

**Investigation of Loss of Well Control
Well No. 24, South Pass Block 60,
Lease OCS-G 1608,
December 26, 1992**



U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office

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Attachments

1. Location of Lease OCS-G 1608, South Pass Block 60
2. Schematic of BOP stack and associated equipment
3. High Pressure gauge
4. Possible radii of exposure of H₂S

Authority and Procedures for the Investigation and Public Report

Authority

A serious loss of well control occurred at approximately 4:00 a.m. on December 26, 1992, aboard Noble Drilling's jack-up rig *Cecil Forbes* during the drilling of Well No. 24 for Arco Oil and Gas Company (ARCO) on Lease OCS-G 1608, South Pass Block 60, in the Gulf of Mexico, offshore the State of Louisiana. Pursuant to Section 208, Subsection 22(d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act, as amended in 1978, 30 CFR Part 250, the Minerals Management Service (MMS) is required to investigate and prepare a public report of this accident. By memorandum dated December 30, 1992, the following MMS personnel were assigned to the investigative panel:

| | |
|-------------------|-------------|
| F. T. Bryan | New Orleans |
| L. T. Herbst | New Orleans |
| C. J. Schoennagel | New Orleans |

Procedures

Minerals Management Service personnel attended a meeting with representatives from ARCO, the State of Louisiana, the U.S. Fish and Wildlife Service, and the U.S. Coast Guard on December 27, 1992, to assess the situation. Because of weather problems, an overflight of the blowout was not conducted by MMS personnel as of that time.

Investigative Panel Members flew to South Pass Block 60 and landed on the *Cecil Forbes* on January 13, 1993. They obtained additional preliminary information from personnel familiar with the accident and toured the accident scene.

The Investigative Panel conducted a hearing on March 5, 1993, in Room 111 of the MMS offices, 1201 Elmwood Park Boulevard, Jefferson, Louisiana, to question the following individuals about the accident:

| | |
|--------------------|---------------------|
| Denver L. Hilliard | - Noble Drilling |
| Sheldon D. Smith | - Noble Drilling |
| Oma Johnson | - Noble Drilling |
| William E. Smith | - Noble Drilling |
| Russell J. Abraham | - Camco STOP |
| Vince T. Gibson | - Stratigraph, Inc. |
| Joseph T. Buckner | - ARCO |

Introduction

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 1.) The lease was issued to the Atlantic Richfield Company (100%), effective July 1, 1967, for a cash bonus of \$5,300,020.60, with a $\frac{1}{6}$ fixed royalty rate. (On May 7, 1985, the name of the Atlantic Richfield Company was changed to the ARCO Oil and Gas Company.)

ARCO submitted an Application for Permit to Drill (APD) for Well No. 24, South Pass Block 60, on November 30, 1992. Initially, ARCO proposed to drill the proposed productive interval with 10 $\frac{3}{4}$ -inch caprock casing set and only a diverter system installed.

A meeting was held on December 18, 1992, between ARCO and MMS to discuss the proposed APD. At this meeting ARCO indicated that they had changed their proposed drilling procedure to include a blowout preventer (BOP) stack in addition to the diverter system.

Noble Drilling's jack-up rig *Cecil Forbes* arrived on location in South Pass Block 60 on December 19, 1992, to drill Well No. 24 for ARCO.

**Description of
Incident**

At approximately 3:30 a.m. on December 26, 1992, after having set caprock casing and drilled a small amount of hole, ARCO had tripped out of the hole with drill pipe to install a core barrel. The hole was filled with seawater and the blind rams were closed.

As the core barrel was about to be tripped into the hole, the blind rams were opened. At this time the well belched and started to flow onto the rig floor and the H₂S sensors pegged out at 99 parts-per-million (ppm) and started to alarm. The diverter system was opened and the blind rams were closed. The well was then blowing out of both ends of the diverter lines.

All personnel donned breathing apparatus and assembled in the living quarters. The rig was ordered evacuated except for a small contingent that would stay to shut down all rig equipment and assess the situation further.

Personnel abandoned the rig via personnel basket onto the motor vessel (MV) *Betty G.* The personnel who remained shut down all rig equipment and then abandoned the rig via an escape capsule.

No injuries were sustained during the incident. Pollution was estimated to be 100 to 500 barrels of oil/water emulsion.

Findings

Preliminary Drive pipe for ARCO's Well No. 24 was driven by Noble Drilling's jack-up rig
Activities *Cecil Forbes* on December 20, 1992. The diverter system, blowout preventer stack, and the choke and kill lines were then installed and tested. Well No. 24 was spudded on December 21, 1992.

While coring operations were being performed on the well on December 23, 1993, returns were lost. Lost circulation material was pumped into the well until the well became static. The core was then retrieved from the well. The well was reentered for the purpose of obtaining additional cores, when returns were again lost. Lost circulation material was again pumped into the well until it became static.

On December 24, 1992, as ARCO was preparing to log the well, returns were lost. Drill pipe was tripped in the well and lost circulation material was added to establish returns. The drill pipe was tripped out of the well, the logging equipment was tripped in the well, and logs were run. The well was then washed and reamed for additional logging, when returns were again lost. Additional lost circulation material was pumped in the well, returns were established, and logging was completed. ARCO then ran and cemented 10 $\frac{3}{4}$ -inch caprock casing in the well.

The BOP stack and associated equipment were nipped down, a 10 $\frac{3}{4}$ -inch casing head was installed, and the BOP stack and associated equipment were nipped up

and tested. (For schematic of the BOP stack and associated equipment, see attachment 2.) At approximately 11:30 p.m. on December 25, 1992, ARCO started to drill cement.

**Loss of
Well Control**

At approximately 3:00 a.m. on December 26, 1992, drilling of the cement and float shoe was completed. Drilling continued using 9.0 pound-per-gallon (ppg) drilling mud for a short period of time, when returns were again lost. Drilling was halted and seawater was pumped into the well until it was stabilized. No lost circulation material was added to the well this time as personnel did not want to contaminate the core they were going to take from the well.

The drill pipe was tripped out of the well with the hole being kept filled with seawater. After the last string of drill collars was tripped out of the well, the borehole was monitored for several minutes to make sure it stayed full. This was done by having someone visually check the hole for fluid drop.

Since the hole remained full, the blind rams were closed to prevent anything from being dropped into the well from the drill floor. At this point the only way to monitor the well was by a high-pressure gauge installed on the choke line. (For a photograph of the high-pressure gauge, see attachment 3.)

After the drillpipe was entirely tripped out of the hole, a core barrel was prepared to be tripped in the well. At approximately 4:00 a.m. the high-pressure gauge was

checked for pressure and none was noted. The blind rams were then opened as the core barrel was going to be tripped in the hole.

At this time the well belched and then started flowing onto the drill floor. Immediately, the blind rams were closed and the port and starboard diverter valves were opened. The H₂S alarms and lights were activated by the escaping gases. All personnel on the rig floor immediately donned their H₂S breathing apparatuses.

**Abandonment
of Rig**

As this was occurring, personnel responsible for rig safety proceeded to the rig floor while off-duty personnel in the living quarters assembled at their emergency stations with their H₂S breathing apparatuses.

Personnel on the rig floor visually checked the diverter. The well fluids, which were blowing out at a very high rate of flow, were being diverted out of both ends of the diverter pipe with the wind carrying the fluids away from the rig. The H₂S readings from the sensor in the area of the rig floor were checked. They were pegged out at 99 ppm and this reading was verified by a hand-held detector. Subsequent analyses estimated the release to be in the range of 80,000 ppm.

At this time it was decided that the rig should be abandoned. All platforms in the vicinity of the rig were alerted of the H₂S diversion. The standby boat *MV June Tide* did not respond to the distress calls, but the field boat *MV Betty G* came alongside to provide a means of evacuation.

All but seven personnel abandoned the rig by crane via the personnel basket and sought refuge on the MV *Betty G*. The abandonment was orderly except for the MV *June Tide* not responding to the distress calls from the rig. This failure to respond could have created a problem if difficulties had occurred, since the MV *Betty G* was not equipped with as much of an air cascade system as the MV *June Tide*.

The seven personnel who remained aboard shut down all power sources and secured the rig. Since the escape capsules were not equipped with an air cascade system, these personnel refilled their breathing apparatuses before abandoning the rig via an escape capsule.

**Subsequent
Activities**

All personnel who abandoned the rig were brought to ARCO's A-D-G complex in South Pass Block 60, which was to the north (upwind) from the diverting well. From there the crew awaited further orders from both ARCO and Noble. ARCO had also evacuated the B-E complex in South Pass Block 60, which was 1 mile south of Well No. 24.

At approximately 3:00 p.m. on December 26, 1992, eight personnel reboarded the rig by helicopter. Flow coming out of the diverter was described as "blowing pretty hard with a yellow tint to it." The personnel who reboarded the rig had been given procedures by ARCO to attempt to shut in the well.

The accumulator system pressure was down to approximately 1,000 psi due to the shutdown of rig power during abandonment. The precharge pressure from the accumulator bottles was still there, but the personnel did not want to attempt the shut-in without additional pressure on the accumulator system. Since it was getting dark, a decision was made to return to the A-D-G complex for the night and reboard the rig the next day.

During the night the wind shifted from the north to the south, temporarily forcing the evacuation of the A-D-G complex. At approximately 12:00 noon on December 27, 1992, a fog cover lifted, and eight personnel again reboarded the rig by helicopter. Some portable compressors were offloaded onto the rig to make available an air pressure supply independent from the rig accumulator system. Air pressure was then increased to 3,000 psi.

At 2:30 p.m. the procedures to attempt to shut in the well were initiated. With the choke valve open and a 300-psi low-pressure gauge installed in addition to the 10,000-psi high-pressure gauge on the choke line, the starboard diverter valve was closed. Pressure on the choke line was 30 psi and increased slightly as the choke was closed.

The choke was reopened and the port diverter valve was then closed, with pressure on the choke line now reading 100 psi. At 3:25 p.m. the choke valve was then closed, with final shut-in pressure reading 117 psi. ARCO's plans had called for rediverting the well if the shut-in pressure exceeded 200 psi, the maximum they were willing to allow the casing shoe to withstand.

For the next several days ARCO alternated between pumping down the drill pipe and bullheading down the annulus both seawater and lost circulation materials in an attempt to kill the well. At 8:00 p.m. on December 30, 1992, ARCO attempted to kill the well by squeezing 150 sacks of cement into the wellbore. However, the effort was not successful in killing the well.

At 10:30 a.m. on December 31, 1992, another 150 sacks of cement were squeezed into the wellbore. After the cement was allowed to set, the pipe rams were opened. This time the squeeze job held, and the well was determined killed at 5:30 p.m. that day.

The well was subsequently drilled to the planned total depth while the hole was kept filled with seawater because of continual problems with lost circulation. The well was then tested, after which it was permanently abandoned, on February 1, 1993.

Damages

The drilling rig *Cecil Forbes* received minor damages from the loss of well control. Pollution from the incident was reported as being anywhere from an initial estimate of 600 to 2,000 barrels of oil/water emulsion to a final estimate of 100 to 500 barrels of oil/water emulsion. No estimate of actual oil spilled could be obtained. No serious injuries were reported as a result of this incident.

Other Affected Activities In addition to the ARCO facility abandonments, the release of the H₂S also led to the abandonments of British Petroleum's (BP) "A" Platforms in Mississippi Canyon Blocks 20 and 109 when BP's production facility operators at Mississippi Canyon Block 20 "A" Platform detected an H₂S odor. These platforms are located approximately 6.5 and 11 miles, respectively, south-southeast of Well No. 24.

The United States Coast Guard (USCG) notified Plaquemines Parish officials that an evacuation of the extreme southern portion of the parish may be required.

Although parish officials were notified, no evacuation was required. The USCG also established a 10-mile radius "No Flying" safety zone around the rig for below 1,500 feet. (For possible radii of exposure of the H₂S, see attachment 4.)

Conclusions

Probable Cause of Incident The probable cause of the incident was the failure to keep the well filled with seawater while the drill string was out of the hole and the well was shut in with the blind rams.

Contributing Causes The following were contributing causes:

1. The inability to be able to monitor the well visually to ensure that it remained filled with seawater. The blind rams being closed prevented this from occurring.
2. The failure to use lost circulation material. In an attempt to prevent contamination of the core with lost circulation material, seawater was used when returns were lost just prior to the loss of well control.
3. The failure to use the choke line valve and pressure gauge to determine if pressure had accumulated under the shut-in blind rams prior to opening them. The increments on the pressure gauge would have made it difficult to detect a small increase in pressure.
4. The uncertainty of what pressure with which the well could be shut in without it breaching around the outside of the casing shoe.

Recommendations

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

1. In shallow wells where lost returns are a problem, lessees should determine if the hole is full after it has been shut in before opening any rams. This can be done by
 - a. Shutting in the pipe rams instead of the blind rams to prevent things from falling into the well, thereby allowing a visual check of the hole.
 - b. Using on the choke line a low-pressure gauge that can be more easily read for detection of low pressures.
 - c. Cracking open the choke line valve to see if there is any pressure in the well.
2. Lessees should attempt to determine, as soon as possible, what type of shut-in pressure, if any, the conductor or caprock casing shoe and the formation can withstand after setting conductor or caprock casing.
3. Lessees should allow for a means of pumping seawater into the well below the ram that they will use to shut in the well while the drill string is out of the hole.

4. Lessees should allow for a diverter design that would divert the well fluids out past the barge of the rig, particularly in areas that contain H₂S.

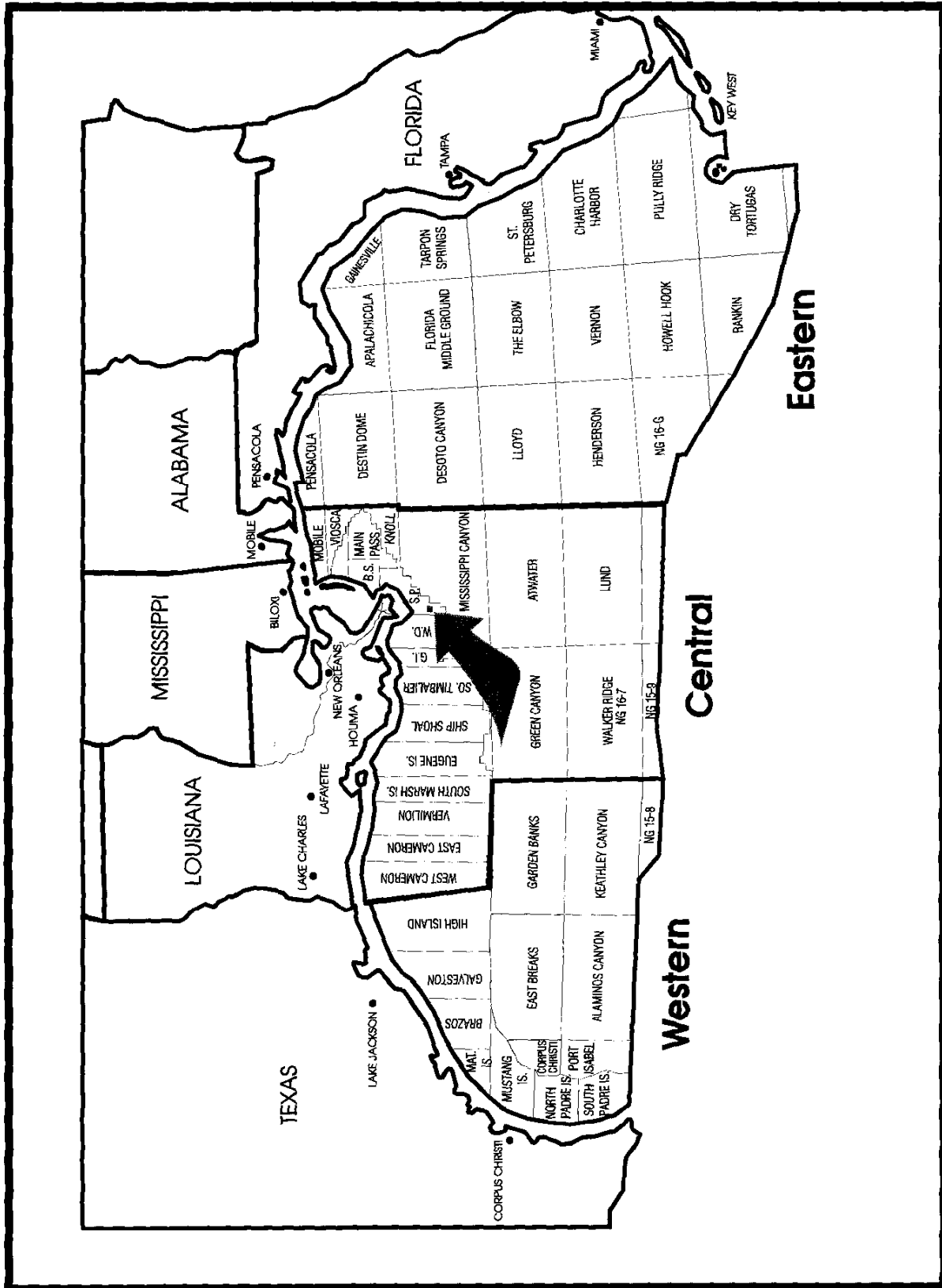
Regulatory Requirements The MMS should require the following when drilling is to be conducted in an area suspected to contain H₂S:

1. H₂S Contingency Plans should include all facilities (both drilling rigs and production platforms) with appropriate telephone/radio contacts within a 3-mile radius of the well. Locations should be accurately depicted on a map.
2. All facilities within a 1-mile radius should be equipped with portable H₂S and SO₂ detectors to determine if evacuation is necessary.
3. Section 30 CFR 250.67(h)(3)(ii)(D) should be amended to require that signs shall be displayed upon reaching depths of H₂S compliance. Current requirements call for signs to be displayed at 20 ppm H₂S.

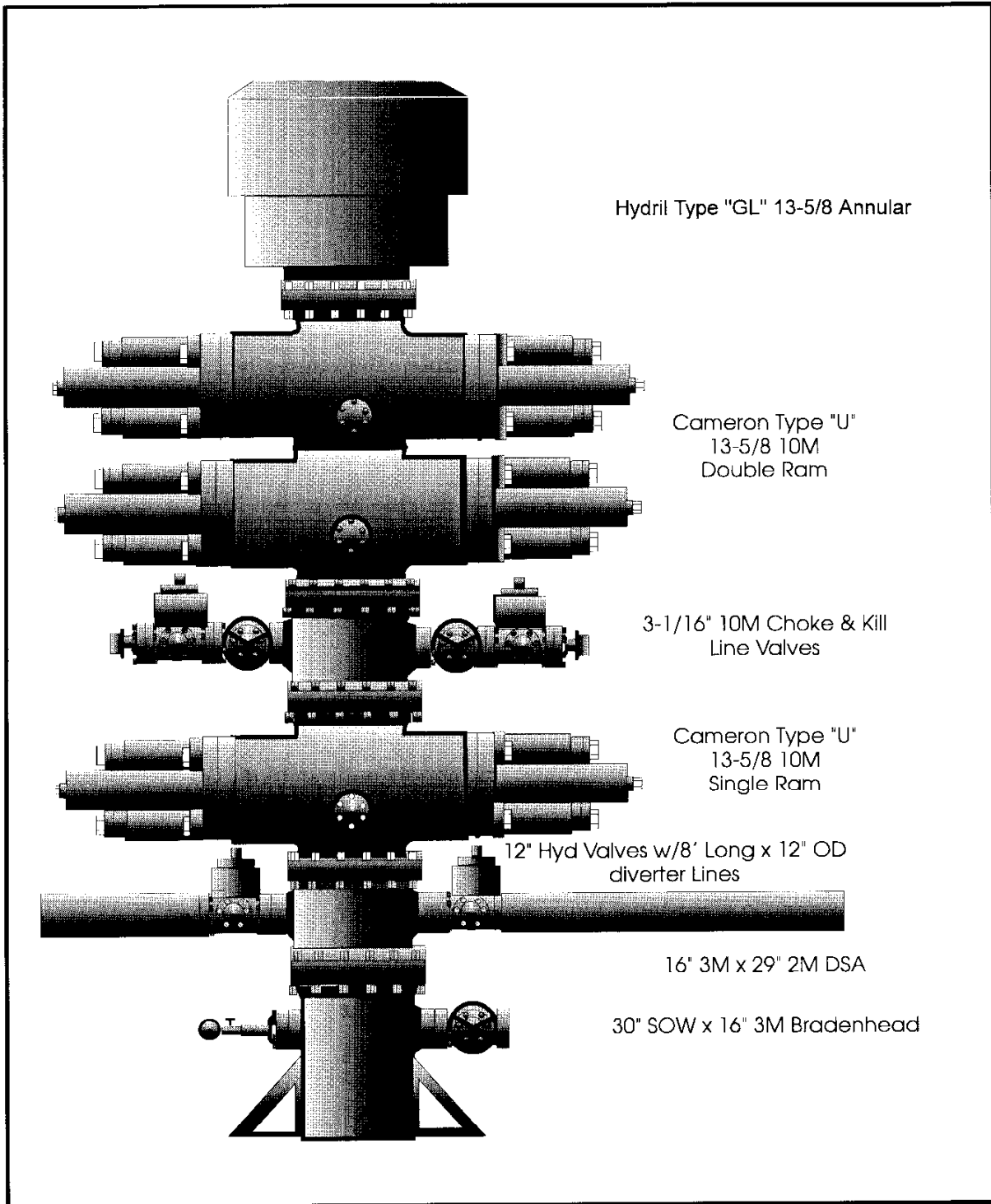
Additional The MMS should proceed with the following:

- Considerations**
1. Investigate the availability of fixed detection equipment that can register higher than 99 ppm. A more accurate reading of the amount of parts per million will help determine what the radius of exposure will be, in this case in excess of 6 miles.

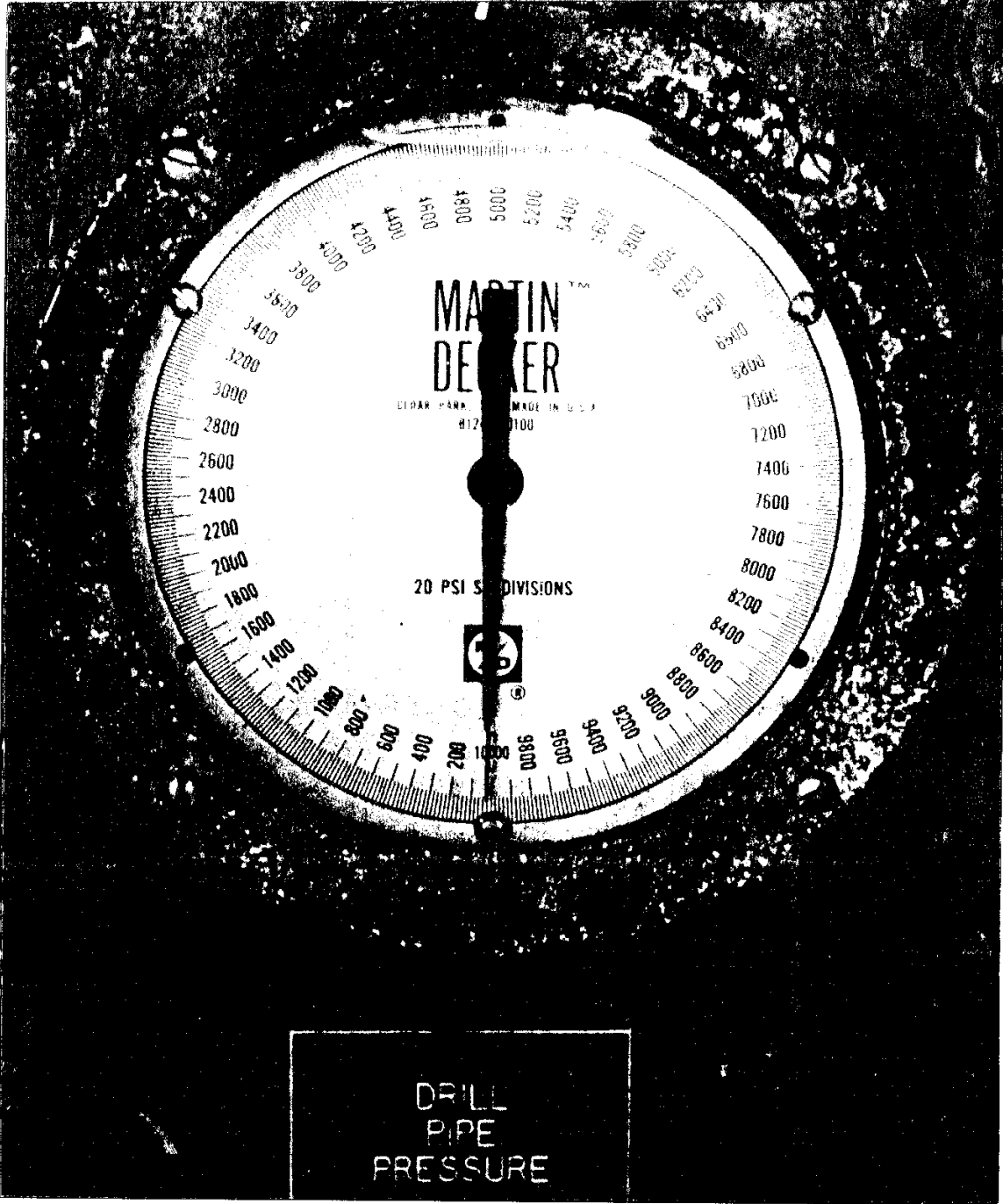
2. Examine well-control procedures for extremely shallow caprock casing setting depths.



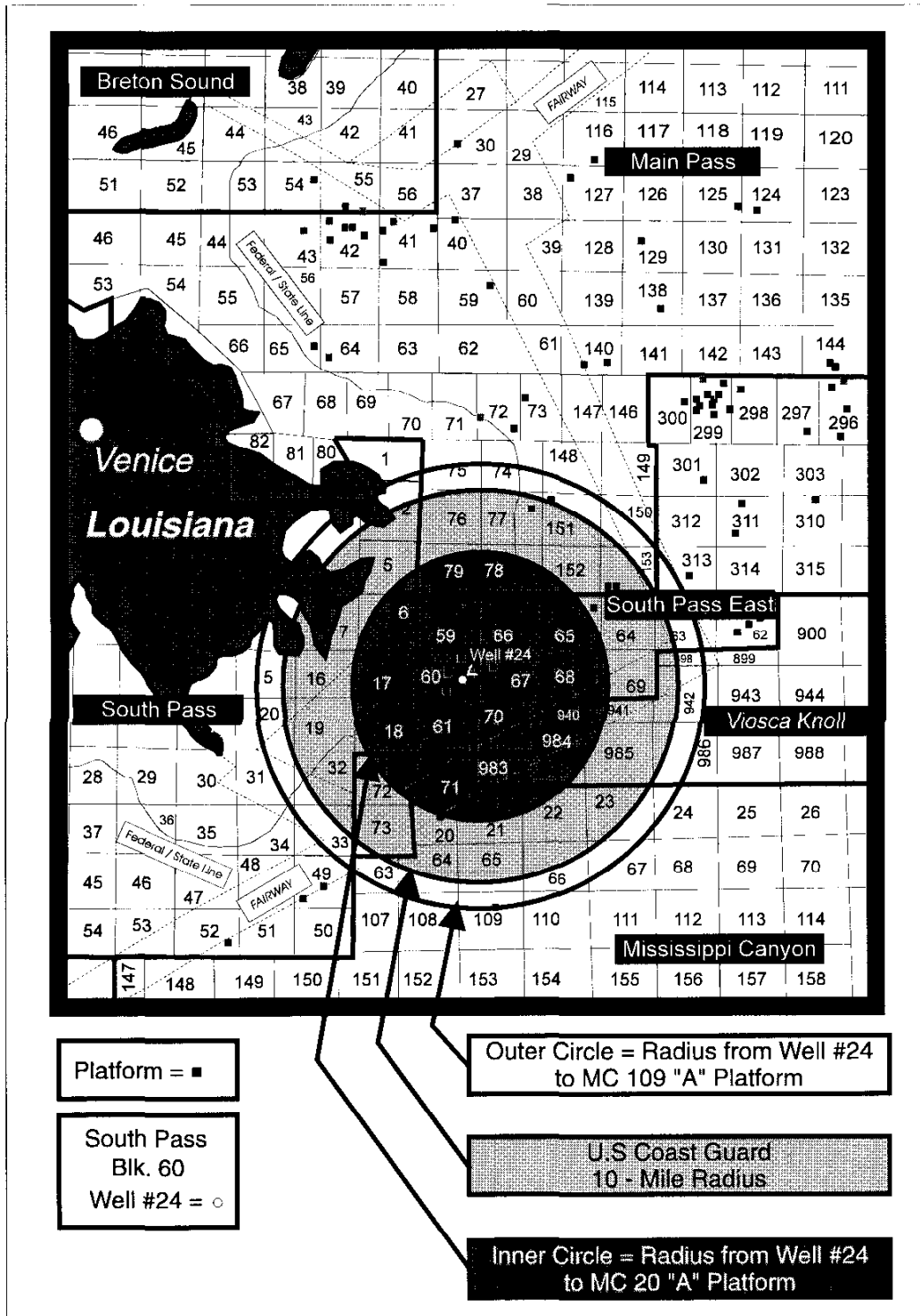
Location of Lease OCS-G 1608, South Pass Block 60



Schematic of BOP stack and associated equipment.



High Pressure Gauge



Possible radii of exposure of H₂S.

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.

