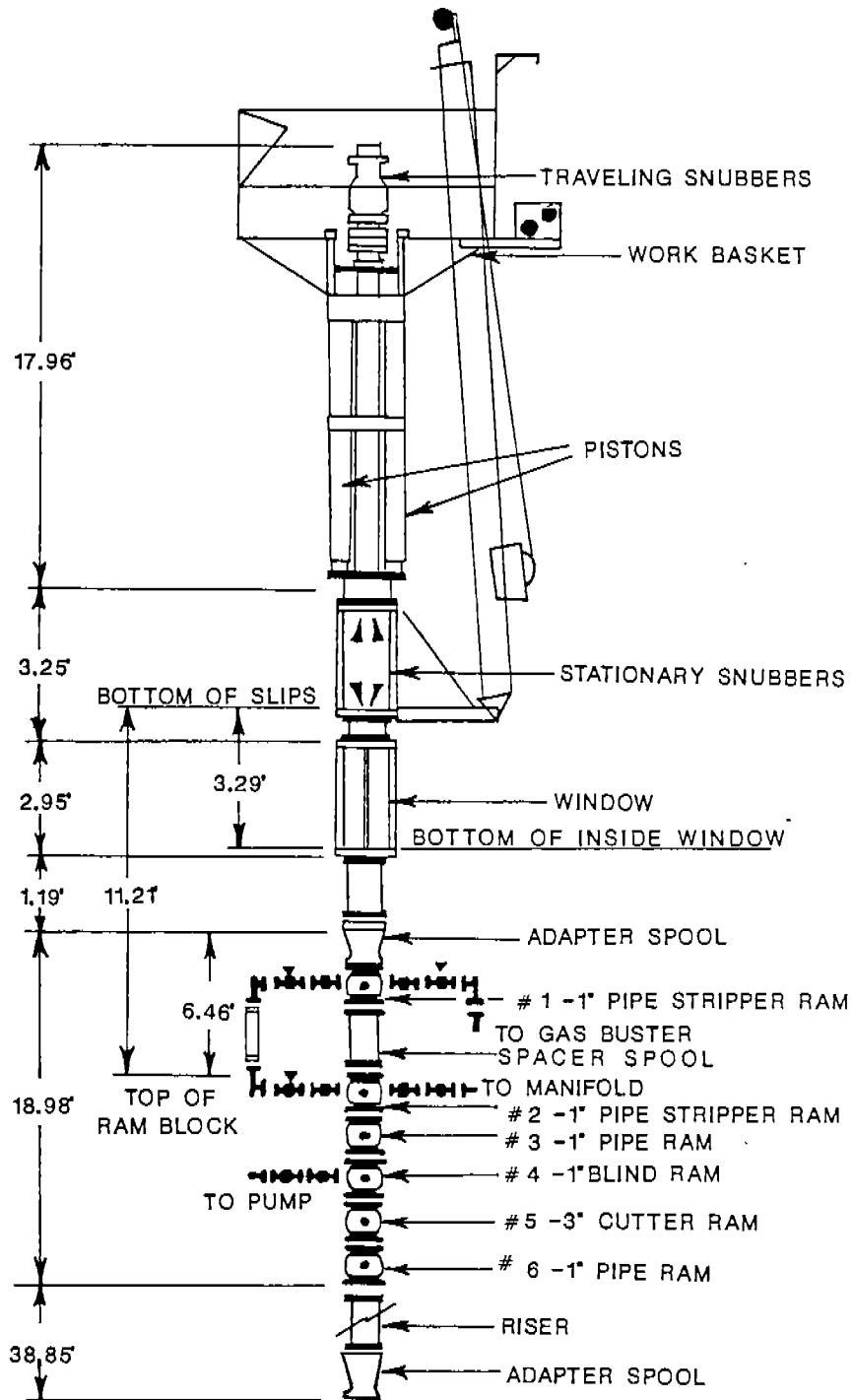
MAIN DECK

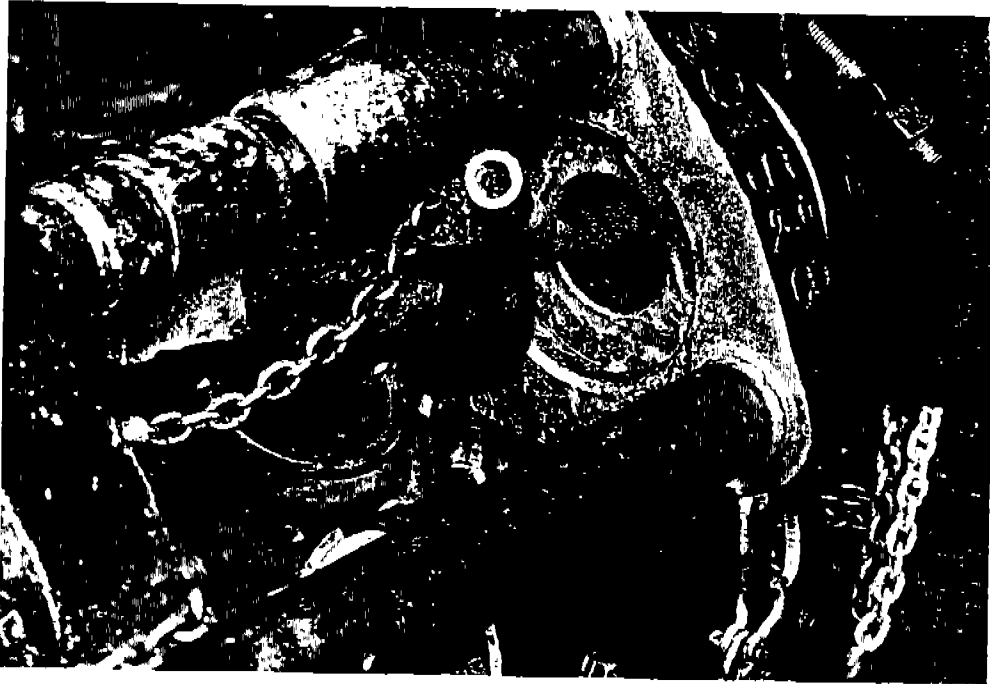


SCHMATIC OF WELL NO. 12

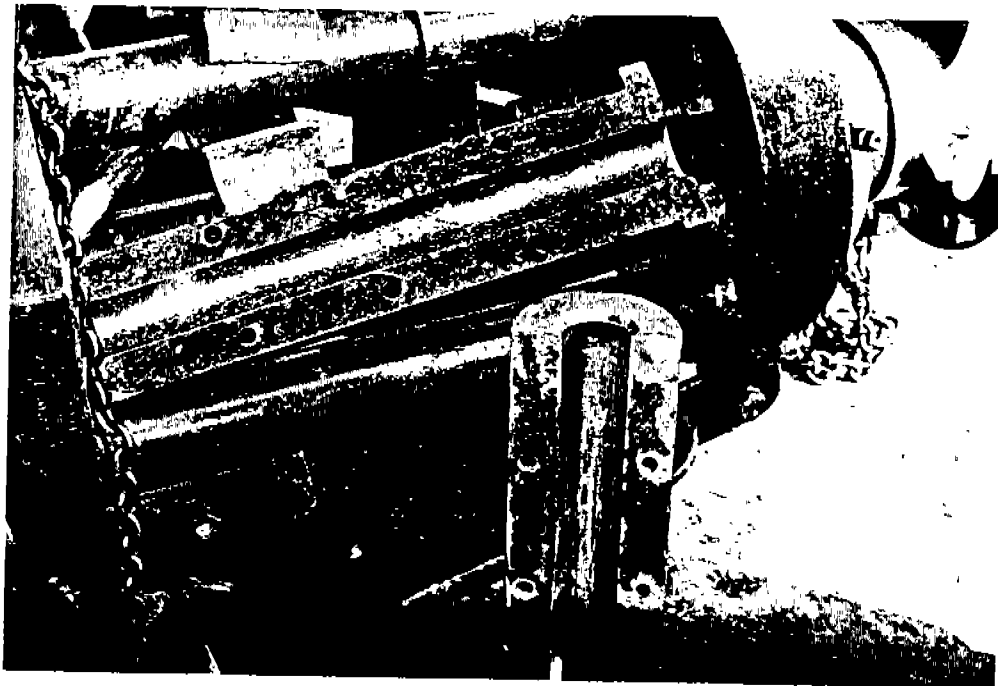


SCHEMATIC OF THE SNUBBING UNIT AND BOP STACK





Pipe remaining in window



High-pressure guides