COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF
NATIONAL DEVELOPMENT

BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS

Record 1972/34

BLOWOUT AT PETREL NO. 1 WELL AND SUBSEQUENT EVENTS

by

L.W. Williams

RECORD NO. 1972/34

BLOWOUT AT PETREL NO. 1 WELL AND SUBSEQUENT EVENTS

by

L.W. WILLIAMS

Statement on Blowout at Petrel No. 1 and Subsequent Events

On 8th August, 1969 the Minister for the Interior, as Designated Authority in respect of the area adjacent to the Northern Territory of Australia, appointed Mr. L.W. Williams of the Bureau of Mineral Resources to be an Inspector under the provisions of the Petroleum (Submerged Lands) Act 1967-1968. The appointment was specifically related to the blowout at Petrel No. 1 and Mr. Williams' instructions were to proceed, as soon as possible, to Darwin and to report by 25th August, 1969. The terms of reference were:

> "To investigate the circumstances and events related to the blowout and subsequent fire which occurred at the Petrel No. 1 location on 6 August and to report to the Designated Authority on -
>
> (a) the causes of the occurrence;
>
> (b) the action taken;
>
> (c) whether any changes in directions to operators or the proposed regulations are indicated."

Background

Petrel No. 1 well was being drilled at Latitude 12°49'34"S, Longitude 128°28'22"E, for Arco Limited by Southeastern Drilling Company Inc. using the semi-submersible drilling vessel Sedco 135G. The initially programmed depth was 13,200 feet and the well was approved to this depth by the Minister for National Development under the provisions of the Petroleum Search Subsidy Act 1959-1969. Prior to the blowout advice had been received from Arco by the Bureau of Mineral Resources that the programmed depth had been changed to 16,000 feet.

As required by the Petroleum Search Subsidy Act, regular reports on progress of the well were received in the Bureau of Mineral Resources. A petroleum engineer from B.M.R., Mr. F.H. Lepine, had been to the location between July 21st and July 23rd on a routine inspection visit.

On 6th August at about 11.00 a.m. Arco rang B.M.R. to advise that they were having some trouble at the well. The advice was that, when drilling at 13,052 feet, the drill pipe dropped 5 feet and a pressure build-up occurred. The Hydril was then closed and circulation was continued. The Hydril blew out and the drill pipe dropped again. The pipe rams were closed but the lower rams were leaking.

...2/

Later advice was that the upper pipe rams were leaking and cementing had commenced.

Late that night B.M.R. were advised that the cementing operation was not successful and that the blind rams were closed. Gas continued flowing and caught fire around the rotary table and spread to the crew quarters. Two deballasting pumps commenced operating and pumped water from two of the three caissons. Men reboarded the vessel and extinguished the fire.

The following day (August 7th) Mr. Lepine left Canberra for discussions with Arco in their Sydney office. On August 8th he flew from Sydney to Darwin. Messrs. Pfeffer and Dean of Arco and Mr. Branger of Australian Aquitaine Petroleum Pty. Ltd., who have a 50% interest in the operation, were on the same flight.

After receiving his instructions on August 8th, Mr. Williams left Canberra at 6.00 p.m. that day and arrived in Darwin at 3.00 a.m. on August 9th.

Course of Investigation

Visits were made by helicopter to the Sedco 135G by Lepine (August 9th) and Williams (August 13th). Discussions were held with all key personnel concerned with the occurrence both individually and in groups.

The most important of these discussions was one which took place in the Southeastern Drilling Company (Sedco) Darwin office on August 10th. The following people were present for part or all of the discussion:

G. Pfeffer	-	Arco Manager for Australia
E. Dean	-	Arco Operations Manager
H. Bryson	-	Arco Darwin Manager
C. Scruggs	-	Arco Drilling Superintendent
R. Grebing	-	Arco Engineer
L. Steinocher	-	Sedco Manager for Australia
W. MacDonald	-	Sedco Construction Engineer
M. Parrish	-	Sedco Subsea Engineer
J. Graham	-	Sedco toolpusher
L. McGowan	-	Magcobar
B. Shroyer	-	Halliburton
J. Branger	-	Australian Aquitaine Engineer
L.W. Williams	-	B.M.R.
F.H. Lepine,	-	B.M.R.

The main purpose of this meeting was to determine a list of, and time table for, the events which took place on August 6th. This would normally be a difficult thing to do and, in view of the stress which must have been associated with some of the more critical times of the day and because some of the records were lost in the subsequent fire it was, in this case, extremely difficult. However, the

discussion and questions were open and frank and the result was a report (Appendix 1) which is agreed to by all parties as being an acceptable statement. It must be emphasized that, because of differences in the time shown by different people's watches and because people do not normally keep detailed records in circumstances such as those prevailing, the times given in the report can only be taken as approximate. But the sequence of events is firmly established.

Discussions with individuals subsequent to this meeting were undertaken primarily to ascertain, if possible, the reasons for, or an explanation of, the occurrences and factual information which were included in the report or which became available later.

Events Related to the Blowout and Subsequent Fire

A factual account of the events which took place on August 6th is given in Appendix 1.

Events prior to this date were adequately reported to B.M.R. and were normal.

The subsequent events worthy of note are:

(a) the upper section of the parted drill pipe was recovered on August 10th;

(b) the escaping gas was relighted on August 13th;

(c) divers found that the blowout preventer stack was upright and intact;

(d) a relief well was commenced on 6th February, 1970.

Cause of the Occurrence

Casing had been run in the hole to a depth of 10,484 feet. This depth was sufficient to protect the formations from any pressures which could reasonably have been expected to the programmed depth. The grade of casing was sufficiently heavy to more than withstand pressures which might be encountered. Further details of the equipment in use is given in Appendix 2 and on Plates 1 and 2.

In modern oilfield drilling operations, blowout preventers are mounted at the wellhead, that is where the bore enters the earth, to control excessive formation

pressures. On this well the blowout preventer stack consisted of one Hydril (an expandable doughnut-shaped rubber seal), two sets of pipe rams (designed to close on drill pipe) and one set of blind rams (designed to close in empty hole). This is a conventional type of B.O.P. arrangement which is generally considered to be adequate to give the necessary protection in the event that abnormally pressured formations are encountered and the well tends to blow out. The Hydril has a rated working pressure of 5,000 psi and each set of rams has a rated working pressure of 5,000 psi. They were tested to half of these pressures each week.

In Petrel No. 1, drilling from 13,052 feet to 13,057 feet was through a permeable and porous formation which contained gas (and possibly water) under a pressure greater than that being exerted by the drilling mud column. The result was that formation fluid flowed into the well displacing drilling mud.

Arco has a predetermined procedure to be followed in emergencies of this nature and this was followed by the personnel on board. This is basically to close the Hydril and then circulate heavier mud down the drill pipe, up the annulus between the drill pipe and casing and out through a choke line. The heavier mud raises the hydrostatic pressure of the mud column to bring the well under control. This procedure was being followed when the Hydril failed.

This failure is still not satisfactorily explained but it was the first step in a chain of events which led ultimately to the complete loss of control of the well.

A possible explanation of the failure of the Hydril is related to the pressures which built up in the annulus. The Hydril is designed so that drill pipe and tool joints (which connect two lengths of drill pipe and are of a larger diameter than the pipe) can be pulled through it. This is accomplished by closing the Hydril with the minimum pressure required to effect a seal and incorporating in the system a valve to regulate this pressure. This valve will allow the Hydril to open a little to permit the tool joint to pass. The annulus pressure can also affect the pressure under which the Hydril is closed and, in the circumstances existing at Petrel No. 1, the Hydril may have been closed with sufficient pressure to cause the Hydril rubber to be damaged when the drill pipe moved through it.

When the Hydril failed a high pressure jet of mud came up to the drilling floor and knocked the driller away from his controls. At this stage the drill pipe

...5/

dropped and the drilling line broke. It could be expected that the hold-down chain would be on the brake at this time but the driller had just released it to move the drill pipe. The pipe was being moved at intervals to prevent it from sticking in the well.

Both sets of pipe rams were then closed but the lower set apparently did not seal. No definite explanation is available for this failure but a possibility is that a piece of metal (similar to that recovered on the rig) may have jammed between the jaws preventing them from closing completely.

The position was then that the drill pipe could not be moved (because of the broken drilling line) and the last B.O.P. unit designed for use with drill pipe in the hole (upper pipe rams) was in use. These rams could not be expected to last very long because they are not designed to have drill pipe moving through them and movement could not be avoided because of the motion of the ship with waves and tide. In normal circumstances the next step would have been to rest a tool joint on the rams and release the pipe at the drill floor, so that movement of the drilling vessel would not cause movement of the drill pipe relative to rams. This, of course, could not be done in this case because of the broken drilling line.

The position was critical but a decision was taken to continue trying to control the well with mud. This appeared to be succeeding with pressures gradually dropping. However, at about 11.25 a.m. the pressure in the annulus built up rapidly and the rams started leaking.

Again no definite explanation is available for the sudden build up in pressure but it appears likely that it was due to gas, which entered the well bore when the Hydril blew out, reaching the top of the well.

Pumping of cement commenced soon after the upper rams began leaking and continued for over four hours. However cement cut mud reached the top of the riser within about 30 minutes. Pumping continued but the flow of the well increased until, at about 3.45 p.m., it was decided that, for the safety of the vessel and personnel still on board, the vessel should be shifted away from its position directly over the well.

This was done and the blind rams were closed, but there was no apparent reduction in the rate of flow of gas. (Subsequent inspection by divers showed that the blind rams had operated and were within 0.724 inches of their fully closed position. This indicates that the drill pipe was crushed by the blind rams but did not part.)

The cause of the gas igniting on the drilling vessel is not known and eye witnesses accounts vary considerably about the point of origin of the fire.

The Action Taken to Control Well

There were two possible ways in which the well could be brought under control:

(a) using the existing B.O.P. stack;

(b) drilling a relief well.

The first step was, if possible, to examine the wellhead and B.O.P. stack to determine whether or not it was damaged. This could not be done immediately because the diving equipment on the drilling vessel had been damaged by fire and replacement equipment had to be assembled. The equipment left Darwin on 20th August on the M.V. Missouri. This was later than expected because further delays had been caused by rough sea conditions which would have made diving impossible.

During this period Arco, realising that the necessity to drill a relief well was a strong possibility, was investigating the availability of offshore drilling vessels both in Australia and overseas. This was done because considerable time would be involved in repairing the Sedco 135G and the company was anxious to bring the well under control as early as possible.

After arriving at the site of the blowout early on 21st August the Missouri positioned a weight, with a wire line attached, in the vicinity of the wellhead and anchored about 350 feet from the boil area. An attempt was made to lower a television camera along the wire line but no useful pictures were obtained. At 6.30 a.m. on 22nd August an attempt was made to lower a diver along the wire line to the vicinity of the wellhead. He was unable to get beyond a depth of 120 feet because of severe turbulence resulting from the escaping gas.

Repeated attempts were made before a diver was able to reach the B.O.P. stack. He reported that the stack was upright and intact with the gas escaping through the top. Arco then decided to attempt to control the well with the existing stack. This required that hydraulic lines be connected to control points and attempts to do this were commenced. These attempts were unsuccessful although the company perservered with their efforts until December. Diving activity was restricted to periods of slack tide, which was the only time that dives could be made with an acceptable degree of safety.

...7/

As a result of their enquiries Arco determined that the "Glomar Sirte" would be available on the coast of Morocco late in September and would require approximately 1½ months to shift to the Bonaparte Gulf area. Negotiations to arrange a contract for this drilling vessel were commenced immediately. However delays in the availability date of this vessel eventually meant that it would not be on site before the Sedco 135G returned after repairs, and negotiations for the "Glomar Sirte" were terminated.

During this period Arco completed arrangements to charter the "Zama M" and shift it from U.S.A. to Australia. The "Zama M" is a barge which is required to store at the location the extremely large quantities of drilling mud which will be required to stem the gas flow. Arrangements were also made to have available all the specialized equipment which was necessary for the drilling of the relief well.

The relief well was spudded on 6th February, 1970 and it is planned that this well will enter the gas reservoir in the vicinity of the bottom of Petrel No. 1. Salt water, mud, and then cement will be pumped down the relief well to control and kill the blowout. The relief well was spudded about 2,000 feet from the original well, drilled vertically for 6,900 feet and then deflected towards Petrel No. 1. On 8th April the well had been drilled to 9,033 feet and the angle was 20° off vertical. This angle will be maintained.

It is expected that the relief well will reach the gas reservoir late in May if no unexpected situations are encountered.

Indicated changes in directions to operators or the proposed regulations

There was not sufficient time during the investigation to fully investigate the desirability of changes but there was sufficient evidence to indicate that the following matters should be investigated more thoroughly in relation to wells in offshore areas.

(a) The desirability of requiring that, when an imminent blowout situation exists, action be taken to ensure that the drill pipe can remain stationary and be independent of the motion of the drilling vessel.

(b) The desirability of including shear type blind rams in the B.O.P. stack.

(c) The desirability of running two Hydril units on every underwater B.O.P. stack.

(d) The desirability of changing Hydril rubbers after a certain period of time or a specified number of tests at certain pressures.

(e) The desirability of including a special tool joint in the drilling string in which a drop-in type of back pressure valve may be seated in a time of emergency.

(f) The desirability of introducing a method to give a more accurate indication of mud return rates.

These suggestions were referred to the Offshore Drilling Regulations Sub-Committee of the Offshore Regulations Committee on which industry and State and Commonwealth governments are represented. Some amendments have since been made to the draft regulations for offshore drilling operations.

Conclusions

The well is flowing gas at a high but undetermined rate. The gas may be accompanied by water but there has been no sign of oil. The course of action taken by the operating company to control the blowout is considered to be appropriate to the circumstances.

During the course of the investigation several points were noted which deserved further consideration with a view to increasing the safety of future operations. These were considered by the Offshore Drilling Regulations Sub-Committee of the Offshore Regulations Committee who have taken appropriate action.

The investigation was facilitated through the operation having been followed in reasonable detail throughout by B.M.R. engineers who received regular reports under the Petroleum Search Subsidy Act. The fact that a B.M.R. engineer had visited the operation prior to the blowout was also of considerable assistance. Action to ensure that all offshore drilling operations, even if not subsidised, will be inspected periodically by a qualified petroleum engineer, who would also receive and examine progress reports, has been taken in relation to the offshore area adjacent to the Northern Territory.

9

REPORT ON BLOW-OUT AND FIRE AT PETREL NO. 1 OCCURRING AUGUST 6, 1969

APPENDIX 1

The following report on the blow-out and fire at Petrel No. 1, which occurred on August 6, 1969, was prepared by summarising and co-ordinating data secured from differing observers who were on the rig at the time.

From 13050 feet to 13052 feet drilling was at the rate of 5 min./ft. From 13052 feet to 13054 feet drilling was at the rate of 2½ min./ft. From 13054 feet to 13057 feet drilling was at the rate of 20 sec./ft. When drilling reached 13057 feet the time was 0730 hours. With this drilling break, with 5 feet of kelly above the drive bushings at 13057 feet, the drill string was picked up to place a tool joint 5 feet above the rotary table (sufficiently high to permit visual observation of mud level) and the pumps were shut down. The PVT warning whistle began sounding and an observer was sent to the mud tanks to observe the mud gain or loss. However, the well was immediately observed to be flowing with 600 psi on the drill pipe. The drill string was lowered approximately 3 feet to position the Hydril in the centre of a joint. The Hydril was closed at 0735 hours. The initial shut-in drill pipe pressure was 600 psi and the initial shut-in annulus pressure was 1500 psi, both of which increased rapidly to 750

psi on the drill pipe and 1800 psi on the annulus. The mud weight necessary to kill the well was calculated to be 11.9 ppg. The total mud gain to the time the Hydril was closed was approximately 190 barrels, of which approximately 60 barrels had been gained prior to the positioning of the tool joint 5 feet above the rotary table, i.e. immediately before the well was first observed to be flowing. The mud from the weighted mud pit (13.4 ppg) was added to the active mud and barytes also was added to raise the active mud weight from 10.5 ppg to 12.0 ppg. During this time all personnel were alerted, the Sedco Helen brought up to the bow of the platform, and a life boat launched. The M.V. Missouri, which was en route from Darwin, was called and ordered to proceed to the platform at top speed, arriving at 1200 hours. The pump was put back on the hole at 0817 hours. The mud weight initially was 11.6 ppg which built up to 12.0 ppg. The shut-in drill pipe pressure was 750 psi and the annulus pressure was 1800 psi. The initial pump pressure, through the drill pipe, was 3200 psi at 380 gpm with an annulus pressure of 2100 psi to 2200 psi through the ABC valve. The pump was slowed down after two or three minutes to 280 gpm and the drill pipe pressure dropped to 2200 psi. The first ABC

valve cut out after 14 minutes pumping time with an annulus pressure of 2100 psi to 2200 psi. The well was shut in and change made to the second ABC valve. The second ABC valve cut out after 4 minutes pumping time. The well was again shut in and placed on an adjustable choke. Pumping was resumed at a rate of 280 gpm with mud weights of 12.0 ppg in and 9.7 ppg out with a pump pressure of 2150 psi and 1750 psi on the annulus at 0849 hours. Pumping was continued as above. At 0910 hours the drill pipe pressure was 2000 psi and the annulus pressure 1750 psi. During this period the annulus pressure varied rapidly between a low of 750 psi and a high of 2200 psi. At 0914 hours the Hydril rubber failed letting the pressured mud column up through the rotary table and blowing the kelly drive bushing, master bushing and split bushing out of the table. Mud was blown both up and out. The driller, who was on the brake to move the pipe periodically to prevent sticking as a 30,000 pound drag was being experienced, was knocked from the brake. He made an attempt to regain the brake and was again knocked away. During this time the brake was released which allowed the drill string to drop until the top kelly upset reached the rotary table. The blocks were slack but still in the guide. The

drilling line unspooled from the drum and parted at the point where it enters the drum. The pump was still running. Both lower and upper pipe rams were closed from the rig floor panel. The lower pipe ram was closed first followed immediately by the upper. The pump was shut down. The choke lines and wedge locks were closed from the Koomey unit panel. The inner kill line valve had remained in the normal closed position and at this time the outer kill line valve was closed. Several pieces of the Hydril rubber were found on the rig floor and cat walk. A piece of steel with a part of a 'J' slot was found on the cat walk. Another piece of steel was reported on the shale shaker but was not recovered. The piece of steel found on the cat walk could have come from either the riser wear bushing or well-head seat protector. At 0918 hours the sub-sea choke valves were opened. The pressure on the annulus was 2200 psi which did not bleed off indicating that the lower pipe ram was not holding. After pumping was resumed the drill pipe pressure was 2250 psi while pumping at a rate of 270 gpm. Prior to starting the pump the stand-pipe pressure was 350 psi. Mud weights were 12.4 ppg in and 9.9 ppg out with 10.3 ppg mud behind the degasser. At times, however,

there was no mud returning, only gas. Evacuation of all unnecessary personnel to the Sedco Helen was commenced. Pumping was continued at a rate of 270 gpm with drill pipe and annulus pressures gradually decreasing. At 1005 hours the drill pipe and annulus pressures were both 1600 psi. At 1017 hours Halliburton was advised to rig the unit. At 1030 hours the drill pipe pressure was 1600 psi and the annulus pressure was 1050 psi. At 1045 hours the drill pipe pressure was 1600 psi and the annulus pressure 700 psi. At 1050 hours the drillipipe pressure was 1750 psi and the annulus pressure was 350 psi. At 1100 hours the well was shut in at the choke manifold to change the power selector to release power for the Halliburton unit and anchor winches. When the number 2 pump was put back on it had no power and the number 1 pump was put on. The above changes were made in a very short time, perhaps one to two minutes and pumping was resumed at a rate of 250 gpm with 1550 psi on drill pipe and 600 psi on the annulus. Mud weights were 12.2.ppg in and 10.4 ppg out. At 1110 hours the drill pipe pressure was 1475 psi and the annulus pressure 350 psi, (this annulus pressure was at the choke manifold gauge; at about the same time the annulus pressure was 100 psi on the driller's console).

At 1125 hours the annulus pressure increased rapidly to 2800 psi and mud was coming over the bell nipple while pumping at a rate of 270 gpm, with a drill pipe pressure of 2000 psi. From the time the Hydril was closed until this time a total of about 1000 barrels of mud was pumped into the drill pipe. The weight varied from 11.6 ppg initially to a high of 12.4 ppg. Decision was reached to pump cement down the annulus in a final control effort. Immediately prior to cementing, 70 barrels of 13.8 ppg to 13.9 ppg mud was pumped into the drill pipe. The rig pumps were stopped, the sub-sea choke valves closed and cementing began through the kill line at 1153 hours using Class 'A' cement mixed with sea water and LCM. The first 600 sacks had a slurry weight of 15.0 ppg to 15.5 ppg; thereafter the slurry weight varied between 13.5 ppg and 15.3 ppg. Cement cut mud started coming over the bell nipple at 1200 hours. The pumping rate was reduced from 3.5 bpm to 1.6 bpm to reduce the pressure on the pipe rams. After 800 sacks of cement had been mixed displacing with 13.8 ppg mud was commenced at 1321 hours. Displacing was discontinued after two or three minutes as a strong flow of 12.9 ppg gas cut mud and cement came up the riser. There was no pressure on the drill

pipe. An additional 250 sacks of cement was mixed with a slurry weight of 13.5 ppg to 15.3 ppg and pumped in at a 1.6 bpm rate. The dry cement line plugged and cementing was suspended from 1507 hours to 1523 hours. Cement was then mixed for two or three minutes with 600 psi then displacing began using 13.5 ppg to 15.3 ppg mud. The initial displacing pressure with both Halliburton pumps on was 600 psi. Displaced cement with 44 barrels of mud with pressure increasing to 2600 psi. The well was unloading in excess of the pumping volume. The Halliburton pumps were shut down at 1550 hours. The anchor winches were prepared to move the rig forward during the time that cement was being displaced. The number 5, number 6, number 7, number 8 and number 9 anchors were slacked off and the number 3 winch engaged to move the platform forward at 1545 hours. The platform had begun moving off the location when the anchor lines were slacked off. The blind ram was closed at approximately 1550 hours and both kill valves were closed immediately thereafter at which time the platform was about 115 feet off the location. When the riser touched the spider deck at approximately 1555 hours, the upper H-4 connector and choke and kill connectors were unlocked. The riser did not dis-

engage at that time. The platform was approximately 150 feet off the location when these connectors were released. Gas was flowing through the riser to the platform. All personnel on the platform were evacuated to the supply vessels leaving the generators on and the number 3 anchor winch engaged. The number 3 anchor winch had moved the platform far enough to get approximately a 15 degree slant on the riser when fires broke out, first under the rig floor then in the crew quarters. Fire broke out at 1705 hours. The number 3 anchor winch stopped at 1715 hours. Two caisson deballasting pumps had apparently engaged from an electrical short circuit and the platform began listing due to uneven ballasting. The riser broke lose from the platform and dropped at 1717 hours. Shortly before the riser dropped a gas boil appeared about 250 feet astern of the platform. When the riser dropped the gas boil astern of the platform increased, the fire under the rig floor diminished and the gas boil which was estimated to be 4 feet to 10 feet high in a 75 foot circle with water blowing 30 feet to 40 feet high in the centre, ignited. At 1805 hours personnel began reboarding the platform to attempt fire and deballasting control. At 1810 hours the Sedco Helen began pumping water for fire control. The

generators were shut down at 1813 hours stopping de-ballasting. At this time the platform had reached a list of 6 degrees to 8 degrees. At 1840 hours, the M.V. Missouri moved in to the number 1 caisson and began running fire hoses up the ladder. By 1940 hours all platform fires were extinguished. The generators were put back on at 1856 hours. The ballast pumps were immediately restarted and the platform was trimmed by 1940 hours. The gas boil fire was drifting towards the platform as a result of current action. Anchor lines were released in the order of number 7, number 8, number 6, number 5, number 9 and number 4. The Sedco Helen was tied to the number 2 anchor line and the platform pulled away from the fire. The tow began at 2003 hours. The number 4 anchor line was cut with 1100 feet of line remaining on the drum. The number 5, number 6, number 7, number 8 and number 9 anchor lines were cut at the drum. At 2035 hours the boil fire stopped and three efforts to reignite it with flares were unsuccessful. At the time the boil fire stopped the boil seemed to have markedly de-creased. The platform was moved approximately 2800 feet from the location. On August 7, the number 3 anchor was picked up and moved about 2500 feet. On August 8, the platform was moved approximately 6.4

miles from the location and placed on one tandem anchor at an approximate location of :

Latitude : 12° 54' 30" South

Longitude : 128° 25' 45" East

The main boil area is estimated to be about 100 feet in diameter, with a much larger surrounding disturbed area varying in extent with current and wave action. No oil slick has been observed. A preliminary damage report is as follows :

Crew quarters and barge control room completely gutted except for office.

Derrick "A" frame legs warped and mast further damaged.

Engine room okay.

Electric panel in engine room okay

Cranes okay.

Mud pumps and tanks okay.

Diving equipment damaged.

Draw-works and motors badly damaged.

All derrick equipment badly damaged.

Geoservices unit destroyed.

All sub-sea equipment on sea bed.

NOTE : Times and pressures herein reported have been taken from differing sources and are believed as accurate as possible, but it should be realised that differing observers sometimes reported slightly differing numbers.

APPENDIX 2

PETREL NO. I

Status 6.00 hours, August 6, 1969

Weather

Clear	
Wind	4 knots SSW
Waves	1.75 feet
Swell	nil

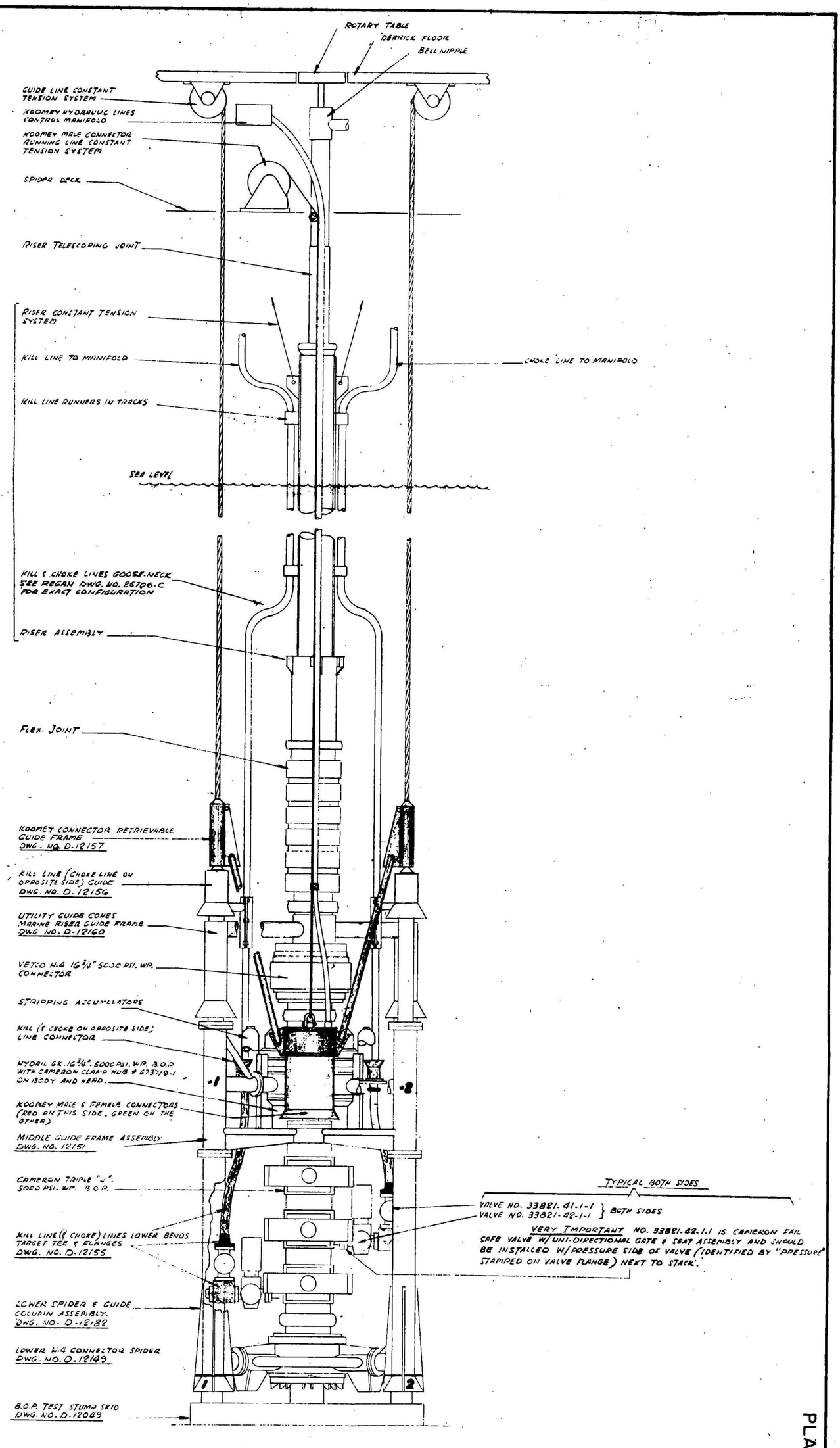
Drillstring assembly

Bit, junk sub, shock sub, 27 drill collars, 2 crossovers	829 feet
5 inch Grade E drillpipe	12,189 feet
Kelly down	17 feet
Depth at 6.00 hours	13,035 feet

Mud Properties

Wl. 10.5 lbs/U.S. gal.	
Viscosity	61 sec
Plastic Viscosity	28
Yield Point	3
Gel Strength	3
10 second G.S.	7
pH	12.5
Water loss	3.3 cc
P/alkalinity	1.6
Cl (ppm)	9000
Ca (ppm)	130
Oil/wt/Solids	7/80/13
Sand	trace
HT-HP WL	18 cc

21

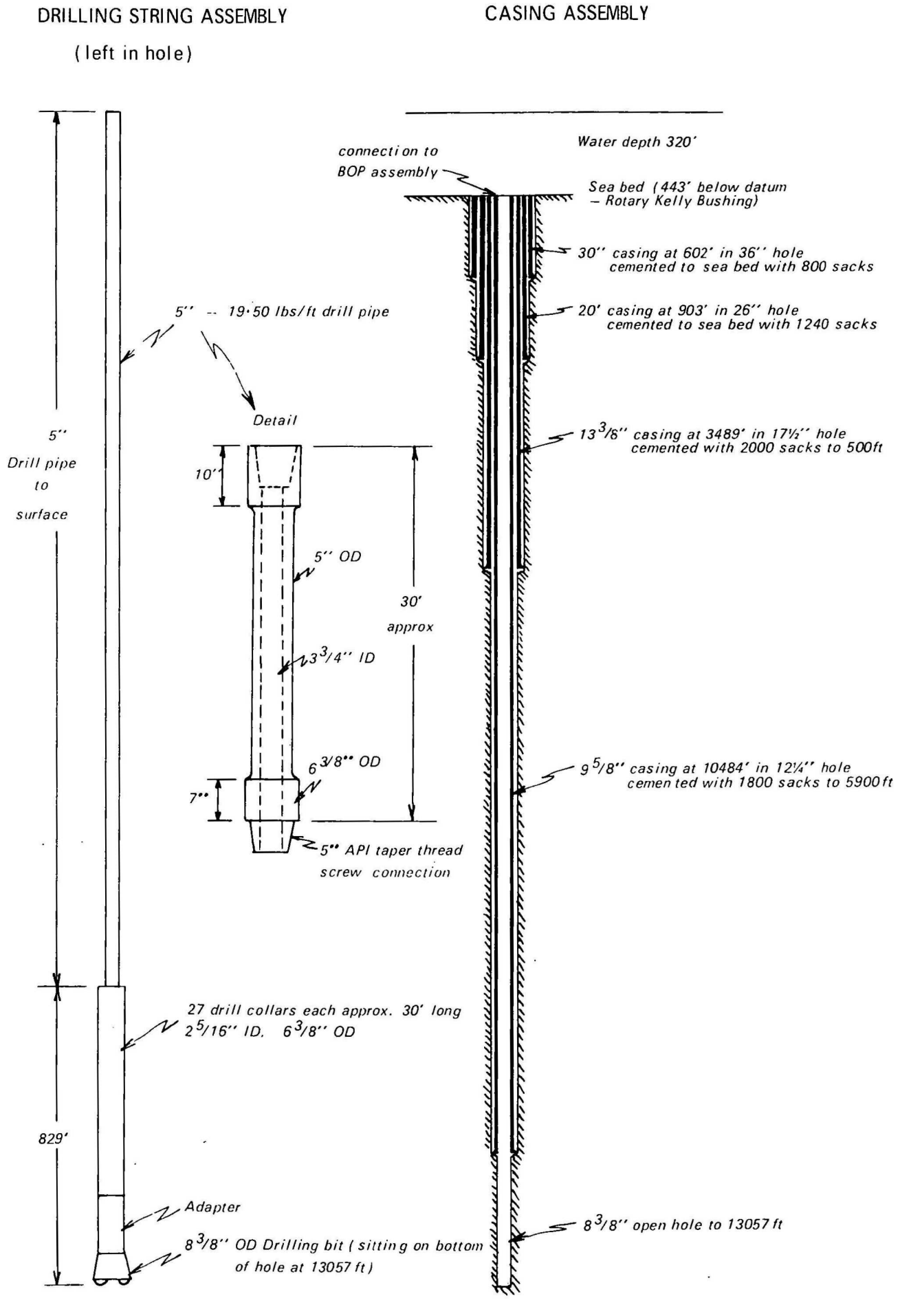


SUB SEA PRESSURE CONTROL EQUIPMENT

FOR SEDCO 135 G AT PETREL No. 1

PLATE 1

G399-10



NOTE: Not to scale, diagrammatic only