OCS Report
MMS 2006-047

Investigation of Loss of Well Control
South Timbalier Block 230, Well A-7
OCS-G 27169
30 November 2005

Gulf of Mexico
Off the Louisiana Coast

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

OCS Report
MMS 2006-047

Investigation of Loss of Well Control
South Timbalier Block 230, Well A-7
OCS-G 27169
30 November 2005

Gulf of Mexico
Off the Louisiana Coast

John McCarroll – Chairman
Joe Levine
Mark Malbrue
Freddie Mosely
Ben Coco

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

New Orleans
July 2006

Contents

.

Investigation and Report

Authority

In November 2005, the Global Santa Fe, Inc. (hereinafter referred to as "Contractor" or "GSF") jack-up rig *Adriatic III* (hereinafter referred to as the "Rig") was engaged in drilling operations for W&T Offshore, Inc. (hereinafter referred to as ''Operator'') for South Timbalier (ST) Block 230 Well A-7 (bottomhole location). The Rig was in place next to the South Timbalier Block 229 "A" platform (hereinafter referred to as the "Platform"). Drilling operations were being conducted with the Rig cantilevered over the Platform. The drilling rig loss of well control event occurred 30 November 2005 at approximately 2000 hrs on the surface location in Operator's Lease OCS-G 13938, South Timbalier Block 229, 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, and Department of the Interior Regulations 30 CFR 250, Minerals Management Service (MMS) is required to investigate and prepare a public report of this accident. By memorandum dated 15 December 2005, the following personnel were named to the investigative panel:

John McCarroll, Chairman – Houma District, Field Operations, GOM OCS Region
Joe Levine – Office of Offshore Regulatory Programs, Herndon, Virginia
Mark Malbrue – Lafayette District, Field Operations, GOM OCS Region
Freddie Mosely – Houma District, Field Operations, GOM OCS Region
Ben Coco - Houma District, Field Operations, GOM OCS Region

Procedures

On the morning of 4 December 2005, inspectors from the MMS Houma District office visited the site of the incident to assess the situation. On 31 January 2006, MMS panel members conducted interviews of the driller and tool pusher. On 01 February 2006, MMS panel members conducted interviews of the relief driller and the company man. On 10 February 2006, MMS panel members conducted an offshore interview of the relief company man. On 19 February 2006, representatives of the Operator met with members of the Panel in the Houma District office for interviews and additional data collection. A total of nine interviews were conducted and other information was gathered at various times from a variety of sources. This information included the following reports and statements:

- Operator Daily Drilling Reports, 24 November 2005 – 5 December 2005, ST-230 Well No. A-7;
- Prior Operator's Report on Diverter Flow, ST-229 Well No. 1;
- Operator's Application for Permit to Drill (APD), ST-230 Well No. A-7;
- Operator's Diverter Incident Report, ST-230 Well No. A-7;
- Operator's Well Prognosis and Evaluation Plan, ST-230 Well No. A-7;
- Cement Contractor's Cementing Program Report, ST-230 Well No. A-7;
- Operator's Well Kill Operations Report, ST-230 Well No. A-7;
- Offset Well Induction/Gamma Ray Electric Logs;
- Interviews with Drilling Management, Engineering, and Geophysical personnel of the Operator;
- Operator's Diverter x 18.625-inch Conductor Casing Circular Pressure Test Chart, ST-230 Well No. A-7;
- Operator's 13.375-inch Surface Casing x 18.625-inch Conductor Casing Annular Circular Pressure Test Chart, ST-230 Well No. A-7;
- Operator's 13.375-inch Surface Casing Tally Sheet, ST-230 Well No. A-7;
- Operator's Time Line, 29 November 2005 through 04 December 2005, ST-230 Well No. A-7;
- Petron's Gas Detector Calibration Report, ST-230 Well No. A-7;
- Operator's 3D Seismic Section Data, ST-230 Well No. A-7.

Introduction

Background

The surface location for Well A-7 is on Lease OCS-G 13938, which covers approximately 5,000 acres and is located in South Timbalier Block 229 (ST-229), Gulf of Mexico, offshore Louisiana *(for lease location see Attachment 1).* The bottomhole location for Well A-7 was planned for South Timbalier Block 230, Lease OCS-G 27169. The leases OCS-G 13938 and OCS-G 27169 were issued to The Louisiana Land and Exploration Company (hereinafter referred to as ‘‘LLE”) effective 01 July 1993**.** On 01 January 2002, W&T Offshore, Inc. acquired LLE and its interest in these leases.

In 1996, following the successful drilling of the ST-229 Well #1 (renamed A-1), the “A” platform was set in ST-229 in 236 feet of water. The platform complex ID No. is 24237 and it is a three-pile, six-slot platform, and production was initiated in 1996.

Brief Description, Loss of Well Control

MMS inspectors from the Houma District conducted a routine inspection of the Rig on 30 November 2005, and no violations of regulations or safety issues were noted. The 26-inch drive pipe had been driven to 724 feet MD/TVD and the 18.625-inch conductor casing had been set at 1,501 feet. The rig crew held a Pre-job Safety Meeting (where they addressed running casing, teamwork, and communications), ran the 13.375-inch surface casing into the hole to 3,350 feet MD/3,204 feet TVD, 50 barrels of spacer, pumped 813 sacks of 12.0-ppg lead cement and 390 sacks of 16.4-ppg tail cement. During the displacement of the cement, the top plug did not bump.

The calculated top of cement (TOC) for the 13.375-inch surface casing cement job was 1,000 feet MD/TVD. However, the cement channeled through the mud and was observed in the returns at the surface, so it is impossible to determine an accurate TOC. The observation of cement at the surface indicates channeling of the cement through the mud column and poor displacement of the

mud out of the hole during the cement job. The lead cement contained Versa Set, a gas block additive that reduces the cement setting time and helps prevent gas flow after cementing.

On 30 November 2005, at 2000 hours, while a 1.25-inch grout string was used to circulate sea water to wash out the cement down to 24 feet below the mudline in the 13.375-inch by 18.625-inch annulus, the well started to flow and was placed on diverter. *(See Attachment 2 for diverter schematic of Well A-7.)* After several attempts to kill the well with 10.1-ppg and 14.8-ppg mud failed, all non-essential personnel were evacuated to the crew boat MV *Seabulk St. Francis*. All personnel were accounted for with no injuries and no accidents.

The well flowed gas, mud, cement, and sand intermittently for approximately fourteen hours. The operator observed a light condensate gas sheen on the water and the estimated spill volume was less than one gallon. The well stopped flowing, the Rig was re-boarded, and repairs were made to the starboard diverter line. This damage was limited to holes in the line resulting from the line being cutout from high velocity flow of cement and sand. Boots & Coots designed and implemented a kill procedure for the well. The 13.375-inch by 18.625-inch annulus was cemented, pressure tested, and drilling operations resumed. *(See Attachment 3 for wellbore sketch of Well A-7.)*

Findings

Preliminary Activities – Preparation of the Well Plan

The ST 229 "A" platform of the ST-228 Field sits in 236 ft of water. The three-legged, six-slot Platform was set in 1996 and five wells have been drilled from the structure prior to the A-7 well. Production was initiated from the Platform in 1996.

In 2005, the Operator planned the addition of a new well, the A-7, to be drilled from the "A" Platform surface location in ST 229 to a bottomhole location in the adjacent block ST 230. According to document and interview testimony, the A-7 well was permitted after a review of the shallow gas hazards in the area by using available seismic and offset well logs, and a review of the drilling history of all the wells previously drilled from the "A" platform and in the immediate area.

The plan for the A-7 well included setting conductor casing at 1,500 feet TVD. The depth of the conductor casing shoe was determined in part because LLE's A-1 well on this platform had experienced a loss of well control while drilling at 2,300 feet TVD with the diverter in place. W&T wanted to be sure that Well A-7's conductor casing was set above the zone that caused LLE problems on their A-1 well. The A-1 well flowed for five hours before it was killed with 11-ppg mud. Thereafter, the well was successfully drilled and completed.

Review of seismic data while planning the A-7 well showed a distinctive pore pressure transition zone at approximately 3,200 feet TVD, so the 13.375-inch surface casing was planned to be set in the top of this transition zone. Because of rapidly increasing pore pressure below the transition zone and a high angle wellbore below the surface casing shoe, approximately 70 degrees at total depth, a 9.625-inch intermediate casing string and a 7-inch production liner were planned to be set in order to reach the total depth of 10,907 feet MD/7,200 feet TVD for the A-7 well.

The water depth at this location is 230 feet and the rig kelly bushing (RKB) was 136 feet, which results in a calculated RKB to mudline depth of 366 feet. The well was designed to facilitate

future permanent abandonment operations by washing out mud and cement to a depth of 390 feet MD or 24 feet below the mud line.

Drilling Activities — Spud, Loss of Well Control, Regain Well Control

(From drilling morning reports and interviews)

23 Nov. – Held pre-spud meeting, which included a discussion on shallow gas hazards. Picked up and drove the 26-inch drive pipe to 724 feet MD/TVD. Nippled up and tested the diverter system.

24 Nov. – Picked up a rock bit and bottomhole assembly and drilled to 1,071 feet MD/1,070 feet TVD.

25 Nov. – Drilled to the conductor casing setting point at 1,501 feet MD/1,500 feet TVD. Maximum of 93 gas units was recorded on the Petron gas detector.

26 Nov. – Ran and cemented the 18.625-inch conductor casing at 1,501 feet MD/1,500 feet TVD. Waited on cement for 8 hours.

27 Nov. – Welded on the wellhead for the conductor casing and nippled up and retested the diverter system. Pressure tested conductor casing to 250 psi and drilled out of casing shoe.

28 Nov. – Directionally drilled to 3,116 feet MD/3,001 feet TVD. No gas units recorded on the Petron gas detector.

29 Nov. – Drilled to the surface casing setting point at 3,350 feet MD/3,204 feet TVD. Maximum of 475 gas units was recorded on the Petron's gas detector while circulating bottoms up. Flow checked well and it was static. Started running the 13.375-inch surface casing.

30 Nov. – MMS inspectors from the Houma District conducted a routine inspection of the Rig. No violations of regulations or safety issues were noted as a result of the MMS inspection. Rig finished running the 13.375-inch surface casing and pumped the cement job during the day. The

calculated top of the 12.0-ppg lead cement was 1,000 feet MD/TVD but the cement channeled through the mud and was observed in the returns at the surface. The operator ran centralizers in the bottom section of the 13.375-inch casing string from 3,348 feet MD to 2,762 MD feet. The lead slurry contained Versa Set, which is a cement additive used to make it set up faster and reduce the chance of gas invasion into the wellbore. To facilitate future permanent abandonment operations of the well, the cement was washed out of the 13.375-inch by 18.625-inch annulus to a point below the mudline. At 2000 hours, while a 1.25-inch grout string was being used to circulate seawater to wash out the cement to 390 feet MD/TVD (24 feet below the mudline) in the 13.375-inch by 18.625-inch annulus, the well started to flow. The grout string was run alongside the 13.375-inch casing and through the diverter. The well was placed on diverter and, after several attempts to kill the well with 10.1-ppg and 14.8-ppg mud failed, all nonessential personnel were evacuated to the crew boat MV *Seabulk St. Francis*. All personnel were accounted for with no injuries and no accidents.

01 Dec. – The well flowed gas, mud, cement, and sand intermittently for approximately 14 hours. The operator observed a light condensate gas sheen on the water and the estimated spill volume was less than one gallon. The well stopped flowing, the Rig was re-boarded, and repairs were made to the starboard diverter line. This damage was limited to holes in the line resulting from the line being cutout from high velocity flow of cement and sand. The rig crew pumped 12.5-ppg kill weight mud and the flow continued in bursts every one to three minutes.

02 Dec. – With approval from MMS, Boots and Coots well control service designed and implemented a kill procedure for the well. The 13.375-inch by 18.625-inch annulus was killed by pumping 10.1-ppg – 18.5-ppg mud and seawater. Cemented the annulus with 172 sacks of 16.4-ppg Class H cement and 98 sacks of 12.5-ppg light cement containing Versa Set. Monitored the annulus while waiting on the cement to set.

03 Dec. – With approval from MMS, they pumped an additional 200-foot cement plug in the annulus as a top job consisting of 138 sacks of 16.4-ppg Class H cement. The cement plug was tested to 100 psi and the rig crew nippled up the surface casing wellhead and BOP's. The Rig continued with normal drilling operations according to the well plan.

Findings – History of Prior Drilling and Diverter Flow on the "A" Platform

The first well drilled at this location was the A-1 Well (Prior No. 1 Well) by LLE in 1994. The APD was approved by MMS on 21 September 1994 with a warning of potential shallow gas/fault at 1,400 feet. The 30-inch drive pipe was driven to 595 feet, the 20-inch conductor casing was set at 1,300 feet and cemented back to the mudline hanger, then the well was drilled to 2,300 feet. While a five-stand short trip to 1,866 feet was being conducted, the gas units spiked up to 100 units and then dropped back to a normal 5 units of background gas. At 2,300 feet, with 9.5-ppg water-base mud in the hole, the well was circulated clean prior to shutting down the pumps for 20 minutes to take a survey. During the 20 minutes that the pumps were off line to survey the wellbore, there was no indication of flow. After the survey, a second five-stand short trip was made and mud was observed to be falling in the wellbore at the bell nipple. After three stands of drill pipe were run back into the well to 2,043 feet, the well started to flow and the annular diverter was immediately closed and automatic diversion of the flow overboard occurred at 1700 hours on 11 October 1994.

The Rowan Gilbert Rowe rig crew pumped a total of 566 barrels of 9.5-ppg mud while the A-1 well diverted at a rate of approximately 25 barrels per minute. Pumps were then switched to seawater and pumping continued while building an 11-ppg kill mud. The well flowed dry gas and mud for approximately five hours before being killed with the 11-ppg kill mud. An additional 5.5 days were spent combating lost circulation problems and squeezing the 20-inch casing shoe. The 13.375-inch surface casing was run and cemented at 2,007 feet instead of the originally planned depth of 3,200 feet. The 13.375-inch casing was tested and drilled out and normal drilling operations resumed.

LLE's geological staff conducted an investigation of the shallow gas flow on the A-1 well, but was unable to determine definitively the depth of the shallow gas flow or the exact cause of the flow. They suggested that the bottomhole pressure during drilling with the 9.5-ppg mud weight was at or near the hydrostatic head of the unknown kick sand at around 2,300 feet; and that the well was swabbed in on the five-stand short trip after the survey was conducted.

LLE revised its drilling plan to include using a slightly higher mud weight and drilled the A-2 and A-3 wells in 1996 without incident. The lease was acquired by W&T Offshore, Inc., who drilled the A-4, A-5, and A-6 wells in 2004 without any additional loss of well control incidents reported

to MMS. The W & T Offshore geophysicist suspects that the unidentified gas kick sand on the A-7 well correlated to approximately the same depth as the gas kick sand encountered at approximately 2,300 feet on the A-1 well.

Conclusions

Cause of Loss of Well Control

The loss of well control was caused by a 41-psi drop of hydrostatic pressure in the 13.375-inch by 18.625-inch annulus, the result of washing out the mud with seawater and draining the diverter lines and bell nipple. This action resulted in the annular pressure falling below the formations' pore pressure to a point where the well was capable of flowing and there was a loss of well control.

Contributing Cause of Loss of Well Control

A contributing cause of this loss of well control was the channeling of the cement through the mud during cementing of the 13.375-inch surface casing. The channeling required that the 13.375-inch by 18.625-inch annulus be washed out to a depth of 390 feet MD/TVD (24 feet below the mudline), which resulted in a drop of hydrostatic pressure of approximately 41 psi in the annulus. The channeling also rendered the specially designed 12.0-ppg lead cement, with the gas flow prevention additive "Versa Set," ineffective in preventing gas invasion into the wellbore. The combination of the gas invasion into the wellbore and the 41-psi drop in the hydrostatic pressure caused the well to flow.

Possible Contributing Causes of Loss of Well Control

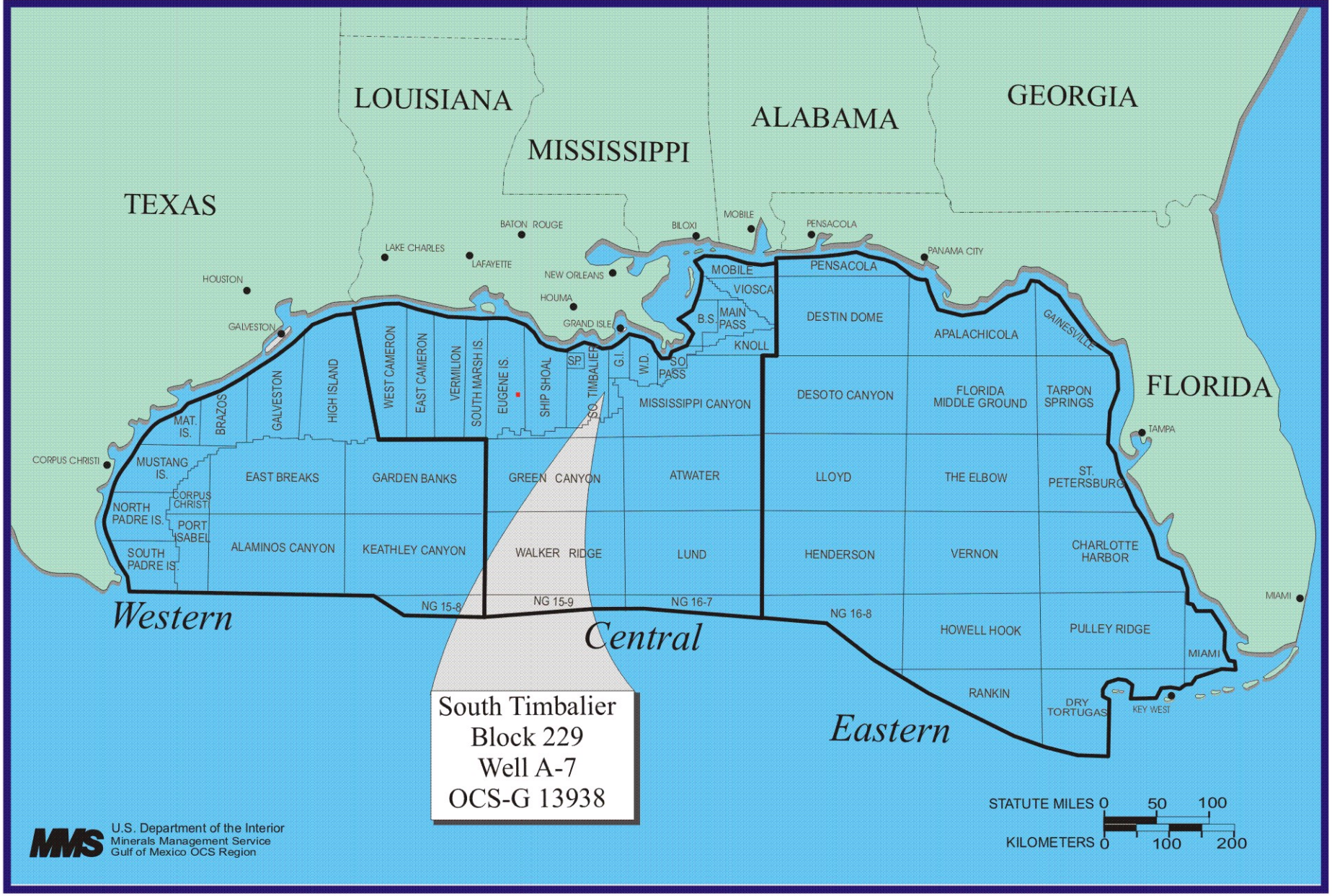
It is possible that the failure or inability to determine the depth of the kick zone in LLE's A-1 well also contributed to an inadequate cement design and mud displacement program in the A-7 well. With a more accurate location of the depth of the gas kick zone, additional centralizers may have been run on the 13.375-inch casing in the A-7 well, which would have improved mud removal by the cement and reduced the tendency for the cement to channel through the mud. Not accurately identifying the location of the potential gas kick zone in the A-1 well contributed to the failure of W&T to install the proper number and placement of centralizers on the 13.375-inch string which, in turn, led to the inefficient displacement of mud by the cement and the eventual channeling. The failure to identify and anticipate the gas kick sand, based on lessons learned for the A-1 well, probably precluded adopting a cementing and mud displacement plan that would have prevented the diverter event.

Recommendations

On the basis of information included in this panel report, members of the team recommend that MMS issue a Safety Alert emphasizing the need for operators to update their geologic and seismic review for shallow hazards for wells being drilled from a platform location that experienced a prior loss of well control event. This review should focus on identifying the depth of the prior kick zone and then using this information to develop a proper cementing design and mud displacement program to prevent a reoccurrence.

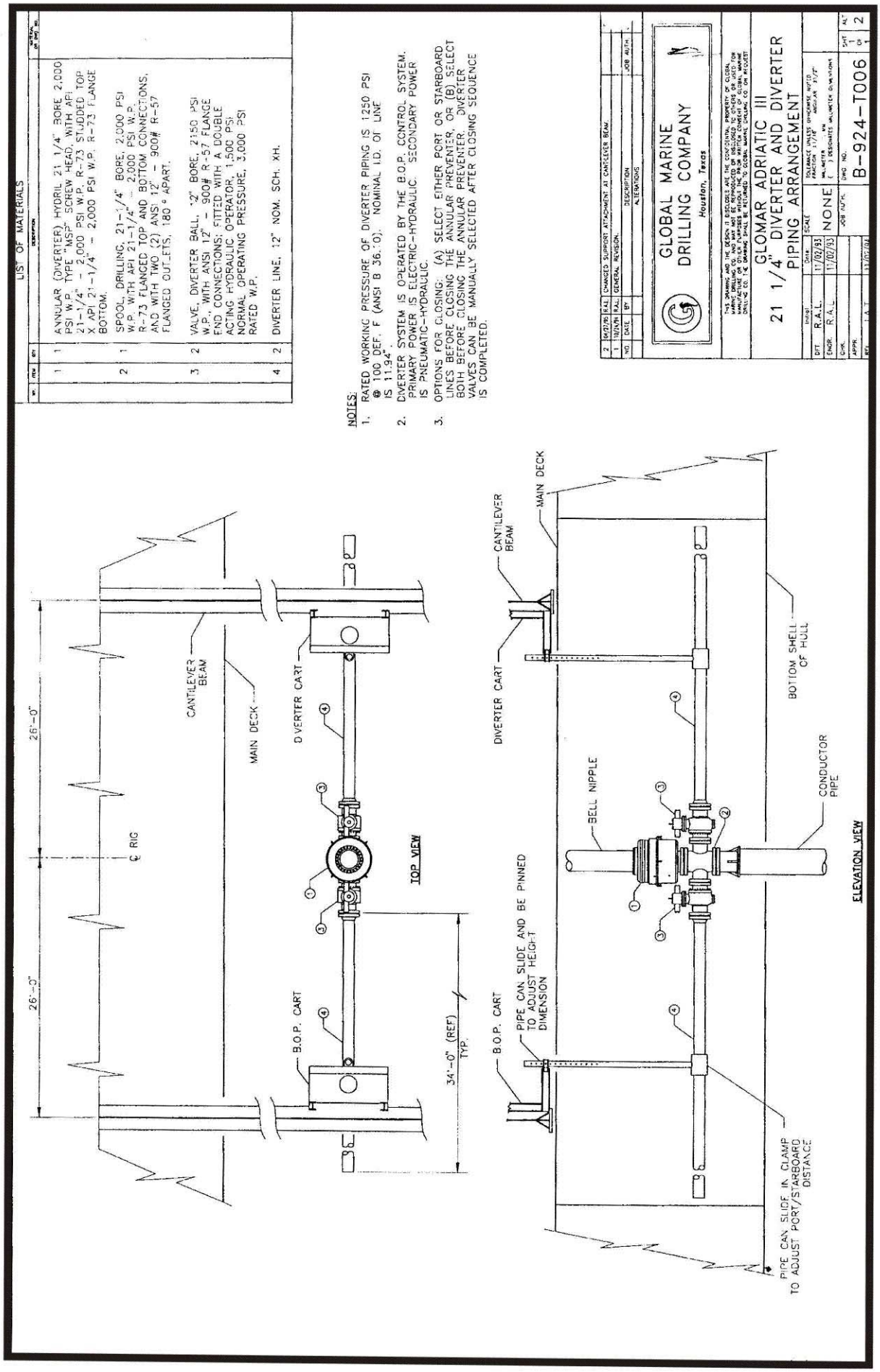
MMS should investigate modifying our current 30 CFR 250.420, 250.421 and 250.422 regulations to require that

- an operator use best cementing practices, including displacement of mud to prevent channeling;
- washing out of an annulus after cementing operations are completed be conducted with mud or another weighted fluid to maintain the hydrostatic pressure in the annulus after cementing; and
- an operator hold a limited amount of back pressure on the casing annulus after cementing to prevent gas from flowing into the wellbore.

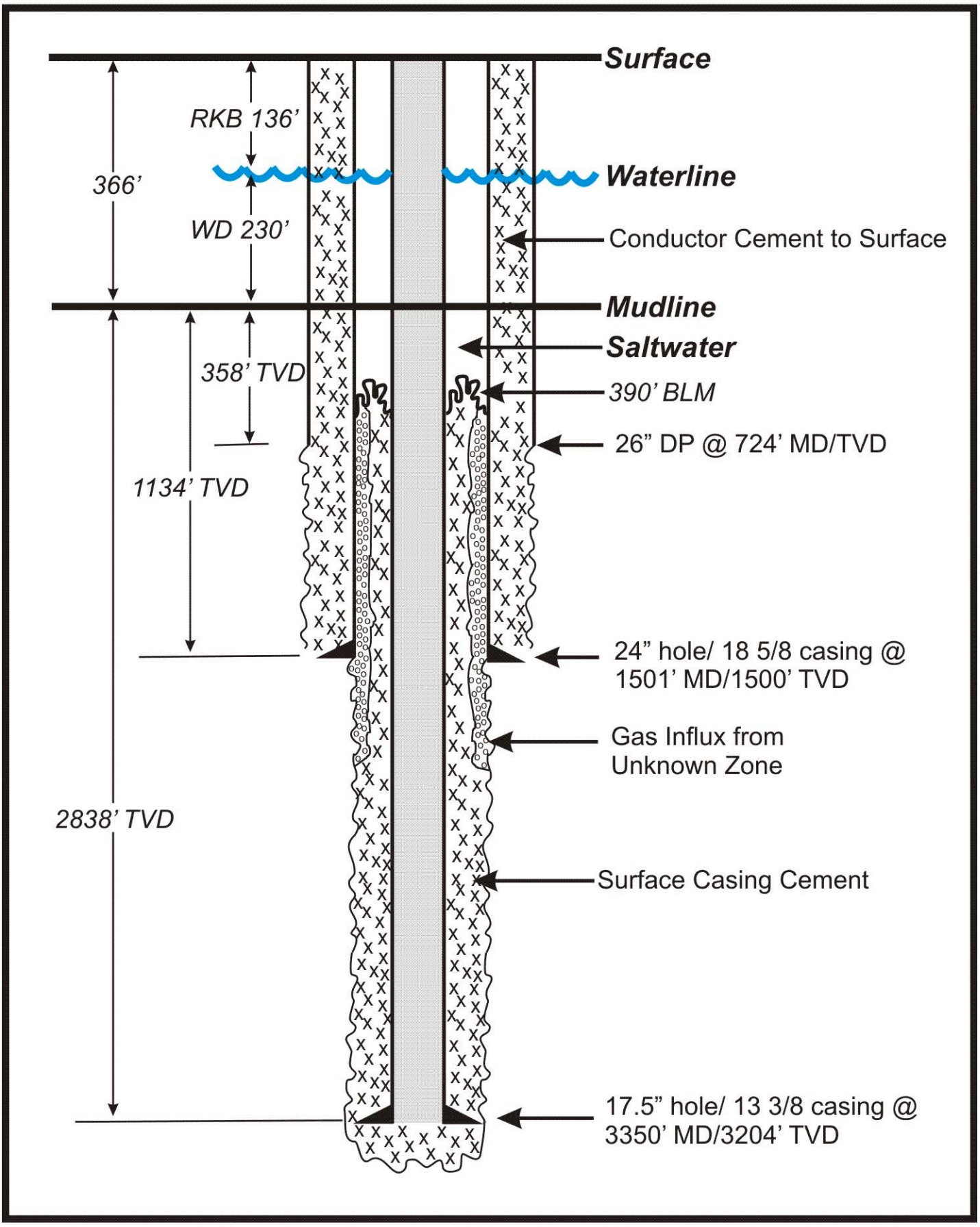


Location of Lease OCS-G 13938, South Timbalier Block 229, No. A-7

Attachment 1



Diverter Schematic, Global Santa Fe, Inc. Jack-up Rig Adriatic III, ST 229, Well A-7



Wellbore Sketch: Lease OCS-G 27169, ST 230, Well A-7.

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 **Minerals Revenue Management** 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.